Exploration of the implementation of the Principles for Innovative Doctoral Training in Europe

Final Report

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EXECUTIVE SUMMARY

Background and objectives

The underlying report is the final report of a study commissioned by the European Commission, DG Research and Innovation, with the aim to "explore the implementation of the Innovative Doctoral Training Principles (IDTP) in Europe". A research team from IDEA Consult, CHEPS and individual experts on higher education and doctoral training have analysed the current and future role of these principles as a 'guiding tool' in the reform of doctoral training and education in Europe. This explorative study aimed to:

- Verify the application of the principles against current institutional practices and the emerging needs of the Innovation Union;
- Provide illustrations of "good practice" in order to increase the exchange of knowledge, and to provide examples of how particular countries/institutions deal with the IDTP;
- Indicate potential shortcomings in the current IDTP;
- Provide recommendations to improve or clarify the principles to policy makers at institutional, national and EU level (i.e. reflect on the individual principles and complement them with the findings where applicable);
- Provide recommendations to promote the implementation of the principles on a European-wide scale;
- Provide recommendations on the design of future programs dedicated to doctoral training at regional, national and European levels.

Approach

The two main tasks in the study concerned:

- The update of the EC mapping exercise "Report of Mapping Exercise on Doctoral Training Europe - Towards a common approach"1 of the 27th of June 2011. The mapping exercise was updated with recent studies from organizations such as EUA, VITAE, ACA, CGS, SG HRM and LERU and with a statistical section containing all relevant and available data on doctoral candidates, their training and career from Eurostat, Researchers Report (2012), Eurodoc (2010), MORE2 (2012).
- Implementation of case studies (study visits and telephone interviews) to institutions across Europe in order to receive 'on-field' experience and information on the implementation of the principles and any barriers or good practice.

The mapping exercise is reported on in the Interim Report; this Final Report focuses on the synthesis of the case studies, cross-case findings and recommendations to further stimulate implementation of the IDTP. Two types of case studies were carried out: site visits (about one third of all cases), whereby an expert team visited the institution concerned, and virtual visits (about two third of all cases) through telephone and/or Skype sessions. The site visits mainly focused on Central, Eastern and Southern European countries to collect in-depth information on a.o. the impact of the economic crisis on doctoral education and the implementation of the IDTP in this respect (see Annex 1 and 2 for an overview of the case studies).

[1] http://ec.europa.eu/euraxess/pdf/research_policies/Report_of_Mapping_Exercise_on_Doctoral_Training_FINAL.pdf

In order to obtain a detailed picture of doctoral training and to derive sensible conclusions, four different target groups have been involved:

1. **Institutional level (university management)**: vice-rectors and heads of doctoral programmes;
2. **Policy level**: national and regional policy makers and funding agencies;
3. **Non-academic level**: representatives from industry and non-academic sectors; and
4. **Individual researcher level**: supervisors and doctoral candidates.

The results of this study are largely based on the findings of the case-studies. As such, the outcome cannot be considered to be representative for the whole of Europe or for the individual European countries in which the institutions are based. Nevertheless, the information and insights obtained do increase our understanding of the 'state of play' with respect to the implementation of the IDTP in Europe and illustrate a range of relevant good practice.

Cross-case findings per principle

The following table summarises the implementation status, the main barriers and a selection of good practice for each of the seven IDTP.

Principle of Innovative Doctoral Training	Implementation status	Main barriers to further implementation	Examples of good practice
Research Excellence	*Research excellence is the main objective of all doctoral programmes. It is common practice in institutional policies to use peer reviews for quality assurance.*	- High pressure, short time to degree (3 years). - Low stipends resulting in part-time research: less time and focus is dedicated to the research.	- A rotation system before the start of the doctoral education optimises the match with topic and supervisor, which positively influences the quality of the research and the chance of success. - Individual budget for personal development of doctoral candidates. - Review of dissertation by three external experts, additional to examination committee.
Quality assurance	*Doctoral schools have been implemented recently and doctoral programmes are under reform in many countries. During reorganisations, procedures and practices have been evaluated and standardized. Some institutions also shifted responsibility for doctoral education to the central level by implementing a university-wide graduate/doctoral school.* *Most doctoral schools have a set of quality assurance instruments in place. Among these are course evaluations, feedback talks and supervisors' evaluations.*	- A lack of transparency as regards standards and rules is perceived as a problem in doctoral training.	- Comprehensive quality manual and statement of expectations for doctorate degrees. - Creation of the position of a Scientific Coordinator to ensure the quality of the program (internal communication, restructuring the program and quality assurance). - Training for supervisors
Interdisciplinary Research Options	*The majority of institutions are in favour of facilitating interdisciplinarity and some have installed structures in doctoral training to promote it (e.g. interdisciplinary doctoral programmes). At other institutions interdisciplinarity comes more naturally to doctoral training. (e.g. students work on interdisciplinary topics and choose supervisors from other disciplines). The field of study as well as the institutional tradition also have an impact on interdisciplinarity.*	- In a few countries, existing legislation and accreditation criteria do not support the implementation of interdisciplinarity – study programmes can be accredited only for a single discipline.	Establishment of: - Interdisciplinary doctoral programs. - Rotation of doctoral candidates between fields before the start of the PhD. - Institutional interdisciplinary research grants. - Doctoral schools that are no longer mono-disciplinary and allow interaction between doctoral candidates and supervisors from different research fields. - Interdisciplinary supervision committees. - Tailor-made course programmes: Students can select courses according to their needs, also from other disciplines.

Principle of Innovative Doctoral Training	Implementation status	Main barriers to further implementation	Examples of good practice
International networking	*International networking is actively encouraged in the majority of the doctoral programmes or schools. Most cases report structured funding for mobility.* *International networking develops via EU mobility schemes and framework programmes (e.g. FP 7 projects, Marie Curie Actions, COST, Erasmus Mundus, etc.).* *International networking takes many forms: research trips; participation in international conferences; guest scientist/international students at the institution; joint degrees, co-tutelle PhD etc.* *Integration of the (main) supervisor(s) plays a significant role for the doctoral candidate to undertake international networking*	- Low grants for doctoral students prevent students from going abroad, particularly when they have to work as well as study to meet their costs of living. - Some students report large amounts of administrative work and problems with recognition of joint degrees or ECTS points. - Older students who already settled and have a family are less mobile.	- Dedicated budget for international mobility results in high outward mobility and international networking rates. - Participation of foreign members in the doctoral examination committee. - Joint degrees and co-tutelle PhDs.
Exposure to industry and other relevant employment sectors	*Exposure to industry+ is generally considered to be the most difficult IDTP to implement. Its relevance is sometimes questioned by institutions as the explicit focus is on doctoral training. The type and tradition of the institution and the research field are important here. The field of study also has an impact: disciplines like e.g. engineering, medicine or law have a high job specificity but for disciplines from the social sciences or arts and humanities, job specificity is rather low.*	- A lack of knowledge-intensive industries around the institution. - In some cases, industry is not sufficiently prepared to integrate doctoral candidates appropriately. - Depends on networks of supervisors: not structural. - Tradition of research collaboration: Universities more integrated in basic research.	- Presence of a science park/Incubator. - Establishment of an Innovation Academy for innovation and entrepreneurship training. - Organisation of (job) fairs with industry. - In social sciences, establishment of links through informal & formal collaborations or courses from state agencies or the government. - Allowing for the participation of an external co-supervisor in the doctoral committee. - Preparation of a business plan in the non-academic environment when the doctorate is completed. - Special funding schemes for 'industrial doctorates'/collaboration with industry.

Principle of Innovative Doctoral Training	Implementation status	Main barriers to further implementation	Examples of good practice
Transferable skills training	*Transferable skills training is quite common. It is usually organised as an additional training program with a choice of elective courses.* *In several cases, transferable skills are narrowly interpreted as presentation and writing skills.* *In some cases respondents mention that transferable skills training is also implicit in the doctoral research project (through presentation of progress, management/ planning of research).* *Respondents also made clear that transferable skills are needed in the academic as well as in the non-academic sector since it has become increasingly entrepreneurial.* *In those countries where doctoral degree holders are rarely employed in the non-academic sector, there is an increasing awareness at institutional as well as at policy making level that doctoral degree holders will become more important for these labour markets in the future.* *The career preferences of doctoral candidates are also determined by this context: In countries where students rarely work in non-academic sectors, students' first choice is to pursue their academic career.*	- One challenge is to balance the transferable skills training and the preparation for non-academic sectors with the demand for research excellence. - For those doctoral courses where transferable skills training is implicit, doctoral candidates have to rely on the supervisor's dedication and skills. - Accessibility: The information on the courses is not always well disseminated and not always available in English.	- Offering explicit funding for transferable skills training. - When funding is an issue, the Structural Funds (in eligible countries) can be applied to develop transferable skills training. - Discussion groups of 6 to 7 students are established to discuss the achievements of the doctoral candidate during doctoral training and in the dissertation. Individual follow-up to prepare for life after the doctorate is foreseen.
Attractive Institutional Environment	*The importance of the working environment and working conditions for researchers is recognized, but the implementation is highly context-dependent and influenced by the countries' historical and economic backgrounds.* *At some institutions there was little inter-institutional mobility, i.e. students did not consciously select for the institution but just continued their Masters' degree at the same institution.* *In most cases students were satisfied with the infrastructure and work environment provided by the institutions.*	- In CEEC cases stipends are often low and at some institutions there is a relatively high teaching load. - Lack of funding prevents every doctoral candidate from having access to office space and a computer, books and scientific journals.	- The use of ESF funding to build new state-of-the-art infrastructure. - Giving rights (and obligations) to doctoral candidates, either through acceptance of Charter & Code or through a similar charter. - Mandatory international publication of vacancies (e.g. EURAXESS). - Mixed funding sources decrease dependency on one. In institutions that are capable of attracting private funding for research, dependency on government funding is lower. This allows a.o. to deal with budget cuts in times of economic downturn. - In the social sciences/arts and humanities: provision of office space and meeting space to facilitate exchange and community building among doctoral candidates.

Conclusions

A synopsis of the main conclusions is provided below. For more details, we refer to chapter 7.

The principles have a strong 'mobilizing' effect

What struck the research team in the preparation and the implementation of the site and virtual visits is the large mobilization of different actors and stakeholders, all being prepared to discuss the implementation of the principles in their countries and institutions. This clearly reflects the importance of doctoral training and the relevancy of the principles.

The principles are fully 'embraced'

The principles are well-accepted and subscribed to by all target groups at institutional, doctoral, policy and non-academic levels, although they are not commonly known in the documented form, or under the name 'Innovative Doctoral Training Principles'. The principles are considered as a 'guiding tool', and this is exactly what they should remain, according to the large majority of interviewees.

Research excellence seems to be the 'leading' principle

Not all principles are regarded as equally important or relevant. In general, a relatively higher weight is attached to the principle of "research excellence", based on quality assurance and attractiveness of the research/institutional environment.

There is a strong interrelation between the principles

The interrelation and interdependency between the seven principles are strong. In a number of cases, it was mentioned that the principles need to be balanced and put in the right perspective. It is challenging to implement and balance all principles within the time limit of three (or four) years available to complete the doctorate. This type of dynamics should be taken into account in the recommendations on further implementation.

Academic 'culture' influences the 'pace of change'

The role of academic culture is an important consideration in the implementation of the IDTP. The culture of the master-apprentice model persists across Europe. Traditionally, professors are sometimes critical of proposed changes and do not always agree with reforms inspired by the IDTP. A strongly hierarchical relation between the 'apprentice' and 'master' sometimes hinders open discussion. The diversity among doctoral candidates across Europe in terms of contract and conditions (e.g. systems with high numbers of part-time candidates) requires flexible solutions for the implementation of the principles and allow researchers to benefit from each of them to the maximum.

The socio-economic 'context' is also influential

National and regional policy objectives play a crucial role in the implementation of the IDTP at institutional level. The policy context determines, among other things, the degree of autonomy and flexibility of the institutions, the vision and emphasis given to doctoral training and the funding available to shape doctoral training and attract candidates (nationally and internationally). This observation also links to the importance of a number of factors exogenous to the institution that play a crucial role in the organisation of doctoral training and implementation of the principles: funding, regulatory stability, economic structure and culture/awareness.

The richness of 'good practice'

During the various visits it became clear that there are many examples of good practice in terms of the implementation of IDTP that could and should be flagged up and disseminated. For example, there are cases which reflect an overall efficient and effective organisation of doctoral training programmes and the active implementation of all principles. But even in cases where major challenges are faced or recent reforms have had a substantial impact, good practice is still highly visible.

Reflections on reorganisation of the principles

Throughout the majority of the cases, no fundamental changes to the existing principles are suggested, nor are new principles proposed. At the same time, the rather static and linear overview of the principles in their current form could be analysed from the perspective of structure (level of importance of the principles); the interrelation between the principles; and the context in which the principles are applied.

Not all principles are regarded as equally important by the interviewees. Higher weight is given to the principle of research excellence, based on quality assurance and attractiveness of the research environment. They are referred to as the more 'basic principles', upon which other principles can build. Although all four other principles, referred to as 'surrounding principles' (international networking, exposure to industry+, interdisciplinary research options or transferable skills training), are acknowledged to contribute to innovative doctoral training, the degree of consent varies.

The interrelation between the principles is dynamic and complex: international networking will improve the quality of the research through peer reviews, inspiration and original ideas. But research excellence may also lead to more opportunities to be internationally mobile and network with people around the world. Transferable skills training can also enable an excellent researcher to excel in another environment outside academia and further build the economic structure needed to strengthen their exposure to industry+.

The building blocks of research excellence, quality assurance and an attractive institutional environment are reinforced by the principles of international networking, interdisciplinary research options, exposure to industry+ and transferable skills training. New ways to attain excellence are found, innovative dynamics and multiplier effects are created. Making the interrelation visible and understandable will allow for better 'management' of their implementation. In chapter 7, a new IDTP framework is provided and discussed.

Clarification of the role of the principles

After the introduction of structure and dynamism in the overview of the IDTP, the role of the principles also has to be clarified. In most institutions, the principles are not known in the format of the EC Communication and Council Decision. The visits were an effective way to introduce the principles and open up discussion on their relevance and implementation when reforming doctoral training. However, during the visits, institutions did recommend that clarification was needed in terms of the guiding role of principles as a framework to inspire reforms in doctoral training. They are not, and should not be, a checklist for the institutions.

Reformulation of some of the principles

As a result of the case studies, a number of suggestions were made to sharpen and reformulate a number of principles:

- Reformulation of "Industry+" into:
  - "non-academic sector"
  - "any sectors to which the research is relevant"
- Reformulation of "Transferable skills training" into:
  - "professional development"
- Clarification of "innovative" in the "innovative doctoral training principles":
  - To many interviewees, the word "innovative" has no meaning here. They make the connection between "innovative" and "principles" and argue that the principles are not at all new, and come naturally to them as they have been the basis of doctoral training for many years.
  - Clarification of the meaning of "innovative" in connection with "doctoral training" is therefore recommended, showing that modern doctoral training needs to look for ways to balance research excellence, knowledge creation for complex societal problem-solving and preparation of doctorate holders for non-academic careers.

Finally, in this section on reformulating the principles, it is appropriate to mention the issue of terminological consistency on a general level. There is barely any consistency in the definitions of 'doctoral schools', 'transferable skills', or 'structured training'. This means that institutions use these terms freely, according to their specific situation.

Recommendations

Keep raising awareness of the principles

The majority of the interviewees were not aware of the existence of the European IDT Principles as such but they were known as the Salzburg principles, or European or ERASMUS PhD, the ORPHEUS principles, university joint PhD agreements, and others. Nevertheless, they were welcomed and the visits opened out many discussions on reform and reorientation of doctoral training and procedures. To further encourage awareness of the principles, a dedicated communication strategy is recommended. These might include direct communication to institutions through existing fora; direct communication to doctoral candidates through the student groups and to supervisors (an IDTP kit was suggested in Italy); and via regional meetings for remote institutions to exchange practices, etc. Existing fora, informal or formal EU organisations (ORPHEUS, etc.), information packages and a series of regional stakeholder's conferences could also be used.

