

The Implementation of the Bologna Process Reforms into Physics Studies in Europe: The Doctoral Level

EPS report



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The Implementation of the Bologna Process Reforms into Physics Studies in Europe: The Doctoral Level

Submitted to the European Physical Society by

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▶ EXECUTIVE SUMMARY

1. The study analyses the *implementation of Bologna reforms* into Physics studies in Europe. After taking an in-depth look at Bachelor programmes in 2008/09 and at Master programmes in 2009/10, this report presents the findings of the analysis of the **doctoral phase**. The study has been supported by the European Commission and carried out in cooperation with the European Physical Society (EPS) and with the help of representatives of National Physical Societies from 26 Bologna signatory countries and of the STEPS II network.

2. An **online questionnaire** was designed and a representative sample of doctoral supervisors/doctoral programme coordinators in 30 Bologna signatory countries was asked to fill it in. A response rate of 54 percent (120 respondents) was achieved. Many responses came from Germany and UK/Ireland. In addition, a secondary analysis of data from Physics respondents to the **EURODOC survey** (2008/09) was carried out. The sample includes 393 doctoral candidates in Physics from 26 countries.

3. Altogether 34 percent of doctoral supervisors stated that doctoral candidates were considered to be both, **students and early stage researchers**, 34 percent said that they were considered students, and 32 percent considered them as early stage researchers. The majority of respondents (57 %) indicated an **actual duration** of the doctoral phase of **three to four years**. The **mean age** of doctoral candidates at the beginning of their doctorate is particularly low in UK/Ireland (between 22 and 24 years) and particularly high in Macedonia (between 30 and 35 years). The overall mean is **between 23 and 27 years**.

4. The main **sources of funding** for doctoral candidates are employment contracts (47 %), non-repayable scholarships (45 %), repayable grants or loans (3 %). Still, supervisors stated that 9 percent of their doctoral students are self-funded.

5. Except for UK/Ireland, a **master degree is required** for admission into doctoral education. Additionally there are frequently further selection criteria.

6. Doctoral education is increasingly integrated into

programmes or graduate schools. Only 13 percent of the supervisors stated that they provide individual supervision only. Programmes or graduate schools typically require **coursework** for which often **tuition fees** (50 %) have to be paid.

7. Doctoral education is **increasingly being formalised** not only in **structure** but also in **process**. Formal agreements regulating rights and duties are signed in 47 percent of the cases, in 61 percent there is an involvement of a committee or board. The number of doctoral candidates per supervisor is increasingly restricted and in a number of countries (*e.g.* Italy, Sweden, Portugal, Spain) special training in supervision is required.

8. In **61 percent** of the cases **coursework** is required from doctoral candidates and often monitored, assessed and credited. More than 80 percent of the respondents to the supervisor questionnaire stated that coursework includes **general or transferable skills**.

9. About **three quarters** of the doctoral candidates carry out their **research work in the department or faculty**, 14 percent at extra-university research institutes, 3 percent at another university in the same country, 5 percent at another university abroad, and 2 percent in industry.

10. A high proportion of supervisors (91 %) stated that doctoral candidates contribute to **activities** in the department or faculty which are **not related to their doctoral research**. They estimated that this requires a mean of 7.1 hours per week. In contrast, doctoral candidates estimated that they are involved in work not related to their own research for 14 hours per week.

11. With regard to **internationalisation**, supervisors stated that 55.2 percent of their doctoral candidates spend time abroad for their research work, 11 percent of doctoral candidates are from other European countries, 11 percent from countries outside Europe, and in 55 percent of the cases the doctoral thesis can be submitted in a foreign language.

12. Supervisors also stated that **more than half of their doctoral candidates** (51.8 %) stay in academic research and **start a postdoc phase**. But also about one quarter are planning to go into industry (esp. in Austria, Germany, Lithuania, the Netherlands, and the Slovak Republic). 57 percent of the supervisors said that there are activities in their university or department to support transition onto the labour market.

13. Among the doctoral candidates answering the EURODOC questionnaire **81 percent are employed** and of these 66 percent at their university, 27 percent have a scholarship, and 7 percent are without any kind of funding. The duration of funding is typically between 3 and 4 years. Doctoral candidates from Belgium, France, the Netherlands, Slovenia, Sweden, and UK/Ireland were very satisfied with their level of funding, while doctoral candidates from Lithuania and Spain were rather dissatisfied.

14. Despite the high level of employment **72 percent** of the doctoral candidates stated that they had a **student status**. Altogether **78 percent** of the doctoral candidates stated that they receive some kind of **skills training**. But while coursework in methods and theories tends to be obligatory, coursework to acquire generic/transferable skills is more often elective. No requirements for coursework are the case particularly often in Portugal (63 %) and Germany (39 %).

15. Doctoral candidates rated the **quality of supervision rather highly**. In terms of supervisor expertise the mean was 4.1 (scale ranging from 1 = low to 5 = very high), in terms of supervisor guidance the mean was 3.7, in terms of aid concerning training needs the mean was 3.6. High and very high levels of satisfaction with the quality of supervision are found among doctoral candidates in Denmark, Germany, Italy, Lithuania, Norway, Slovakia, Slovenia, and Sweden. Low levels of satisfaction with the quality of supervision are found among doctoral candidates in Austria, Belgium, Finland, the Netherlands, and UK/Ireland.

16. Concerning their **time budget** doctoral candidates stated that they spend on average more than 34 hours

per week on research related to their thesis and about 14 hours per week on work not related to their thesis.

17. About **13 percent** of the doctoral candidates had spent **some time abroad**. Main destinations were Germany, the USA, Italy, and France. Altogether **20 percent** of the EURODOC respondents were pursuing their doctorate **in another country**.

18. Concerning future employment **39 percent** of the doctoral candidates **intend to stay abroad or move abroad** after their doctorate. Preferred countries for future work are the USA, Germany, France, Switzerland, UK, and Sweden. The main reasons for this kind of mobility were better research facilities, better career prospects, and opportunities to cooperate with prominent scientists. Doctoral candidates from CEE countries also stated better financial conditions and better social security.

19. The **preferred sector of future employment is the academic research sector** (79 %), followed by public or private non-academic research sector (52 %). The advantages of a doctoral degree for future employment were seen as better opportunities for research, challenging work tasks, possibilities to pursue one's own ideas, and a high degree of independence. Social security, a high income or social recognition play a much lesser role.

20. Comparing the responses of the two groups (supervisors and doctoral candidates) there is a **clear trends towards a hybrid status** of doctoral candidates, namely being early stage researchers and students at the same time. This is reflected in the mix of funding and the payment of tuition fees for coursework.

21. Concerning the **structure and quality** of doctoral education we observed a **mix of individual supervision plus coursework** and an increase in formalised agreements. Satisfaction with the quality of supervision is generally high, satisfaction with coursework is more mixed and higher for theories and methods than for transferable skills training.

22. Supervisors and doctoral candidates also differ in their assessment of **temporary mobility** of doctoral candidates (supervisors: 5 %; doctoral candidates: 13 %). Typically there are between **20 and 22 percent of international doctoral candidates**. At more than half of the universities submission of the thesis in a foreign language is possible and in many cases it is also possible to include international supervisors.

23. Concerning the **transition into the labour market and issues of employability** the surveys show that only very few doctoral candidates (2.4 %) do their research in industry. Coursework includes transferable skills acquisition but received a low level of satisfaction and is often elective. 43 percent of the supervisors stated that there are no activities to support transition into the labour market. Finally, most doctoral candidates stated a preference to continue with academic research in universities after their doctorate.

24. The **main conclusions** of this study are:

- The average duration of doctoral studies is three to four years.
- Integration of doctoral training into programmes and schools has progressed considerably.
- Individual supervision is often combined with formalised coursework.
- Access to doctoral education has become more selective.
- In many countries the number of international doctoral candidates has increased.
- The idea of the “third cycle” is being distorted into a hybrid status of early stage researcher and student at the same time.
- Supervision and assessment is becoming more formalised.
- There is a relatively high degree of satisfaction with the quality of supervision.
- Subject related knowledge and transferable skills acquisition are treated differently in the framework of coursework.
- More than half of the doctoral candidates aim for a postdoc position in academic research, about one third plan to go into industry.
- Almost 40 percent of doctoral candidates plan to stay abroad or move abroad after their doctorate.

- The overall picture continues to be rather heterogeneous but there are clear trends towards a higher degree of formalisation and regulation of the doctoral process.

1. Introduction: description of project

In 2007 the European Physical Society (EPS) received funding from the European Commission to carry out a study of the implementation of the two-cycle (Bachelor/Master) study and degree structure into Physics programmes in European Universities. It was envisaged to cooperate with the National Physical Societies of at least 15 European countries to collect relevant Physics curricula for in-depth analysis and conduct an online survey addressed to coordinators of Physics programmes in a representative sample of universities in each of the countries involved in the study. The International Centre for Higher Education Research (INCHER-Kassel) at Kassel University was subcontracted as a partner in this project to analyse the curricula and administer the survey. Representatives of the European Physical Society acted as members of the steering group of the project as a whole and as contact persons to the national Physical Societies. Two separate though related reports have been published by the European Physical Society, the first focusing on Physics programmes at the Bachelor level, the second on Physics programmes at the Master level (cf. Kehm et al. 2009; Kehm et al. 2010).

In 2010 EPS received further funding from the European Commission to analyse the doctoral level as well. INCHER-Kassel was again commissioned to carry out the study. However, due to the fact that views and traditions vary in the Bologna signatory countries whether young researchers in the phase of doctoral qualification should be regarded as early stage researchers or as students and consequently whether doctoral programmes constitute a third cycle a different approach was chosen. For purposes of neutrality the term “doctoral candidate” is chosen throughout this report. It includes doctoral students, early stage researchers in the phase of getting their doctoral degree, as well as junior academic staff in the process of getting their doctoral degree. Except for the relevant questions in the surveys the term “doctoral candidate” includes no implications concerning form of

funding, status, external or internal candidate, or form of supervision. The term refers to all persons in the process of getting their doctoral degree.¹

With the help of contact persons in 21 national Physical Societies and national contact persons from nine additional countries who are involved in the STEPS II project² supervisors of doctoral candidates as well as coordinators of doctoral studies programmes were contacted and asked to fill in an online questionnaire (see Appendix II). The data collection took place from October 2011 until January 2011. In addition, permission was requested and granted to analyse responses from doctoral candidates in Physics which had participated in the 2008/09 EURODOC survey among doctoral candidates in all subjects in Europe. This served to include the views of doctoral candidates themselves about their situation. Altogether 393 respondents to the EURODOC survey (questionnaire in Appendix III) getting their doctoral degree in (classical) Physics (out of 9,000 respondents in total) were included in the analyses of this project. Overall, the study aims to provide a profile of the implementation of Bologna reforms in European doctoral education and training in Physics and arrive at conclusions pertaining to the following issues:

- assessing whether major goals of the Bologna Process have been addressed;
- enabling Physics Departments involved in the study to recognise potential partners for exchange and cooperation;
- yielding the basis for advice to doctoral candidates interested in changing university or spending some time of study or research abroad;
- providing a basis for modifications and amendments which might become necessary to achieve the overall reform goals.

¹ EURODOC is the European Council of Doctoral Candidates and Junior Researchers founded in Girona (Spain) in 2002 with a secretariat in Brussels since 2005. It is a federation of 34 national organisations of doctoral candidates and of young researchers from 34 EU and European Council countries. It represents the interests of doctoral candidates and young researchers at the European level (*i.e.* vis-à-vis the European Commission and in the framework of the Bologna Process).

² STEPS II refers to the second phase of an ERASMUS funded academic network Stakeholders Tune European Physics Studies Two. The network is active in reforming Physics curricula, introducing modern teaching methods in Physics education, and making proposals for reforms in Physics teacher education.

2. Design of the Study

The study is divided into two parts which will complement each other and be linked together in the concluding chapter. After having determined the sample size – approximately 60 percent of all universities offering Physics programmes in the large countries involved in the study and as close as possible to 100 percent of all universities offering Physics programmes in the small countries – contact persons in the respective National Physical Societies and from the STEPS II project were asked to select the respective number of universities and ask the local programme coordinators and doctoral thesis supervisors to fill in an online questionnaire.

The online questionnaire was designed focusing exclusively on doctoral education and training and covered altogether five areas:

- personal and institutional details of respondents,
- doctoral degree structure and organisation,
- process of doctoral studies,
- award of the degree,
- statistics on recent doctoral awards in the faculty/ the department.

Together with a cover letter explaining the project and including the link to the online questionnaire a sufficient number of personal identification numbers (PINs) generated by chance were then sent again to the contact persons with the request to forward the letter and one PIN to the supervisors and programme coordinators in the selected universities. Due to reasons of data protection all persons filling in the online questionnaire were assured of complete anonymity.

Parallel to the administration of the online questionnaire to supervisors the EURODOCS data set was analysed and all responses from candidates indicating that they were in the process of getting their doctoral degree in (classical) Physics were aggregated into a separate data set. The EURODOCS questionnaire covered altogether seven areas:

- career paths,
- funding,
- training and supervision,
- working conditions
- academic work
- mobility,
- gender/socio-demographic indicators/work-life balance.

3. Doctoral Education and Training and the Bologna Reform Agenda

The original Bologna Declaration from 1999 (Bologna Declaration 1999) did not include doctoral education and training. The main goal in the creation of a European Higher Education Area (EHEA) was to harmonise the European structures of study programmes and degrees by establishing two cycles of studies (undergraduate and graduate) which were soon labelled Bachelor and Master (without explicit reference to the USA or the UK) and were supposed to last no longer than five years altogether. In the course of implementation a European mainstream began to emerge with the majority of newly established Bachelor programmes lasting three years and the majority of newly established Master programmes lasting two years. Still, there was a wide range of variety in between, *e.g.* the combination of 4 plus 1 years. The only exception was the United Kingdom where the majority of Bachelor programmes traditionally had a duration of three years and the majority of Master programmes a duration of one year. UK integrated Master programmes have a duration of four years.

How did doctoral education and training find its way onto the Bologna agenda? While the Bologna Declaration was a somewhat surprising intergovernmental initiative introduced by the Ministers responsible for higher education who intentionally excluded the European Commission from this undertaking in the beginning, the Commission took its own initiative one year later (in 2000) by proposing to the European Council the so-called “Lisbon Strategy for Growth and Jobs” (Lisbon Strategy 2000) in which the creation of a European Research Area (ERA) was suggested and adopted by the Council. In his concluding speech the acting Commissioner for Research, Philippe Busquin, formulated the often quoted and famous sentence that the intention of the strategy was “to make Europe the most dynamic and competitive knowledge-based economy in the world ...” (Busquin 2000).

Despite the fact that the original Lisbon Strategy has failed and been further developed into the “Europe 2020 Strategy” (Europe 2020 Strategy Website) in the meantime, one element of the original Strategy was eventually taken up on the Bologna reform agenda: a more systematic and efficient training of young researchers for the

emerging knowledge-intensive sectors of the economy. Thus, the Bologna follow-up meeting of ministers in Berlin in 2003 concluded with a Communiqué in which not only “the need to promote closer links between the EHEA the ERA in a Europe of Knowledge” was stated but also the necessity “to go beyond the present focus on two main cycles of higher education to include the doctoral level as the third cycle in the Bologna Process” (Berlin Communiqué 2003, p. 1).

Two years later, at the ministerial meeting in Bergen in 2005, the Communiqué became more specific with regard to doctoral education and training, although some of the formulations also reflect ongoing disagreement, like the statement that the ministers “consider participants in third cycle programmes both as students and as early stage researchers” (Bergen Communiqué 2005, p. 4). Another contradiction reflecting ongoing disagreement among ministers is the fact that the Communiqué pushes for further regulation of doctoral education and training on the one hand while at the same time stating that “overregulation of doctoral programmes must be avoided” (*ibid.*, p. 4). Neither the Berlin nor the Bergen Communiqué take the continental European practice of individual supervision into account. Instead, the Berlin Communiqué speaks about a “third cycle” (of studies) while throughout the Bergen document reference is made to “doctoral programmes”. The specifications made in Bergen with regard to doctoral education and research training include the following elements:

- to align doctoral level qualifications with the European Qualifications Framework;
- to have structured doctoral programmes with transparent supervision and assessment;
- to establish a workload in the third cycle that corresponds to 3 to 4 years full time;
- to ensure that doctoral programmes promote interdisciplinary training;
- to develop transferable skills meeting the needs of the wider employment market;
- to increase the overall numbers of doctoral candidates (cf. Bergen Communiqué 2005, p. 4).

In the same document the Bologna Follow-up Group and the European University Association (EUA) together with other interested partners were invited “to prepare a report ... on the further development of the

basic principles for doctoral programmes” (ibid, p. 4) which was to be presented at the ministerial meeting in London in 2007.

In response to the inclusion of doctoral education and training into the Berlin Communiqué in 2003, EUA organised a Bologna Seminar on “Doctoral Programmes for the European Knowledge Society” in 2005 which concluded with the so-called “Salzburg Principles” (EUA 2005). In preparation of the ministerial meeting in London in 2007 and with support of the Bologna Follow-up Group, EUA also carried out a survey in 36 Bologna signatory countries to gather more knowledge about doctoral programmes which was published 2007 (EUA 2007). The core issues of this report focused on the need for further clarification of funding issues to which the question of the status of doctoral candidates is closely related. The report also demanded more consultation and coordination with regard to doctoral education and training in the Bologna signatory countries.

In 2008 the EUA Council for Doctoral Education (EUA-CDE) was established “to create a voice for European universities on doctoral education” and with the mission “to contribute to the development, advancement and improvement of doctoral education and research training in Europe” (EUA Council for Doctoral Education Website). Since then the activities of the EUA-CDE have included a report on doctoral careers (EUA 2009) and the Salzburg II Recommendation issued in 2010 (EUA 2010).

