

# Set-in LifeLong Learning for PhD students in Electrical and Information Engineering

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**Abstract** — New European rules try to encourage the lifelong learning whatever the level of the Higher Education. Some studies were encouraged, mainly thematic networks, devoted to the development of LifeLong Learning (LLL) in Europe: the ELLEIEC project in the case of Electrical and Information Engineering.

The new national rules have encouraged since the beginning of 2007 the validation of the professional experience leading to a diploma at the bachelor and master levels as well as at the doctoral one. Lifelong learning at the doctoral level may cover several aspects. The first consists to consider LLL a student preparing a thesis in a company with an academic supervisor. In practice, this work is mainly performed in an industrial environment and is applied usually just after the graduation or master diploma. A second more interesting case, is the situation where the student has already a professional experience of several years mainly in a research and development environment and applies to get a doctoral diploma, thanks to an APEL (Accreditation Of Prior And Experiential Learning). Specific approach and evaluation must be set-in. This paper deals with Lifelong Learning in the case of a person wishing to get a doctoral diploma in Electrical and Information Engineering, from his professional experience.

## I. INTRODUCTION

Following the set-in of the doctoral studies in the frame of the Bologna process (B, M, D) [1], the functioning of the associated structures, called doctoral schools or post-graduate study departments as a function of the countries, have now more than eight years of functioning for most of them. It is clear that the complete harmonization is not reached in Europe yet but in the field of Electrical and Information Engineering their missions and their evaluation criteria are now well established and discussed; these activities constituted a part of the work of previous networks, more especially

THEIRERE [2] and EIE-Surveyor [3-4]. Even if some differences remain in the functioning and in the policy of the European academic institutions (European Higher Education institutions), similar activities are now well established and performed.

In parallel, a Communiqué of the European Commission [5] established between the Ministries of Higher Education aims to encourage and develop the lifelong learning and the validation of professional experience through the European space.

On the basis of the first approach that was made in the frame of the final report of the EIE-Surveyor programme [6], and following a review on the doctoral studies in electrical and information engineering for the Bologna handbook [7], this paper wants to highlight the application of LLL at the doctoral level. Several aspects will be approached:

- validation of previous professional experience,
- building of juries,
- administrative approach for the diploma delivery,
- conditions of defence,
- validation and acceptance of the diploma by the socio-economical world,
- European extension of this approach in the frame of the ELLEIEC [8] project.

After a presentation of the context and after the development of the mentioned points, the aim of this paper is to give some suggestions towards a European Union harmonization of the Higher Education in order to foster the European mobility of doctors and researchers.

## II. LIFELONG LEARNING GLOSSARY

In order to well understand the different approaches of lifelong learning a first point consists

to define the usual vocabulary and associated acronyms. We will see successively the meaning of LLL & LLP, APL, APCL and APEL.

**LLL or Lifelong Learning, and LLP or Lifelong Learning Programme:** The general objective of the Lifelong Learning Programme is to contribute through lifelong learning to the development of the European Union as an advanced knowledge-based society, with sustainable economic development, more and better jobs and greater social cohesion, while ensuring good protection of the environment for future generations. In particular, it aims to foster interchange, cooperation and mobility between education and training systems within the Community so that they become a world quality reference [9].

**APL or Accreditation of Prior Learning [10]:** APL is an opportunity for student to be given credits for learning that student has done before started at the University, or for learning that student is currently doing outside of the University. It avoids the necessity of duplicating previous learning, whilst ensuring a system to demonstrate successful attainment of the learning outcomes appropriate to student's award.

**APCL or Accreditation of Prior Certificated Learning:** APCL is learning for which student will have received a formal qualification, for example a Certificate or Diploma, or individual modules/course units completed at another institution.

**APEL or Accreditation Of Prior And Experiential Learning [11]:** APEL is a process that enables people of all ages, backgrounds and attitudes to receive formal recognition as an official Diploma for Knowledge, skills and competences they already possess.

A person's learning and experience can be formally recognised and taken into account to:

- gain entry to further or higher education courses,
- give exemption from certain parts of a new course of study,
- qualify for an award in an appropriate subject in further or higher education.

### III. ASPECTS OF LLL SPECIFIC TO THE PHD LEVEL

The possibility of European employees to reach the PhD (or doctorate) level from master degree by the way of LLL is opened by both ways:

- entering the PhD via APL. In this case, the PhD students are included in the regular doctoral studies after APL procedure. Then, they prepare the doctorate similarly to the other PhD students,
- passing the PhD through an APEL process. The preparation of the doctorate is thus specific.

Whatever the path, the final diploma must have the same value than a classical PhD. It is thus

important to verify that the future doctor will have the knowledge, skills and competences that are required.

### IV. MANDATORY CONDITIONS TO PREPARE A PHD AND CONTEXT

To prepare a doctorate the student must reach a specific environment that allows developing new researches. This environment is summarized in figure 1 that shows the main points that must be fulfilled to prepare a doctorate in suitable conditions in a classical way. It is well accepted since a very long time that to prepare a doctorate (or PhD) a student must produce a scientific work that is mainly performed, at least in the field of electrical and information engineering (EIE), in a research laboratory or research unit. In this environment, the student may manage some technical experiences, create new tools or instruments, analyze the existing results in the international environment, propose modelling and simulation involving recent tools, etc.