Stimulate alternative and mixed-funding possibilities

Given the key findings that funding is a prerequisite to implement the IDTP on the one hand, and that the Structural Funds are much appreciated as tools to guarantee continuity in investments, improve working conditions (e.g. level of the stipends) and allow for infrastructure building on the other, it is recommended that European funding possibilities continue to be found - especially for those institutions most in need of it. Nonetheless, at the same time, it is also necessary to look for sustainable solutions in countries where dependence on this type of funding is high.

In countries where funding is not necessarily low, the emphasis lies on the flexibility to apply the funding. Each institution has its own historical, economic and political context. A critical level of institutional autonomy is necessary in order for them to attribute the funds in such a way that they contribute to an optimal implementation of the principles.

Hands-off approach for the 'basic' principles

The basic principles, identified as research excellence, quality assurance and attractive institutional environment, receive primary attention from institutions. They are implemented by definition, because they form the heart of what doctoral research should be in the eyes of the interviewees. For this type of principle, a hands-off approach is recommended, alongside an offer of support/inspiration.

Hands-on approach for the 'surrounding' principles

The surrounding principles of international networking, interdisciplinary research options, exposure to industry+ and transferable skills training are implemented less structurally. Each institution stresses its own emphasis, based on their mission, vision and type of research. For this type of principles there is room to develop policies/instruments that actively encourage their implementation – in a hands-on approach that sufficiently takes into account the degrees of freedom an institution needs to adapt the instruments to the national, institutional and disciplinary context.

Take a global perspective

One striking result of this study is the large variation in the way in which doctoral education is organised across countries and within institutions. This makes cooperation in doctoral education - for example - between two countries, difficult, as their requirements in term of training (number of courses, credits and type of courses), and the process for defending the PhD are not compatible. A global perspective is needed in order to encourage the international competitiveness of European doctoral training and to open out the labour market for doctoral graduates internationally. Once European institutions', researchers', policy makers' and non-academic employers' priorities in terms of doctoral training have been determined, it is increasingly necessary to consider the nature of doctoral training and good practice outside of Europe.

Help Member States to create an adequate regulatory framework

The principles' implementation is sometimes hindered (or not favoured) due to a law or to an accreditation mechanism (based on input such as the number of professors funded by the programme, the training offered, etc.). The evaluation agency (or ministry) also has a powerful effect by looking at all IDTP and not a selection of them. Government and national agencies could conduct an IDTP 'compatibility check' (similar to the HRS4R check) and review whether the national legislation and mechanisms sufficiently allow for flexibility and changes so that reforms compatible with the IDTP are possible. Any such process should primarily aim at assessing this type of flexibility rather than the implementation itself – in line with institutional autonomy. A similar exercise could be conducted at institutional level, down to lowest level of decision-making: faculty or doctoral school. The European Commission could facilitate this process (through e.g. an Open Method of Coordination).

GUIDE TO THE READER

This underlying report is the final report of the 'Exploration of the implementation of the Principles for Innovative Doctoral Training in Europe (IDTP)'. The final report has the objective to reach conclusions about good practice and barriers to it in the implementation of the IDTP from material and data collected in institutional case studies across Europe. It will also provide key findings on the implementation of the principles and the way ahead for their further implementation. The final report thus syntheses a multitude of different practices.[2]

In the first section, a general understanding of the principles and the context, objectives and approach of the study will be given.

Sections 2 to 6 will present the cross-case findings of the exploration exercise. Each section will focus on one of the following topics that have been discussed with different groups of actors in the case studies:

- Section 2 will focus on the general vision on the IDTP,
- Section 3 on the organisation of doctoral training,
- Section 4 on the four principles related to research performance: research excellence, quality assurance, interdisciplinary research options and international networking,
- Section 5 will focus on the two principles related to the interface with the labour market: exposure to industry+ and transferable skills training,
- And Section 6 will focus on the principle of attractive institutional environment, including working conditions, recruitment, career perspectives and funding.

Finally, section 7 will present the key findings and recommendations/reflections on further clarification and implementation of the principles.

A list of the institutions visited and of the virtual visits is provided in annexes 1 and 2.

[2] Available in detail in the individual case reports for each of the visited institutions.

1 GENERAL BACKGROUND

1.1 Context

The "Innovation Union" is one of the seven flagships of the EU 2020 strategy. Its primary objective is 'to improve conditions and access to finance for research and innovation, to ensure that innovative ideas can be turned into products and services that create growth and jobs.'[3] Researchers and the availability of well-trained personnel in general are one of the elements underlying this vision. As a result, doctoral training has gained considerable importance across Europe, thereby touching upon issues such as increased policy coordination and better funding.

The European University Association (EUA) conducted the Doctoral Programme project[4], which has led to the Salzburg conference and the 10 "Salzburg Principles"[5] (reproduced in the Bergen declaration) as the basis for the reforms of doctoral education in Europe. These principles concern the key role of doctoral programmes and research training in the Bologna process:

1. **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 academia.
2. **Embedding in institutional strategies and policies**: universities as institutions need to assume responsibility for ensuring that the doctoral programmes and research training they offer are designed to meet new challenges and include appropriate professional career development opportunities.
3. **The importance of diversity**: the rich diversity of doctoral programmes in Europe - including joint doctorates - is a strength which has to be underpinned by quality and sound practice.
4. **Doctoral candidates as early stage researchers:** should be recognized as professionals – with commensurate rights - who make a key contribution to the creation of new knowledge.
5. **The crucial role of supervision and assessment:** in terms of individual doctoral candidates, arrangements for supervision and assessment should be based on a transparent contractual framework of shared responsibilities between doctoral candidates, supervisors and the institution (and where appropriate, including other partners).
6. **Achieving critical mass:** Doctoral programmes should seek to achieve a critical mass and should draw on the different types of innovative practice being introduced in universities across Europe, bearing in mind that different solutions may be appropriate to different contexts and particularly across larger and smaller European countries. These range from graduate schools in major universities to international, national and regional collaboration between universities.
7. **Duration:** doctoral programmes should operate within appropriate time lengths (three to four years full-time as a rule).

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3 European Commission, "Europe 2020 Flagship Initiative – Innovation Union, SEC(2010) 1161 final, Brussels, 6 October 2010.

4 http://www.eua.be/eua-work-and-policy-area/research-and-innovation/doctoral-education/doctoral-programmes-project/

5 http://www.eua.be/eua/jsp/en/upload/Salzburg_Conclusions.1108990538850.pdf

8. **The promotion of innovative structures:** to meet the challenge of interdisciplinary training and the development of transferable skills.
9. **Increasing mobility**: doctoral programmes should seek to offer geographical as well as interdisciplinary and intersectoral mobility and international collaboration within an integrated framework of cooperation between universities and other partners.
10. **Ensuring appropriate funding**: the development of quality doctoral programmes and the successful completion by doctoral candidates requires appropriate and sustainable funding.

Five years after the Salzburg Principles, the European University Association – the Council for Doctoral Education - conducted a series of seminars, workshops and conferences in order to explore the level of implementation of Salzburg Principles at European universities. The Salzburg Recommendations II (2010)[6] provide a set of guidelines for diverse doctoral programmes and schools across Europe. The Salzburg Principles and Salzburg Recommendations II have successfully contributed to achieve a balance between a number of tensions that have been characteristic of doctoral training to date:

- To balance out the level of structured skills training versus individual supervision, guidance and autonomous research;
- Creating critical mass within institutions whilst recognising the different cultures, needs and expectations of cognate disciplinary groups;
- Creating efficiency in terms of time to degree vs. allowing time to develop individual autonomy and independence;
- Supporting labour market development vs. the risks that particular students will be unemployed, overeducated or mismatched with available employment opportunities;
- Balancing the right level of academic education with skills necessary for future career development outside academia;
- Balancing immediate skill requirements of the labour market with skills that will aid progression through the course of the career;
- The balance between specific (sub-disciplinary) individual skills vs. wider academic and generic skills.

Subsequently, the European Commission developed a set of seven principles for innovative doctoral training[7] in the framework of the European Research Area. These seven EU principles were based on the ten Salzburg Principles and Salzburg Recommendations II, good practices in Member States and the Marie Curie experience. These seven principles are presented in Figure 1 and Box 1 below.

The "Principles for Innovative Doctoral Training" have been endorsed by the EU Council of Ministers in their conclusions on the modernization of higher education on 28/29 November 2011. The Council calls on institutions and Member states "to link, where relevant and appropriate, national funding to the Principles for Innovative Doctoral Training". National funding agencies will have new opportunities to fund innovative doctoral training under Horizon 2020 as the COFUND scheme of the Marie Skłodowska-Curie Actions will be enlarged to also cover the co-financing of national or institutional doctoral training programmes.

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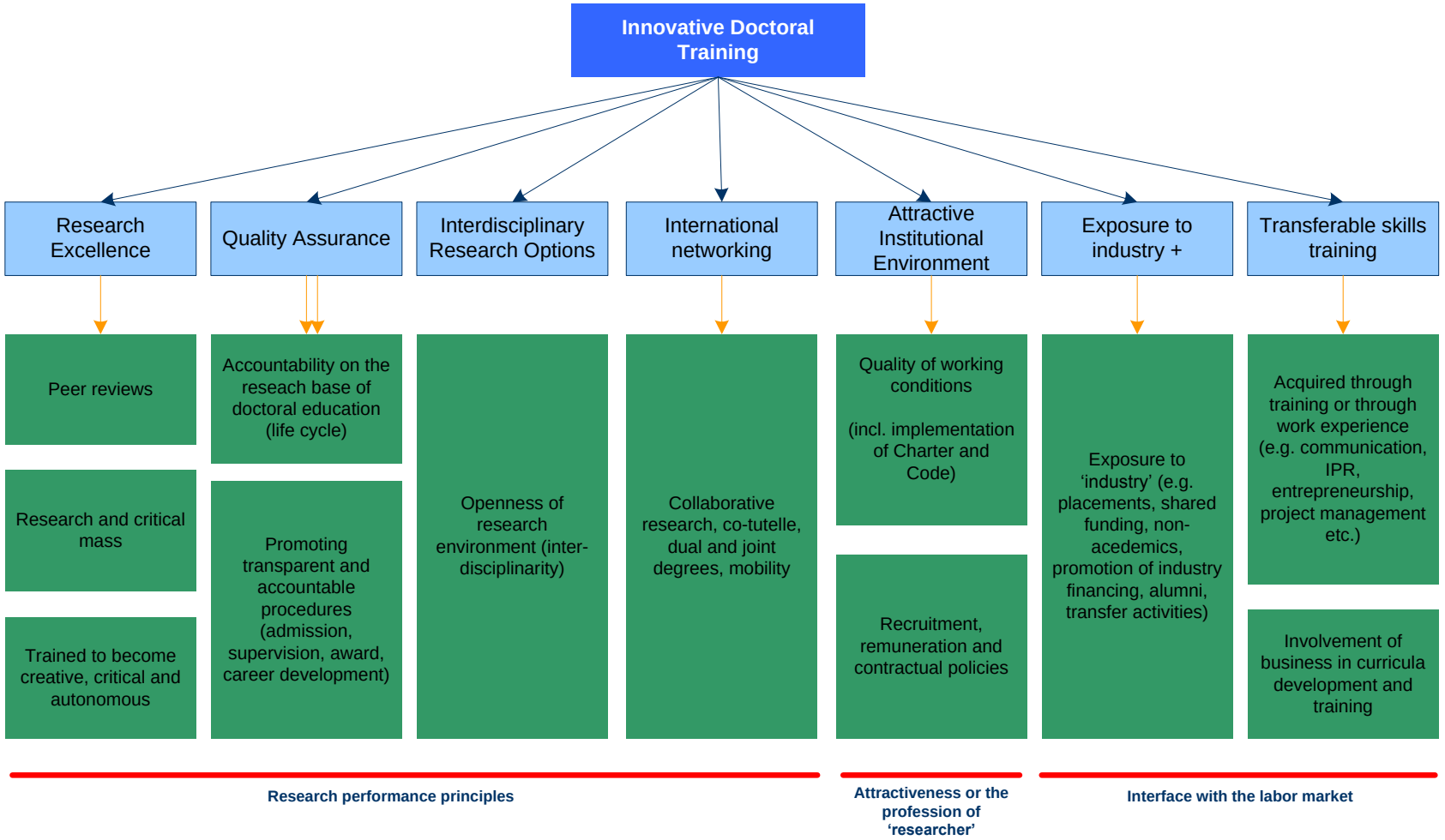
6 http://www.eua.be/Libraries/Publications_homepage_list/Salzburg_II_Recommendations.sflb.ashx

7 Based on the "Report of Mapping Exercise on Doctoral Training in Europe: Towards a common approach" of 27 June 2011(final), adopted by the ERA Steering Group on Human Resources and Mobility. The seven principles were defined with the help of experts from university associations; industry and funding organizations.

Figure 1: Overview of the IDT Principles: "IDT-tree"



Source: IDEA Consult based on Report of Mapping Exercise on Doctoral Training in Europe: Towards a common approach (2011)

Box 1: Seven Principles for Innovative Doctoral Training

1. 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.

2. 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 Researchers.

3. 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.

4. Exposure to industry and other relevant employment sectors

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.

5. 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.

6. 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 experience". 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 Forum and the outcomes of the EUA DOC-CAREERS project. 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.

7. 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.

Source: Report of Mapping Exercise on Doctoral Training in Europe: Towards a common approach (2011)

1.2 Objectives

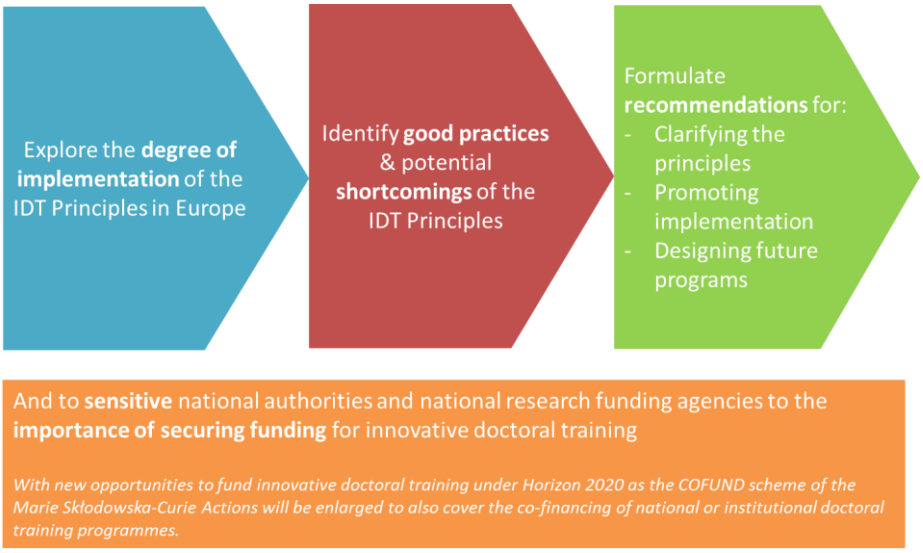
The main objective of the study is to **explore the implementation of Principles for Innovative Doctoral Training in Europe**. Their current and future role as a 'guiding tool' in the reform of doctoral training and education in Europe is analysed.

As represented in Figure 2 below, the objectives of this study are to:

- Verify the application of the principles against current institutional practices and the emerging needs of the Innovation Union (i.e. increase the overall research intensity of society by better training doctoral candidates and make them capable of working in a variety of employment areas, including industry);
- Provide a number of illustrations of "good practice" in order to increase the exchange of knowledge and to provide examples of how particular countries/institutions deal with the innovative doctoral training principles;
- Indicate potential shortcomings of the current innovative doctoral training principles;
- Provide recommendations to policy makers at institutional, national and EU level to improve or clarify the principles (i.e. reflect on the individual principles and complement them with the findings where applicable);
- Provide recommendations to promote the implementation of the principles on a European wide scale;
- Come up with recommendations on the design of future programs dedicated to doctoral training on regional, national and European level.

As noted earlier, the Council calls on institutions and Member states to make optimal use of the opportunities to fund innovative doctoral training under Horizon 2020 as the COFUND scheme of the Marie Skłodowska-Curie Actions will be enlarged to also cover the co-financing of national or institutional doctoral training programmes. With the integration of national/regional policy makers in the case studies the project also aimed to sensitize national authorities and research funding agencies to the importance of securing funding for innovative doctoral training.