This brief history of the inclusion of doctoral education and training into the Bologna reform agenda serves as a framework for the presentation of results from two surveys addressing doctoral education in Physics.

4. Description of the Sample

The questionnaire addressed to the supervisors and programme coordinators (for short henceforth: EPS-INCHER survey or supervisor questionnaire) was sent to all those institutions and persons included in the previous analyses of the Bachelor and Master phase provided that the local Physics Department or Faculty also had doctoral candidates. In addition, contact persons in universities were addressed who were involved

in the STEPS II project. If the STEPS II respondents were located in a country already included in the previous samples their answers were added to the main sample. If they were located in an additional country not previously involved in the EPS Physics project (altogether nine countries: Bulgaria, Cyprus, Estonia, Latvia, Malta, Romania, Russia, Serbia, Turkey) responses are subsumed under “others” because only seven responses were received from persons in this group of countries. Apart from responses in the category “others” respondents to the online questionnaire came from 24 countries. Altogether 120 supervisors filled in the questionnaire which constitutes a response rate of 54 percent. Table 1 provides an overview of the sample included in this study. As in the previous studies of the Bachelor and the Master level, we have again a certain bias towards three countries (Germany, UK, and Ireland) due to the higher number of responses received.

The majority of the respondents to our online questionnaire had the status of a professor, lecturer or reader (46 %) or of a dean, programme director or head of studies (39 %). Most of them were either involved in teaching and supervising (68 %) or in the coordination of doctoral programmes (47 %). More than 90 percent of the respondents came from a university, seven percent from a technical university. Three quarters of these universities had more than 15,000 students and 63 percent of the Physics Departments or Faculties had more than 200 students.

The EURODOC survey sample is more difficult to describe, in particular, as the results of the survey as a whole have not yet been published by EURODOC. The survey was administered online from December 2008 until end of May 2009 and the questionnaire distributed via e-mail, newsletter, mailing lists and web pages of all EURODOC member organisations. Roughly 100,000 doctoral candidates were addressed. The response rate was about 9 percent (almost 9,000 respondents) from more than 30 countries. From this sample of 9,000 respondents we extracted those who had indicated that they were getting their doctoral degree in (classical) Physics. Engineering Physics and other interdisciplinary subject combinations were not included in our sample. This resulted in a sample of 409 respondents. However, we took a closer look at the countries in which the respondents were doing their

doctorate and then excluded all those countries which are not part of the sample of the EPS-INCHER survey of supervisors (*i.e.* Armenia, Brazil, India, Japan, Liechtenstein, Luxemburg, Tunisia, United States, and Burkina Faso). To make the sample of doctoral respondents to the EURODOC survey more comparative we also aggregated those countries into a category

of “others” which formed the additional STEPS II respondents in the EPS-INCHER survey (Bulgaria, Estonia, Latvia, Romania, Russian Federation, and Turkey). Thus, we included altogether 393 respondents to the EURODOC survey from 21 countries (the group of “other countries” counting as ‘one country’) into our analyses.

► **TABLE 1: Countries, number of universities involved in the study, response rates**

Country	Total number of universities	Number of universities offering Physics programmes	Number of universities to be included in the project	Number of universities in the sample offering doctoral programmes in Physics	Number of respondents -Data
Albania	36	4	4	2	2
Austria	31	6	6	6	4
Belarus	28	6	4	4	1
Belgium	15	10	6	6	5
Croatia	5	4	4	4	1
Czech Republic	24	12	5	5	5
Denmark	12	4	4	4	1
Finland	13	11	8	8	6
France	87	37	19	21	4
Germany	97	59	35	35	18
Greece	23	5	5	5	1
Hungary	26	5	5	5	5
Ireland + UK	139	57	34	34	18
Italy	89	36	20	20	5
Lithuania	15	4	4	4	3
Macedonia	5	2	2	2	1
Netherlands	14	9	5	5	6
Poland	18	12	8	8	4
Portugal	34	15	10	10	2
Slovenia	4	3	2	2	2
Slovakia	33	14	2	2	2
Spain	73	20	12	12	10
Sweden	21	9	6	6	7
Switzerland	12	7	8	8	0
Ukraine	81	10	3	3	0
Others					7
Total	935	361	221	221	54% (120)

Table 2 provides an overview of countries in which doctoral candidates responding to the EURODOC survey were living at the time of the survey (only four percent started their doctorate in a different country and then moved to another country to continue).

Table 2 shows that there is a high representation of French doctoral candidates in physics (18 percent), followed by candidates from Germany (10 percent), Finland, Norway and Austria (9 percent each), and Sweden (8 percent).

The respondents to the EURODOC survey also included some socio-demographic features so that we can describe our sample in a bit more detail. The mean age of the respondents was 28.7 years. Gender distribution was 26 percent female and 74 percent male respondents. Concerning their current family situation 43 percent were single, 50 percent were married or living together with a partner. Altogether 87 percent of the respondents stated that they did not have children. The social background was relatively high. In 43 percent of the cases the father had a higher education degree and in 40 percent of the cases the mother had a higher education degree.

5. Results from the EPS-INCHER Survey: The View of the Supervisors

In this chapter the results from the online questionnaire to the supervisors will be presented. In most cases results are presented in form of overall percentages or means. References to individual countries will only be made if there is a sizeable number of responses because there were several countries from which only one response was received so that no representative statements can be made with respect to these countries.

5.1 Doctoral Degree Structure and Organisation

In recent years more and more countries have issued guidelines about the maximum duration of the doctoral phase. The Bologna reform agenda proposes a duration between three and four years in full-time mode. However, traditionally the duration of the doctoral phase is closely related to funding and status. In the majority

of continental European countries we can distinguish between four basic forms of funding and status with regard to doctoral candidates:

- they are regarded (and enrolled) as students and might have to pay tuition fees for the taught part of their education and training;
- they are employees of the university receiving a salary and working as junior researchers in projects or assisting a professor in his/her work (including teaching);

► **TABLE 2: Country in which the doctorate is carried out (Percent)**

	%	Count (n)
Austria	8.7	(34)
Belgium	2.0	(8)
Belarus	0.3	(1)
Croatia	2.3	(9)
Denmark	0.3	(1)
Finland	8.9	(35)
France	18.1	(71)
Germany	10.4	(41)
Hungary	0.3	(1)
Italy	0.5	(2)
Lithuania	1.3	(5)
Netherlands	4.1	(16)
Norway	8.9	(35)
Portugal	4.6	(18)
Slovakia	1.5	(6)
Slovenia	2.0	(8)
Spain	6.4	(25)
Sweden	7.9	(31)
Switzerland	1.5	(6)
United Kingdom	1.8	(7)
Other	8.4	(33)
Total	100.0	(393)

Question A2: In which country did you start your doctorate?

Note: There are a few cases (16 out of 393) in which respondents started their doctorate in one country and then moved to another country to continue their work. In addition there are a few respondents who did not indicate the country in which they were living at the time of the survey.

- they are scholarship holders and might be enrolled in a doctoral programme or just have a supervisor; registration is getting more common but not necessary everywhere;
- they are external candidates with a job outside the university and receiving individual supervision, thus having not necessarily any status at all at the university.

As long as a maximum duration of the doctoral phase is not definitively prescribed, candidates can work on their research as long as they can find funding or are self-supported. Responses to the question whether the duration of the doctoral phase is fixed were largely inconsistent, *i.e.* respondents from the same country answering that there was national regulation, or university regulation or another kind of regulation or no regulation at all. Basically 65 percent of our respondents stated that the duration was fixed while 35 percent stated that it was not (also cf. Appendix I).

It is more interesting here to look at the average actual duration of the doctoral phase:

- Less than 3 years: 3 percent
- Three to four years: 57 percent
- Four to five years: 36 percent
- More than five years: 4 percent

The result shows that 60 percent of doctoral candidates take four years or less to finish their degree while 40 percent need more than four years. The arithmetical mean indicates a minimum duration of 3.0 years and a maximum duration of 4.6 years.

We also asked about the typical age of doctoral candidates

at the beginning of their doctorate. At the beginning of their doctorate candidates are on average between 23.4 and 26.4 years old. There are no big differences among countries, except in UK/Ireland where candidates are rather young (between 21.6 and 24.4 years old) and Macedonia where candidates are rather old (between 30 and 35 years).

Concerning the organisation of doctoral studies/research 47 percent of our respondents stated that doctoral studies are integrated into formal programmes or graduate schools, 13 percent said that doctoral work is undertaken with individual supervision only, and 40 percent said it was both, individual supervision and doctoral programme/graduate school. Countries with a high proportion of individual supervision are Austria and Slovakia. Countries with a high proportion of formalised structures (programmes, schools *etc.*) in doctoral education are Belgium, the Czech Republic, France, Hungary, Italy, Lithuania, Portugal, Spain, and UK/Ireland. This indicates the growing formalisation of doctoral education and training in the Bologna signatory countries.

Those respondents having stated that doctoral education is integrated into programmes and schools were also asked how these were funded. Frequently we find a funding mix for them, *i.e.* programmes/schools funded by the university was indicated by 81 percent of the respondents, funding by a research council or a foundation by 53 percent of the respondents, and other forms of funding can be found in 23 percent of the cases. Countries with a high proportion of external funding (research council, foundation or similar) are Finland, Germany, and the UK/Ireland.

► **TABLE 3: Other special requirements for acceptance as doctoral candidate (percent; multiple responses)**

	%	Count
Submission and acceptance of research outline	20	(9)
Passing of an entrance examination with a minimum grade point average	33	(15)
Trial period of months' duration	13	(6)
A minimum grade point average of previous degree	56	(25)
Evidence of proficiency in a foreign language	31	(14)
Other	36	(16)
Total		(45)
Question 4.2: Are there other special requirements for acceptance as doctoral candidate?		

5.2 Recruitment, Selection, Admission, Funding

In continental Europe it is still the norm that acceptance as a doctoral candidate requires a Master degree. Only the UK and Ireland provide access into doctoral studies after the Bachelor degree more frequently. However, somewhat less than half of the respondents (46 percent) stated that in special cases Bachelor graduates can be admitted directly into doctoral studies, typically if a student is highly talented. Nevertheless, there is a relatively high degree of selectivity going on with regard to the acceptance of doctoral candidates. Table 3 provides an overview of further special requirements for the acceptance as doctoral candidate. It also shows that the grade point average for the previous degree continues to be an important indicator.

Permeability between different levels and types of education seems to have increased. Only in 25 percent of the cases graduates with a non-university degree are not accepted at all into doctoral studies. 21 percent of respondents stated that they are accepted without further requirements. However, slightly more than half of the respondents (55 percent) stated that these graduates have to fulfil further requirements (*e.g.* in terms of a high grade point average, additional credits or a trial period) before they are accepted for doctoral studies. Regulations in this respect seem to vary from institution to institution because responses from individual countries vary as well.

The recent reforms in doctoral education have also led to the fact that it is increasingly no longer the supervisor alone (42 percent) who decides about the acceptance of a person as doctoral candidate. Frequently deans of graduate schools or heads of programmes (20 percent) and even more often committees or boards at the faculty/departmental level (73 percent) or at the university level (10 percent) are involved in such a decision. Naturally all doctoral candidates are assigned one (or more) supervisor but the decision who supervises the research work of a given candidate might be taken independently from his or her acceptance into a programme or school.

The status of doctoral candidates is closely related to funding arrangements and to some extent related to the question whether doctoral training is integrated into a programme or school. As stated

further above, we can basically distinguish between four different types of possible status in Europe: students, university employees, scholarship holders, external candidates.

There are countries in Europe (*e.g.* the Netherlands and Germany) in which all of these types are present. In addition, a few European countries do not have a well established system of registering doctoral candidates so there are actually no statistical data about doctoral candidates in the process of getting their degree or the number of drop-outs (*e.g.* Germany). Furthermore, in those countries in which doctoral candidates regardless of their status or their form of funding have to participate in some kind of formalised research training, they have to pay tuition fees for this training (*e.g.* the Netherlands) and sometimes are considered to be students and junior academics at the same time. Finally, there are also a few countries (*e.g.* Austria, Germany) in which no tuition fees have to be paid.

This situation is rather complex and difficult to analyse because no clear-cut typologies are possible.

The respondents to our online survey considered the status of doctoral candidates as follows:

- They are students 34 percent
- They are early stage researchers/junior academics 32 percent
- They are both 34 percent.

A high proportion of student status can be found in Greece, Poland, Portugal, Slovakia, and the UK/Ireland. A high proportion of early stage researcher status was found in Albania, Belgium, Belarus, Finland, France, Germany, the Netherlands, and Macedonia. Being both occurs to a high extent in Austria, the Czech Republic, Italy, Lithuania, and Spain.

Only 38 percent of our respondents stated that there is an official status for part-time doctoral candidates, the others said that this is not possible. Here again regulations seem to vary from university to university and differ within a given country. Those countries in which an official part-time status seems to be common are: the Czech Republic, Finland, Hungary, Slovakia, and UK/Ireland.

In 50 percent of the cases respondents stated that doctoral candidates pay tuition fees, while the other

half said that they did not have to pay tuition fees. Fees for domestic doctoral candidates are approximately the same as those for doctoral candidates from other EU member states showing a mean of 1,952 € for domestic and of 2.096 € for European candidates. Doctoral candidates from outside Europe pay more than three times as much in terms of tuition fees. Tables 4 shows the amount of tuition fees for all three groups in terms of minimum and maximum level and as arithmetic means.

The two most important sources of funding for doctoral candidates themselves are employment contracts with the host university or department (43 %) and non-repayable scholarships (44.8 %). Repayable grants or loans were indicated in 3.4 percent of the cases and 8.8 percent of doctoral candidates are self-funded.

Employment contracts are most common in Austria, Croatia, Finland, Germany, Lithuania, the Netherlands, Sweden, and Macedonia. Scholarships as a means of funding for doctoral candidates can be found frequently in Belgium, the Czech Republic, Hungary, Italy, Poland, Portugal, Slovenia, Spain, and UK/Ireland. High number of self-funded doctoral candidates can be found in Albania and Greece, while repayable grants or loans are a frequent means of funding in France.

5.3 The Process of Doctoral Education and Training

Despite the fact that in 90 percent of the cases the thesis project is the result of an agreement between the candidate and the supervisor, the topic is mainly assigned by the supervisor (70 %). Moreover, the thesis subject needs additional approval in 53 percent of the cases. Slightly less than half of the respondents (47 %) state that there is a formal agreement regulating rights and duties between the doctoral candidate and most commonly the supervisor (58 %) or the host department/faculty (49%). Furthermore, 61 percent of our respondents stated that there is an additional committee or board involved. Such committees have on average about ten members and are mainly responsible for the following issues: formal admission of doctoral candidates (65 %), approval of thesis subject (61 %), approval of supervisor(s) (55 %), appointment of examiners (56 %), admission of candidate for thesis defence (69 %).

The requirements for doctoral supervision vary to some extent from country to country and even from university to university within one country. Mainly the

► **TABLE 4: Tuition fees for doctoral candidates (means)**

	AL	AT	BE	FR	DE	HU	IT	LT	PL	PT	SK	SI	ES	UK/IE	Other	Total
<i>For domestic doctoral candidates</i>																
Arithm. mean	1500,0	412,5	371,7	412,5	600,0	1300,0	100,0	,0	,0	2750,0	,0	5900,0	142,5	4232,6	958,0	1952,2
Minimum	1000,0	75,00	80,00	300,00	200,00	900,00	100,00	,00	,00	2750,0	,00	3700,0	50,00	1500,0	40,00	,00
Maximum	2000,0	750,00	835,00	600,00	1000,0	2000,0	100,00	,00	,00	2750,0	,00	8100,0	400,00	7000,0	2700,0	8100,0
Count	(2)	(2)	(3)	(4)	(2)	(3)	(1)	(1)	(2)	(1)	(2)	(2)	(5)	(16)	(5)	(51)
<i>For doctoral candidates from other EU countries</i>																
Arithm. mean	.	412,5	371,7	412,5	600,0	1300,0	100,0	,0	,0	2750,0	,0	5900,0	142,5	4414,8	1648,0	2096,1
Minimum	.	75,00	80,00	300,00	200,00	900,00	100,00	,00	,00	2750,0	,00	3700,0	50,00	3600,0	40,00	,00
Maximum	.	750,00	835,00	600,00	1000,0	2000,0	100,00	,00	,00	2750,0	,00	8100,0	400,00	7000,0	3600,0	8100,0
Count	(0)	(2)	(3)	(4)	(2)	(3)	(1)	(1)	(1)	(1)	(2)	(2)	(5)	(15)	(5)	(47)
<i>For doctoral candidates from countries outside Europe</i>																
Arithm. mean	.	787,5	517,5	412,5	600,0	1966,7	100,0	.	3000,0	2750,0	.	5900,0	142,5	15723	2480,0	6168,4
Minimum	.	75,00	200,00	300,00	200,00	900,00	100,00	.	1000,0	2750,0	.	3700,0	50,00	10500	900,00	50,00
Maximum	.	1500,0	835,00	600,00	1000,0	4000,0	100,00	.	5000,0	2750,0	.	8100,0	400,00	20000	4000,0	20000
Count	(0)	(2)	(2)	(4)	(2)	(3)	(1)	(0)	(2)	(1)	(0)	(2)	(5)	(14)	(5)	(43)
Question 4.7: Please indicate the average amount of tuition fees (in Euro) per year in your department/faculty for different types of doctoral candidates.																

*habilitation*³ (41 %) or the status of a professor is required (22 %). In some cases (18 %) a doctoral degree is sufficient. However, a few respondents also stated that special training in supervision is required (Italy, Sweden, Portugal, Spain).

In the vast majority of universities the number of doctoral candidates per supervisor is not higher than five. Increasingly doctoral candidates have more than one supervisor (22 %). In many universities it is common to cooperate with external supervisors which can be from a different department of the same university (84 %), a different university (92 %), from a university abroad (80 %), or from an extra-university research institute. In fewer cases these external supervisors come from a non-university higher education institution (32 %) or from industry (44 %). However, it should be pointed out that involvement of external supervisors is required in only two percent of the cases but possible in 88 percent of the cases. Only 10 percent of the respondents stated that no external supervisors are involved.

Apart from improving the quality of supervision, structuring the doctoral phase is another reform goal of the Bologna agenda for the third cycle. This means to integrate doctoral education and training into programmes or schools and frequently adding obligatory course work which might also have credit points attached to it. Altogether 75 percent of our respondents stated that doctoral education and training includes coursework. No coursework is common, in particular, in Germany and Greece. 61 percent of cases including coursework also have the coursework quantified by ECTS credit points and further 13 percent stated that other types of credit points are used. The types of courses that are offered include specialised third cycle (doctoral) courses (81 %) as well as joint courses for master students and doctoral candidates (63 %). Typically coursework is assessed (83 %) and participation is formally monitored (72 %). Successful completion of the coursework is a requirement for the final degree in 70 percent of the cases but in only ten percent it is weighted as part of the final degree. Candidates failing the coursework can mostly re-sit or re-take the examination (80%).

³ The *habilitation* has often been compared to a second, more demanding doctorate. It is a formal qualification typical for Germany, Austria and most of the Central and Eastern European countries which makes a person eligible for a professorship and a professorial chair.

Furthermore, coursework is often partly or completely offered in a foreign language, mostly in English (except in the UK/Ireland). A high number of respondents from the Czech Republic, Germany, the Netherlands, Portugal, Croatia, and Sweden stated that all of the coursework is offered in a foreign language. The coursework also includes the provision of general skills and competences (82 %) but is not exclusively focused on these general skills. Apart from regular coursework there are additional offers for doctoral candidates, for example regular research seminars or colloquiums (82 %) and summer or winter schools (55 %). We also asked where the doctoral candidates actually carry out their research work. More than three quarters of the respondents stated that they do their research work in the department or faculty. A further 14 percent of the respondents said that research work is carried out in extra-university research institutions. And between two and five percent each named another university in the same country (3.3 %), outside the country (5.2 %), in industry (2.4 %) or another place (2.4 %). Only in very rare cases (0.6 %) is the research work carried out in a non-university higher education institution. Candidates are often obliged to present of their work in progress in the department or faculty (60 %) or in the framework of their doctoral programme or school (40 %). In addition they are expected or encouraged to present their work at national (87 %) or international (89 %) conferences. Only nine percent of our respondents stated that their doctoral candidates do not contribute to any kind of activities in the department or faculty but just do their own research work (especially in Portugal, Spain and the group of other countries) Those respondents who stated that doctoral candidates carry out different activities in the department or faculty indicated that the mean maximum hours per week for such work was 7.1 hours. The minimum number of hours was one and the maximum 20 hours per week.

Table 5 provides an overview in what kind of extra activities doctoral candidates are typically involved in.

Contributing to the work of the department or faculty, doing coursework, presenting their work in progress eats up time for research. We did not ask our respondents to estimate the time left over for doctoral candidates to do their own research. However, this question will be answered when analysing the responses of doctoral candidates to the EURODOC survey (cf. Section 6.5).

► **TABLE 5: Activities of doctoral candidates in the Department/Faculty (percent; multiple responses)**

	%	Count
Laboratory or problem solving sessions	94	(100)
Tutoring students	65	(69)
Lecturing, teaching seminars	43	(46)
Providing advice for project/thesis of first- or second cycle students	49	(52)
Marking/assessment of homework	58	(61)
Support supervisor/professor in publications	63	(67)
Write own publications	80	(85)
Support supervisor/professor in writing project proposals/tenders	39	(41)
Support supervisor/professor in administrative/organisational work	25	(27)
Other	2	(2)
Total	519	(106)

Question 5.29: Do doctoral candidates typically carry out or contribute to teaching, research or administrative activities?

5.4 Internationalisation

Apart from teaching in a foreign language (cf. Chapter 5.3) and offering doctoral candidates the opportunity to spend a research period abroad (cf. Chapter 5.3) we were also interested in the international composition of doctoral candidates in Physics at the universities of our respondents. It turns out that the arithmetic mean across all countries involved in this study is that 11 percent of doctoral candidates come from other European countries and the same proportion from

outside Europe. Thus, Physics Departments or Faculties have almost one quarter of international doctoral candidates. Particularly high proportions (15 percent or more) of international candidates from within Europe can be found in Belgium, the Netherlands, Sweden, and the UK/Ireland. High proportions (15 percent or more) of international doctoral candidates from outside Europe can be found in Austria, Belgium, France, Italy, the Netherlands, and Sweden. Table 6 provides the respective overview indicating the overall composition of doctoral candidates.

► **TABLE 6: Percentage of the doctoral candidates from home university by country (means)**

	AL	AT	BE	BY	CZ	FI	FR	DE	GR	HU	IT	LT	NL	PL	PT
Percentage of the doctoral candidates from home university															
Arithm. mean	60,0	56,3	52,0	70,0	80,0	72,5	45,3	61,7	80,0	62,5	60,0	91,7	28,3	82,5	80,0
Count	2	4	3	1	4	6	3	15	1	4	4	3	6	4	2
Percentage of the doctoral candidates from your own country (excluding home university)															
Arithm. mean	40,0	12,5	5,3	20,0	8,8	11,7	25,7	18,2	10,0	24,8	21,3	8,3	16,7	11,8	5,0
Count	2	4	3	1	4	6	3	15	1	4	4	3	6	4	2
Percentage of the doctoral candidates from other EU member states															
Arithm. mean	,0	13,8	17,0	,0	8,5	6,7	14,0	8,7	5,0	9,0	2,5	,0	27,5	,5	,0
Count	2	4	3	1	4	6	3	15	1	4	4	3	6	4	2
Percentage of the doctoral candidates from countries outside Europe															
Arithm. mean	,0	17,5	21,7	10,0	2,8	9,2	16,7	11,4	5,0	3,8	16,3	,0	27,5	5,3	5,0
Count	2	4	3	1	4	6	3	15	1	4	4	3	6	4	2

Question 4.10: What is the origin of doctoral candidates in your department/faculty? (Please indicate percentages, percentages should add up

► **TABLE 7: Criteria for the final assessment (mean)**

	Arithm. mean	Count
Percentage of thesis quality from the final assessment	66.7	104
Percentage of oral presentation from the final assessment	11.5	104
Percentage of answers to questions from examiners from the final assessment	15.9	104
Percentage of answers to questions from audience from the final assessment	2.3	104
Percentage of performance in broader oral examination from the final assessment	3.6	104
Question 6.12: What are the criteria for the final assessment and the award of the degree? (Please indicate percentages, percentages should add up to 100%)		

5.5 Award of Doctoral Degree

The doctoral thesis continues to be the major element for the award of a doctoral degree. It consists mainly of a previously unpublished report or piece of text (81 %) but a cumulative thesis⁴ is also possible quite often (56 %). There is a relatively high proportion of doctoral theses in Physics which are submitted in a foreign language (mean of 55 %). High proportions (around 80 percent and higher) can be found in Austria, Finland, Italy, the Netherlands, Portugal, and Sweden. Altogether 22 percent of our respondents stated that credits are allocated to the thesis. In case of failure it is frequently possible (57 %) to resubmit a revised thesis within six to twelve months.

⁴ A "cumulative" thesis (in English speaking countries also called "PhD by published work") consists of several, as a rule peer reviewed journal articles plus an additional framework text which integrates the articles into a field of specialisation or provides some kind of (theoretical) linkage between the articles.

SK	SI	ES	SE	MK	UK/IE	Other	Total
88,5	57,5	59,6	44,6	100,0	37,3	80,6	59,8
2	2	9	7	1	15	8	106
10,5	22,5	23,0	20,9	,0	27,5	11,9	18,1
2	2	9	7	1	15	8	106
,0	10,0	9,6	19,3	,0	21,4	4,4	11,0
2	2	9	7	1	15	8	106
1,0	10,0	7,9	15,3	,0	14,5	3,1	11,0
2	2	9	7	1	15	8	106
to 100%)							

Thesis submission is followed by an oral examination or defence as a rule (99 %) which can also take place in a foreign language (actual arithmetic means is 33.3 percent). Surprisingly, 64 percent of our respondents stated that there is no formal time limit to the duration of the defence, although on average the duration is between one and two hours. Furthermore, in 85 percent of the cases the defence is public. In case of failure it is possible to retake the examination or repeat the defence (56%) within six to twelve months time.

In the final assessment the main criteria for the award of the degree are indicated by our respondents as follows (cf. Table 7):

In 52 percent of our cases the award of the doctoral degree is on a pass/fail basis. Still, 48 percent of our respondents stated that there is a grade or mark attached to it which is given either in Latin or the home country language. Grading is typical in Albania, Austria, Finland, Germany, Hungary, the Netherlands, and Spain.

5.6 After the Doctorate

Transition of doctoral degree holders into the labour market has received more attention in recent years because the number of doctoral degree awards has clearly risen beyond the number of academic and research staff needed in universities and extra-university research institutes. There are considerable differences in the Bologna signatory countries in terms of the acceptance of doctoral degree holders in the non-academic labour market. In Germany this has traditionally been rather easy and non-academic labour markets are very open with regard to doctoral degree holders. In other countries, e.g. Italy but also Poland, this has not been the case very much.

► **TABLE 8:** Activities/services to ease transition into the labour market (percent; multiple responses)

	%	Count
Career services and advice	84	(56)
Organisation of interviews with potential employers	33	(22)
Internships	25	(17)
Lectures by alumni or potential employers about labour market and career opportunities	60	(40)
Training for job applications and job interviews	45	(30)
Information brochures about potential job areas	42	(28)
Other activities/services	6	(4)
Total	294	(67)

Question 6.18: If your institution offers activities/services to ease transition into the labour market, please indicate which ones (Multiple replies possible)

► **TABLE 9:** First destinations after award of the degree (means)

	Arithm. mean	Count
Percentage of candidates going into a postdoc phase	51.8	97
Percentage of candidates going into industrial research	21.2	92
Percentage of candidates going to other fields in industry	17.1	75
Percentage of candidates teaching in secondary school (possibly after further training)	11.3	58
Percentage of candidates teaching in the non-university sector of higher education (possibly after further training)	7.9	46
Percentage of candidates going to other destinations	28.8	32

Question 7.6: Can you please estimate the first destinations of candidates having been awarded a doctoral degree?

► **TABLE 10:** Doctoral Funding Meets Living Costs by Country (percent; arithmetic mean)

	AT	BE	HR	DK	FI	FR	DE	IT	LT	NL	NO	PT
Sufficient funding for doctorate												
1 Not at all	0	0	0	0	3	2	0	0	25	0	0	7
2	16	0	14	0	17	3	3	0	25	14	0	7
3	24	0	29	0	28	22	30	100	25	7	16	53
4	32	60	57	100	28	39	37	0	0	36	29	27
5 To a very high extent	28	40	0	0	24	34	30	0	25	43	55	7
Total	100	100	100	100	100	100	100	100	100	100	100	100
Count	(25)	(5)	(7)	(1)	(29)	(59)	(30)	(1)	(4)	(14)	(31)	(15)
Recoded values												
1,2	16	0	14	0	21	5	3	0	50	14	0	13
3	24	0	29	0	28	22	30	100	25	7	16	53
4,5	60	100	57	100	52	73	67	0	25	79	84	33
Arithmetic mean	3,7	4,4	3,4	4,0	3,5	4,0	3,9	3,0	2,8	4,1	4,4	3,2

Question C2: To what extent does your level of doctoral funding meet your living costs?

Universities have started to provide their doctoral candidates with a number of generic competences that can be used in non-academic jobs and are supposed to help smooth transition processes. However, still 43 percent of our respondents stated that their institution does not offer any kind of activities or services to ease this transition. In those universities which offer such services (57 % of respondents) career services and advice are the most important ones. Table 8 shows the range of services on offer.

We asked our respondents to provide an estimate of where their doctoral degree holders are heading after the award of the degree. Table 9 provides an overview of the responses based on arithmetic means.

The results show almost two fifths of doctoral degree holders in Physics do not stay in academia but go into industrial research or to other sectors outside universities. A high number (more than 50 percent) of doctoral degree holders staying in the university can be found in Austria, the Czech Republic, Finland, France, Hungary, Lithuania, Portugal, Spain, and the UK/Ireland. A high proportion (more than 25 %) of doctoral degree holders going into industrial research were indicated for Austria, Germany, Lithuania, the Netherlands, and the Slovak Republic.

In the following, the results from the EURODOC survey will be presented and then compared and contrasted to the results of our survey in the last chapter.

6. Results from the EURODOC Survey: The View of the Doctoral Candidates

In this chapter the results of the EURODOC survey among doctoral candidates will be presented which was carried out in 2008/09. Only classical Physics candidates have been included of which altogether 393 responded to the online survey. Doctoral candidates in Physics from 21 countries are included in our analysis.

6.1 Funding, Status and Employment Situation

Despite the fact that status and funding are closely related, many doctoral candidates seem to be in a rather hybrid situation having more than one status at the same time (*i.e.* being a student and being employed). Many of the responses are inconclusive because the indicators were not properly separated from each other and multiple replies were possible. Altogether 81 percent of the respondents stated that they were employed and 66 percent of these indicated they were employed by the university. Furthermore, 71 percent of the respondents stated that they had a fixed-term contract. Employment levels are particularly high (more than 80 percent) in Austria, Belgium, Hungary, Denmark, France, Germany, the Netherlands, Norway, Sweden, and Switzerland. However, 27 percent of the respondents said that they had a scholarship (especially respondents from Hungary, Italy, Portugal, Slovakia, and the UK/Ireland). The duration of funding (be it in the framework of an employment contract or of a scholarship) is between three (36 %) and four (25 %) years. Altogether 72 percent of the respondents stated that they had a student status.

The question whether they receive any funding at all for their doctorate was answered positively by 93 percent of the respondents and negatively by seven percent (especially doctoral candidates from Austria, Finland, and Portugal). 60 percent of the respondents were highly or very highly satisfied with their level of funding (4 and 5 on a five point scale). High satisfaction can be found in particular among doctoral candidates in Belgium, France, the Netherlands, Slovenia, Sweden, and the UK/Ireland. A low level of satisfaction (1 and 2 on a five point scale) with their funding was indicated by doctoral candidates from Lithuania, Spain, and the group of other

SK	SI	ES	SE	CH	UK/IE	Other	Total
0	13	6	0	0	17	25	4
0	0	29	4	17	0	42	11
80	0	47	4	50	17	29	25
0	50	18	22	0	33	0	29
20	38	0	70	33	33	4	31
100	100	100	100	100	100	100	100
(5)	(8)	(17)	(27)	(6)	(6)	(24)	(314)
0	13	35	4	17	17	67	15
80	0	47	4	50	17	29	25
20	88	18	93	33	67	4	60
3,4	4,0	2,8	4,6	3,5	3,7	2,2	3,7

countries. Table 10 provides an overview of the degree of satisfaction with their funding among doctoral candidates. Only a minority of respondents to the EURODOC survey (12 percent) stated that they had no time limitation for the completion of their doctorate (especially respondents from Austria, Finland, Portugal, and Spain). About one third of the respondents (32 percent) said that the duration is strictly limited and 49 percent indicated that there is a limitation which depends on funding or the permission to prolong. These statements indicate that only about one third of the doctoral candidates have to finish their work for the degree in a fixed period of time. For the other two thirds the period is either not fixed or can be prolonged.

6.2 Training and Competencies

Concerning the subject related and transferable skills training during the work on the doctorate, more than three quarters of the respondents to the EURODOC survey (78 %) indicated that they received some kind of training at their university. Still, 16 percent said that they did not receive any training (not even outside their university). The proportion of those who did not receive any training is particularly high in Portugal (63 %) and Germany (39 %).

Interestingly training for the more generic or transferable skills (including teaching skills and foreign language skills) is often offered on a voluntary basis and the satisfaction with the quality of these provisions is generally lower in comparison to training in theories and methods of the subject and mandatory courses.

The EURODOC survey also asked the doctoral candidates to compare their level of competencies in theories and methods of their subject at the start of their doctorate and at the time of the survey. Despite the fact that no indication was given at what point in time the respondents were concerning their doctoral work (*i.e.* the proportion of respondents in the first, second, third, *etc.* year of their doctoral work), the results are still quite interesting. Only a minority of respondents stated that they had a high or very high level of competencies at the start of their doctorate in the theories (19 %) and methods (22 %) of their subject. Theoretical knowledge was rather high in Slovenia (38 %) and the UK/Ireland

(50 %) and rather low in Austria (14 %) and Finland (9 %). Methodological knowledge was rather high in Germany (42 %) and Slovenia (38 %) and rather low in Finland (9 %) and Spain (6 %). At the time of the survey all respondents indicated an increase in competencies (high or very high level of competencies) compared to the time at the start of their doctorate with regard to theoretical (75 %) and methodological (82 %) competencies. At the time of the survey high competencies in theoretical knowledge were indicated by respondents from Belgium, Denmark, and Hungary (100 % each) and from Slovenia (88 %). Rather low competencies were indicated by respondents from Croatia (57 %) and Lithuania (25 %). A rather high level of methodological competencies was stated by respondents from Belgium, Denmark, Hungary, Italy and Slovenia (100 % each) and a rather low level was stated by respondents from Switzerland (60 %) and Lithuania (50 %).

6.3 Supervision

The role of the supervisor is evaluated rather positively by the respondents to the EURODOC survey in terms of being an expert in the field (mean of 4.1 on a scale from 1 = poor to 5 = excellent), with regard to guidance (mean of 3.7) and with regard to aid concerning training needs (mean of 3.6). Very high and high levels of satisfaction with the supervisor (above 60 percent of the respondents) can be found among doctoral candidates from Denmark, Germany, Italy, Lithuania, Norway, Slovakia, Slovenia, and Sweden. A sizeable number of respondents from Austria, Belgium, Finland, the Netherlands, UK/Ireland, and the group of other countries (above 20 percent of the respondents) did not find their supervisors very supportive.