Figure 2: Objectives of the study



Source: IDEA Consult

1.3 Approach

1.3.1 Tasks and deliverables

The exploration study consisted of three main tasks:

1. Update of the 2011 mapping exercise
2. Institutional visits: questionnaire and template development, guidebook to the interviewers, selection, planning and carrying out the visits
3. Cross-case analysis and reporting

The organisation of the visits is further discussed in section 1.3.2 and the cross-case analysis and reporting in section 1.3.3.

The Interim Report of this project contains an update on the 2011 mapping exercise of the European Commission. In the "Report of Mapping Exercise on Doctoral Training Europe - Towards a common approach"[8] of the 27th of June 2011, the European Commission provided an overview of recent developments in doctoral training and tried to identify a common approach. EU and national efforts were reviewed with the aim to identify some supporting measures and suggestions for the EU and Member States. To update this mapping exercise we added an extended statistical section containing relevant and available data on doctoral candidates, their training and career. Sources were selected to collect relevant and recent information: Eurostat, Researchers Report (2012), Eurodoc (2010), MORE2 (2012). In addition, an extensive literature review was performed including studies from organizations such as EUA, VITAE, ACA, CGS, SG HRM and LERU.

1.3.2 Study visits

1.3.2.1 Site and virtual visits

Two types of visits have been implemented: site visits and virtual visits. In around one third of the cases an on-site visit to the selected institution was undertaken. In another two thirds the visit was 'virtual' in the sense that telephone/Skype sessions were planned with each of the interviewees/target groups.

1.3.2.2 Target groups

In order to obtain a detailed picture of doctoral training and reach sensible conclusions, four different target groups have been involved:

1. **Institutional level (university management)**: vice-rectors and heads of doctoral programmes;
2. **Policy level**: national and regional policy makers and funding agencies;
3. **Non-academic level**: representatives from industry and non-academic sectors
4. **Individual researcher level**: supervisors and doctoral candidates

The case reports discuss further the distinct views of the different target groups.

1.3.2.3 Selection

Overall, the site and virtual visits together cover many different European countries and regions. The selection of countries and institutions for the more extensive site visits was based on several criteria. Special attention was paid to countries where intensive reforms have taken place recently or are on-going,

[8] http://ec.europa.eu/euraxess/pdf/research_policies/Report_of_Mapping_Exercise_on_Doctoral_Training_FINAL.pdf

and/or where the economic crisis is expected to impact doctoral training. The selection of site visits was therefore focused on the Central, Eastern and Southern European countries. The fact that doctoral training for these regions is also less well documented than in several Western or Northern European countries played a role in the selection (cf. mapping exercise in the Interim Report of this study).

Starting from a list of volunteering institutions and additional suggestions from within the European Commission, and by the experts of the research team, the EC decided on the final selection. Institutions that were not able to participate have been replaced by another institution selected by the EC and the research team.

An overview of all case studies is provided in Annexes 1 and 2.

1.3.2.4 Organisation

Preparation of the toolbox

To prepare for the visits, data collection templates and interview guides were prepared. These have been discussed with the EC for approval in the initial phases of the project. All following templates were delivered in Annex to the Interim report:

- **Agenda** of the visit, including target groups for each of the sessions
- **Procedure for contacting** institutions, including letter of endorsement by the EC
- **Questionnaire** for the visits, including the implementation of a short version in an online survey for both institution and interviewer to prepare the visit beforehand
- **Briefing book** for the institutions, including context information, objectives, expectations in terms of organisation, agenda and questionnaire for the visits
- **Guidebook** for the interviewers, including the briefing book as well as additional set-up to safeguard consistency in approach and reporting
- **Reporting template** for the case studies

Additionally, a web link was inserted on the website of IDEA Consult containing information on the project objectives, set-up and timing and additional information on the topic for reference e.g. during the contacting phase of the case institutes.

Organisation of the visits

Each of the candidate institutions was contacted first by the research team at IDEA Consult or CHEPS, followed by an endorsement letter from the European Commission. Once the institution decided to participate, it received the briefing book with all relevant context information and consequently appointed a person as a so-called Single Point of Contact (SPOC). The communication from then on was established directly between the SPOC and one of the research experts from the consortium:

- Alexandra Bitusikova (Matej Bel University)
- Emmanuel Boudard (La Rochelle Consulting)
- Sybille Hinze (iFQ)
- Lena Tsipouri (University of Athens)
- Andrea Kottmann, Liudvika Leisyte and Elke Weyer from CHEPS
- Arnold Verbeek, Miriam Van Hoed, Annelies Wastyn, An De Coen and Ruslan Lukach from IDEA Consult

The SPOC was invited to organise the visit from a practical point of view: contacting the relevant stakeholders to participate, organising time and room for the meetings, keeping the experts posted on progress, etc.

A preparatory discussion by phone with the SPOC was common, in order to fine-tune expectations and support progress to date.

Carrying out the visits

The research experts used different sources and materials to prepare for the visits: particularly information from the pre-completed online questionnaire and existing secondary sources such as MORE2 and ERAWATCH. The experts also consulted national and institutional documentation (website, regulations, brochures) where available.

The site visits foresaw two days, the virtual visits comprising one day of discussion sessions. For both types of visits the same target groups have been included. For each case visit, the leading experts drafted a case report following the structure of the questionnaire. In these case reports particular attention was paid to the context information, impact of the economic crisis, good practice and recommendations. Draft reports were sent to the SPOC to correct for factual mistakes and misunderstandings. The final version served as input to the cross-case synthesis that is presented in this Final Report.

1.3.3 Cross-case synthesis

In the cross-case synthesis the individual case reports have been used to describe general trends in the implementation of the IDTP across Europe. Main barriers to as well as best practice in their implementation will be also presented.

Due to the special set-up of the study – a non-representative sample of higher education institutions across Europe - the findings cannot be used to make generalizations about countries or even on the 'general situation in Europe'.

Therefore, this final report mainly serves as an inspiration to all actors involved in the development and organisation of doctoral training: the institutions themselves as well as European, national and regional policy makers and funding agencies, doctoral supervisors and doctoral candidates.

The report is structured around the key questions of the study and visits. For each question, the "cross-case findings" are findings that represent the majority of the institutions visited. The cross-case findings will also refer to specific examples or arguments that only represent a minority of cases or opinions of specific target groups, when the argument is relevant for the general picture. The cross-case findings are thus to be seen as a collection of the most relevant findings across cases, rather than a generalisation across cases. Furthermore, for each key question main barriers and good practices are listed. These have been taken from the specific cases.[9]

[9] For detailed description of barriers and main barriers please refer to the individual case reports.

2 VISION AND IMPLEMENTATION OF THE IDTP

2.1 Vision on IDTP

2.1.1 Cross-case findings

In the majority of the institutions, the principles are not known as the European Commission 2011 mapping exercise or Council Conclusions. Awareness is higher among the heads of research and/or doctoral schools than among doctoral supervisors and candidates, policy makers and non-academic representatives.

Nevertheless, the IDTP are recognised in all institutions as valid principles to support and guide innovative doctoral training. They are confirmed as being relevant and important.

Only in a few institutions was reform of doctoral training explicitly based on the Salzburg Principles. All other institutions state that their doctoral training is based on principles that are very similar to the Salzburg and IDT principles, only different in wording or not explicitly taken from the European documents. The principles thus 'come naturally' to all institutions.

It is recognised that the visit within the context of this study has opened the discussion on doctoral training and that the IDTP help to structure this discussion.

Not all principles are regarded as equally important by the different group of actors. A higher weight is given to the principle of research excellence, based on quality assurance and attractiveness of the research environment. The importance of the other four principles (international networking, exposure to industry+, interdisciplinary research options and transferable skills training) depends more on the specific vision, typology and context of the institutions, and also on the discipline.

Research excellence

The fact that research excellence is supported by peer review processes and needs to involve the education of creative, critical and autonomous individual researchers is commonly agreed upon by all target groups.

Supervisors and heads of doctoral schools discuss the role of building a critical mass for research excellence. Critical mass is considered important for the sustainability of the institutions' overall research capacity, but a handful of institutions questioned whether it could also be a tool to stimulate research excellence. Research excellence could equally be assumed to trigger the growth of a critical mass instead of the other way around. This was mentioned with respect to new, interdisciplinary topics that are to be developed.

Quality assurance

Institutions agree that having quality assurance processes in place is an essential part of modern doctoral programmes. In those cases where doctoral training has only recently been reformed, attention was almost always paid to this issue.

Attractive institutional environment

Quality of working conditions and remuneration are important to all institutions, though it is partly out of their control due to legislative/regulatory and funding-related barriers. It is recognised that this principle supports the doctoral training in various ways: for example through balancing time for research (versus teaching or versus working alongside the doctoral education), providing up-to-date research infrastructure, attracting bright doctoral candidates and excellent supervisors, etc.

Even though the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers (Charter & Code) are known at institutional level, doctoral candidates themselves are often not familiar with the documents. In some countries doctoral candidates have the legal status of a student and not of an employee.

Interdisciplinary research options

Regarding interdisciplinary research options, opinions are diverse. Some respondents view interdisciplinarity to be an essential aspect of research in general and of innovative doctoral training in particular. They also think that interdisciplinarity is one of the future pathways in research that needs to be actively encouraged. A number of the institutions visited have a strong interdisciplinary tradition and promote it throughout all aspects of teaching and learning at their institutions. Other respondents reported that there is hardly any interdisciplinary at their institutions and that it is not on the institutions' strategic agenda. Some institutions reported that they would like to implement more interdisciplinarity but that some legal restrictions hinder this process.

International networking

International networking is well accepted as principle of innovative doctoral training. The need to interact with researchers from all over the world is recognised as a central feature of modern science. International networking is performed in various ways: aside from taking research stays abroad, doctoral candidates attend international conferences; institutions attract international scientists and students, collaboration with researchers abroad, publishing internationally etc. The main barrier (if applicable) is the lack of funding. Administrative or regulatory burdens might also be demotivating, e.g. for dual degrees. Depending on the age of the doctoral candidate, family responsibilities might also prevent him/her from going abroad.

Exposure to industry+

Most discussion revolved around the topic of "exposure to industry+" with the "+" referring to all other relevant employment sectors[10]. Opinion is divided across a broad spectrum, ranging from 'necessity for innovative doctoral training' and 'not at all needed'. Much seems to depend on the disciplines under review and the economic structure of the country or region.

In the exact sciences, more interaction with companies is observed. Nevertheless, in countries with a low degree of industry-university collaboration, industry representatives argue that the involvement of industry from the start of the doctoral education and during the definition of research topics would further improve the applicability of research to technical or scientific solutions for real problems. The institutions acknowledged this point but do not entirely agree as they want to safeguard their and the researchers' scientific independence. Firms' lack of 'preparedness' to adapt to the specific requirements of doctoral training is mentioned as a barrier here. The presence of high-tech companies in the region of the university facilitates the university-industry interaction and/or funding for research projects with specific links with the companies' research and development.

In the social sciences and humanities, less importance is assigned to interactions with non-academic partners. Here research collaboration between universities and possible 'industries' of the social sciences and humanities have traditionally been low. Training in the social sciences and humanities is also less job-specific.

[10] 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. museums).

Transferable skills training

In terms of transferable skills training, opinion is also divided. First, the definition of transferable skills is not clear to all institutions and is often reduced to a limited set of topics such as presentation and writing skills only. In rare cases it is considered to be an elementary part of doctoral training. The majority of institutions recognise the value of these types of skills, yet some questioned whether the training and soft skills should be part of doctoral training. In these cases, doctoral training was seen as a preparation for academic sectors and the academic career specifically.

Non-academic representatives and doctoral candidates put more emphasis on transferable skills training than the institutional level.

2.2 Implementation in national/regional policy

2.2.1 Cross-case findings

It is clear from all cases that national and regional policy plays a crucial role in the implementation of the IDTP in institutions. The policy context determines the degree of autonomy and flexibility of the institutions, the vision of and emphasis given to doctoral training and the funding available to shape doctoral training and attract doctoral candidates.

Institutional autonomy

Concerning autonomy and flexibility of the institutions, the strongly centralised governance of higher education in the majority of the Central and Eastern European countries and Baltic countries leaves little room for the higher education institutions to adjust the modalities of doctoral training. Many details are fixed by legislation and the administrative burden to change rules or processes is generally high. Nevertheless, policies follow principles that are in line with the IDTP, e.g. to assure quality, to improve international networking and research excellence etc. On the other hand, in some case (e.g. Austria) if autonomy is granted to institutions, policy makers are hesitant to engage in too strict a discussion of implementation of the IDTP.

Policy vision and regulatory stability

In a number of countries, the lack of long-term vision and a stable strategy in policy is mentioned as a hindrance to the sustainable implementation of the principles. Examples are Lithuania, Romania and Bulgaria. Regulatory and legislative stability is important for higher education institutions and other actors involved in doctoral training to start mid- or long-term processes and to develop a reform strategy.

Funding for research

Furthermore, funding plays an important role. Here the funding mechanisms, the level and stability of the funding assigned to doctoral training are factors that determine the sustainable implementation of doctoral training according to the principles and the overall attractiveness of doctoral research.

The implications of the economic crisis on the overall government budget (and in particular for research) in Greece, Cyprus and Spain clearly demonstrate that there is a critical level of funding and that stability in funding is crucial. Because the economic crisis did not directly impact on research funding, the level of funding and projects did not change for some time, but as the current schemes will end and not be renewed the researchers feel there are no prospects in their countries.

In some countries the national funding agencies use schemes to promote structural doctoral training. In Germany, the German Research Foundation has set up programmes like research training groups (Graduiertenkolleg) or the Graduate Schools in the Excellence Initiative to do this. Here, the projects have to adhere to some principles of doctoral training in order to receive the funding.

Other countries, e.g. Finland choose for a combination of setting general rules for doctoral education in the legislation and lump-sum funding for doctoral training. Here a new law prescribes that doctoral candidates have to enrol at their institutions and that institutions need to have a structural framework for doctoral education in place. Universities, on the other hand, are free to decide how the structural framework is organized and how funding for doctoral education received from the Ministry of Education will be spent.

As is further discussed in sections 2.3 and 6.2.3, Structural Funds are much appreciated as source of funding for doctoral education, and some countries rely on this funding to a very significant extent when running their doctoral training programmes. However, there is a problem with the sustainability of doctoral programmes or schools funded by Structural Funds once the funding ends. Difficulties also emerge when the stability of the funding stream is at stake. In the case of the Romanian institutions, the national level failed to transfer the funds to the institutions in good time, which posed serious liquidity problems for them and delays in the payment to doctoral candidates.

2.2.2 Barriers or challenges[11]

Institute	Barrier/challenge
Bulgaria, Bulgaria Academy of Science and Sofia University	A lack of a clear development strategy and common priorities at national level forms a barrier to the implementation of the IDTP in Bulgaria. It is felt that the IDTP are not promoted at government level. Moreover, the state funds have started to decrease during the financial crisis and institutions have limited access to European resources due to slow absorption of EU Structural Funds. The BAS experienced a 40% cut in its budget in recent years, which hinders further development of innovative doctoral training.
Lithuania, Vilnius University	Frequent legislative changes, bureaucracy, administrative burdens and uncertainty of central funding levels are barriers to change and long term strategies.
Bosnia-Herzegovina, University of Banja Luka	In Bosnia-Herzegovina, two ministries are responsible for the legislation on doctoral training: the national Ministry of Science and Technology (also the main funding body) and the regional Ministry of Education and Culture of the Republic of Srpska which is in charge of higher education and third cycle education. This 'double governance' leads to administrative and practical inefficiencies which deteriorate the attractiveness of the institutional environment.

[11] The tables with barriers and good practices are based on the individual case reports of the visits to the institutions. For more context information on each of the examples, we refer to these case reports.

Greece, University of Athens Cyprus, University of Cyprus	The importance of policy and funding speaks from examples of the Universities of Athens and Cyprus. In Greece and Cyprus, the implications of the economic crisis are felt at all levels (salaries, student support, research equipment, facilities). The financial constraints touch upon the basic funding and the core of the doctoral education system: there are only few funded positions for doctoral candidates and almost none for post-doctoral research. Infrastructure is now at a reasonable level, but maintenance and renewal are low. Both aspects have implications for the attractiveness of the institutional environment. The situation is expected to aggravate as time passes and inertia is lost: current schemes will come to an end and not be renewed.