Increasingly we find formal agreements between the doctoral candidates and their supervisors defining their respective roles, rights, and duties. A formal binding agreement is the rule especially in France, the Netherlands, Slovakia, and Switzerland. In 64 percent of these cases the role of the supervisor is defined and in 60 percent also the role of the doctoral candidate.

The number of doctoral candidates per supervisor is relatively moderate and lies between one and two candidates (50 % of the respondents) and three to four

candidates (31 %). But there are exceptions from these numbers as well. Some respondents from Denmark, Finland, Germany, the Netherlands, Portugal, Sweden, and Switzerland indicated that their supervisor had between five and nine doctoral candidates; in Switzerland and the group of other countries there were a few cases in which the supervisor had between 10 and 14 candidates; and in rare cases in Finland and the UK/Ireland there were supervisors with 20 and more doctoral candidates. Croatia, France, Lithuania, and Slovenia tend to be countries with a low number of doctoral candidates per supervisor (three to four), while Germany and Portugal tend to be countries with a high number of doctoral candidates per supervisor (ten and more).

6.4 Work – Life – Balance

As a rule, female doctoral candidates do not feel disadvantaged due to their gender (89 % stated this). There were eight percent neutral answers to this question and four percent of the respondents stated that they feel disadvantaged to a high or very high extent (these respondents were mainly located in Austria and Switzerland). Altogether 70 percent of respondents of both genders have a right to maternity or paternity leave during their doctorate. Only some respondents (7 % altogether) from the Netherlands, Portugal, Spain, and the UK/Ireland stated that they did not have such a right. There was also a sizeable group of respondents (23 %) who did not know whether they had this right or not.

46 percent of all respondents said that they are either fully or partly paid during maternity/paternity leave. However, there is also a relatively large group of respondents (42 %) who do not know this. Of the eight percent of respondents who answered this question with no, many came from Hungary, Slovakia, UK/Ireland and the group of other countries.

Furthermore, 63 percent of all respondents stated that they get an extension of their contract for the time they are on maternity/paternity leave. No extension of contract is especially the case in Austria, Belgium, Finland, France, Hungary, the Netherlands, Switzerland, and UK/Ireland.

Only a minority of women indicate that they feel pressure to postpone having children:

No pressure at all or only to a small extent	57 percent;
Neutral answers	8 percent;
Pressure to a high or very high extent:	14 percent;
Question not applicable:	20 percent.

Women who answered that they felt high or very high pressure to postpone having children were located mainly in France, Portugal, Spain, Switzerland, and UK/Ireland.

6.5 Research, Teaching, Publications

The main components of academic work in the process of getting a doctoral degree can be listed as research, teaching, and publication. In the framework of the Bologna reforms coursework has been added in most countries and typically there is also a certain amount of administrative tasks involved. Slightly less than one quarter (23 %) of the respondents to the EURODOC survey stated that they had sufficient time to write their thesis (4 and 5 on a scale ranging from 1= no time at all to 5 = very much time), while 18 percent said that they did not have enough time (1 and 2 on the scale). About one quarter (24 %) indicated a medium amount of time (3 on the five point scale) and 34 percent said that they had not yet started writing their thesis.

The questionnaire also asked respondents to produce a weekly time budget indicated the average number of hours spent on different activities. Table 11 provides an overview of the answers.

► **TABLE 11: Hours per week spent on different activities (Mean)**

	Mean
Writing my thesis/dissertation	3.3
Research related to my thesis/dissertation	33.4
Research not related to my doctorate in general	3.8
Teaching related to my thesis/dissertation	5.0
Teaching not related to my doctorate in general	2.0
Attending courses related to my thesis/dissertation	5.6
Attending courses not related to my doctorate in general	1.0
Administrative tasks not related to my doctorate in general	2.1
Other (please specify)	5.2
Question F3: Please estimate how many hours per week in average you spend on the following activities.	

► **TABLE 12: Intention to move/stay abroad after the doctorate by country (percent)**

	AT	BE	HR	DK	FI	FR	DE	HU	LT	NL	NO	PT	SK	SI	ES	SE	CH	UK/IE	Other	Total
Yes	38	40	50	0	28	49	45	100	0	38	30	31	25	50	50	27	100	83	27	39
No	31	0	33	0	28	12	10	0	0	8	23	31	25	38	6	8	0	0	27	18
I'm not sure	31	60	17	100	44	39	45	0	100	54	47	38	50	13	44	65	0	17	45	43
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Count (n)	(26)	(5)	(6)	(1)	(32)	(51)	(31)	(1)	(3)	(13)	(30)	(16)	(4)	(8)	(16)	(26)	(5)	(6)	(22)	(302)

Question G10: Do you intend to move abroad or stay abroad for work related purposes after you finish your doctorate?

The low number of hours spent per week on writing the dissertation is related to the fact that 34 percent of the respondents had not started writing yet but were engaged in research work related to their thesis. Between 50 and 25 hours per week on average (mean: 33.4 hours) are spent on research activities related to the thesis or to the doctorate in general. Altogether 68 percent of the respondents indicated that their doctoral research is experimental and 48 percent stated that it is theoretical (multiple replies were possible). Many doctoral candidates (59 %) are also involved in planning new research projects and between one quarter to one third of the respondents to the EURODOC survey stated that they were also involved in choosing collaborators for research projects, writing grant proposals, determining authorship, and organising conferences and conference panels.

Doctoral candidates who indicated that they were engaged in a high amount of activities (clearly above average) not related to their doctoral work (*i.e.* research, teaching, coursework, and administrative tasks not related to doctoral work) came from Belgium and Switzerland (research not related to doctoral work), Hungary (teaching not related to doctoral work), Belgium (course work not related to doctoral work), Germany, Portugal, and Slovakia (administration not related to doctoral work).

Doctoral candidates responding to the EURODOC survey were also asked to indicate their involvement in publications since they had started getting a doctoral degree. Altogether 17 percent of the respondents said that they had published one article in an international peer reviewed journal (an above average proportion of candidates from Belgium, Germany,

and Slovenia) and 12 percent said that they had published two articles (an above average proportion of candidates from Lithuania, Slovakia, Switzerland and the group of other countries). Furthermore, 25 percent stated that they had published one article in conference proceedings (an above average proportion of candidates from Hungary, Germany, Lithuania, Slovakia, and Switzerland) and 16 percent said that they had published two articles in conference proceedings (an above average proportion of candidates from Portugal, Slovenia, Spain, and Switzerland). Publication of articles in national journal or in international journals without peer review is very rare. The same holds true for online publications.

► **TABLE 13: Reasons for International Mobility by Country (arithmetic mean)**

	No	AT	BE
	Answer		
Better financial conditions	3,6	3,0	3,6
Better research facilities abroad	3,8	4,0	4,1
Better career prospects	4,0	4,3	4,1
Better recognition of profession	3,6	3,7	3,0
Better social security	3,5	2,9	2,4
Cooperation with prominent scientists	3,5	3,9	3,8
Better training process	3,5	3,5	3,4
Professional plans of my family members	4,8	2,8	2,9
Wanting to live/work in another culture	4,2	3,7	3,3
Other	.	.	.
Count (n)	(6)	(24)	(10)

Question G12: How important are the following motivational reasons

6.6 Mobility

Unfortunately the EURODOC survey does not provide information about the number of doctoral candidates who had been abroad during the phase of getting their degree. However, from the responses to the question how many days they had been abroad during their doctorate we can assume that approximately 13 percent of the Physics respondents had spent some time abroad during their doctorate. The purposes for going abroad are manifold. Mainly doctoral candidates participate in international conferences (especially doctoral candidates from Finland, France, and Germany), research projects abroad (often candidates from Austria, France, Norway), summer schools (candidates from Finland and France), and international workshops (candidates from France and Germany). Many doctoral candidates also spend some time abroad for data collection (especially candidates from Austria and France). Overall it seems that doctoral candidates from Finland, France and Austria are particularly mobile in the phase of getting their degree.

The main destinations of international mobility are Germany (32.4 %), USA (23.1 %), Italy (24.7 %), and France (23.1 %). Altogether 20 percent of all respondents stated that they are pursuing their doctorate abroad. This was the case especially for respondents from Germany, Norway, and Switzerland. Among those doctoral candidates who are doing their doctorate abroad (either partially or completely) 57 percent receive additional funding. The two most important sources of additional funding are scholarships (58%) and employment (47%).

6.7 Future Employment

Altogether 39 percent of the Physics respondents to the EURODOC survey stated that they intent to move abroad or stay abroad for work related purposes after receiving their doctorate; 43 percent said that they don't know yet, and only 18 percent excluded this option. Among those who intend to move or stay abroad is a high proportion of Belgian (40 %), Hungarian (50 %), French (49 %), German (45 %), Slovenian (50 %), Spanish (50 %), Swiss (100 %) and British/Irish (83 %) doctoral candidates. The following table (Table 12) provides an overview of the responses to this question which can imply a high degree of flexibility and mobility for some countries but also a high degree of brain drain for others.

The most preferred countries for work after the doctorate are the USA (17 % of the respondents) followed by Germany (15 %). France (8 %), Switzerland (9 %), UK and Sweden (6 % each) are also quite attractive.

The main reasons for the intention to stay abroad are better research facilities (mean of 4.1 on a scale from 1 = "not important at all" to 5 = "very important"), better career prospects (mean of 4.2), and opportunities for cooperation with prominent scientists (mean of 4.1). Respondents from some of the Eastern European countries also stated that better financial conditions or better social security abroad is very important. Table 13 provides an overview by country.

	HR	DK	FI	FR	DE	HU	LT	NL	NO	PT	SK	SI	ES	SE	CH	GB	Other	Total
	4,0	4,0	3,5	3,6	3,3	4,0	4,2	3,5	2,9	4,3	4,3	4,3	4,2	3,7	3,8	4,5	4,5	3,6
	4,7	3,0	3,6	3,8	3,9	5,0	4,5	3,7	4,1	4,4	4,3	4,7	4,5	4,1	4,2	4,4	4,3	4,0
	4,3	4,0	4,1	4,0	4,2	4,0	3,8	4,0	3,8	4,6	4,5	4,3	4,5	4,3	4,7	4,2	4,3	4,1
	3,6	2,0	3,3	3,9	3,4	4,0	3,7	3,3	3,5	4,7	4,5	3,9	3,8	3,5	4,7	4,0	4,1	3,6
	3,3	1,0	2,4	2,4	2,5	2,0	3,8	2,8	2,6	4,1	4,0	3,1	3,2	2,9	3,2	3,7	4,3	2,8
	4,5	4,0	4,0	4,0	3,6	5,0	4,3	4,1	4,2	4,4	4,8	4,0	4,3	4,0	4,2	4,5	4,2	4,0
	4,7	3,0	3,2	3,0	3,2	3,0	4,0	3,5	3,2	4,5	4,3	4,0	3,9	3,8	3,5	3,8	4,2	3,5
	2,8	5,0	2,9	2,8	3,1	5,0	3,0	3,3	3,2	2,8	4,0	3,6	2,7	3,2	3,4	3,7	3,5	3,1
	3,2	5,0	3,6	3,6	3,8	1,0	3,3	3,6	3,5	3,1	2,8	3,4	3,6	3,3	3,7	3,3	3,3	3,5
	.	.	4,0	2,8	1,0	.	.	4,0	4,2	.	.	.	3,0	5,0	.	.	4,0	3,5
	(10)	(1)	(33)	(67)	(57)	(1)	(6)	(34)	(44)	(14)	(4)	(7)	(26)	(35)	(6)	(7)	(20)	(412)

for your mobility? Scale from 1=Not at all to 5=To a very high extent

Respondents to the EURODOC survey were also asked what would constitute a potential barrier for staying or moving abroad during and after the doctorate. The highest score was given to family/partnership reasons (mean of 3.6 on a five point scale) and low amount of funding (mean of 3.5).

The vast majority of the respondents to the EURODOC survey (79 %) intend to work in the academic research sector after having received their doctorate. However, the public or private non-academic research sector also seems to be quite attractive (about 52 % of respondents stated that this was an alternative for them; multiple replies were possible). Table 14 provides an overview of the desired sector of future employment according to country.

In addition, respondents to the EURODOC survey were asked what kinds of advantages they expected from getting a doctoral degree. On a scale from 1 = “not at all” to 5 = “to a very high extent” respondents valued in particular the opportunity for research (mean of 4.4 on a 5 point scale), challenging work tasks (mean of 4.2), the opportunity to pursue their own ideas (mean of 4.1) and a high degree of independence in their work (mean of 3.8). Compared to these characteristics addressing the quality of work, social security (mean of 2.7), a high income (mean of 2.8), and social recognition (mean of 2.7) played a much lesser role.

► **TABLE 14: Wanted Sector of Employment by Country (percent; multiple responses)**

	AT	BE	HR	DK	FI	FR	DE	HU	IT	LT	NL	NO
Academic research sector (University)	83	60	86	100	82	74	59	100	100	75	87	84
Public non-academic research sector	66	40	71	0	55	57	50	0	0	50	67	59
Private non-academic research sector	55	80	43	100	73	44	66	0	0	50	73	72
Public non-research sector	21	0	0	0	27	7	16	0	0	0	27	6
Private non-research sector	28	0	29	0	33	13	22	0	0	0	33	13
Non Governmental Organisation (NGO)	17	0	0	0	21	11	13	0	0	0	33	16
Military	0	0	0	0	12	3	3	0	0	0	0	3
Other	3	0	0	0	3	3	0	0	0	0	0	3
Total	272	180	229	200	306	213	228	100	100	175	320	256
Count (n)	(29)	(5)	(7)	(1)	(33)	(61)	(32)	(1)	(1)	(4)	(15)	(32)

Question B7: In which sector would you want to work after finishing your doctorate? ((Multiple responses possible))

7. Comparison and Conclusions

A comparison shows that there are four broad topics which were covered by both surveys:

- status of doctoral candidates and funding;
- structure and quality of doctoral education;
- internationalisation of doctoral education;
- labour market opportunities and employability.

In the following sections results from both surveys will be compared in more detail for these themes. The chapter will end with conclusions.

7.1 Status of Doctoral Candidates and Funding

Keeping in mind that the reforms of doctoral education and training in Europe are not fully implemented yet everywhere, it is not surprising that the status of doctoral candidates shows variations. About one third each of the respondents to the EPS-INCHER survey stated that their doctoral candidates were students (34 %), early stage researchers (32 %) or even both (34 %) and being both is somewhat of a hybrid status. In contrast to the answers from the supervisors, 72 percent of doctoral candidates responding to the EURODOC survey stated that they had a student status while 28 percent said they did not. Answers from the latter group remain, however, inconclusive as there was no answer category for being both, early stage researcher and student.

Concerning the sources of funding we encounter frequently a mix of sources. Supervisors estimated that about 43 percent of their doctoral candidates had an

employment contract, roughly 45 percent had a non-repayable scholarship, 3 percent a repayable grant or loan, and about 9 percent were self-funding. Among the doctoral candidates 80 percent said that they had an employment contract and 26 percent said they had a scholarship. Average duration of funding was indicated by the doctoral candidates be between three (37 %) and four (25 %) years. In many cases (63 %) an extension of the contract is possible in case of maternity or paternity leave, often (45 %) linked to full or partial payment of the salary. Furthermore, 56 percent of the doctoral candidates indicated that they had received or can receive additional funding for doing a doctorate abroad or for temporary mobility periods. Overall, 60 percent of the doctoral candidates were satisfied with their level of funding insofar as it was meeting their living costs. Despite somewhat differing responses from the supervisors we can assume that the majority of doctoral candidates has some kind of employment contract, often as an employee of the university, but is also a student when it comes to the taught and formalised parts of doctoral education and training.

7.2 Structure and Quality of Doctoral Education

Altogether 47 percent of the supervisors (EPS-INCHER survey) stated that doctoral education in Physics is integrated into a formal school or programme. Still 40 percent said, however, that individual supervision continues. This is of course not mutually exclusive. In most cases doctoral candidates continue to have one (sometimes two) supervisor who is responsible for counselling and

	PT	SK	SI	ES	SE	CH	UK/IE	Other	Total
	65	100	63	78	97	100	100	85	79
	29	60	100	33	34	67	83	27	52
	35	20	50	39	69	33	50	46	56
	12	0	25	17	14	0	33	8	13
	12	40	25	6	14	17	33	23	19
	12	0	13	6	21	0	17	4	13
	0	0	38	0	14	17	17	4	5
	0	0	0	11	0	0	0	0	2
	165	220	313	189	262	233	333	196	240
	(17)	(5)	(8)	(18)	(29)	(6)	(6)	(26)	(336)

guidance. In addition, they frequently do coursework which is then offered in the framework of a programme or school. Three quarters of the EPS-INCHER survey respondents said that doctoral education involves coursework which is confirmed by 78 percent of the respondents to the EURODOC survey. Thus, we can safely assume that about 75 percent or more of doctoral candidates in Physics receive some kind of formal training beyond supervision. Formal agreements defining the role of the supervisor and/or doctoral candidates also seem to have increased to a considerable extent. The existence of such agreements was indicated by 48 percent of the supervisors and by 63 percent (agreement defining role of supervisor) respectively 59 percent (agreement defining role of doctoral candidate) of the respondents to the EURODOC survey. These figures show a trend towards an increasing amount of formalisation in doctoral education and training.

Concerning the quality of supervision we have figures on the average number of doctoral candidates per supervisor. The majority of supervisors said that the number of doctoral candidates a single supervisor can have is smaller than six, while 80 percent of doctoral candidates indicated that it is smaller than five. Concerning the satisfaction of doctoral candidates with their supervisors we find a mean of 3.8 on a scale from 1 (poor) to 5 (excellent).

Supervisors and doctoral candidates differ considerably in their assessment how much of the weekly time budget is spent for doctoral candidates' own research and how much on other activities. While supervisors estimated that doctoral candidates spend slightly more than seven hours per week on average on other activities, doctoral candidates stated that they spend a mean of 18.2 to 22 hours per week on their own research and that other research activities required a mean of 6.9 hours per week, teaching activities a mean of three to five hours per week, and administrative tasks a mean of 2.5 to 3.7 hours per week. This indicates that doctoral candidates estimate that they spend on average 14 hours per week on activities which are not deemed to be their own research, while supervisors indicated that these other activities only required 7.1 hours of the weekly time budget. In order to be able to properly explain this difference it would be necessary to know in more detail the proportion of doctoral candidates being employed as research and/or teaching assistants.

7.3 Internationalisation of Doctoral Education

The most prominent features of internationalisation in doctoral education and training can be described as (a) mobility, (b) coursework in foreign languages (mostly English); (c) supervisors from abroad; and (d) international doctoral candidates and doctoral candidates pursuing their doctorate abroad.

Supervisors (*i.e.* respondents to the EPS-INCHER survey) estimated that slightly more than five percent (5.3 %) of their doctoral candidates are temporarily mobile during their doctorate, mainly carrying out research work for their thesis in a university abroad. The EURODOC survey went into more detail regarding the issue of temporary mobility and also included summer schools, participation in international workshops and conferences, *etc.* Unfortunately the EURODOC survey only asked how many days doctoral candidates had spent abroad rather than whether they had been temporarily mobile or not. However, our own calculations allow an estimate of about 13 percent of the respondents to the EURODOC survey who had spent some time abroad during their phase of doctoral training. We can add to this the responses to questions regarding the presence of international doctoral candidates (EPS-INCHER survey) and spending the whole doctorate abroad (EURODOC survey). The figures do not differ very much. The supervisors indicated that they had about 22 percent international doctoral candidates and 20 percent of the respondents to the EURODOC survey stated that they spent their doctorate abroad. Compared to European averages in Bachelor and especially Master study Programmes (about 10 to 12 percent international students) and to existing knowledge about the lack of mobility in the doctoral phase this tends to be a relatively high proportion.

Somewhat more than half of the supervisors (55 %) from 82 percent of those universities in which submission of thesis in a foreign language is possible stated that doctoral theses have been submitted in a foreign language and 33 percent of the supervisors indicated that oral examinations or thesis defences are carried out in a foreign language. Furthermore 80 percent of the supervisors (in 90 percent of the universities in which this is possible) indicated that

there are also supervisors from other countries included in guiding and counselling during the phase of the doctorate. This confirms a relatively high degree of internationalisation in Physics doctoral education and training.

7.4 Labour Market Opportunities and Employability

Altogether 44 percent of the respondents to the EPS-INCHER survey coming from 90 percent of the universities in which this is possible stated that they also include supervisors from industry. In contrast to this, there were only 2.4 percent of the overall number of respondents who said that at least some of their doctoral candidates carry out their research work in a private sector company. This means, that in many universities doctoral candidates can carry out their research in industry and even might have a second supervisor from the company in which they carry out their research but in reality this possibility rarely reflects actual practice. Looking at the coursework, 82 percent of the supervisors from universities which offer coursework for doctoral candidates indicated that the coursework includes the provision of general skills to help ease the transition to the labour market. Altogether 43 percent of the supervisors said however, that there were no activities to ease transition of doctoral candidates into the labour market in their department or faculty. Mostly, coursework of such kind seems to be optional (44 %) rather than obligatory (38 %). This is confirmed by the respondents to the EURODOC survey who said that general skills are offered more on a voluntary basis. Therefore, it is not very surprising that the satisfaction of doctoral candidates with the quality of the general skills provision is lower than with the provision of subject related theories and methodologies.

In terms of labour market opportunities and employability the responses seem to be rather heterogeneous, and even contradictory within the group of supervisors. Overall, general skills training tends to be somewhat neglected and considered less important than additional training in subject related methods and theories.

7.5 Conclusion: European Trends in Doctoral Education in Physics

Going back to the as yet relatively unspecified ideas for reforming doctoral education in Europe which were documented in the Bergen Communiqué of ministers in 2005 (cf. chapter 3 of this report) we can see six elements reflected in our surveys:

- duration of doctoral education and training (3 to 4 years full-time);
- integration of doctoral education into programmes;
- increase in numbers;
- third cycle of studies;
- supervision and assessment;
- interdisciplinary training and transferable skills.

No statements can be made concerning the adaptation of doctoral education and training to the European Qualifications Framework (EQF).

Overall the analysis of the surveys shows a picture of ongoing reforms. Many aspects of doctoral education and training are in the process of being changed. In this concluding section we will try to outline the main trends in European doctoral education in Physics.

Around 60 percent of the respondents to both surveys state that the average duration of doctoral education is **between three and four years**. This is more closely monitored than before. The other 40 percent of the respondents indicate a longer duration for getting a doctoral degree.

The integration of doctoral education into **programmes or schools** in order to structure the process has progressed considerably. Only 13 percent of doctoral candidates have individual supervision only. The other **87 percent** have one (or more) supervisors and also do coursework within a doctoral programme or graduate school. This indicates an increasing process of formalisation of doctoral education and training in which coursework is monitored and assessed and formal agreements exist to regulate rights and duties of supervisors and doctoral candidates. The growing formalisation seems to be a widely accepted trend.

Despite the call to **increase the numbers** of doctoral degree holders, access to doctoral education has become more selective. A wider range of criteria is applied in the process of acceptance and admission accompanied

by decisions of committees or board. From general statistics about doctoral degree output we know that numbers have increased in the last ten to 15 years in most European countries. Two factors resulting from our surveys can explain this increase: (a) a higher number of international doctoral candidates (in Physics about one quarter of all doctoral candidates); (b) through monitoring duration it is possible to get more candidates through the system and also reduce drop-out.

The Bologna reform goal of having doctoral education as a **third cycle** (of studies) is to some extent distorted into a **hybrid status** in those countries in which doctoral candidates have traditionally been regarded as early stage researchers or junior academic staff. Supervisor responses indicated that about one third of doctoral candidates have a student status, one third have a status a junior academics and another third see them as students and junior academic at the same time. The responses from the doctoral candidates themselves are similar. Although 66 percent indicated that they are employed by their university (*i.e.* as junior academics), 72 percent said that they had a student status. This can be explained by the fact that many doctoral candidates have an employment contract while being enrolled as students in a programme or graduate school at the same time. About half of the doctoral candidates have to pay tuition fees at least for the coursework they are doing in the framework of doctoral programmes or graduate schools.

Supervision and assessment are elements of the process of getting a doctoral degree. We can observe here as well an increasing **trend towards formalisation and regulation**. The right to supervise doctoral candidates and to accept as many candidates as an individual professor sees fit or wants is no longer an option in quite a number of countries. Frequently the number of doctoral candidates per supervisor is restricted and in several countries additional training in supervision is required before being allowed to supervise doctoral candidates. There is also a trend towards assigning more than one supervisor to a doctoral candidate. This may also be an external supervisor, *i.e.* person from industry or a professor from a university in another country. Doctoral candidates indicate a **relatively high degree of satisfaction with their supervision** (between 3.6 and 4.1 on a 5-point scale).

As the integration of doctoral education into programmes or schools is mostly linked to **additional coursework** we took a closer look at this element. Coursework is often offered in a foreign language and thus a further element of internationalisation. Altogether 75 percent of doctoral candidates in Physics are doing coursework which mostly had credit points attached to it (74 %). Coursework is assessed and participation monitored. Successful completion of the coursework is required for the final degree but mostly not weighted as part of the final grade. Thus, the thesis remains the most important part of getting a doctoral degree.

Coursework can be divided into two categories: (a) courses to provide **subject knowledge** (mostly theories and methodologies of the subject) and (b) courses to provide general and **transferable skills**. The latter are mostly not obligatory and 16 percent of the respondents to the EURODOC survey stated that they receive no training at all in form of coursework. This is to some extent reflected in the responses concerning support for the transition into the labour market which seems to consist mostly of the use of career services or the organisation of alumni lectures.

However, most doctoral candidates are also involved in activities not related to their research and thesis topic. About half of the weekly working hours are spent on a variety of other activities (*e.g.* preparing conferences and research proposals, teaching, administrative work *etc.*). Looking at **first destinations** after the award of the PhD supervisors stated that more than half of their doctoral degree holders aim for a postdoc position at a university, about a third go into industry, and approximately one fifth aim for teaching jobs. The doctoral candidates themselves anticipated somewhat different destinations. Almost 40 percent stated that they want to stay abroad or move abroad after getting their doctoral degree. Almost 80 percent want to stay in the academic research sector at universities but more than half (52 %) find the non-university research sector attractive as well.

As a **final conclusion** it can be stated that the overall picture is still rather heterogeneous, however, there are clear trends towards a higher degree of formalisation and regulation in doctoral education and training as well as supervision. Doctoral education in Physics seems to be rather international. Obviously more can be done still concerning employability and support for the transition into the non-academic labour market.

8. Literature

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► APPENDIX I: COUNTRY SPECIFICITIES

1. Regulation of the duration of doctoral studies

Country	Regulative Level	Minimum Duration	Maximum Duration
Austria	National legislation	3 years	Not regulated
Belgium (fr)	Not regulated	Not regulated	Not regulated
Belgium (nl)	Not regulated	Not regulated	Not regulated
Czech Republic	University	4 years	8 years
Estonia	University	Not regulated	4 years (nominal period)
Finland	Not regulated	Not regulated	Not regulated
France	National legislation	3 years	Not regulated
Germany	Not regulated	Not regulated	Not regulated but possibly limited by availability of funding (typically 3-4 years)
Hungary	National legislation		3 years for coursework (student status) plus 2 years for thesis research (candidate status)
Ireland	University	3 years	8 years (funding for up to 4 years)
Lithuania	National legislation	Not regulated	4 years full-time, up to 6 years part-time
Malta	University	Not regulated	3 years full-time, up to 6 years part-time, up to 2 years extension possible for both
The Netherlands	Not regulated	Not regulated but typically not less than 3 years.	Not regulated but usually limited by the availability of funding (typically 4 years).
Portugal	National legislation	3 years (grant: 1 year)	5 years (grant: 4 years)
Romania	National legislation	2 years	5 years
Serbia	No information	Coursework: 3 years	No information
Slovakia	National legislation	3 years	4 years (4 years as a rule in Physics)
Slovenia	National legislation	3 years	3 years
Spain	National legislation	Not regulated	3+1+1 years. Typical duration of 3 years can be extended twice by 1 year upon application.
Sweden	National legislation	Not regulated	4 years (or up to 5 years if doctoral candidate has been teaching) with funding
Turkey	University	3 years	5 years
UK	University	2 years	4 years with funding
Ukraine	National legislation	Not regulated	3 years

2. Qualification requirements for acceptance as doctoral candidate

Country	Degree and Other Requirements	Other Options/Non-university degrees
Austria	University Master degree or equivalent foreign degree in the relevant field	Non-university Master degree but additional coursework
Belgium (fr)	Research oriented university Master degree (300 ECTS, incl. first cycle studies) or equivalent foreign degree in the relevant field	Other Master degree (university or non-university) but additional coursework may be required / is mandatory if degree accounts for less than 300 ECTS
Belgium (nl)	University Master degree or equivalent foreign degree in the relevant field	Non-university Master degree but additional coursework required
Czech Republic	University Master degree, or equivalent degree from technical university, or equivalent foreign degree.	None.
Estonia	University Master degree or equivalent (incl. traditional 5 year degree and recognised foreign degrees; agreement letter from prospective supervisor	None.
Finland	University Master degree or equivalent foreign degree; minimum grade of "good"	Faculty decision concerning existence of sufficient knowledge and skills
France	University Master degree or equivalent foreign degree.	Validation of professional experience or other degrees (e.g. from higher schools in engineering, business, or management) as equivalent to Master degree
Germany	University Master degree or equivalent traditional degree ("Diplom") or equivalent foreign degree	"Fast track" option for excellent Bachelor graduates offered in some universities; non-university Master degree plus additional coursework (plus, in some cases, an assessment of candidate's skills/knowledge)
Hungary	University Master degree or equivalent traditional degree plus passing an oral examination for acceptance as doctoral student; Absolutorium from doctoral school for acceptance as doctoral candidate.	Doctoral school (coursework) can be skipped. Acceptance as candidate then requires 2 to 3 articles in peer reviewed journals plus 2 language examinations.
Ireland	Upper 2nd class honours grade (Bachelor) or equivalent in a relevant field	Case-by-case consideration based on prior learning, experience and other factors; enrolment in a Master programme and shift to PhD track after one year based on merit and suitable research project
Lithuania	Master degree in Physics or equivalent university degree	None.
Malta	University master degree in a relevant field	1 st or upper 2 nd class honours grade (Bachelor) under certain conditions; the university senate may accept other qualifications
The Netherlands	University Master degree or equivalent foreign degree in the relevant field.	Master degree from a university of applied sciences (<i>hogeschole</i>)
Portugal	Master degree in Physics with a GPA of higher than 16 out of 20; or 14 to 15 if accepted by the Scientific Committee of the Physics Department.	Decision of the Scientific Committee of the Physics Department regarding the existence of sufficient knowledge and skills.
Romania	Master degree or equivalent 5 years of studies representing 300 ECTS	Acceptance of candidates with non-university degrees not possible

3. Possibilities to combine funding sources

Serbia	Master degree or equivalent traditional degree; GPA of 8.5 min. out of 10 within regular duration of programme	None.
Slovakia	Master degree or equivalent from Technical University	None.
Slovenia	University Master degree or equivalent traditional degree	None.
Spain	Master degree or equivalent from another country.	None.
Sweden	University Master degree or national degree corresponding to 4 years of undergraduate studies	None.
Turkey	University Master degree	Passing of a national examination (academic postgraduate education exam) with a minimum of 60 out of 100 plus foreign language skills
UK	Master degree, in some cases good Bachelor degree	Relevant work experience
Ukraine	University Master degree or equivalent traditional degree	None.

4. Requirements for doctoral supervision

Country	Employment contract	Scholarship	Repayable Grant/Loan
Austria		Can be supplemented by paid teaching duties but without regular contract.	
Belgium (fr)	Employment contract excludes grant or scholarship		
Belgium (nl)	Employment contract excludes grant or scholarship		
Czech Republic	Part-time jobs can be combined with scholarships.	As a rule, doctoral candidates are supported by scholarships.	
Estonia	Combination of funding sources is possible.		
Finland			Full-time grants require giving up salaried positions.
France	Employment contract excludes grants or scholarships.		
Germany		Can be supplemented by paid teaching duties but without regular contract.	
Hungary	Doctoral candidates typically have an employment contract.	Scholarships are offered for the 3 years of being a doctoral student.	
Ireland	Broad variety of combinations of funding sources is possible.	Can be supplemented by paid teaching duties.	
Lithuania		State scholarships can be supplemented by part-time contracts	

The Netherlands	Most doctoral candidates have a 4-year employment contract with a university or a funding agency. No combination with scholarship possible.	Some foreign candidates have a scholarship from a non-Dutch agency.	Not (or almost never) occurring.
Portugal		Grants from different donors can be combined (e.g. company plus National Science and Technology Foundation).	Loans are available from State Bank with State guarantee.
Romania	Combination of funding sources neither typical nor encouraged		
Serbia		Candidates with scholarships are not engaged in faculty activities	Candidates with grants/loans are not engaged in faculty activities.
Slovakia	No combination of funding sources possible		
Slovenia	No combination of funding sources possible.		
Spain	Employment contract excludes scholarship and grant.		
Sweden	There are only PhD positions with salaries.		
Turkey	Combination of funding sources is possible.		
UK	Almost any combination of funding sources is possible.		
Ukraine	Contract can be combined with scholarship and/or grant/loan		

5. Elements of doctoral degree award

Country	Individual Supervision	Joint Supervision	Additional Elements
Austria	Professorship or habilitation		
Belgium (fr)	Professor or director of research with a position in a university or public research institution	It is possible to have a second supervisor	
Belgium (nl)	Professor or director of research with a position in a university or public research institution	It is possible to have a second supervisor	
Czech Republic	Professorship or habilitation		The doctoral candidate has one or two consultants.
Estonia	Being a professor or having a PhD degree		At least one supervisor has to be from the home university.
Finland		2 supervisors with at least a doctorate and a research director who is professor in the field	Written supervision agreement
France	Professor or director of research with a position in a university or public research institution		In special cases a PhD holder from outside the university can be chosen as supervisor due to specific expertise.