2.2.3 Good practice(s)

Institute	Good practice
Germany - BIGSSS	**"Require adherence to similar principles for funding"** In Germany, the German Research Foundation has set up programmes like research training groups (Graduiertenkolleg) or the Graduate Schools in the Excellence Initiative to increase the quality of doctoral training. Here the projects have to adhere to principles similar to the IDTP to receive the funding.

2.3 Implementation in institutional policy

2.3.1 Cross-case findings

Institutions are generally aware of the importance of each of the principles for excellent and competitive research and training. They implement the principles (sometimes in the form of the IDTP, but more often in their own words) in their doctoral schools and programmes.

The principles are implemented to differing extents, as some principles are more important for the institution than others. In particular, research excellence is perceived as a fundamental principle for doctoral training.

For the majority of institutions, the IDTP are an inspiring framework. They do not see them as compulsory rules. Based on their autonomy and their vision of doctoral training, most institutions have realized the IDTP in their doctoral training but via a different terminology. Hence, there is still a variety of different forms of doctoral training across Europe and institutions claim that this variety should be preserved.

As mentioned in the previous section, institutional autonomy and funding are the most important factors that determine the degree of freedom and budgetary support to reform doctoral training at the institutional level. The historical, economic and cultural background of the country where the institution is located is crucial in this respect. A lack of funding is the main barrier in the implementation of the IDTP. This is, in particular, true for countries that are currently able to invest only a little money in doctoral training. A lack of funding affects the development of research excellence for various reasons: low grants force students to work alongside their doctoral research work. This leaves only a little time for students to dedicate to PhD research. Applying low grants or salaries for doctoral candidates runs the risk that highly qualified students will not be attracted to doctoral training as they can easily find more attractive working

conditions e.g. in other countries or through other careers. As is further elaborated in section 6.2.3, Structural Funds are much appreciated as source of funding for doctoral research. In countries which have this option, the Structural Funds are actively used for investments in doctoral training. Next to funding stipends for doctoral candidates, the money is used for investments in research infrastructure and reforms in doctoral education. For example, the University of Vilnius constructed a new biotech valley with ESF funding in order to increase the attractiveness of the biotech research in Vilnius and offer doctoral candidates and researchers the opportunity to work in state-of-the-art laboratories and perform top level research. The project is very much appreciated by doctoral candidates and supervisors as well as by industry. In Estonia, the ESF funding was used to reform doctoral training: a new structure for doctoral schools has been established.

The organisational cultures, traditions and attitudes of academic staff also form a barrier to the implementation of the IDTP. For staff that has been integrated in more traditional forms of doctoral training, a change to more structured forms is sometimes difficult to accept. The fear of losing professional control over one of the core elements of the academic profession might account for this tendency. Also, top-down approaches for the implementation of more structured forms of doctoral training result in low levels of acceptance among (senior) staff.

For a discussion on the concrete implementation per principle, we refer to sections 4 to 6 of this report.

2.3.2 Barriers or challenges

Institute	Barrier/challenge
Netherlands, Technical University Delft	Acceptance of the new more structured form of doctoral training is particularly low among senior staff.
Croatia, University of Zagreb	The University of Zagreb also emphasises that reforms require a change of culture and mind-set from the traditional perspective, which takes some time to take place.

2.3.3 Good practice(s)

Institute	Good practice
Ireland, University College Cork	**"Share good practices – but look out for adequacy"** Practice-sharing: in the period 2005-2008 there was regular contact with UK universities to share practices through joint events and workshops. There are important similarities in the education systems which make practice-sharing successful.
Finland, University of Oulu	For the reform of doctoral training and the implementation of the University of Oulu Graduate School examples of good practice in doctoral training were collected throughout university. There was initially some resistance towards the Graduate School among students and supervisors as they feared losing traditional rights that have been related to their status. Most of this has been resolved as all participants now see the benefits of the Graduate School.

Estonia, Tallinn University of Technology	**"Doctoral schools through Structural Funds"** In 2005, 3 doctoral schools were established in Estonia and in 2009, 10 additional doctoral schools were established from Structural Funds. These doctoral schools are interdisciplinary and across universities. From some departments of TTU, PhD candidates become automatic members. From other departments, an application procedure is required. The doctoral school hosts summer/winter schools, seminars etc. In addition to this, the doctoral schools also offer the opportunity to apply for certain types of funding.
Bulgaria, Bulgaria Academy of Science and Sofia University	Structural Funds are also applied at the University of Sofia and Bulgaria Academy of Science to 'experiment' with the implementation of doctoral schools. The fact that there are resources to try out this 'a miniature model of how the university should be' is very important to the institution in order to learn from the experience and improve efficiency of new initiatives.

3 ORGANISATION OF DOCTORAL TRAINING

3.1 Implementation and evolution in doctoral training

3.1.1 Cross-case findings

Doctoral training is organized very differently across Europe. There are universities that have chosen to implement graduate schools at the central level, whereas in other universities these units can be found in each faculty. On the other hand, some universities have chosen to implement doctoral programmes without offering the organisational framework of a doctoral school. Structured forms of doctoral training are prevalent in the majority of institutions that have been included in the study. Here doctoral study includes (though to a different extent) a course phase where students participate in different forms of training (field-specific knowledge, methodologies and transferable skills training). The volume of course work differs strongly across the institutions, in some cases also within the institution. During their studies doctoral candidates are mostly supervised by teams in the majority of institutions. Supervision meetings take place regularly, and most doctoral candidates also have a main supervisor whom they can approach for their questions on a day-to-day basis. The form of supervision is also strongly dependent on the discipline with more collaboration in the experimental sciences and solitary work in the social sciences and humanities.

In the following we will present some good practices[12] of implementation of the IDTP in doctoral training. We will look particularly at good practice in:

- Doctoral Schools and Structured Training
- Recruitment
- Supervision

3.1.2 Good practice

Institute	Good practice
Doctoral Schools and Structured Training	
Luxembourg, University of Luxembourg	**"Centralize where possible"** The University of Luxembourg gradually implemented doctoral schools based on the "Doctoral Education Framework". This framework sets ambitious objectives for the doctoral schools and encourages the implementation of structured doctoral education. With the implementation of structured doctoral training the University of Luxembourg expects to improve quality assurance and to further support research excellence. Many services for doctoral schools are organized centrally, particularly training for supervisors and transferable skills training. The institution benefits from efficiency gains because not all doctoral schools/programmes need to establish the training separately.

[12] The examples of good practice were reached through the site and telephone visits undertaken for this study. These case studies do not present a representative picture of doctoral training in the countries under review. For more detailed descriptions of the doctoral training please refer to the case reports.

Estonia, Tallinn University of Technology	**"Trigger collaboration and interdisciplinarity by organisational forms"** In Estonia, 13 thematic doctoral schools were established with funding through ESF (calls targeted the establishment of doctoral schools that offer transferable skills training and include international collaboration). The doctoral schools are interdisciplinary and across universities (inter-institutional), thus fostering opportunities for collaboration.
Recruitment	
	"Set rules to attract and select best candidates and to achieve a good match between candidates, supervisors and research topics"
Germany - BIGSSS Bremen International Graduate School of Social Sciences, University of Bremen and Jacobs University Bremen	The BIGSSS has implemented its own online application system. Positions are announced once per year and very different channels are used to publish the fellowships world-wide. The school receives applications from all over the world. When applying students already have to hand in a project proposal. Students are selected on the following criteria: quality of their post-graduate degree, quality of their research proposal and goodness of fit of the research proposal with the research interest of the faculty. Selecting on these criteria allows choosing the right candidates and contributes to a very high completion rate at BIGSSS.
Austria, VBC	Access to the VBC training program is only granted if a candidate has been successful in the central admission and selection process. A call is published internationally twice a year. Each written application is reviewed and graded by four VBC group leaders. A shortlist is prepared and potential candidates are invited to a selection event ("Interview week") at VBC which lasts five days. Usually twice as many candidates are invited than there are positions to be filled. During the interview week each candidate is interviewed by a panel of four group leaders, each institute being represented. Applicants are assessed with regard to their educational background, research experience, scientific interests, scientific questions and references. Each candidate is graded and at the end of the second day offers are made to the successful candidates. Day 3 and 4 are matching days, successful candidates have the opportunity to get to know research groups and prioritize which group they would want to work in. Candidate's interests and group leader interests are matched and candidates are made specific offers. PhD candidates who could not be matched during these days still receive an offer and the matching process has to be completed within a defined period of time after the program started. PhD candidates who are made an offer have to accept or decline within three weeks. Applicants who were not made an offer cannot reapply. In the most recent selection round, the VBC received almost 500 applications for 32 positions.

Supervision	
Slovakia, Comenius University	**"Limit the number of doctoral candidates per supervisor"** The number of doctoral candidates per supervisor is stipulated by law (maximum 5 doctoral candidates per supervisor) to ensure the quality of supervision.
Ireland, University College of Dublin	**"Facilitate communication between doctoral candidates and supervisors"** A student supervisor coach is appointed at the University College of Dublin to support the interactions between the student and the supervisor.
Germany, BIGSSS United Kingdom, University of Nottingham	**"Share responsibilities and enrich opinions by teams of supervisors"** – Doctoral candidates are supervised by a committee of three to five supervisors. The committee is selected by the doctoral candidate. The candidate has to report at least once a year to this committee in a 'progress assessment colloquia'. Then achievements of the last year and plans for the next year are evaluated. Candidates as well as supervisors benefit from team supervision – the doctoral candidate does not only have to rely on one opinion, he/she can integrate interdisciplinary perspectives into the research work by choosing supervisors from different disciplines. Also, international networking is developed, as at least one supervisor has to be an external. Here students mostly choose a supervisor from abroad. Supervisors also report benefits: they are forced to prepare more intensively for the supervision meetings. Looking at research from different perspectives is experienced as enrichment. – A similar practice is also observed in the University of Nottingham, where there is a shift in favour of having a team of supervisors rather than a single supervisor. One of the benefits pointed out is that external supervisors can participate and that there is more flexibility and critical mass to discuss the research.
Croatia, University of Zagreb Luxembourg, University of Luxembourg Ireland, University College of Cork	**"Train the trainers"** – At the University of Zagreb, it is mandatory for supervisors to take a mentorship workshop (or equivalent) to optimize and discuss supervision before accepting first mentorship. Supervisors welcome the initiative and indicate that they learn from the discussions. The benefit is that supervisors are invited to think about their role and can discuss case studies, problems, solutions in order to be better prepared for their supervision tasks. – The University of Luxembourg's Research Office organizes training in supervision for supervisors, planned for all UL supervisors as part of the continuous profession skills development of academic staff. – At the UCC in Ireland, a programme involving a number of workshops has been established to further improve the supervisors' qualification and help them discuss every aspect of supervision.

4 RESEARCH PERFORMANCE PRINCIPLES

4.1 Research excellence

4.1.1 Cross-case findings

Research excellence is the main objective of all doctoral programmes (according to our interviewees).

Among the cases included in the study it is common to apply peer reviews for quality assurance by various means. Among these practices are regular team meetings, supervision and examination/assessment committees including external members and publication requirements. Building critical mass is generally not part of the institutional policy and in some institutions it was questioned as to whether critical mass is a necessary condition for research excellence.

The understanding of research excellence and the instruments taken to reach out for it clearly reflect different institutional cultures, the disciplinary traditions and also national legislation. For example – in line with the publication cultures of the different disciplines, for some doctoral programmes stimulating research excellence was closely related to the publication of peer-reviewed journal articles before the defence of the thesis. In other programmes the integration of external reviewers in the supervision or in the examination committee was undertaken as a good practice to achieve research excellence.

Barriers for implementation

Most respondents also state that achieving research excellence is strongly dependent on the realization of the other IDTP. For example: assuring quality; being involved in international networking; having an attractive institutional environment and interdisciplinary research options - all these contribute to the development of research excellence. Conversely, problems in implementing these principles lead to difficulties in research excellence.

The main barrier in relation to striving for high levels of research excellence is a low level of **funding.** Limited funding makes it challenging to provide an attractive institutional environment, including sufficient grants for doctoral candidates, up-to-date research infrastructure and to install attractive research groups led by top-scientists and so attract good doctoral candidates. This is especially true for those institutions in countries facing severe consequences of the financial crisis or in countries with only limited resources. The aforementioned low grants for doctoral candidates are particularly problematic. This makes it, on the one hand, difficult for the institutions to attract the best students. On the other, students are also negatively affected: In order to meet their living costs, most of them have to work alongside their doctoral studies and are not able to dedicate all of their time to doctoral studies/research projects. This may prevent them from completing in time or from completing at all. Also, these students might be prevented from focusing on their research project to the extent needed to achieve excellent results.

In countries that set the **duration** of the doctoral studies at three years (for example in France, Italy, Ireland, Slovakia and Romania), doctoral candidates and supervisors report difficulties in balancing the research with other activities. Next to the research, doctoral candidates are expected to participate in transferable skills training, international networking and work on additional publications and have other duties in the lab (such as research projects, administration, etc.) or in the faculty (such as teaching, mentoring, student association, etc.). The

combination of these activities with research creates a challenge for doctoral candidates to preserve the quality and excellence of their research and still complete their dissertation within the three year period. Some students also report too much work pressure during doctoral studies.

Good practice

Peer review, as a means towards achieving excellence, is also becoming more common and open. External evaluators or even the institution itself are called to conduct annual or mid-term assessments of the progress of the PhD students. Similarly, external evaluators are also part of the final examination committee. Sometimes only external evaluators can contribute to the examination committee (e.g. Italy). In some countries it was difficult to establish international peer review in the examination process because of the higher costs. Language barriers also play a role for those countries where the dissertation in commonly written in the national language (such as Croatia, Spain, Slovakia or Czech Republic.

4.1.2 Barriers or challenges

Institute	Barrier/challenge
Slovak Republic, Comenius University Bratislava Romania, Bucharest University and AIC University Iasi EIT, ICT Labs	Research excellence is considered the most important element in a PhD. Quality is assessed through various methods, for example through requirements on peer reviewed publications. But the final outcomes may sometimes be questionable due to the short time in which to complete the degree. Time pressure is very high for supervisors and doctoral candidates when the 3-year limit is strictly applied and if it needs to include course work.
Romania, Bucharest University, AIC University Iasi, University of Iceland	Research excellence at the Romanian institutions is also threatened by the low level of stipends for doctoral candidates. A substantial share of doctoral candidates has to work alongside their research to support their living costs. Those students can therefore dedicate less time to and focus on their research projects. The low stipends also prevent the institution from attracting the best students for doctoral positions. Many of them choose to study abroad.

4.1.3 Good practice(s)

Institute	Good practice
Austria, Institute of Science and Technology	**"Achieve a good fit"** At the Institute of Science and Technology a rotation system is set in place before the start of the doctoral training in order to enforce interdisciplinary collaboration and at the same time support the adequate selection of a research group and research topic. The doctoral candidate thus has the opportunity to get a 'feel' for the research and decide what he/she would like to specialise in and under whose supervision. This improves the candidate's match with the topic and supervisor, which positively influences the quality of the research and the chance of success.
Liechtenstein, University of Liechtenstein	**"Support individual and autonomous development"** To support doctoral candidates in their individual development as autonomous researchers, the University of Liechtenstein provides each doctoral candidate with a personalized budget to fund his or

	her development by own choice. This practice allows for training, mobility and interdisciplinarity that is tailor-made to the needs of the specific research trajectory of individual researchers.
Italy, Sapienza University in Rome	**"Include external reviewers"** For the final examination, the doctoral thesis is sent to three independent external reviewers (different from the examination committee) for an evaluation report. The examination committee also has to write an evaluation report. The final awarding decision is based on the thesis and on the reports, and is made by the whole faculty of the doctoral programme. This is standard practice and can also be considered to be good practice to ensure the quality of the research and dissertation.

4.2 Quality assurance

4.2.1 Cross-case findings

Like research excellence, quality assurance is seen as another key element of doctoral training. The principle aims at enhancing the quality of the research environment as well as at promoting transparent and accountable procedures. Through doing so it strongly supports all other principles, particularly research excellence.

Barriers to implementation

Many of the barriers to the implementation of quality assurance are linked to the general barriers for the implementation of the IDTPs such as the lack of resources or national legislation.