Germany	Professorship or habilitation; leaders of Emmy Noether research groups		
Hungary	PhD degree and good scientific record		Doctoral Committee decides who is allowed to supervise
Ireland	Principal supervisor must be permanent member of academic staff.	Two supervisors for those doctoral students doing their research work outside the university (one from the university, one from the research institute).	Doctoral committee decides who is allowed to supervise.
Lithuania	Supervisor for permanent contact		Doctoral studies committee for annual monitoring of progress
Malta	Senate appoints principal supervisor from among the members of the academic staff	Appointment of co-supervisor possible	Neither principal supervisor nor co-supervisor may have a family relationship with the candidate
The Netherlands	Full professorship	Sometimes. Assistant or associate professors (who can not grant the degree) can be responsible for daily supervision.	
Portugal	Professor or director of research with a position in a university or a public research institution.	Principal supervisor with a co-supervisor who must be a professor in the field from another university or director of research in a public research institution or company.	
Romania	Habilitation		
Serbia			2 papers published in SCI listed journals within the last 5 years.
Slovakia	Habilitation (not necessarily professorship)		
Slovenia	Assistant professor or higher or equivalent research title		Published and cited scientific papers in international journals in the field of the dissertation topic.
Spain	Doctoral degree plus additional requirements established individually in each university.	Joint supervision possible with up to three supervisors.	
Sweden	National academic degree, docent status (equivalent of habilitation)	Appointment of co-supervisor mandatory	Pedagogic merits
Turkey	Assistant professor or higher, member of the academic staff		
UK	Principal supervisor must be a member of the academic staff	It is common to have joint supervision or a second supervisor.	
Ukraine	Supervisor must have a doctoral degree		

6. Tuition fees

Country	Pass/Fail	With distinction/honours	Grades
Austria	As a rule	Possible	Diploma Supplement includes grades for thesis, coursework, and final examination (incl. defence)
Belgium (fr)	As a rule		
Belgium (nl)	As a rule		
Czech Republic	As a rule.	Possible for upper ten percent.	In some universities Latin grading system still in use.
Estonia	As a rule		
Finland	As a rule	Possible for upper ten percent	In some universities Latin grading system is used.
France		With some exceptions no longer awarded.	Grades are given
Germany			Grades (mostly in Latin) are given
Hungary			Latin grades are given calculated from the average of the grades obtained in oral examination and thesis defence.
Ireland	As a rule		
Lithuania	As a rule		
The Netherlands	Usually a pass (thesis is not admitted for defence if a 'fail' is expected)	Distinction 'cum laude' can be granted (applies to less than 5 percent)	
Portugal	As a rule	Possible	Grades are given (mostly in Latin).
Romania	As a rule		
Serbia	As a rule		
Slovakia	As a rule		
Slovenia	As a rule plus grades		From 1 to 10 with 6 being the pass grade
Spain	As a rule	With distinction can be granted	Grades are given.
Sweden	As a rule		
Turkey	As a rule		
UK	As a rule	Weak candidates may be required to go through a second oral examination	
Ukraine	As a rule		

7. Involvements of Boards or Committees and their role

Country	No Fees	Fees	Special Regulations
Austria	No fees		Fees if duration is longer than 4 years; fees for non-EU citizens possible
Belgium (fr)		First year: 835 €;	
Subsequent years: 32 €	Possibilities for reduced fees based on applicant's financial situation		
Belgium (nl)		Fee in academic year of start and in academic year of defence: each 270 €	
Czech Republic	No fees		
Estonia	No fees		
Finland	No fees		
France		360 € per year	
Germany (*)	No fees in federal states without tuition fees for students.	Fees possible in federal states with tuition fees for students.	Doctoral candidates mostly exempted from fees; where they have to pay it's for 3 years maximum (tuition fee level for students)
Hungary	No fees for scholarship holders in the doctoral schools.	Fees of the doctoral school for external candidates are paid by their home research institution	All doctoral candidates pay a special fee for processing the degree application (exams and defence).
Ireland		Fees are set individually by each university and differ between home/EU candidates (5,000 € av.) and international candidates (10,000 € av.)	
Lithuania	No fees for holders of government scholarships	Candidates without scholarships pay 3,300 € per year.	
Malta		Annual enrolment and tuition fees	
The Netherlands	No fees.		
Portugal		2,750 € per year	Fees are included in the grant from the National Science and Technical Foundation.
Romania	No fees		
Serbia	No fees for government grant holders	1,500 € per year	
Slovakia	No fees for home/EU candidates.	Fees for international candidates.	
Slovenia		2,700 € per year	
Spain		Level of tuition fees is established by each university.	
Sweden	No fees		
Turkey		On average around 600 € per year	
UK		Fees are set individually by each university and differ between home/EU candidates (3,900 to 4,200 €) and international candidates (13,500 to 22,500 €)	
Ukraine	No fees		

▶ APPENDIX II: EPS-INCHER

Country	Name of Body	Composition and Number of Members	Role / Decisions
Austria	(a) Committee (b) Committee of examiners	(a) 9 members (representatives of professors, staff, students) (b) 3 members (incl. supervisor)	(a) Curriculum, general regulations (approval of senate required); (b) Assessment of thesis and defence
Belgium (fr)	(a) Review Committee (b) Examination Committee	(a) Minimum 3 members (incl. supervisor(s)), at least 1 external, PhD or equivalent qualification (b) Minimum 5 members; at least 1 external; presided by dean or his/her representative	(a) Support and judgment of research (b) Assessment of thesis and defence
Belgium (nl)	(a) Guiding Committee (b) Examination Committee	(a) Minimum 3 members (incl. supervisor(s)), 1 external (b) Minimum 5 members; at least 3 from home university, at least 1 external	(a) Support and judgment of research (b) Assessment of thesis and defence
Czech Republic	Committee	Minimum of 5 members, two of whom from another university.	Award of doctoral degree
Estonia	Committee of thesis defence	At least 5 members with PhD degree or equivalent (no supervisor allowed) of which at least 2 have to come from outside the university and 1 from a non-Estonian university	Presiding oral defence.
Finland		2 external reviewers, 2 external opponents at defence	
France		Between 3 and 8	
Germany	(a) Committee (b) Examination committee	(a) Usually 4 to 5 (Dean, Vice-Dean, some professors) (b) Usually 4 (among them the supervisors/reviewers of the thesis)	(a) Admission for defence, supervision of proper procedure (b) Presiding oral defence
Hungary	(a) Board of doctoral school (b) Doctoral committee	(a) Professors involved in doctoral school (b) Internal and external professors	(a) Acceptance of applicants into doctoral school (b) Composition of examination board and jury for oral exam; granting of the degree
Ireland	(a) Examination committee (b) University Board/Committee	(a) 3 (one internal, one external examiner, one chairperson; no supervisor allowed) (b) Composition varies in each university	(a) Presiding oral defence (b) Approving nomination of external examiner; making formal decision on outcome
Lithuania	Committee	5	
Malta	(a) PhD Sub-Committee (b) Board of Examiners	(a) 5 members (rector, 3 senate members, registrar, dean/director) (b) 3 members (chairperson, external examiner, one other person; no supervisors allowed)	(a) Acceptance of applications for PhD registration (b) Assessment of thesis

The Netherlands	Promotion Committee	Varies by candidates but typically 10 members (Dean, promoter, assistant promoter, at least 4 professors, 2 of whom from another university, preferably from abroad)	Assessment of thesis; decision about admission to defence; granting the degree.
Portugal	(a) Science Committee of the Physics Department (b) Science Committee of the Faculty of Sciences (and Technology)	(a) 4 members (professors) (b) 4 members (professors)	(a) Assessment of thesis and defence (b) General regulations (approval of Senate required)
Romania		5 members minimum (among them 3 from other institutions)	
Serbia		3 members minimum	
Slovakia	Board	5 members minimum (supervisor, colleagues from same department, colleagues from other universities)	Award of doctoral degree
Slovenia		3 to 5 members	
Spain	Academic Committee	Depends on the university.	Depends on the university.
Sweden	Examination Committee	3 to 5 members	
Turkey		3 members	
UK	(a) Examiners (b) Board/Committee	(a) At least 2 (one external, one internal, no supervisor allowed) (b) Composition is a matter of the university	(a) Presiding oral defence; making recommendation on outcome to Board/Committee (b) Formal decision on outcome
Ukraine	Board	Around 20 members or more	Admission to defence; supervision of proper procedure; presiding oral defence.

(*) Germany: In September 2007 the German Physical Society (Deutsche Physikalische Gesellschaft, DPG) presented a study on the doctorate in Physics at German universities. This study will be briefly summarised here despite the fact that the DPG opted out of participating in the analysis of Bologna reform implementation into doctoral studies presented in this report. It should also be noted that the author of this report does not share the view of the DGP. The DGP study recognizes that a broad spectrum of suitably different forms of the doctorate has developed in line with the specific characteristics and requirements of professional practice in the different fields of Physics. A reform aimed at improving the process of getting the degree and increasing its efficiency in relation to achieving the objectives associated with the doctorate in the respective subjects must, however, take into consideration the specificities of these individual subjects. Doctoral candidates possess a full professional qualification and in their doctoral work they are basically pursuing a professional activity. The doctoral candidate is given the task of working on a challenging modern topic at the cutting edge of research, entering new territory, having

sole responsibility under the real conditions of her or his own subject. The pioneering results required for a doctoral degree can only be achieved by focusing intensely on the particular field of work. The DGP disapproves of the notion that the doctorate is a "Third Cycle" of higher education because this view puts too much emphasis on the aspect of the student's ongoing learning process along the lines of a school model. Therefore, models of "structured doctoral programmes" have to be rejected if the time "structures" and additional subject "structures" that they introduce result in the doctorate being made too school-like. The study rates the introduction of graduate schools and graduate colleges as positive provided that they help to increase the efficiency in achieving the scientific aims of the doctorate. Collective responsibility in supervision is rejected because it can not ensure a faultless process. However, alternative ways to the doctorate besides graduate schools must still be maintained in the future, e.g. by pursuing a doctoral degree through dissertations on autonomous topics not covered by a graduate school or writing a thesis at extra-university research institutes or in industry (under academic supervision). The fundamental

admission requirement for the doctorate must be a Master's degree. Only exceptionally talented applicants without a Master's or *Diplom* degree may be admitted to doctoral research after passing a procedure to ascertain their suitability. In general, lectures and courses are to be kept to a minimum in the doctoral phase to enable the candidate to dedicate herself or himself to the extremely tough requirements of the actual research topic. The DPG study acknowledges the usefulness of taking lectures from a field outside Physics for candidates with a Master's degree in Physics. The study also adopts a critical view of stays abroad during the doctoral period unless the primary purpose is to advance the candidate's research.

An English summary of the DPG study can be downloaded from:

www.dpg-physik.de/veroeffentlichung/broschueren/promotionsstudieeng2011.pdf

The complete text of the DPG study in German can be downloaded from:

www.dpg-physik.de/static/info/promotion2007.pdf

▶ QUESTIONNAIRE FOR SUPERVISORS

Questionnaire "The Implementation of the Bologna Reforms into Physics Studies in Europe".

Dear Madam or Sir,

On behalf of the European Physical Society the International Centre for Higher Education Research at Kassel University (Germany) is carrying out an analysis of the implementation of the three cycle structure into Physics Studies in European universities. After an analysis of Bachelor programmes in 2008/09 and of Master programmes in 2009/10 (reports are available from the European Physical Society: s.loskill@eps.org) we are now looking into reforms of doctoral education and training. Approximately 25 European countries and 260 universities are involved as partners in this project.

In the year 2010/2011 we are carrying out the third phase of the project, namely the analysis of the doctoral phase. We are well aware that there is no unified view about this phase, *e.g.* whether it should be the "third cycle (of studies)" or whether young people in the process of getting their doctoral degree should be regarded as "students". We would like to ask you kindly for your cooperation again and want to emphasize that we have tried to formulate our questions as neutral as possible. Nevertheless, we would like to offer clarification of some terms that might be associated with different meanings in different countries.

Doctoral candidate: This term is chosen throughout the questionnaire as the most neutral designation we could come up with in order to avoid any discussion or queries about the status (student or not).

Course work: In the majority of European countries the traditional way was to select doctoral candidates after the Master degree (or equivalent). By that time no further coursework was required. In the framework of the ongoing reforms the phase of getting a doctoral degree is increasingly "structured", *i.e.* integrated into programmes, centres, or schools with some coursework attached (*i.e.* the doctoral candidates have to attend seminars or lectures and possibly fulfil homework tasks). This is also becoming important in those cases in which the "taught" part of graduate education does not distinguish between

Master degree students and doctoral candidates (*i.e.* the American model of graduate education). The coursework has varying degrees of importance and sometimes credit points are attached. If this is not the case in a given country we normally have the option to tick "no".

Doctoral study/studies: We have chosen this term to cover the phase of course work plus doing the research for the thesis and/or doing the research for the thesis in the framework of a project because we believe that doing research is also a form of studying.

Doctoral (Examination) Committee/Board: There are countries or institutional cases in which there is an official body called Doctoral (Examination) Committee or Doctoral (Examination) Board that has responsibilities in the approval of the thesis project and/or other responsibilities in the guidance and with regard to the examination of the doctoral candidate. An Examination Board/Committee, for example, exists apart from or in addition to the supervisor(s) and possibly even the examiners in the oral defence. The Examination Committee/Board is typically composed of members of the university (elected or appointed) and might have varying tasks (even the task of examining the candidates) but normally is responsible for keeping track that the process of submitting and grading the thesis and organising the defence is carried out correctly and that all conditions are fulfilled according to the rules.

Doctoral programme: What we mean by doctoral programme is an organised or structured period of study and research in the framework of which coursework is offered, supervision takes place, progress is monitored, and thesis research is carried out.

Graduate school: A graduate school can be faculty/department based or university based. It is typically responsible for organising the coursework, assign supervisors, monitoring progress, deal with complaints,

and take care of administrative issues. It can have more or less tasks and responsibilities and terminology might vary by country or even institution (*e.g.* doctoral school, graduate centre, *etc.*).

Supervisor: The supervisor is the person who provides advice where needed, monitors progress and generally helps the candidate along the way. Each doctoral candidate typically has at least one (often more than one) supervisor. In some countries the supervisor is also the main examiner in the oral defence, in other countries the supervisor can not be the examiner. In some countries there are also regulations what types of specific qualifications and/or what position (*e.g.* professor) a person needs to have in order to supervise doctoral candidates. Supervisors are frequently associated to a doctoral programme or a graduate school but this is not the case in all countries.

We would be grateful if you could fill in the questionnaire electronically till **Friday, 15 October 2010**. We assure confidentiality of the data and information you are providing. No university will be identified by name and the report will present only aggregate data. This third report will be available in summer 2011 from the European Physical Society. The electronic questionnaire is available through the following link: <http://hrz-vm146.hrz.uni-kassel.de/qtafi/projects/physics/>

Our contact person in the National Physical Society has been asked to forward this letter to you together with a PIN in order to access the link to the questionnaire.

Should you have problems in filling in the questionnaire please contact:

Bettina Alesi

International Centre for Higher Education Research
Kassel (INCHER-Kassel)
alesi@incher.uni-kassel.de

Thank you for your cooperation.

Prof. Barbara M. Kehm

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Part I: General Questions

1. Personal Details

1.1 What is your status in the Department/Faculty?

- Dean/Director/Head of Studies
- Professor/lecturer/reader
- Junior teacher/researcher
- Member of administrative staff
- Other, please indicate:

1.2 What is your function in relation to the Physics Programme(s)? (Multiple replies possible)

- Programme coordinator
- Teacher (professor/lecturer/reader)
- Administrative staff
- Other, please indicate:

2. Institutional Details

2.1 Please provide the name of the country in which your institution is located:

.....

2.2 How old is your institution counting from date of establishment?

..... years.

2.3 Please indicate the type of your institution:

- University
- Technical University
- Other, please indicate:

2.4 In what subject groups does your institution provide study/degree programmes? (Multiple replies possible)

- Natural Sciences
- Engineering
- Humanities
- Social Sciences
- Arts (incl. Design and Architecture)
- Medicine
- Law
- Agriculture
- Other, please indicate:

2.5 Please indicate the size of your institution in terms of numbers of students (without doctoral students/doctoral candidates)

- Below 2.000
- 2.001-5.000
- 5.001-10.000
- 10.001-15.000
- 15.001-20.000
- 20.001-30.000
- More than 30.000

2.6 Please indicate the size of your Physics Department/Faculty in terms of numbers of students (without doctoral students/doctoral candidates)

- Below 10
- 11-30
- 31-50
- 51-100
- 101-200
- More than 200

3. Doctoral Degree Structure and Organisation

3.1 Please state the name of the doctoral qualification(s) awarded in your department/faculty.

- Full name in language of country:
.....
- Full name in English translation (if applicable):
.....
- Abbreviated form (e.g. Dr., or PhD, or other):
.....

3.2 Is the duration of doctoral studies fixed?

- No (Please go to question 3.4)
- Yes, by national regulation
- Yes, by university regulation
- Yes, others. Please indicate:

3.3 If the duration of doctoral studies is fixed, please indicate the

- minimum and maximum duration.
- Minimum: years
- Maximum: years

3.4 What is the average actual duration of doctoral studies?

- Years plus months.
- No information available.

3.5 What is the typical age of candidates at the beginning of their doctoral studies? (Please do not take into account part-time candidates.)

- Between and years.

3.6 Are doctoral studies integrated into a formal (i.e. institutionally established) doctoral programme, graduate school or similar structure?

- Yes
- No, individual supervision only
- Both, individual supervision and doctoral programme/graduate school or similar.

3.7 How is the programme or school funded (excluding salaries for academic staff and funding of doctoral candidates)? (Multiple replies possible)

- Funding from the university
- Funding from a research council/foundation
- Others (please indicate)

4. Recruitment, Selection, Admission

4.1 What are the qualification requirements for acceptance as doctoral candidate (except of a Master degree)? (Multiple replies possible)

- First-cycle (Bachelor) degree:
 - Yes
 - Only in special cases
- years of professional experience
- Other possibilities. Please indicate:

4.2 Are there other special requirements for acceptance as doctoral candidate?

- No
- Yes (Multiple replies possible)
 - Submission and acceptance of research outline
 - Passing of an entrance examination with a minimum grade point average
 - Trial period of months' duration

- A minimum grade point average of previous degree
- Evidence of proficiency in a foreign language
- Other. Please specify:

4.3 Is there a non-university sector (e.g. Fachhochschulen, Hogescholen, Polytechnics, Colleges) in your country?

- Yes
- No (Please go to question 4.5)

4.4 If there is a non-university sector in your country, is it possible that candidates with a degree from a non-university higher education institution are accepted into doctoral studies?

- No
- Yes, without further requirements
- Yes, with further requirements (Multiple replies possible):
 - A high grade point average
 - After a period of additional studies/course work
 - After a trial period of months' duration
 - Others. Please indicate:

4.5 Who decides about the acceptance as doctoral candidates/into doctoral studies? (Multiple replies possible)

- Supervisor
- Dean of the programme/school
- Committee/board at faculty/department level
- Committee/board at university level
- Others. Please indicate

4.6 Are doctoral candidates in your department considered to be:

- Students
- Early stage researchers/junior academics
- Both. Please explain:

4.7 Do your doctoral candidates have to pay tuition fees?

- No
- Yes. Please indicate the average amount of tuition fees (in Euro) per year in your department/faculty for different types of doctoral candidates.