One of the challenges in quality assurance is the number of doctoral candidates under the **supervision** of one supervisor. Although some supervisors are very popular due to their good reputation, there is a limit to the number of candidates and projects that can be adequately supervised by one person. On the other hand, the discussions show that there is no such thing as a 'standard' and much depends on the institutional support and personal capacities of the supervisor.

Usually, the number of candidates per supervisor is monitored by the institution, the faculty or the doctorate school/programme. In some cases, there is a maximum established by national regulation (e.g. Czech Republic, Serbia, Slovakia and Romania). On the other hand, the number of doctoral candidates is, in a number of cases, a criterion for accreditation of the doctoral programme or school. Some institutions have set up a commission (for example Bulgaria) to look into the number of candidates supervised by taking into account all the activities of the supervisor before making a decision such as the number of research contract under supervision, administrative responsibilities, etc.

Similarly, supervisors may not be sufficiently prepared for their role. This is recognised by most countries experimenting with training future supervisors.

In the majority of the cases, senior staff has difficulties to accept the new and more structured forms of doctoral training. The traditional organisation in doctoral programmes at faculty level, with high degrees of autonomy in terms of supervision per programme, has resulted in large variations across and within institutions. The transition towards centralisation in one doctoral school requires a culture of change at all departments, programmes and supervisors.

Good practice

Doctoral schools are implemented and **doctoral programmes are under reform** in many countries (see previous Sections). In some cases, the doctoral school serves as an umbrella institution which covers the different programmes; in others it is a new organisational unit that provides an administrative framework and actively provides doctoral training on a central level.

Overall, the recent and on-going reorganisations are seen as an important factor for improving the quality of admission, supervision and training of doctoral candidates. Organisational frameworks also allow a closer monitoring of doctoral candidates and their achievements. These structures also ease the evaluation of different procedures in doctoral training (e.g. to achieve more transparency in admission to doctoral studies) and to centralize and rationalize some efforts (e.g. transferable skills training organized on the central level). Institutions report that centralizing some processes on the central level leads to efficiency gains but they also mention that these central structures cannot respond adequately to discipline specific requirements and cultures.

Most doctoral schools or programmes also provide a mechanism to monitor quality e.g. through a doctoral committee or specific council. These structures also serve as mechanisms for tackling issues with respect to supervision, admission, examination, etc. Some doctoral schools or programmes are even looking at the **satisfaction** of doctoral candidates concerning courses offered or the doctoral programme/ school through a survey (e.g. Austria, Lithuania) or ask doctoral candidates to have a say when deciding future orientations (e.g. Belgium).

4.2.2 Barriers or challenges

Institute	Barrier/challenge
Slovak Republic, Comenius University Bratislava	Due to the high autonomy of faculties, the university leadership often has no power on PhD organization or quality control. As a consequence, quality varies across faculties and resources cannot be used efficiently. The national law on accreditation is also very detailed, which is positive but at the same time limits flexibility. E.g. it makes provision for only one supervisor per candidate. Supervision of more than one candidate can only be informal and their workload cannot be recognized (financially and in term of merit).
Czech Republic, Masaryk University Brno	Strong autonomy of faculties does not often allow for the central reorganization of doctoral training and the introduction of standardise quality assurance regulations. Quality across faculties varies significantly.
Liechtenstein, University of Liechtenstein	A lack of transparency as regards standards and rules is mentioned as a problem in doctoral training. The doctoral candidates refer to lack of faculty policies such as a list of journals where PhD candidates should attempt to publish.

4.2.3 Good practice

Institute	Good practice
Lithuania, Vilnius University Austria, Institute of Science and Technology Austria, Vienna Biocenter	**"Ask for the opinions of doctoral candidates"** An example of good practice in Vilnius University and the Austrian institutions is the implementation of a survey among doctoral candidates on their satisfaction with the processes, research environment and working conditions. The surveys are used in the institutional policy as feedback on the processes and input for future developments. Another way to handle doctoral candidates' concerns or problems is the Ombudsperson in the Austrian Institute of Science and Technology, who can be approached if disputes arise.
United Kingdom, University of Nottingham	**"Describe procedures clearly and publish them"** A comprehensive quality manual and statement of expectations for doctorate degrees clearly describe the procedures and expectations in place.
Austria, Vienna Biocenter	**"Make quality assurance a distinguished task"** Quality assurance is actively pursued in the Vienna Biocenter. A new position, the Scientific Coordinator, has recently been installed to ensure the quality of the programme. This person is also in charge of internal communication, restructuring the program and quality assurance. The newly appointed scientific coordinator participates in all PhD committee meetings. It is expected that the scientific coordinator will also initiate changes to the program e.g. regarding the curriculum (for example, integrating transferable skills training into the curricula in the context of an introductory training course), internal communication and information provision.
Turkey, Middle East Technical University	**"Diversify quality assurance instruments"** Several internal policies for quality assurance in doctoral training: control for plagiarism, implementing 'Guidelines for Good Practice and Conduct', standardization of practices across doctoral schools, course evaluations, Alumni surveys.
Italy, Sapienza University in Rome	**"Allow different forms of supervision, closely monitor progress"** Supervision can take place according to 2 models: 1) the renaissance model, and 2) the modern model. The modern model is based on: - Thesis committee: supervisor and 2 senior researchers 'very removed' from the research work, - The thesis committee monitors progress annually and makes recommendations, - The board of the school (teachers) is providing authorisation to move to the next year.
Croatia, University of Zagreb Luxembourg, University of Luxembourg	**"Train the trainers"** The practice of training supervisors at the University of Zagreb and the University of Luxembourg, described in section 3.1.2, are examples of quality assurance in the supervision process.

4.3 Interdisciplinary research options

4.3.1 Cross-case findings

Interdisciplinarity takes vary different forms in teaching and research during doctoral training. Most common is that doctoral candidates conduct an interdisciplinary research project. Also, during their course work they can select courses and training from different disciplines. Some candidates also select supervisors from different disciplines.

Interdisciplinarity is recognised as a key principle in doctoral training by the institutions. Many institutions face legislative, administrative or practical barriers when implementing interdisciplinarity. Interdisciplinarity is also strongly dependent on the characteristics of the discipline itself, like the 'proximity' to other disciplines. For some disciplines it is easier to collaborate (e.g. biology and medicine, physics and engineering) while some do not easily 'relate' to other disciplines.

The tradition of the institution plays a role for the implementation of interdisciplinarity. For example, for institutions that have merged (combining different research institutes into one organization) or combine different disciplines under one roof, it will be easier to facilitate interdisciplinary collaboration.[13]

Barriers for implementation

Supervision and quality assurance of interdisciplinary doctoral research is difficult. Practical problems in balancing the roles of two supervisors do occur. The institutional structure can equally hinder interdisciplinary research, for example when budgets are allocated per department/field and no clear rules for funding collaboration across department/faculty borders are in place. Finally, it is mentioned in several cases that multidisciplinary research is not generally appreciated, even though the examination committee come from different fields, because each member can only assess part of the dissertation to the full.

National regulation often also hinders implementation of interdisciplinary research. For example, the accreditation of doctoral programmes by a specific field of research (especially when they are too many) prevents the programme from being multidisciplinary (e.g. in Czech Republic, Bulgaria or Slovakia).

Good practice

In many countries, recent **reorganisations** of doctoral programmes or schools have led to new interdisciplinary programmes, thus responding to demand for this kind of programme.

The implementation of a **rotation system** before the start of the doctoral research also enforces interdisciplinary collaboration and supports the aim to find a good match between research group, supervisor, doctoral candidate and research topic.

Interdisciplinary exchange is also supported by institution-wide lecture and seminar series. Regular public colloquia where doctoral candidates present their research and discuss it with a larger audience are also helpful. Institution-wide training courses provide some more occasions for interdisciplinary exchange. Some institutions are stimulating interdisciplinarity by implementing interdisciplinary doctoral programmes and interdisciplinary supervision committees.

[13] For example, this has been the case in the Bulgarian Academy of Sciences, Austrian Vienna Biocenter and National Technical University of Athens.

4.3.2 Barriers or challenges

Institute	Barrier/challenge
Bulgaria, Bulgaria Academy of Science & Sofia University Czech Republic, Masaryk University Brno Slovak Republic, Comenius University Bratislava Romania, Bucharest University and AIC University Iasi	In Bulgaria, Czech Republic and Slovak Republic, existing legislation and accreditation criteria do not support the implementation of interdisciplinarity. In these cases, study programmes can only be accredited for single disciplines. In Romania, the rigidity of the law also makes innovations such as interdisciplinary titles hard to realize.

4.3.3 Good practice(s)

Institute	Good practice
Hungary, Eötvös Loránd University The Netherlands, Technical University Delft	**"Build interdisciplinary structures"** Interdisciplinarity is most common and general among fields in institutions that were created as interdisciplinary institutions
Turkey, Middle East Technical University Portugal, University of Porto	**"Build unique interdisciplinary doctoral programmes"** At the METU, interdisciplinarity is organized via doctoral programmes. Each of the doctoral schools at the university offers a number of interdisciplinary programs. Some of these doctoral programmes are also unique because of their combination of different disciplines. Doctoral candidates also adopted interdisciplinary approaches in their research projects. At the Universidade do Porto, some of the doctoral programmes are also explicitly interdisciplinary (20 out of 93 doctoral programmes).
Austria, Institute of Science and Technology	**"Achieve a good fit"** As mentioned in section 4.1.3, a rotation system is set in place before the start of the doctoral programme to enforce interdisciplinary collaboration and at the same time support the adequate selection of a research group and research topic. Even though interdisciplinarity remains within the boundaries of the scientific or technological fields of the institution, it is considered to be strongly encouraged through this system.

Slovenia, University of Ljubljana	**"Achieve a smart mix of different forms of interdisciplinary"** Interdisciplinarity is at the heart of doctoral education at the University of Ljubljana. In doctoral training the teaching as well as the research is interdisciplinary: Students can choose from a wide range of different courses, supervisory teams can be interdisciplinary as can the research project. Nonetheless interdisciplinarity is not pushed for its own sake; it finds its limits in the adequacy of the approach itself. Promoting interdisciplinarity has contributed to an increase of intra- and inter-institutional cooperation, some efficiency gains have also been reported.
Czech Republic, Masaryk University Slovakia, Comenius Universities	Both the Masaryk University and Comenius University offer institutional interdisciplinary research grants for doctoral candidates and other researchers (through competition and peer reviewed evaluation).
Ireland, University College of Cork	**"Make interdisciplinarity an integral part of teaching and research"** At the University College of Cork, interdisciplinarity is indirectly encouraged by integrating it into the research processes and training set-up: – School of Education: Mutual learning between different areas within the field of education. – Social sciences: 'research' clusters hold seminars, showcases, research projects – (Compulsory) Summer schools: often across colleges and disciplines – Doctoral showcases where students have to present to non-academic audience

4.4 International networking

4.4.1 Cross-case findings

International networking is actively encouraged in the majority of the doctoral programmes or schools. There is often a long tradition of collaboration with other institutions. In relatively young institutions or economies, the ad-hoc initiatives by doctoral candidates and supervisors are an important driving force. In a number of programmes or schools, a stay abroad is mandatory as part of the doctoral training (e.g. EIT ICT Labs).

The European mobility schemes and framework programmes provide an important funding source for most of the institutions under review. For example, FP projects, Marie Curie Actions, COST, and Erasmus Mundus have been used by all institutions.

Barriers to implementation

As with most principles, funding is the main barrier reported. Yet for international networking, this barrier seems less high than for other principles as a number of funding opportunities enable international mobility. Those having a fellowship from the university can find their budget for mobility under pressure as soon as the general budget of the institution is under pressure (Greece, Cyprus, Bosnia-

Herzegovina, Bulgaria, Hungary, Italy, Latvia, and Lithuania). In those cases, maintaining the number of positions for doctoral candidates and infrastructure was given priority. In some cases, opportunities to collaborate internationally are affected by national working conditions: these make it difficult to attract international researchers.

In some cases it is also reported that the family situation of the doctoral candidates also plays a role in international mobility, particularly for those students who already have a family and are less motivated to go abroad during their doctoral studies.

Good practice

Some institutions and/or fellowships provide an individual budget for doctoral candidates. This can also be used for international mobility, including attending international conferences, long-term research stays abroad or inviting international scientists for training or lectures. Having a **specific individual budget** attributed to international networking ensures that the researcher is able to attend international conferences, visit other research teams and even stay abroad for up to 6 months (Luxembourg, Estonia, Austria).

Governments have been supporting international collaboration as part of the modernisation of doctoral training by allocating additional funds for outgoing and incoming fellowships (e.g. France). In many countries where funds are limited, **EU funding** is used to compensate for the lack of national resources (e.g. Cyprus, Latvia, and Portugal).

The degree of internationalisation of an institution has a multiplier effect as it enables institutions to engage **international staff** and to attract **foreign doctoral candidates**. This again helps to further build international collaboration and exchange.

International **co-tutelle** and joint degrees are other forms of international collaboration. It is established in several cases where it already has been evaluated positively. Several institutions are currently developing co-tutelle and joint degrees. A number of practical difficulties arise due to regulatory and administrative issues or due to the lack of comparable criteria for evaluation of doctoral training (EIT).

4.4.2 Barriers or challenges

Institute	Barrier/challenge
Hungary, Eötvös Loránd University Bosnia-Herzegovina, University of Banja Luka Bulgaria, Bulgaria Academy of Science & Sofia University Latvia, University of Latvia Italy, Sapienza University in Rome	In general, when funding is restricted and there are no additional resources for mobility, the lack of financial resources is mentioned as a main barrier to international mobility.

Lithuania, Vilnius University	Low stipends and early career salaries result in the fact that many doctoral candidates work during their doctoral education in positions that are often unrelated to their research. This is also a barrier to the opportunities for mobility and collaboration, as stays abroad become more difficult to organise with the additional job.
Czech Republic, Masaryk University Brno Slovak Republic, Comenius University Bratislava	International co-tutelle and joint programmes are not common at doctoral level. Main barriers are the high level of administrative work and problems with recognition of joint degrees and sometimes of ECTS credits.

4.4.3 Good practice

Institute	Good practice
Luxembourg, University of Luxembourg	**"Individualised budgets for doctoral candidates"** At the University of Luxembourg there is a dedicated budget for international mobility: each doctoral candidate receives the amount of 6,000 EUR over three years for attending conferences or participation in training abroad. This practice is very much appreciated by the candidates; on average they participate in three to five conferences during their doctoral education. In general, the UL has an international staff and welcomes many foreign students.
Austria, Institute of Science and Technology	Doctoral candidates have a budget which can be used for attending international conferences, workshops, summer schools etc.
Estonia, Tallinn University of Technology	**"Make international networking obligatory"** More recently, doctorate holders are encouraged to go abroad for a post-doc period. You cannot apply for funding if you have not spent a post-doc period abroad (thus it is actually an obligation for a post-doc to go abroad). In the doctoral examination committee, foreign professors are present (there are often 2 foreign professors involved).
Italy, Sapienza University in Rome	**"Internationalize and talk about it"** The implementation of a collaborative and joint degree to support international networking in doctoral training: the Sapienza Academic Senate approved the foundation of a Co-ordination Programme for Joint European/International Doctorates. Consequently, actions have been taken to promote the internationalization of the doctoral programs, by sharing experiences and expertise of best practice in doctoral programs.

5 INTERFACE WITH THE LABOUR MARKET

5.1 Exposure to industry+

5.1.1 Cross-case findings

Exposure to industry+ is generally considered the most difficult IDTP to implement. First, institutions sometimes question whether it is appropriate to focus on this principle. In most European countries doctoral education has traditionally been a preparation for an academic career. Preparing for labour markets outside academia is a relatively new requirement. Most institutions define doctoral education as preparation for a research career, they do not identify themselves as training institutions that have to respond to the different requirements of the labour market. Second, university-industry collaboration also has very different traditions and takes very different forms across Europe. Within countries traditions also differ across disciplines and institutions. All these characteristics determine the possibility of including exposure to industry and other non-academic sectors on a structural basis. For those countries where there is only little knowledge-intensive industry the situation is even more difficult. The location of the university also plays a role. Institutions in more remote areas with little industry around have major difficulties implementing exposure to industry+.

Finally the type of institution has to be considered when looking at exposure to industry+. Technical universities and academies that are more strongly involved in applied research than comprehensive universities are more likely to collaborate with industry+. The latter is particularly the case for the polytechnic universities we visited or in fields that are very open to technology transfer (e.g. ICT with high applicability of research results and low initial investments as compared to physics or chemistry). It is generally assumed that scientific and technological research fields have more applications and opportunities for collaboration with the non-academic environment than the social sciences and humanities. But when the definition is broadly interpreted as all non-academic sectors to which research is relevant, quite a number of university-industry collaborations take place (also see examples in the EUA DOC Careers I & II projects[14]).

Exposure to industry+ was also the IDTP that was mostly criticized by respondents for its wording. The word "industry" was evaluated as being particularly misleading as it would mostly focus on the manufacturing industries. Non-academic sectors like public service, non-profit organizations in different service sectors of society and different other sectors would not be integrated within this definition (hence the recommendation to redefine this principle).

Barriers to implementation

The lack of **opportunities for collaboration** or **careers outside academia** due to the lack of knowledge intensive sectors and/or traditions of the country is the most important barrier to exposure to industry+. The financial crisis is reinforcing this effect.

Another barrier is the rigidity of legislation and the administrative burden associated with it. In the majority of the cases, it is difficult to include representatives from the non-academic environments in doctoral education. In some institutions they are permitted to participate in the examination committee based on the condition that they meet the academic requirements to be a

[14] www.eua.be/eua-work-and-policy-area/research-and-innovation/doctoral-education/doc-careers

supervisor. But it is much harder to include them in the early stages of a doctoral programme, particularly in the supervising committee. National regulation is a barrier to this in e.g. Romania or Lithuania.

Next to national regulation, the academic culture is also a barrier to university-industry collaboration. For many researchers or professors, working with the non-academic sector is not part of their vocation. Many doctoral candidates do not consider working in industry or other non-academic sectors as an option for their later career. This is an observation made in many cases and in all regions of Europe.

On the other side, there are also cultural barriers in non-academic sectors. Many economies across Europe are SME-driven, but it is mentioned that SMEs are seldom research-oriented and often do not recognise the value of doctoral degrees and if they do, are not in a position to financially compensate this value. Non-academic career perspectives are often situated in large enterprises with R&D centers, public or private research institutes, government bodies and to a limited extent, in academic start-ups. Even then, enterprises are not always prepared to provide an environment that reflects the requirements for doctoral training.

Good practice

The interaction depends largely on the factors mentioned above. But good practice is identified in many countries. In Romania, doctoral candidates in education sciences collaborate with schools to collect information or teach themselves; there is also an example of interaction with the cultural sector to collect material in exchange for support in the archives.

Many institutions have a set of instruments to achieve more collaboration with industry. Among these instruments are fairs (Portugal), co-supervision with industry (UK) and co-degree with the private sector (Hungary) or fellowship funded by the private sector (most countries), etc. The EIT ICT Labs are pushing the principle to the limit by having systematic trainings with experts from the private sector during 6 months at the end of the doctoral degree, funded by the EIT and devoted to preparing a business plan based on the doctoral degree research. To create future opportunities, many countries have specific doctoral fellowship for conducting doctoral studies in collaboration with industry (France, Denmark, Italy, Portugal) or funding schemes for collaboration (Turkey) or facilitate the recruitment of doctoral holders through tax credits (France, Italy).

5.1.2 Barriers or challenges

Institute	Barrier/challenge
Lithuania, Vilnius University Bosnia-Herzegovina, University of Banja Luka Slovenia, University of Ljubljana	At Vilnius University and at the University of Banja Luka there are only limited opportunities for collaboration or career development outside academia due to the low presence of knowledge intensive sectors and companies. When the economic crisis affects the economy significantly, as in Slovenia, this has also a negative effect on interaction and collaboration with industry.

Bulgaria, Bulgaria Academy of Science & Sofia University Luxembourg, University of Luxembourg Portugal, University of Porto Slovak Republic, Comenius University Bratislava Italy, Sapienza University in Rome	Interaction with the non-academic sector also depends on the research field: in the social sciences and humanities opportunities to collaborate occur less often than in the natural sciences.
Turkey, Middle East Technical University	METU has, in recent years, been very actively intensifying its collaboration with industry. Different funding schemes as well as an incubator/business park have been built up. As a result of these measure students have the opportunity to interact with non-academic environments. This is particularly true for the engineering sciences and other hard sciences. Currently, it is rarer for doctoral degree holders to work in a non-academic environment on completion. In Turkey, the doctoral degree largely prepares a researcher for an academic career. Employment in the private R&D or other non-academic sectors is rare. Turkey has implemented a strategy to increase the employment of highly qualified researchers in non-academic sectors. In addition to this, the Turkish higher education sector is also expanding tremendously; the establishment of new universities/other HEI will also absorb a significant number of doctoral degree holders in the coming years.
Austria, Vienna Biocenter	The preparedness of industry to integrate doctoral candidates appropriately and ensure that they comply with the requirements for doctoral training and research is questioned by the institute and its staff and students. This is a barrier to implementing collaboration with industry in doctoral training on a structural basis.
Belgium, University of Liege	Exposure to industry+ is not structural. Initiatives are bottom-up and depend on the network of the supervisor. In some cases, the lack of an industry+ network is a barrier to take initiative towards the direction of non-academic collaboration.
Italy, Sapienza University in Rome France, European University of Brittany and University of La Rochelle	Doctoral graduates are not visible to industry, and the degree is not valued. For example, in Italy, the administrative system for formal applications often does not recognize the doctoral degree; there is no ticking option for PhD in most of the administrative systems.

5.1.3 Good practice

Institute	Good practice
Turkey, Middle East Technical University	**"Develop dedicated funding schemes for collaboration with industry+"** At the Middle East Technical University, different funding schemes for collaboration with industry are in place. The presence of a science park nearby offers opportunities to collaborate with industry.
Ireland, University College Dublin	**"Meet industry+ in training"** The Innovation Academy (cooperation between UCD, Trinity College Dublin and Queen's University Belfast) offers innovation and entrepreneurship training, where doctoral candidates interact with industry partners and NGOs.
Portugal, University of Porto	**"Provide opportunities to meet"** The University of Porto organizes some fairs with industry and companies from other parts of the private sector (Academia to business meetings). These meetings open opportunities to develop networks and to discuss future research opportunities. **"Develop dedicated funding schemes for collaboration with industry+"** The University of Porto has – in cooperation with other Portuguese universities and companies – a PhD programme that is funded by the new scheme of the national funding agency to intensify university-industry collaboration. In the programme student work in industry and simultaneously work in industry.
UK, University of Nottingham	**"Allow for co-supervision possibilities"** At the University of Nottingham, an external co-supervisor, coming from industry+, can be included in the supervision committee of a PhD.
EIT ICT Labs	**"Hands-on training by non-academic experts"** At the EIT ICT labs, the doctoral training centre is devoted to entrepreneurship and innovation. It organizes formal and informal trainings with experts from the non-academic sector. In addition, the six months before the end of the PhD are devoted to preparing a business plan that helps to market the PhD research.

5.2 Transferable skills training

5.2.1 Cross-case findings

Transferable skills training has received increasing attention in recent years but is also understood differently by different stakeholders. Specifically, the range of skills that are understood as transferable skills clearly differs. This is also true for the four target groups that have been involved in the case studies. Some of them interpreted transferable skills more narrowly as presentation and writing skills only, whereas the actors referred to a broad set of skills, including entrepreneurial competencies and field specific knowledge.

Training in transferable skills is quite common. It is usually organised as an additional training course with a choice of elective courses. The aim is to support personal and professional development of doctoral candidates. There is often a lack of structural framework, although in many cases the development is on-going. At some institutions respondents also mentioned that transferable skills training is implicit to the doctoral programme/research: candidates have to present their research to different audiences, communicate with sectors outside academia, organize themselves and their research project and sometimes they have to teach. A few respondents also mentioned that transferable skills should not only be regarded as necessary for non-academic environments. As the academic sector becomes increasingly entrepreneurial, preparation for an academic career also requires transferable skills training.

Depending on tradition and past reforms, institutions offer trainings in three different areas: 1) in the core subject area, 2) across different related subject areas, and 3) transferable skills to outside academia. Many institutions still focus on core subject training during the first and eventually in the second year.

Across the institutions two forms of training were prevalent: formal classes and on-the-job training. The doctoral candidates value the latter as well, especially when they have responsibilities in terms of project proposal writing and grant management. Formal classes mainly concern courses on core subjects and research methodologies, but in several cases there are also formal courses on transferable skills.

On the other hand, the needs and expectations also differ according to the types, size and fields of the companies. For example, doctoral graduates taken up by Novartis (Italy) are recognised for their scientific excellence, their specialism and creativity/curiosity. Novartis trains the doctoral holders further on other skills, like IPR and communication.

Barriers to implementation

One important barrier is linked to the **requirement to complete the doctoral** study within a time frame of three or four years. Some institutions find it difficult to include activities other than research into the curriculum because they want doctoral candidates to focus on their research project (e.g. Ireland). Hence, training during research is mandatory in most countries while transferable skills training is not. Sometimes, doctoral candidates themselves feel there is no need to get prepared for the non-academic environment, as their intention is to work in academia. On the other hand, most of them recognise its importance and are very interested in receiving more training in presentation, communication or management skills.

In several cases, it appeared that the traditional master-apprentice model (and the supervisor himself/herself) does not encourage doctoral candidates to **attend transferable skill training** because this is not a priority for the doctoral research and the thesis. Informal training is often offered directly by the supervisor, which leads to a strong variation in the training quality and effectiveness. Finally, information on the courses offered is not always well disseminated. In several cases, it was up to the doctoral candidate to find the courses.

Good practice

Some countries tackle the funding issue by using Structural Funds to develop transferable skills training (e.g. Hungary, Bulgaria, Slovak Republic, Estonia, Czech Republic).

Another example of good practice in terms of quality assurance is to use only **professional trainers** from outside academia to provide transferable skills (e.g.

Luxembourg, France). Some institutions also offer courses for supervisors (e.g. Croatia, France). The course on "le nouveau chapitre de these (LCT)" helps prepare doctoral candidates for their life after the doctoral education by looking at their achievements during the thesis. A human resources consultant is responsible for the course (e.g. France).

5.2.2 Barriers or challenges

Institute	Barrier/challenge
Turkey, Middle East Technical University Ireland, University College Dublin and University College Cork	In the Irish case, it was considered a challenge to balance the transferable skills training and the needs from non-academic career perspectives with time for research and excellence.
Ireland, University College Dublin	Another challenge is to encourage doctoral candidates not to postpone (non-mandatory) transferable skills training to later stage.
Hungary, ELTE University	At the doctoral education level, it is more "learning by doing" as the relationship between the supervisor and the doctoral candidate is traditionally close (few students per supervisor).
Italy, University of Sapienza	The information on the courses is not always well disseminated - and is often only available in Italian, except from the programmes (especially the international doctorates) that have developed a web-platform in English. It is up to the doctoral candidate to find the courses. Courses do not pay enough attention to entrepreneurship and independent business development.

5.2.3 Good practice

Institute	Good practice
The Netherlands, Technical University Delft Luxembourg, University of Luxembourg France, European University of Brittany	**"Develop training programmes"** Training programmes are well developed in several universities (for example, TUD, UL and EUB). At the Technical University of Delft, specific attention goes to subjects like personal effectiveness, self-organization, effective presentation, cooperation etc.
Italy, University of Camerino	**"Mandatory transferable skills training"** At the University of Camerino, transferable skills training is mandatory in the form of a one-week training, organised every year (if it cannot be attended the first year, it must be attended the second or third year). Notably, one aspect is the development of a concrete business plan (competition).

France, European University of Brittany and La Rochelle University	"Le nouveau chapitre de these (LCT)" helps prepare doctoral candidates for life after the doctoral education by looking at their achievements during the thesis. LCT is conducted by small groups of 6 to 7 students and then individual follow up. The training lasts about 2 months.
EIT ICT Labs	**"Foresee specific funding for transferable skills training"** EIT explicitly foresees funding for transferable skills training. The programme is well developed with the following skills courses: – "Teaser raising awareness" 2-days training; – "Opportunities recognition" one-week training; – "Business modelling" over 12 weeks (in France over 2 years) with half day per week during 12 weeks the first year and 12 weeks the second year organized at the end of the day (with personal homework); – "Growth and harvest": 2 weeks training.
Slovak Republic, Comenius University Bratislava Bulgaria, Bulgaria Academy of Science and Sofia University	In the Comenius University and in the Bulgarian institutions a lack of national funding is tackled by using Structural Funds to develop transferable skills training.
Ireland, University College of Dublin	**"Raise awareness among supervisors and doctoral candidates"** At the Irish university association, a 'Graduate Skills Statement' was developed. The Statement stipulates the skills the PhD students would be expected to acquire during the four years of study (ex. research and awareness, ethics, communication skills, team work, management, entrepreneurship, etc.). It raises awareness among supervisors and doctoral candidates.

6 ATTRACTIVENESS OF THE RESEARCH PROFESSION

6.1 Working conditions and career perspectives

6.1.1 Cross-case findings

Working environment and conditions

The importance of the **working environment and conditions for researchers** is well established, but implementation is highly context-dependent and influenced by the countries' historical and economic backgrounds.

Important issues at doctoral candidate level are the status (employee or student), level of stipends/wages, facilities offered by the institution (work space, research infrastructure, access to publications, travel grants, etc.) Each of these can affect the attractiveness of the institutional environment.

Differences in statutes between doctoral candidates in one and the same institution are also important. For example, in the Croatian case doctoral candidates are either full employees of the institute enjoying all social benefits related to the status of an employee or 'private' students who are self-funded and have no social benefits (this is also the case in Iceland). In the Romanian case, a large difference in stipends occurs between those doctoral candidates with national funding versus those with funding from the European Structural Funds. The latter have a much higher stipend, but at the same time face stricter requirements, such as the maximum duration of the doctoral education being 3 years (including courses).

The infrastructure and research facilities of an institution are also important. Access to scientific literature is very different across institutions and disciplines. Some doctoral candidates reported difficulties in accessing the most relevant journals. Others had problems is accessing data needed for their research projects. An excellent research infrastructure is very much appreciated by doctoral candidates and other researchers and helps to attract excellent researchers from within the country and from abroad but also simply to perform high-quality research.

Finally, differences in levels of stipends/wages between sectors affect the attractiveness of academic research compared to non-academic positions.

Career perspectives

In recent years the status of the doctoral degree in the labour market has been changing significantly in some European countries. In particular, those countries which do not have a strong tradition in doctoral education face a completely new situation. For such countries the doctoral degree has traditionally been a degree that (more or less) solely prepared one for an academic career. These countries currently face an increase in the number of doctoral degree holders and also the fact that doctoral degree holders become employed in non-academic sectors.

For countries which have already been educating doctoral degree holders for purposes other than the academic career, the situation did not change as dramatically as for the other countries. Here, the increase in the number of doctoral degree holders is the bigger challenge.

Aside from these traditions, the economic structure and the current economic situation impact the career perspectives of doctoral degree holders. In those countries that only have a little knowledge-intensive sector the demand for doctoral degree holders is also low. In some countries the economic crisis strongly affects career chances in academia (e.g. Portugal and Spain currently

only have a small number of open positions in academia). These countries are also sometimes are affected by significant brain-drain, i.e. a high number of doctoral graduates leave the country for better employment opportunities abroad.

Traditions, economic structure and the economic situation are reflected in the career preferences of doctoral candidates. In countries where the doctoral degree has traditionally prepared a graduate solely for an academic career, doctoral candidates had a strong preference for an academic career. In countries where the doctoral degree traditionally prepared a researcher for different labour markets, doctoral candidates also had diverse preferences. The current economic situation also influences how doctoral candidates perceive their overall career chances upon graduation.

Despite these traditions, institutions became increasingly aware of the fact that the status of the doctoral degree in the different labour markets is changing. Some started to implement instruments to improve the interface with these labour markets and to adjust doctoral training to the requirements of these diverse sectors. As regards an academic career, some institutions claim that the post-doc system of their countries does not offer adequate funding and/or needs to be developed further in order to offer the best graduates an attractive environment to remain in a research career in academia.

Barriers to implementation

The attractiveness of doctoral training and the research profession is also strongly related to funding. Excellent infrastructure and adequate levels of PhD stipends are both a matter of finding and attributing the necessary resources to the institution and doctoral research.