	Euro	No information available
For domestic doctoral candidates		
For doctoral candidates from other		
EU member states		
For doctoral candidates from countries outside Europe		

4.8 In which way are your doctoral candidates funded? (Please indicate percentages: percentages should add up to 100%)

Employment contract by host university/department/faculty as teaching or research assistant (or similar)% of the doctoral candidates	..... % of the doctoral candidates
Repayable grant/loan (by host institution, public agency, or private foundation)	..... % of the doctoral candidates
Non-repayable scholarship (by host institution, public agency, or private foundation)	..... % of the doctoral candidates
Self-funded (own or parents' means)	..... % of the doctoral candidates
	100% of the doctoral candidates

4.9 Do you have an official status for part-time doctoral candidates?

- Yes
- No

4.10 What is the origin of doctoral candidates in your department/faculty? (Please indicate percentages: percentages should add up to 100%)

From your home university	..... % of the doctoral candidates
From your own country (excluding home university)	..... % of the doctoral candidates
From other EU member states	..... % of the doctoral candidates
From countries outside Europe	..... % of the doctoral candidates
	100% of the doctoral candidates

5. The Process of Doctoral Studies

5.1 Is the (possibly preliminary) topic of the thesis / the object of the research work determined:

- At the beginning of doctoral studies?
- After some coursework / preparatory training?
- At another point in time? Please indicate:

5.2 Is there a formal and signed agreement regulating rights and duties of both parties (*i.e.* doctoral candidate and supervisor)?

- Yes
- No (Please go to question 5.4)

5.3 If such an agreement exists, by whom is it signed? (Multiple replies possible)

- By the doctoral candidate and his/her supervisor
- By the doctoral candidate and the host department/faculty
- By the doctoral candidate and the host university
- By the doctoral candidate and a committee or body/board responsible for doctoral education and training
- Between the doctoral candidate and another party. Please specify:

5.4 In which way is the thesis subject/project decided? (Multiple replies possible)

- Agreement between the candidate and the supervisor
- based on candidate's preference
- topic is assigned by supervisor
- Topic is decided by a committee or board
- taking the candidate's preferences into account
- not taking the candidates preferences into account
- Topic is decided by a Director of Doctoral Studies/ Director of Graduate School/Doctoral Programme
- taking candidate's preferences into account
- not taking candidate's preferences into account
- Topic is decided in another way. Please specify:

5.5 Does the thesis subject/project need additional approval?

- No
- Yes. Please indicate by whom:

5.6 Is there a Committee or Board involved that has responsibilities in the approval of the thesis project and/or other responsibilities in the guidance and with regard to the examination of the doctoral candidate?

- No (Please go to question 5.9)
- Yes. How many members does it have? members

5.7 Are the members elected or appointed and by whom?

- Elected. Please indicate by whom:
- Appointed. Please indicate by whom:

5.8 What are the main tasks of this Committee or Board? (Multiple replies possible)

- Management of thesis/project
- Deciding about coursework
- Approval of course work
- Admission of doctoral candidates
- Approval of thesis subject
- Approval of supervisor(s)
- Appointment of examiners
- Admission of candidates for defence of thesis
- Award of degree
- Other tasks. Please specify:

5.9 What are the requirements for doctoral supervision?

- Supervisor must be a professor
- Supervisor must be a professor and have special training in doctoral supervision
- Supervisor can be below professor but must have habilitation
- Supervisor must have doctoral degree
- Supervisor must have doctoral degree and special training in doctoral supervision

5.10 Are doctoral candidates in your department/faculty always formally supervised by more than one supervisor?

- No
- Yes. How many supervisors does each candidate have?

5.11 Is it possible or even required to involve with external supervisors (*i.e.* supervisors who are not members of your faculty/department)?

- No (Please go to question 5.13)
- Yes, possible
- Yes, required

5.12 If it is possible or even required to involve with external supervisors, what types of external supervisors are involved? (Multiple replies possible)

- From a neighbouring department/faculty
- From another university in the same country
- From a university in another country
- From a non-university higher education institution (e.g. Fachhochschulen, Colleges, Hogescholen, Polytechnics)
- From a research institution (e.g. CERN, Academy, Max.-Planck-Institute, CEA, INFN)
- From industry/companies
- Other. Please indicate:

5.13 How many doctoral candidates can a supervisor have?

- As many as s/he wants to have and can cope with:
Please indicate an average number of candidates:
.....
- Number of candidates for supervision is regulated:
Please indicate the maximum number of candidates:
.....

5.14 Do doctoral candidates have to do coursework (i.e. participate in taught seminars or lectures)?

- Yes
- No (Please go to question 5.24)

5.15 How is the coursework quantified?

- By ECTS credit points
How many must be earned?
- By other credit points
How many must be earned?
- Other quantification. Please specify:

5.16 What types of courses are provided? (Multiple replies possible)

- Specialised third-cycle (doctoral) courses
- Joint courses for Master students and doctoral candidates
- Other courses (please specify):

5.17 Is the coursework assessed?

- No
- Yes

5.18 Is coursework a requirement for the final degree?

- No.
- Yes, successful completion is the condition for admission to final examination, but it is not weighted for the final degree.
- Yes, coursework is weighted for the final degree.

5.19 Is progress in coursework formally monitored?

- No.
- Yes: (Multiple replies possible)
 - By supervisor
 - By committee or board
 - By director of doctoral studies, programme director or dean of graduate school
 - Others. Please specify:

5.20 Is the coursework (or parts of it) offered in a foreign language?

- No
- Yes, all of it. Please indicate the main foreign language used in coursework:
- Yes, parts of it. Please indicate the main foreign language used in coursework:

5.21 What are the options if a candidate fails the coursework or parts of it? (Multiple replies possible)

- Re-take/re-sit the examination
- Take a different course
- Carry out an alternative activity
- Other option(s). Please specify:

5.22 Does the coursework include provision of general skills and competences (e.g. presentation skills, writing project applications, managing research teams and projects, etc.)

- Yes, obligatory
- Yes, optional
- No

5.23 Please estimate the proportion of general skills and competences training among the overall coursework. percent

5.24 Is it possible or even required to perform doctoral research outside the university?

- Yes, possible
- Yes, required
- No

5.25 Where does research work typically take place? (Please indicate percentages: percentages should add up to 100%)

In your department or institution	..... % of the doctoral candidates
In another university in your own country	..... % of the doctoral candidates
In another university outside your country	..... % of the doctoral candidates
In non-university higher education institutions (e.g. Fachhochschulen, Colleges, Hogescholen, Polytechnics)	..... % of the doctoral candidates
In a research institution (e.g. CERN, Academy, Max.-Planck-Institute, CEA, INFN)	..... % of the doctoral candidates
In industry/companies	..... % of the doctoral candidates
Other. Please specify	..... % of the doctoral candidates
	100% of the doctoral candidates

5.26 Do you organise regular research seminars or colloquiums for your doctoral candidates to attend?

- No
- Yes. How many per year on average?

5.27 Do you organise summer or winter schools for your doctoral candidates?

- Yes
- No

5.28 Do your doctoral candidates make presentations of their work in progress? (Please tick appropriate box)

	Yes, obligatory	Yes, expected	Yes, encouraged	No	Not applicable
In the department/faculty					
In the framework of the doctoral programme, doctoral school etc.					
At national conferences					
At international conferences					
Elsewhere (please specify):					

5.29 Do doctoral candidates typically carry out or contribute to teaching, research or administrative activities?

- No, they just do their own research work. (Please go to question 6.1)
- Yes (Multiple replies possible):
 - Laboratory or problem solving sessions
 - Tutoring students
 - Lecturing, teaching seminars
 - Providing advice for project/thesis of first or second cycle students
 - Marking/assessment of homework
 - Support supervisor/professor in publications
 - Write own publications
 - Support supervisor/professor in writing project proposals/tenders
 - Support supervisor/professor in administrative/organisational work
 - Other. Please specify:

5.30 If doctoral candidates carry out or contribute to the above listed activities, what is the maximum number of hours per week they are allowed to do this?

..... maximum number of hours per week

6. Award of Doctoral Degree

6.1 What does the thesis consist of? (Multiple replies possible)

- A previously unpublished report or piece of text
- A collection of scientific papers published in peer-reviewed journals (possibly with an introduction and commentary or conclusion)
- Other. Please specify:

6.2 Is it possible to submit the thesis in a foreign language?

- No (Please go to question 6.4)
- Yes, for all students.
- Yes, but only for foreign students.

6.3 If it is possible to submit the thesis in a foreign language, please estimate the proportion per year.

..... percent

6.4 Are credits allocated to the thesis?

- No
- Yes

6.5 Is there an oral examination or defence?

- No
- Yes

6.6 Is it possible to hold the oral examination/defence in a foreign language?

- No (Please go to question 6.8)
- Yes, for all students.
- Yes, but only for foreign students.

6.7 If it is possible to hold the oral examination/defence in a foreign language, please estimate the proportion per year.

..... percent

6.8 What is the minimum and maximum duration of an oral examination or defence?

- hours minimum and hours maximum
- No formal time limit

6.9 Is the oral examination or defence open to a wider audience?

- Yes, it is public
- No, only candidate and examiners

6.10 What does the oral examination or defence consist of? (Multiple replies possible)

- Oral presentation of thesis
- Answers to questions from examiners
- Answers to questions from audience
- Broader comprehensive oral examination
- Other: Please specify:

6.11 What is the composition of the group of examiners? (Please fill in the minimum number for each box and indicate the total number in the last box)

Number of supervisors/promoters	
Number of colleagues from the same department/faculty of your university	
Number of colleagues from other faculty of your university	
Number of colleagues from other universities	
Number of colleagues from abroad	
Total number of examiners	

6.12 What are the criteria for the final assessment and the award of the degree? (Please estimate weight in percent: percentages should add up to 100%)

The quality of the thesis	..... % of the final assessment
The oral presentation	..... % of the final assessment
Answers to questions from examiners	..... % of the final assessment
Answers to questions from audience	..... % of the final assessment
Performance in broader oral examination	..... % of the final assessment
	100 % of the final assessment

6.13 Is the doctoral degree awarded on the basis of a pass/fail assessment or are grades attached to it?

- Just pass/fail
- Pass/fail plus possibility to pass “(summa) cum laude” (or equivalent)
- Grades (in Latin or home country grading system) are given (e.g. summa cum laude, magna cum laude, cum laude, rite)

6.14 What happens if a candidate’s thesis is not approved?

- S/he may not re-submit (it’s over)
- S/he may resubmit a revised thesis within months
- S/he may be awarded a lower level qualification. Please specify
- Other. Please indicate:

6.15 What happens if a candidate fails the oral examination/defence?

- S/he may not retake the oral examination/defence (it’s over)
- S/he may retake the oral examination/defence within months
- S/he may be awarded a lower level qualification. Please specify
- Other. Please specify:

6.16 Apart from thesis submission and oral examination/defence, are there further requirements for getting a doctoral degree?

- No
- Yes. Please indicate:

6.17 Does your institution offer activities/services to ease transition into the labour market? (Multiple replies possible)

- No (Please go to question 7.1)
- Yes, specialised activities/services for doctoral candidates
- Yes, joint activities/services for Master students and doctoral candidates
- Yes, others. Please indicate:

6.18 If your institution offers activities/services to ease transition into the labour market, please indicate which ones (Multiple replies possible)

- Career services and advice
- Organisation of interviews with potential employers
- Internships
- Lectures by alumni or potential employers about labour market and career opportunities
- Training for job applications and job interviews
- Information brochures about potential job areas
- Other activities/services, please indicate:

7. Some Statistics in Recent Doctorates in Your Faculty/Department

The figures we want to collect in this final part should cover or take into account the last five academic years.

7.1 What is the average number of doctoral degrees awarded per year in Physics in your faculty/department?
..... average number of doctoral degrees

7.2 What is the proportion of doctoral degrees awarded to women on average?
..... percent on average

7.3 What are the proportions of doctoral degrees awarded at your department/faculty to candidates with degrees from different institutions respectively countries? (Please indicate percentages, percentages should add up to 100%)

Candidates with degrees from your university	..... % of doctoral degrees
Candidates with degrees from universities in your own country (excluding home university)	..... % of doctoral degrees
Candidates with degrees from universities abroad but within the EU	..... % of doctoral degrees
Candidates with degrees from universities abroad but outside the EU	..... % of doctoral degrees
	100% of doctoral degrees

7.4 What is the average proportion of doctoral candidates per year who fail their final assessment (thesis and/or oral examination/defence)?
..... percent on average

7.5 What is the average proportion of drop-outs from doctoral studies per year (those beginning a doctoral degree qualification but giving up in the process)?
..... percent on average

7.6 Can you please estimate the first destinations of candidates having been awarded a doctoral degree (please indicate percentages, percentages should add up to 100%).

Postdoc	..... % of the candidates
Industrial research	..... % of the candidates
Other fields in industry	..... % of the candidates
Teaching in secondary school (possibly after further training)	..... % of the candidates
Teaching in the non-university sector of higher education (possibly after further training)	..... % of the candidates
Other. Please specify:	..... % of the candidates
	100% of the candidates

DONE ! Thank you very much.

▶ APPENDIX III: EURODOC QUESTIONNAIRE FOR DOCTORAL CANDIDATES



The European Council of
Doctoral Candidates and
Junior Researchers

Dear Doctoral Researcher,

EURODOC – the European Council of Doctoral Candidates and Junior Researchers – is conducting a Europe-wide survey of doctoral researchers. Within this framework, a group of young volunteers has set up a Europe-wide online survey. The results of this survey will help EURODOC in its efforts to improve the training and research conditions of doctoral researchers. The term “doctoral researcher” is used as a synonym for doctoral candidates, doctoral students, *etc.*

This is the first survey of its kind and roughly 100,000 European doctoral researchers will be asked to take part in this study. The survey will be conducted in Austria, Belgium, Belarus, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Latvia, FYR Macedonia, Moldova, Norway, Poland, Portugal, Russia, Slovenia, Spain, Sweden, Switzerland, The Netherlands, Turkey, and Ukraine.

For a successful survey, we need your participation. The questionnaire will take about 30 minutes to complete and contains questions about your background, career path, funding, training and supervision, working conditions, academic work, mobility, future prospects and socio-demographic indicators.

The contribution to this survey is voluntary. We assure you that your replies will be used only in the framework of this research project. The results will be published in a way that individual identification is impossible as the data will be made anonymous.

ANY INFORMATION YOU MAY SUBMIT WILL BE TREATED STRICTLY CONFIDENTIAL.

We thank you in advance for your valued co-operation. Feel free to contact us in case of technical problems at [guist\(at\)incher.uni-kassel.de](mailto:guist(at)incher.uni-kassel.de) and for all other questions about the survey at [surveys\(at\)eurodoc.net](mailto:surveys(at)eurodoc.net).

Max Reinhardt

Karoline Holländer

Harald Schomburg

Survey coordinator
EURODOC

President
EURODOC

Senior Researcher
INCHER

A. Background

We would like to ask for the unemployment/ work/ maternity/ paternity experience before your doctorate and qualification for the doctorate

A1 Please write down the month and the year you started your doctorate (MM YYYY)

..... / Month/ Year

A2 In which country did you start your doctorate?

.....

A3 In which country are you doing your doctorate?

- Same as the country where I started
- Other:

A4 Please choose your field of science for your doctorate based on the International Standard Classification of Education (ISCED). (Multiple reply possible)

- **1 Teacher training and education science**
 - Teacher training for pre-school, kindergarten, elementary school, vocational, practical, non-vocational subject, adult education, teacher trainers and for handicapped children.
 - General and specialized teacher training programmes.
 - Education science: curriculum development in non-vocational and vocational subjects.
 - Educational assessment, testing and measurement, educational research, other education science.
- **2 Arts**
 - Fine arts: drawing, painting, sculpture;
 - Performing arts: music, drama, dance, circus;
 - Graphic and audio-visual arts: photography, cinematography, music production, radio and TV production, printing and publishing;
 - Design; Craft skills.
- **3 Humanities**
 - Religion and theology;
 - Foreign languages and cultures: living or 'dead' languages and their literature, area studies;
- **4 Social and behavioural science**
 - Native languages: current or vernacular language and its literature;
 - Other humanities: interpretation and translation, linguistics, comparative literature, history, archaeology, philosophy, ethics.
- **5 Journalism and information**
 - Journalism; library technician and science; technicians in museums and similar repositories;
 - Documentation techniques;
 - Archival sciences.
- **6 Business and administration**
 - Retailing, marketing, sales, public relations, real estate;
 - Finance, banking, insurance, investment analysis;
 - Accounting, auditing, bookkeeping;
 - Management, public administration, institutional administration, personnel administration;
 - Secretarial and office work.
- **7 Law**
 - Local magistrates, 'notaires', law (general, international, labour, maritime, *etc.*), jurisprudence, history of law.
- **8 Life sciences**
 - Biology, botany, bacteriology, toxicology, microbiology, zoology, entomology, ornithology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences.
- **9 Physical sciences**
 - Astronomy and space sciences, physics, other allied subjects, chemistry, other allied subjects, geology, geophysics, mineralogy, physical anthropology, physical geography and other

geosciences, meteorology and other atmospheric sciences including climatic research, marine science, vulcanology, palaeoecology.

• **10 Mathematics and statistics**

- Mathematics, operations research, numerical analysis, actuarial science, statistics and other allied fields.

• **11 Computing**

- Computer sciences: system design, computer programming, data processing, networks, operating systems software development only (hardware development should be classified with the engineering fields).

• **12 Engineering and engineering trades**

- Engineering drawing, mechanics, metal work, electricity, electronics, telecommunications, energy and chemical engineering, vehicle maintenance, surveying.