Low funding of the institution, particularly in some countries in Central Eastern Europe, South East Europe and Southern Europe, prevents some institutions from offering good working conditions: office space and/or access to the most recent library books and scientific journals are limited.

Limited funding for doctoral candidates is often mentioned, particularly in the social sciences and the humanities. In some countries, the fellowship is not sufficient to support living costs, and doctoral candidates have to work alongside their doctoral education (e.g. Romania, Latvia, and Lithuania).

Good practice

In many countries with limited funding, working conditions in terms of **infrastructure and equipment** are generally appreciated. Funding is often improved thanks to the EU structural funds.

Many countries currently offer a work contract with social security benefits (for doctoral candidates having funding) following the recommendations of the EU **Charter & Code.** Some countries have their own charter inspired by the EU Charter (e.g. Belgium, France). The charter gives rights and obligations and is signed by the doctor, director of doctoral school, and the supervisor.

6.1.2 Barriers or challenges

Institute	Barrier/challenge
Lithuania, Vilnius University Latvia, University of Latvia Greece, National Technical University of Athens Czech Republic, Masaryk University Brno	Low stipends and early career salaries result in the fact that many doctoral candidates work alongside their doctoral education in positions that are often unrelated to their research. This is a barrier to the attractiveness of the research profession and the institutional environment.
Hungary, Eötvös Loránd University	Funding does not allow for every doctoral candidate to have office space, access to a computer, books and scientific journals. Around 50% of the students have a full time job alongside their doctoral education, which threatens the time reserved for research.

6.1.3 Good practice

Institute	Good practice
Lithuania, Vilnius University	**"Compete through state-of-the art infrastructure"** The use of ESF funding to build new state-of-the-art infrastructure for biotechnology fields improved the attractiveness of the research environment for researchers in this field up to the level of renowned foreign biotech centres. Doctoral candidates with foreign experience (e.g. in Germany and Belgium) find the infrastructure very competitive and indicate this as a reason to stay at the Vilnius University.
Austria, Institute of Science and Technology Austria, Vienna Biocenter	**"Treat doctoral candidates as employees"** The combination of regarding doctoral candidates as employees of the institute and the state-of-the-art infrastructure for research leads to a much appreciated research environment for supervisors and doctoral candidates.
Portugal, University of Porto	**"Increase quality through funding instruments"** The new funding scheme "PhD programmes" of the national funding agency FCT finances both costs for the doctoral education and research as well as fellowships for the doctoral candidates. Funding criteria of the programme intend to increase the quality of doctoral education, hence also to improve the working conditions for doctoral candidates.

6.2 Open recruitment

6.2.1 Cross-case findings

Many institutions are aware of the importance of open and transparent recruitment. In the sections on the organisation of doctoral training (Section 3), the report already touched upon recruitment processes. It is found that the majority of institutions have procedures in place to increase the transparency of the process and establish objective admission criteria for doctoral study and doctoral positions. In recent years, inter-institutional recruitment has been increasing, but intra-institutional recruitment is predominant.

Only a few institutions mentioned that they publish their vacancies on the EURAXESS portal, but it is common that vacancies appear on the website of the institution (also in English) and are open to all applications. A minority of cases took legislative steps for making sure EURAXESS is used (Austria, Italy).

6.2.2 Barriers or challenges

Institute	Barrier/challenge
Latvia, Estonia, Hungary, Many cases Romania, University of Bucharest	There is an obligation to publish vacancies for doctoral positions in the official newspaper or on the website of the university. The language is often English. The EURAXESS website is known but hardly used (at least for doctoral positions). Moreover, there is no confidence that the research environment is attractive enough for foreign doctoral candidates so EURAXESS is not considered relevant.

6.2.3 Good practice

Institute	Good practice
Italy, University of Sapienza	**"Encourage open recruitment through wide advertising of vacancies"** The use of portals for the announcement of vacancies (like EURAXESS) is becoming obligatory as a result of the new decree. Wide advertisement of vacancies and funding opportunities is considered important.
Austria, IST Austria, University of Vienna	EURAXESS is used as a means of communicating vacancies. Further communication is organised at faculty-level, by post docs and students on conferences and through social media such as Facebook.
Denmark, Aarhus University	The university makes use of the EURAXESS portal whenever there are open positions.

6.3 Funding

6.3.1 Cross-case findings

As noted above, funding is key to implementation of the IDTP. The lack of funding is the most frequently mentioned barrier. However, it would be wrong to overemphasise the funding issue without leaving room for discussion on how the implementation of the IDTP can be further encouraged within the financial constraints that a specific country or institution faces.

In the discussion we broadly distinguish between two types of funding for doctoral education:

- Funding to establish and improve the institutional environment and working conditions for doctoral candidates, for example infrastructure and research equipment; office space; hardware and software; libraries and access to relevant publications; funds for international networking and transferable skills training.
- Funding for the individual doctoral candidates as stipends or salaries.

The establishment of the institutional environment is often funded through government block funding for the institutions – commonly based on criteria such as the number of students and doctoral candidates. As mentioned before, the European Structural Funds, distributed through the national bodies, are appreciated as funding source for infrastructure and establishing reforms in the organisation of doctoral education (e.g. Lithuania, Estonia). Where applicable, it is regarded as a necessary source to fund research because national funding would not suffice to build critical mass and to lift the research infrastructure to a competitive level.

Additional funding from regional or local government and competitive funding from national or European funding agencies also occurs. Additional or competitive funding is generally awarded for a fixed and limited period of time.

Funding for the stipends and wages of doctoral candidates also comes from different sources. The mix is different across countries and institutions but the majority is funded by government block grants, where applicable funded (partially) through the European Structural Funds. Competitive grants from national research funding agencies and European projects also exist. Funding from private industry is uncommon and depends on the type of institution and the field.

Two aspects of funding vary significantly across countries and hinder the establishment of an 'equal status as employees' for all doctoral candidates:

- Equal working conditions: In some countries, equal working conditions are offered to all doctoral candidates, regardless of the source of their funding. In others, doctoral candidates have different statutes related to specific source of their funding. In that case, working conditions can differ substantially in terms of the level of the stipend, time to complete the PhD, contractual stipulations for example on abandoning the doctoral education, etc.
- Self-funded candidates: In some institutions, (nearly) all doctoral candidates are funded by the institution or a third party. In others, a large share of the doctoral candidates is self-funded. In that case, working conditions may again differ when the self-funded are not regarded as employees of the institution and funded doctoral candidates are.

In that respect it is worthwhile to mention that the ESF funding for individual doctoral candidates generally results in higher stipends than the national funding. Even though there is a personal risk and time pressure is very high, doctoral

candidates prefer this type of stipend which allows them to dedicate more time to research than when they need to earn a living by taking a job outside academia.

6.3.2 Barriers or challenges

Institute	Barrier/challenge
Bulgaria, Bulgaria Academy of Science	In Bulgaria, funding has decreased due to and even before the financial crisis and BAS experienced a 40% cut in its budget. Such large cuts are difficult to cope with, particularly when there is limited access to EU financial resources and slow dissemination by the national government thereof.
Hungary, Eötvös Loránd University	The central region of Hungary, where the university is situated, is no longer eligible for structural funds – but the state budget cannot compensate either. There is thus as decrease in the funding which is expected to influence the implementation of the IDTP and, more generally, the organisation of modern doctoral training.
Romania, Bucharest University and AIC University Iasi	In a number of cases, problems with the transfer from the national authorities to the institutions have caused delays in the payment of the doctoral candidates as well as serious liquidity problems for the institutions.

6.3.3 Good practice

Institute	Good practice
Bulgaria, Bulgaria Academy of Science	**"Attract mixed funding"** The Academy of Science is able to attract private funding through projects and collaboration outside academia. EU financing is used to ensure mobility and cooperation in international environment and transferable skills and training.
Greece, National Technical University of Athens	In the National Technical University of Athens, it is also good practice to look for other forms of mixed funding. 90% of doctoral candidates are funded by research contracts, only less than 10% by fellowships.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Key findings

7.1.1 The principles have a strong 'mobilizing' effect

What struck the research team in the preparation and the implementation of the site and virtual visits is the large mobilization of different actors and stakeholders all being prepared to discuss the implementation of the principles in their countries and institutions. This clearly reflects the importance of doctoral training. Policy makers, university leaders, professors, industry representatives and of course doctoral candidates, have intensively exchanged opinions and ideas about the way doctoral training should be organised. This is perhaps a unintended effect of the underlying study, that it has set in motion a 'co-creation' process in which different stakeholders look for the best way to organise doctoral training in a particular context. The study created a momentum which could and should be maintained and used to move forward.

7.1.2 The principles are fully 'embraced'

From the detailed analysis in the previous sections, it becomes clear that all principles are well-accepted and subscribed to by all target groups at institutional, doctoral, policy and non-academic levels. The principles are not commonly known in the documented form or under the name 'Innovative Doctoral Training Principles', but they come to the institutions naturally. Similar ideas or principles, often worded differently, form the basis of doctoral training across Europe.

The principles are considered as a 'guiding tool', and this is exactly what they should remain, according to the large majority of interviewees. Institutions also emphasise that they autonomously choose to implement the principles and this in line with their own vision (and their degree of acceptance of each specific principle).

7.1.3 Research excellence seems to be the 'leading' principle

Not all principles are regarded equally important or relevant. In general, a relatively higher weight is given to the principle of "research excellence", based on quality assurance and attractiveness of the research/institutional environment. The relative importance of the other four principles (international networking, non-academic and interdisciplinary collaboration or the training of transferable skills) depends more on the specific vision, type and tradition of the academic institution, school or discipline.

7.1.4 There is a strong interrelation between the principles

The interrelation and interdependency between the seven principles are strong. In a number of cases, it was mentioned that the principles need to be balanced and put in the right perspective. A concrete example is the balance between transferable skills training, accommodating the demand of non-academic employers, and the time dedicated to quality and excellence of the doctoral research. Another case demonstrates that quality of research is strongly interrelated with the remuneration conditions in terms of stipends, opportunities of mobility and collaboration with industry+. It is challenging to implement and balance all principles within the time limit of three (or four) years available to complete the doctoral education. This type of dynamics should be taken into account in the recommendations on further implementation.

7.1.5 Academic 'culture' influences the 'pace of change'

The role of the academic culture is also important to consider in the implementation of the IDTP. The culture of the master-apprentice model persists across Europe. Traditionally, professors are sometimes critical of proposed changes and do not always agree with reforms inspired by the IDTP. Especially with respect to interaction with industry and transferable skills training, but also in terms of the organisation of doctoral education (such as the establishment of doctoral schools, etc.) there are some critical opinions. A strongly hierarchical relation between the 'apprentice' and 'master' further hinders open discussion. Finally, the diversity among doctoral candidates across Europe in terms of contract and conditions (e.g. systems with high numbers of part-time candidates) requires flexible solutions for the implementation of the principles and allow researchers to benefit from each of them to the maximum.

7.1.6 The socio-economic 'context' is also influential

It is clear from all cases that national and regional policy objectives play a crucial role in the implementation of the IDTP at the institutional level. The policy context determines, among other things, the degree of autonomy and flexibility of the institutions, the vision and emphasis given to doctoral training and the funding available to shape doctoral training and attract doctoral candidates (nationally and internationally). This observation also links to the importance of a number of factors exogenous to the institution that play a crucial role in the organisation of doctoral training and implementation of the principles: funding, regulatory stability, economic structure and culture/awareness.

7.1.6.1 Context factor 1: the role of funding

The funding mechanisms, the level of funding assigned to doctoral training, and the stability of this funding, are all factors that determine the sustainability of the organisation of doctoral training according to the principles, but also the overall attractiveness of doctoral training.

The level and number of stipends and the quality of the infrastructure are important factors for creating an attractive institutional environment. They depend heavily on the level of funding attributed to research by the government and other parties and the priority given by the institution's management. The quality/excellence of research also depends on funding in that respect, for example through state-of-the-art infrastructure, access to international publications and libraries, attraction of excellent researchers as doctoral supervisors and teachers, etc.

Schemes for international mobility and transferable skills training seem most vulnerable to budgets cuts. For international mobility other channels can often be addressed. For transferable skills training, insufficient funding often results in the lack of structured approach, lack of high-level specialist teachers, or postponement of the development of a training programme for transferable skills.

The implications of the economic crisis on the overall government budget (and in particular for research) in Greece, Cyprus and Spain clearly demonstrate that there is a critical level of funding and that stability in funding is crucial. Because the economic crisis did not directly impact on research funding, the level of funding and projects did not change for some time, but as the current schemes will end and not be renewed the researchers feel there are no prospects in their countries.

As elaborated in sections 2.3 and 6.2.3, Structural Funds are much appreciated as source of funding for doctoral research. However, difficulties emerge when the continuity of this funding stream is threatened or when it is not clear how to

disseminate these funds from the Ministry to the institutions. By the time that the Structural Funds can no longer be applied for, the Member State needs to build the capacity to finance research independent of the ESF. It is therefore important to strive for a balanced funding mix, stemming from different sources.

7.1.6.2 Context factor 2: the role of regulatory stability

Among other issues, in many Eastern European countries who recently went through revolutions and major reforms, the lack of a long-term vision and a stable policy are mentioned as hindrances to the sustainable implementation of the principles. The relevant policy makers are also often distributed over several ministries or government bodies and did not establish a good communication culture. This certainly relates to the security and stability of funding, as elaborated above, but regulatory stability is also important to start mid- or long-term processes and develop a reform strategy. The bureaucracy and administrative burden (also at the institutional level) related to rigid legislative systems are also mentioned as barriers to the implementation of the principles.

7.1.6.3 Context factor 3: the role of the economic/industrial structure

The economic structure is mentioned as influencing doctoral training, and particularly the principle of exposure to industry+. The presence or lack of research intensive sectors and enterprises determines the possibility of collaborating with industry during the doctoral research as well as the career prospects for doctorate holders. Industry+ interaction is commonly accepted as beneficial for both doctorate holders and enterprises/broader society. These interactions cannot be realised when there is no relevant industry in the region.

Non-academic representatives emphasise that research is not focused on 'real' problem-solving. They also request that there should be more mechanisms in place to make research relevant to non-academic sectors. Examples mentioned are stronger involvement of industry representatives in the doctoral education phase, instead of only in the examination committee, monitoring and rewarding of applications of their research, patents, etc.

On the other hand, it is worth mentioning that 'industry+' goes beyond industrial sectors and includes all sectors that are relevant to the doctoral training.

7.1.7 A richness of 'good practice'

During the various visits, it became clear that there are many examples of good practice with respect to the implementation of IDTP that could and should be flagged up. For example, there are cases with overall efficient and effective organisation of their doctoral training and active implementation of all principles. But also in cases where strong challenges are faced or recent reforms have had a substantial impact, examples of good practice can also be found.

It is clear that good practice can generate inspiration on how to deal with particular difficulties, and this across institutions and countries, thereby acknowledging that transferability depends on many different factors. As a result, broad exchange of good practice is essential.

7.3 Impact of the economic crisis

The implications of the economic crisis on the overall government budget (and in particular for research and education) in Greece, Cyprus and Spain clearly demonstrate that a minimum level of and stability in funding are essential to guarantee the infrastructure and human resources needed to ensure the quality of research.

The high unemployment rates in the entire economy encourage people to stay longer in academia to increase their qualifications. The number of doctoral candidates is currently stable in the Spanish case. However, in the Cypriot case, a reduction in applications is observed because many doctoral candidates are not in a position to pay their fees and/or need to find a job outside academia to support themselves and in certain cases their family suffering from the increasing unemployment levels.

Moreover, the positions available for doctoral graduates (post-doc funding and researcher positions) also decrease. In the Spanish case, it is exactly in the career perspectives and the availability of suitable positions, where the crisis is most felt. There are no positions in academia for doctoral holders, but unemployment is also high outside academia.

The lack of career perspectives has already led, and is expected to increasingly lead to researchers moving abroad: a brain drain which exacerbates the situation and threatens quality and critical mass in the home country. In this respect, the ageing of the academic population becomes another threat for the future in those countries. In the Spanish case, it is emphasised that all Member States should share one vision on doctoral training and that all national governments should be equally committed in order to re-establish the balance.