• **13 Manufacturing and processing**

- Food and drink processing, textiles, clothes, footwear, leather, materials (wood, paper, plastic, glass, *etc.*), mining and extraction.

• **14 Architecture and building**

- Architecture and town planning: structural architecture, landscape architecture, community planning, cartography;
- Building, construction; Civil engineering.

• **15 Agriculture, forestry and fishery**

- Agriculture, crop and livestock production, agronomy, animal husbandry, horticulture and gardening, forestry and forest product techniques, natural parks, wildlife, fisheries, fishery science and technology.

• **16 Veterinary**

- Veterinary medicine, veterinary assisting.

• **17 Health**

- Medicine: anatomy, epidemiology, cytology, physiology, immunology and immunoaematology,

pathology, anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, neurology, psychiatry, radiology, ophthalmology;

- Medical services: public health services, hygiene, pharmacy, pharmacology, therapeutics, rehabilitation, prosthetics, optometry, nutrition;
- Nursing: basic nursing, midwifery;
- Dental services: dental assisting, dental hygienist, dental laboratory technician, odontology.

• **18 Social services**

- Social care: care of the disabled, child care, youth services, gerontological services;
- Social work: counselling, welfare n.e.c.

• **19 Personal services**

- Hotel and catering, travel and tourism, sports and leisure, hairdressing, beauty treatment and other personal services: cleaning, laundry, drycleaning, cosmetic services, domestic science.

• **20 Transport services**

- Seamanship, ship's officer, nautical science, air crew, air traffic control, railway operations, road motor vehicle operations, postal service.

• **21 Environmental protection**

- Environmental conservation, control and protection, air and water pollution control, labour protection and security.

• **22 Security services**

- Protection of property and persons: police work and related law enforcement, criminology, fire-protection and fire fighting, civil security; Military.

A5 Please mention any unemployment/ work/ maternity/ paternity experience between your previous degree and the beginning of your doctoral research. ((Multiple responses possible))

- I had no work experience between the end of my previous degree and the beginning of my doctoral research. I started my doctorate straight after my previous degree

- I have been in maternity / paternity leave
- I have been unemployed. Please write down the duration you have been unemployed:
- weeks months unemployed before the beginning of my doctoral research
- I have worked in:
 - the academic sector (University)
 - the public non-academic research sector
 - the private non-academic research sector
 - the public non-research sector
 - the private non-research sector
 - a Non Governmental Organisation (NGO)
 - the military
- I have done my military/ alternative service
- Other (please specify):

B. Career Path

Our aim in this section is to understand the career path/ sequence that different doctoral researchers follow during their doctoral research and to assess the future career aspirations of doctoral researchers.

B1 What is your current employment situation as a doctoral researcher? (Multiple responses possible)

- Employed doctoral researcher
- Self employed doctoral researcher
- Unemployed doctoral researcher
- Doctoral researcher with a scholarship
- Doctoral researcher without a scholarship
- Other (please specify):

B2 What are the contract conditions of your doctoral research?

- Fixed term contract
- Open-ended contract
- Not applicable, I am self employed
- I have no contract

B3 Do you have a student status?

- Yes, full-time student
- Yes, part-time (if this is an official status in your country)
- No

B4 Referring to your paid employment in B1 and B2 is your doctoral research part of your employment contract?

- Yes
- No
- Not applicable, I have no contract

B5 Are you aware of the European Charter for Researchers/ Code of Conduct for the Recruitment of Researchers?

- Yes
- No

B6 Does your contract follow the recommendations from the European Charter for Researchers/ Code of Conduct for the Recruitment of Researchers?

- Yes
- No
- Not applicable, I have no contract
- I don't know

B7 In which sector do you carry out your doctoral research? (Multiple responses possible)

- Academic research sector (University)
- Public non-academic research sector
- Private non-academic research sector
- Public non-research sector
- Private non-research sector
- Non Governmental Organisation (NGO)
- Military
- Other (please specify):

B8 In which sector would you want to work after finishing your doctorate? (Multiple responses possible)

- Academic research sector (University)
- Public non-academic research sector
- Private non-academic research sector
- Public non-research sector
- Private non-research sector
- Non Governmental Organisation (NGO)
- Military
- Other (please specify):

B9 To what extent do you agree to the following statements regarding your doctorate?

The doctorate increases my job opportunities in:					
	1 = Not at all 5 = To a very high extent				
	1	2	3	4	5
the academic research sector					
the public non-academic research sector					
the private non-academic research sector					
the public non-research sector					
the private non-research sector					
another sector. Please specify:					

B10 Did you choose to do a doctorate while turning away better paid job opportunities?

- Yes.
- No.

B11 To what extent do you expect an advantage from your doctoral degree for your later occupation (job)?

	1 = Not at all 5 = To a very high extent				
	1	2	3	4	5
Largely independent disposition of work					
Opportunity of pursuing own ideas					
Challenging tasks					
Chance of doing something for the society					
Chance of political influence					
Career prospects					
Opportunity for research					
Social recognition					
Job security					
High income					
Social security					
Prevention of unemployment					

C. Funding

The purpose of this section is to determine what funding is secured for researchers when they start their doctorate as well as whether the funding they have is competitive and sufficient to meet living costs.

C1 Do you/ did you receive any funding (income as salary or scholarship) for your doctorate?

- Yes.
- No (Please go to question D1)

C2 To what extent does your level of doctoral funding meet your living costs?

	1	2	3	4	5
1 = Not at all 5 = To a very high extent					

C3 For how long was your funding arranged at the start of your doctorate?

- Length of confirmed funding/ employment contract in months

C4 Will it be possible to prolong the funding arranged at the start of your doctorate?

- Yes, for additional months
- No
- I don't know

D. Training and Supervision

This section aims to determine whether doctoral researchers identify the need for training and if they are given the chance to receive training when they require it.

It will also consider the subject specific aspects of training, as well as transferable skills and how supervisors are involved in this training. Finally, it aims to establish insight into satisfaction with the working relationship researchers have with their supervisor.

questions on next page ►

D1 How do you judge your level of competencies *at the start* of your doctorate in the following areas?

Very low ▶ Very high	1	2	3	4	5
Theories of my subject					
Methods of my subject					
Transferable skills (e.g. presenting, report writing, project management <i>etc.</i>)					
Teachable skills					
Language skills					
Research ethics					
Information technology					

D2 How do you judge your level of competencies in the following areas *now*?

Very low ▶ Very high	1	2	3	4	5
Theories of my subject					
Methods of my subject					
Transferable skills (e.g. presenting, report writing, project management <i>etc.</i>)					
Teachable skills					
Language skills					
Research ethics					
Information technology					

D3 Did you receive any kind of training (*e. g.* courses) at your university during your doctorate?

- Yes
- No. I received training outside my university. (Please go to question D6)
- No (Please go to question D6)

D4 Was the training you received voluntary or mandatory?

1/Voluntary 2/Mandatory 3/Not applicable, no training	1	2	3
Theories of my subject			
Methods of my subject			
Transferable skills, e.g. presenting, report writing, project management <i>etc.</i>			
Teaching			
Language skills			
Research ethics			
Information technology			

D5 To what extent are you satisfied with the training you received?

Not at all satisfied ▶ Very satisfied	1	2	3	4	5
Theories of my subject					
Methods of my subject					
Transferable skills (e.g. presenting, report writing, project management <i>etc.</i>)					
Teachable skills					
Language skills					
Research ethics					
Information technology					

D6 How supportive do you find your supervisor in planning and reviewing your training?

	1	2	3	4	5
Not at all supportive ▶ Very supportive					
Not applicable, I don't have a supervisor (Please go to question E1)					

D7 How useful is the feedback you receive from your supervisor with regard to your research?

	1	2	3	4	5
Not at all useful ▶ Very useful					

D8 Does any kind of formal, binding agreement between you and your supervisor (such as a contract, or university regulations) exist that defines the role of *your supervisor*?

- Yes
- No
- I don't know
- Not applicable

D9 Does any kind of formal, binding agreement between you and your supervisor (such as a contract, or university regulations) exist that defines your own role?

- Yes
- No
- I don't know
- Not applicable

D10 Please rate how you feel your supervisor is fulfilling his role:

1= Poor 5=Excellent 6=not applicable	1	2	3	4	5	6
As expert in my field of research						
When providing regular guidance						
When supporting and aiding me in my training needs						

D11 Please rate how you feel you are fulfilling your role:

1= Poor 5=Excellent 6=not applicable	1	2	3	4	5	6
At implementing the research						
At reporting regularly						
At discussing and acting upon my training needs with my supervisor						

D12 How many doctoral researchers does your supervisor supervise in total?

- 1 ▶ 2
- 3 ▶ 4
- 5 ▶ 9
- 10 ▶ 14
- 15 ▶ 19
- 20 and more

E. Working Conditions

In the following section we ask for the duration of a doctorate, whether you have a right to use your own data and eventual gender discrimination.

E1 Is there a minimum required time for completing your doctorate?

- Yes
- No
- I don't know

E2 Is there a maximum allowed time for completing your doctorate?

- Yes, the maximum duration is strictly limited
- No, the maximum duration is not strictly limited but I have to get a permission (e.g. from my supervisor or institute)

- No, I have as much time as I want
- No, I have as much time as I want, as long as I get funding
- Other: (Please specify)
- I don't know

The following two questions aim at finding out if the supervisor or another senior person prevents a doctoral researcher from the right to use data produced by themselves and if there are clear indications of contractual agreements from any collaborative projects.

E3 Are you prevented by your supervisor or the university from using findings you have produced during your doctorate?

- Yes
- Yes. I cannot use the data, because it is explained in my contract
- No
- I don't know

E4 If you are on a collaborative project, are there clear agreements on using the project findings?

- Yes
- No
- I don't know
- Not applicable

The following seven questions aim at finding out eventual gender discrimination and the conditions for maternity/ paternity.

E5 To what extent do you feel disadvantaged in your academic career because of your gender?

	1	2	3	4	5
Not at all ▶ Very much					

E6 Do you have a right to maternity/ paternity leave?

- Yes
- No
- I don't know
- Not applicable

E7 Are you paid for maternity/ paternity leave?

- Yes, fully paid
- Yes, partly paid
- Yes, unpaid
- No
- I don't know
- Not applicable

E8 Does your contract become extended with the duration of the maternity/ paternity leave?

- Yes
- No
- Not applicable (I do not have children/ I do not have right to maternity/ paternity leave)

E9 To what extent are you discouraged from taking maternity/ paternity leave?

	1	2	3	4	5	6
1 = Not at all 5 = To a very high extent 6 = not applicable						

E10 To what extent are you pressured to postpone having children?

	1	2	3	4	5	6
1 = Not at all 5 = To a very high extent 6 = not applicable						

E11 To what extent was the requirement to complete military service an obstacle to start your doctorate?

	1	2	3	4	5	6
1 = Not at all 5 = To a very high extent 6 = not applicable						

F. Academic Work

In this section we ask for the academic work as the results of your research and the different types of work / activities you are doing during your doctorate.

F1 Please provide the amounts of the following items that resulted from your doctoral research so far (fill in 0 if none).

(Multiple responses possible)

- Articles in national publications without peer review
- Articles in national publications with peer review
- Articles in international publications without peer review
- Articles in international publications with peer review
- Articles in proceedings
- Scientific monographs
- Edition of books
- Reviews
- Online articles
- Patent applications
- Other (please specify):

F2 How would you describe your doctoral research?

(Multiple responses possible)

- Experimental
- Theoretical
- Data collection
- None of the above

F3 Please estimate how many hours per week in average you spend on the following activities.

- Writing my thesis/ dissertation
- Research related to my thesis/ dissertation
- Research related to my doctorate in general
- Research not related to my doctorate in general
- Teaching related to my thesis/ dissertation
- Teaching related to my doctorate in general
- Teaching not related to my doctorate in general
- Attending courses related to my thesis/ dissertation
- Attending courses related to my doctorate in general
- Attending courses not related to my doctorate in general

..... Administrative tasks related to my doctorate in general
 Administrative tasks not related to my doctorate in general
 Other (please specify):

F4 To what extent do you have time to write your thesis?

	1	2	3	4	5	6
1 = Not at all 5 = To a very high extent 6 = not applicable						
I did not start to write my thesis						

F5 To what extent are you working more for tasks not related to your thesis/ dissertation as stated in your contract?

	1	2	3	4	5	6
1 = Not at all 5 = To a very high extent 6 = not applicable						

F6 Have you been involved in any of the following activities?

1/Yes 2/No 3/Not applicable	1	2	3
Planning new research projects			
Choosing collaborators			
Writing grant proposals			
Determining authorship			
Organizing panels/ conferences			
Deciding about institutional policy			
None of the above			

G. Mobility

This Section Aims At Finding Out The Interest In Mobility And About The Mobility You Have Undertaken In The Past

G1 During your course of study before your doctorate: Did you spend any time abroad for study?

- Yes, months for study
- No

G2 To what extent are you interested in going abroad with regard to your doctorate for the following reasons?

1 = Not at all ▶ 5 = To a very high extent	1	2	3	4	5
Data collection for research					
Research project					
Doctoral programme courses					
Joint degree programmes					
Finishing dissertation					
Teaching activities					
Search in a library					
Conferences without active participation					
Conferences with active participation					
Summer schools without active participation					
Summer schools with active participation					
Workshops without active participation					
Workshops with active participation					
Other (please specify):					

G3 How many days have you approximately been abroad during your doctorate for the following reasons?

Not applicable, I have not been abroad ▶ Please go to question G10

- Data collection for research
- Research project
- Doctoral programme courses
- Joint degree programmes
- Finishing dissertation
- Teaching activities
- Search in a library
- Conferences without active participation
- Conferences with active participation
- Summer schools without active participation
- Summer schools with active participation
- Workshops without active participation
- Workshops with active participation
- Other (please specify):

G4 If you have been abroad: in which countries?

.....

G5 Are/ were you pursuing your doctorate abroad?

- Yes
- No ▶ Please go to question G10

G6 Are/ were you receiving any additional funding your doctorate abroad?

- Yes, completely
- Yes, partially
- No ▶ Please go to question G8

G7 If you are/ were receiving funding for pursuing your doctorate abroad, was it difficult to get?

- Yes
- No
- I don't know

G8 Please tick the most important sources (up to three sources) of funding your doctorate abroad. (Multiple responses possible)

<input type="checkbox"/>	Scholarship
<input type="checkbox"/>	Employment
<input type="checkbox"/>	Exchange programme
<input type="checkbox"/>	My study/ research abroad was a part of my official doctoral programme (e.g. cotutelle)
<input type="checkbox"/>	Support by relatives (parents, friends, wife/ husband, etc.)
<input type="checkbox"/>	Government loan
<input type="checkbox"/>	Personal savings
<input type="checkbox"/>	Bank loan
<input type="checkbox"/>	Unemployment benefit
<input type="checkbox"/>	Social welfare
<input type="checkbox"/>	Other (please specify):

G9 If you are currently abroad: Are you still linked to your country of origin? (Multiple responses possible)

- I keep in touch with official dispersed networks. (Dispersed networks bring together researchers from the same country of nationality working abroad.)

- I have a wide informal network formed by friends/ acquaintances/ colleagues from my country of origin
- I am available for various possible linkage mechanisms (visits, training, joint projects, fundraising)
- I maintain business relationship with my country of origin
- I collaborate with national professional associations in my country of origin
- I collaborate with scientific journals in my country of origin
- Not applicable, I am currently not abroad

G10 Do you intend to move abroad or stay abroad for work related purposes after you finish your doctorate?

- Yes
- No ▶ Please go to question G13
- I'm not sure

G11 In which countries do you like to work after your doctorate? Please state the three most important ones.

- 1.
- 2.
- 3.

G12 How important are the following motivational reasons for your mobility?

1 = Not at all ▶ 5 = Very important 6 = Not applicable	1	2	3	4	5	6
Better financial conditions						
Better research facilities abroad						
Better career prospects						
Better recognition of profession						
Better social security						
Cooperation with prominent scientists						
Better training process						
Professional plans of my family members						
Wanting to live/ work in another culture						
Other (please specify):						

G13 To what extent are the following barriers significant for your mobility?

1 = Not at all ▶ 5 = Very important 6 = Not applicable	1	2	3	4	5	6
Low funding						
Visa regime						
Language skills						
Family/ partnership reasons						
Childcare facilities						
Reduced career opportunities back home						
Loss of professional networking in the home country						
Partners job opportunities						
Lack of information						
Transfer of qualification						
Transferability of social security						
Institutional reasons (i.e. approval of supervisor)						

H. Sociodemographic Indicators

In this section we ask for the sociodemographic indicators. They are important for the comparison of the data.

H1 What is your year of birth?

.....

H2 What is your gender?

- Female
- Male

H3 In which country were you born? If you were born in a country that does not exist any more (e.g. Yugoslavia), please indicate the country your place of birth currently belongs to.

.....

H4 In which country do you reside?

- Same as the country where I was born
- Other:

H5 In which country did you get your entry qualification for higher education?

- Same as the country where I was born
- Other:

H6 In which country did you receive the degree which was required to start your doctorate?

- Same as the country where I was born
- Other:

H7 What is your nationality?

- Same as the country where I was born
- Other:

H8 What is your current family situation?

- Single
- Single. Living with parents
- Living together without official partnership arrangement
- Official partnership arrangement/ married
- Divorced/ widowed

H9 How many children do you have?

- No children ▶ Please go to question H11
- One child
- Two children
- Three children or more

H10 How old are your children?

- Age of youngest child years months, if younger than one year
- Age of oldest child years

H11 What is the highest school qualification of your father/ mother?

Father	Mother	
		Higher education entrance qualification
		Secondary qualification
		Primary education
		I don't know

H12 What is the highest vocational qualification of your father/ mother?

Father	Mother	
		Higher education entrance qualification
		Secondary qualification
		Primary education
		I don't know



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