On a positive note, it is mentioned that the crisis is expected to trigger a number of reforms of doctoral education as well (Italian case), mainly focused on rationalisation and efficiency.

In the Greek and Cypriote case, the institutions look forward to the new programming period of the Structural Funds (2014) by which means a new bundle of measures can be planned.

7.4 Reflections on reorganisation of the principles

The detailed findings from the case studies lead to a number of reflections (soft recommendations) on the way ahead. Here two broad lines of thinking are applied. The first (Section 7.4), relates to the re-organisation of the principles, including (slight) reformulations, whereas the second (Section 7.5) concerns the further promotion of the implementation of the principles in Europe and making use of the 'momentum' that was created.

7.4.1 Reorganisation of the principles

Throughout the majority of the cases, no fundamental changes are suggested to the existing principles, nor are any new principles proposed. At the same time the rather static and linear overview of the principles in their current form could be further analysed from the perspective of structure (level of importance of the principles), the interrelation between the principles, and the context in which the principles are applied.

7.4.1.1 On the 'structure'

Not all principles are regarded as equally important by the interviewees. A higher weight is given to the principle of research excellence, based on quality assurance and attractiveness of the research environment. They are referred to as the more 'basic principles', upon which other principles can further build.

The relevant quality assurance procedures need to be in place to guarantee that a number of basic requirements are fulfilled. It is mentioned that this quality assurance system also provides a framework for assessment and comparability of quality, at institutional, and by extension, even at national level. Nevertheless, the system should not result in 'standards' and leave sufficient space for flexibility and diversity across institutions and disciplines.

The attractiveness of the research environment is another basic condition which needs to be fulfilled in order to balance doctoral training as a whole. Availability of positions, level and stability of funding, infrastructure, status of doctoral candidates, organisation of training etc., play an important role in attracting and fostering bright students and excellent researchers, supervisors and teachers.

Both quality assurance and attractiveness of the research environment are thus building blocks to stimulate research excellence. To the institutions, doctoral candidates and supervisors, but also to policy makers and non-academic representatives, these three principles are so crucial that they deserve to be dealt with first.

Even though all four other principles, referred to as 'surrounding principles' (international networking, exposure to industry+, interdisciplinary research options or transferable skills training), are acknowledged to contribute to innovative doctoral training, the degree of consent varies. International networking and transferable skills training are as good as unanimously accepted as principles, while opinions vary more on the exposure to industry+ and interdisciplinary research options. Also, the structural attention they receive at independent institutions depends on the specific vision, typology and context of that institution.

In some cases, international mobility is strongly encouraged, specific funding is foreseen; joint programmes (and even joint degrees) are established. In others, for example polytechnic universities, the link with industry+ is stronger and more attention goes to structural collaboration and interaction with the non-academic sector.

Interdisciplinarity is organised to all degrees, from occasional and bottom-up initiatives, to top-down approaches, through interdisciplinary doctoral schools or a rotation system to oblige and offer students the chance to 'taste' different (sub-) disciplines before deciding on their final research topic and supervisors. The strategy depends on the historical context of the institution (e.g. long tradition of interdisciplinary research, or the setup of a collaboration between different institutions), as well as on their vision on the future (e.g. interdisciplinarity as a response to the increasingly complex issues of society). Moreover, there is some discussion on interdisciplinarity and most institutions do not see this as a means of organising research at the cutting edge, rather than as a goal as such.

Similarly, transferable skills training is also offered to all extents, from being mandatory to being totally absent (learning on the job), depending on the relative importance attached by the institution and the amount of budget that can be allocated to it.

7.4.1.2 On the 'interrelation'

Interrelations between the principles are dynamic and complex: international networking will improve the quality of the research through peer reviews, inspiration and original ideas. But research excellence may also lead to more opportunities to be internationally mobile and network with people around the world. Transferable skills training can allow the excellent researcher to also excel in another environment outside academia and further build the economic tissue needed to strengthen their exposure to industry.

The building blocks of research excellence, quality assurance and attractive institutional environment are reinforced by the principles of international networking, interdisciplinary research options, exposure to industry+ and transferable skills training. New ways to reach excellence are found, innovative dynamics and multiplier effects are created. Making the interrelation visible and understandable, will allow for a better 'management' of their implementation.

7.4.1.3 On the 'context'

Finally, as described in detail in the key findings, the majority of cases emphasized the importance of 'context' for the implementation of the principles. Factors such as funding, regulatory stability, economic structure and culture (openness to change) determine to a significant extent the degree to which, and pace at which, the implementation of the principles can take place.

Based on these findings and reflections with respect to the importance of structure, interaction and context, a more dynamic and powerful overview of the principles and their interaction is presented below (Figure 3).

Figure 3: Dynamic picture of the IDT

Source: IDEA Consult based on Report of Mapping Exercise on Doctoral Training in Europe: Towards a common approach (2011) and key findings of the case studies

7.4.2 Clarification of the role of the principles

Next to the introduction of structure and dynamism in the overview of the IDT principles, the role of the principles also has to be clarified. In most institutions, the principles are not known in the form of the EC Communication and Council Decision. The visits were an effective way in which to introduce the principles and open up a discussion on their relevance and their implementation in reforming doctoral training. However, the interviewees recommended on several occasions during the visits that the guiding role of principles as a framework to inspire reforms in doctoral training required clarification. They are not, and should not become, a checklist for the institutions. While institutions insisted on their autonomous approach to emphasise those principles that are most relevant to their individual scope and vision for future development, they appreciated the principles as such and the efforts made to provide a consistent framework, examples of good practice across Europe and open up a discussion on this.

7.4.3 Reformulation of some of the principles

As a result of the case studies, a number of suggestions were made to sharpen and reformulate a number of principles.

- Reformulation of "Industry+":
  - "non-academic sector"
  - "any sectors to which the research is relevant"
- Reformulation of "Transferable skills training":
  - "professional development"
- Clarification of "innovative" in the "innovative doctoral training principles":
  - To many interviewees, the word "innovative" has no meaning here. They make the connection between "innovative" and "principles" and argue that the principles are not at all new and come naturally to them exactly because they have formed the basis of doctoral training for so long.
  - Clarification of the meaning of "innovative" in connection with "doctoral training" is thus recommended, showing that the modern doctoral training needs to look for ways to balance research excellence, knowledge creation for complex societal problem-solving and preparation of doctorate holders for non-academic careers.

Finally, in this section on reformulating the principles, it is appropriate to mention the issue of terminological consistency more generally. There is hardly consistency in the definitions of 'doctoral schools', 'transferable skills', or 'structured training'. This means that institutions use the terms as they consider appropriate to their own situation. In the current study we refer to the terminology used by the specific institutions without judging the content of the term as such. The result is that comparability is somewhat reduced and the terms are to be interpreted each time in the specific context. A new version of the principles could contain a set of basic definitions of key concepts used.

7.6 Recommendations on promoting implementation

A number of recommendations to promote further implementation of the Principles for Innovative Doctoral Training are drawn from the key findings and recommendations on clarification of the principle.

7.6.1 Further diffuse the principles

The majority of the interviewees were not aware of the existence of the European IDT Principles as such but they were known under the Salzburg principles, or European or ERASMUS PhD, ORPHEUS principles, university joint PhD agreements, or others. Nevertheless, they are welcomed and the visits opened up the discussion in many cases on reform and reorientation of doctoral training and procedures.

It was suggested that communication was coordinated between these different forums or EU associations in order to spread the principles more effectively. The coordination with the Bologna process could also be improved.

In addition, many agreements have been concluded between European institutions for doctoral education that could also be better aligned with the IDTP (the EIT is a recent example). They were not in the scope of this study but we came across several examples (Italy, and Bulgaria for example). Their funding is often based on EU funding (Marie Curie Actions, ERASMUS or structural funds) which opens the possibility to have more aligned EU funding requirements.

To further encourage promotion, a dedicated communication strategy is recommended. Instruments for this can be direct communication to institutions through existing fora, direct communication to doctoral candidates through the student groups and to supervisors (an IDTP kit was suggested in Italy), regional meetings for remote institutions to exchange practices, etc. Existing fora, informal or formal EU organisations (ORPHEUS, etc.), information packages and a series of regional stakeholders conferences can be used in this respect.

It was noted earlier that communication should specify the role and value attached to the principles as guiding inspiration, rather than goals or check lists. Finally, dissemination of the principles should also be ensured inside the institutions, to the community of supervisors and doctoral candidates.

7.6.2 Stimulate alternative and mixed-funding possibilities

Given the key findings that funding is a prerequisite to implement the IDTP on the one hand, and that the Structural Funds are well appreciated as tools to guarantee continuity in investments, improve working conditions (e.g. level of the stipends) and allow for infrastructure building, on the other hand, it is recommended that there is further stimulation in the use of European funding possibilities - especially for those institutions most in need of it. Nonetheless, it is also necessary to look for sustainable solutions in countries where dependence on this type of funding is high.

In countries where funding is not necessarily low, the emphasis lies on the flexibility to apply the funding. Each institution has its own historical, economic and political context. A critical level of autonomy at the institutions is needed in order for them to attribute the funds in such a way that they contribute to an optimal implementation of the principles.

7.6.3 Hands-off approach for the 'basic' principles

The basic principles, identified as research excellence, quality assurance and attractive institutional environment, receive primary attention from institutions. They are implemented by definition, because they form the core of what doctoral research should be in the eyes of the interviewees. For this type of principles, it is recommended that a hands-off approach and offers of support/inspiration are implemented:

- Research excellence: share good practice regarding formal and informal peer review methods and of procedures to optimising excellence and personal development of doctoral candidates
- Quality assurance: share good practice in terms of procedures and management
- Attractive institutional environment: share good practice regarding funding mechanisms, HR, infrastructure investments, exchanges, etc.

7.6.4 Hands-on approach for the 'surrounding' principles

The surrounding principles of international networking, interdisciplinary research options, exposure to industry+ and transferable skills training are implemented less structurally. Each institution introduces its own emphasis based on its mission, vision and type of research.

For this type of principles there is room to develop policies/instruments that actively encourage their implementation in a more 'hands-on' approach that sufficiently takes into account the degrees of freedom an institution needs to adapt the instruments to the national, institutional and disciplinary context.

7.6.5 Take a global perspective

One striking result of this study is the large variation of organisation of doctoral education across countries and within institutions. This makes cooperation in doctoral education, for example, between two countries difficult, as their requirements in term of training (number of courses, credits and type of courses), and process for defending the PhD are not compatible.

Even given the country differences hindering competition, the labour market for a doctoral candidate or doctoral holder is global. A global perspective is needed in order to encourage international competitiveness in European doctoral training and to open the labour market for doctoral graduates internationally. Once European institutions', researchers', policy makers' and non-academic employers' priorities in terms of doctoral training have been determined, it is increasingly necessary to consider the nature of doctoral training and good practice outside of Europe. One example is the duration of a doctoral degree, which is ideally fixed at three or four years of full-time research. In the case studies it is mentioned that restricting the length of the degree will need to be balanced with the requirements on international and industrial interactions or transferable skills training. Research should consider how this is dealt with by other global players, such as the United States, or in agreements between EU institutions and outside Europe, in order to observe, learn and draw conclusions that would benefit the competitive position of European doctoral degrees.

7.6.6 Help Member States to create an adequate regulatory framework

The principles are sometimes prevented from implementation (or not favoured) due to a law or to an accreditation mechanism (based on input such as the number of professors funded by the programme, the training offered, etc.). The evaluation agency (or ministry) also has a powerful effect by looking at all IDTP

and not a selection of them. Government and national agencies could conduct an IDTP 'compatibility check' (similar to the HRS4R check) and review whether the national legislation and mechanisms sufficiently allow for flexibility and changes so that reforms compatible with the IDTP are possible. Any such process should primarily aim at assessing this type of flexibility rather than the implementation itself – in line with institutional autonomy. A similar exercise could be conducted at institutional level, down to lowest level of decision: faculty or doctoral school. The European Commission could facilitate this process (through e.g. an Open Method of Coordination).

ANNEXES

ANNEX 1: LIST OF SITE VISITS

Country	University/institution	Date of the visit	Experts	
Portugal	University of Porto	30/09 – 1/10	Andrea Kottmann (CHEPS)	Emmanuel Boudard (La Rochelle)
Italy	La Sapienza university of Rome	17-18/09	Arnold Verbeek (IDEA Consult)	Emmanuel Boudard (La Rochelle)
Greece	National Technical university of Athens	5-6/09	Lena Tsipouri (University of Athens)	Emmanuel Boudard (La Rochelle)
Cyprus	University of Cyprus	13/09	Lena Tsipouri (University of Athens)	
Austria	Research institute of Molecular Pathology/Vienna biocenter	24-25/06	Sybille Hinze (iFQ)	Annelies Wastyn (IDEA Consult)
Austria	institute of science and technology	26-27/06		
Turkey	Middle East technical university	18-19/06	Andrea Kottmann (CHEPS)	Ecorys Turkey
Romania	University of Bucharest	8-9/07	Andrea Kottmann (CHEPS)	Miriam Van Hoed (IDEA Consult)
Romania	University of Iasi	10-11/07		
Czech Republic	Masaryk University	5-6/09	Alexandra Bitusikova (Matej Bel University)	Ruslan Lukach (IDEA Consult)
Slovakia	Comenius University in Bratislava	11-12/09	Alexandra Bitusikova (Matej Bel University)	Emmanuel Boudard (La Rochelle)
Hungary	Eotvos Lorand Tudomanyegytem Budapest	9-10/07	Emmanuel Boudard (La Rochelle)	Annelies Wastyn (IDEA Consult)
Bulgaria	Sofia University	24-25/06	Emmanuel Boudard (La Rochelle)	Ecorys Bulgaria
Bulgaria	Bulgarian Academy of science	27-28/06		
Slovenia	University of Ljubljana	10-11/09	Andrea Kottmann (CHEPS)	Elke Weyer (CHEPS)
Estonia	Talinn University of Technology	18-19/09	Annelies Wastyn (IDEA Consult)	Alexandra Bitusikova (Matej Bel University)
Latvia	University of Latvia in Riga	26-27/08	Sybille Hinze (iFQ)	An De Coen (IDEA Consult)
Lithuania	Vilnius University	20-21/06	Liudvika Leisyte (CHEPS)	Miriam Van Hoed (IDEA Consult)

ANNEX 2: LIST OF VIRTUAL VISITS

Country	University/institution	Date of the visit	Experts
France	University of La Rochelle	28/08 and 25/09	Emmanuel Boudard (La Rochelle)
France	University European of Brittany	28/08 and 25/09	Emmanuel Boudard (La Rochelle)
United Kingdom	University of Nottingham on behalf of Energy CDT Network	04/09	Ruslan Lukach (IDEA Consult)
Germany	University of Bremen	08/10 and 11/10	Andrea Kottmann (CHEPS)
Belgium	Université de Liège	03/09 and 26/09	Emmanuel Boudard (La Rochelle)
Netherlands	University of Delft	September	Elke Weyer (CHEPS)
Norway	University of Oslo	Early October	Andrea Kottmann (CHEPS)
Finland	University of Oulu	Early October	Andrea Kottmann (CHEPS)
Denmark	Aarhus University	02/09	Arnold Verbeek (IDEA Consult)
Ireland	University college Dublin	July to September	An De Coen (IDEA Consult)
Ireland	university college Cork	July to September	An De Coen (IDEA Consult)
Luxembourg	University of Luxembourg	June to July	Emmanuel Boudard (La Rochelle)
Liechtenstein	University of Liechtenstein	20/08	Elke Weyer (CHEPS)
Switzerland	Western Switzerland University Conference	September	Annelies Wastyn (IDEA Consult)
Croatia	University of Zagreb	19/09	Miriam Van Hoed (IDEA Consult)
Bosnia-Herzegovina	University of Banja Luka	13/09	Annelies Wastyn (IDEA Consult)
Iceland	University of Iceland	September	Arnold Verbeek (IDEA Consult)
Spain	Universitat Politècnica de València	Week of 16/9	Miriam Van Hoed (IDEA Consult)
Austria	University of Vienna	September	Annelies Wastyn (IDEA Consult)
pan-European	European Central University	September (1 interview)	Ruslan Lukach (IDEA Consult)
pan-European	EIT	September	Emmanuel Boudard (La Rochelle)
Lithuania	Kaunas University of Technology	24/09	Andrea Kottmann (CHEPS)