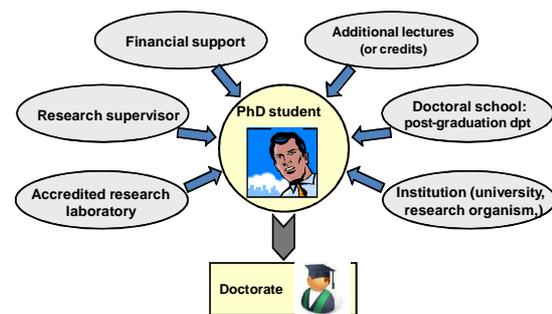


Figure 1. Main general conditions for preparing a doctorate. Not only the research environment is required. Credits of additional education or training may be required.

However, this approach reduces the education of the doctorate to a scientific work while several aspects are presently mandatory to well perform doctorate.

In addition of this scientific environment and scientific work, the doctors must have gained and also proved several skills and competences that could warranty their future job as well in an academic institution or research organism as in a Research and Development (R & D) service of an industrial company. These skills and competences are summarized in Figure 2. Discussions and comments were given in previous published studies [7,12]. However, it is important to notice that the main idea corresponds to the capability of the doctor to manage researches, not only thanks to scientific knowledge and knowhow, if possible close to "excellence", but also very good knowledge of the economical and industrial environment, high intrinsic knowledge including languages and communication.

Although the students are severely selected at the entrance of doctorate studies by the doctoral schools (or post-graduate schools) and the

associated research units, due to the permanent and very strong increasing of the general scientific level, additional or complementary knowledge and skills must be acquired during these studies; thus, one of the main roles of the doctoral school is to organize such additional education or training, to ensure the quality of the additional knowledge, or in other words the improvement of the global capabilities of the doctors [13]. The doctoral school [see for example 14] has to warranty their skills and competences with a large spectrum in order to cover all the aspects of their future job.

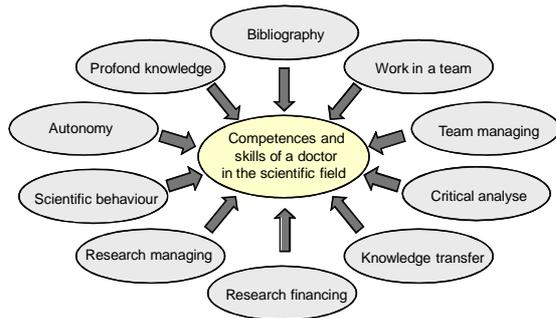


Figure 2. Required skills and competences at the Doctoral level [10]. Whatever the way to obtain the doctorate these skills and competences should be reached by the doctor.

The main question arisen at this stage is “is it possible to reach the same level of quality on the different aspects of the Doctoral level in the frame of LLL?” The following parts will try to give an answer to this question.

#### V. LLL AT THE DOCTORAL LEVEL

As above mentioned, the LLL at PhD level may exist under several paths to obtain the doctorate. Figure 3 shows the four main paths that can be considered to get a doctorate through a LLL approach.

The first path corresponds to the regular situation of the majority of PhD students and does not involve directly LLL. The students are selected among the best students of master degrees. Let us notice that they can be employed by the academic institution; in France, some of them are employed in the frame of a Doctoral contract, that corresponds to a work contract for the three years of the theoretical duration of the thesis.

The second path is strictly the same than the previous one but the students are selected after the master degree diploma obtained in the frame of APCL. In the case of APL, the students have not the master degree, but they are enrolled at the university thanks to an equivalent level.

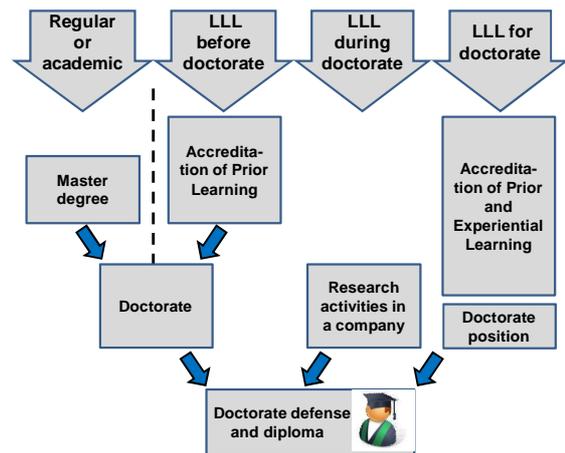


Figure 3. Several paths involving LLL to reach the doctorate diploma. The first path corresponds to the regular doctorate. The three others are considered as corresponding to lifelong learning approaches.

The third path is followed by students that are involved in a research work performed in both environments based on a partnership between a company and an academic laboratory. This is the most frequent situation in the field of electrical and information engineering. The main reason comes from the huge technological facilities needed to perform some of these works that are not available in a classical laboratory (microelectronics foundries, for example). In practice, with a serious partnership and a specific attention of the academic supervisors, the scientific work can be very close to the traditional thesis one. Because the student takes benefice of the industrial environment, for some European countries, this approach is assimilated to lifelong learning because the students can be an employee (full-time or part-time) of the company. This approach is in practice no so difficult to set-up and the LLL denomination can be opened to discussion.

The fourth way consists to validate the professional and scientific experience, mainly in a company, in order to minimize the duration of the PhD studies and to deliver the doctorate diploma. This approach is not easy, the main problems coming from the fact that doctorate duration in the EIE field ranges from three to four years depending of the national regulations. Even though the Bologna Declaration Communiqué [1] strongly recommends a three year formation in order to force the doctors to enter early in the economical world (an age if possible lower than thirty), it is frequent for the students to spend four years and sometimes more. But, the usual rules agreed by European Community and concerning the LLL mention the possible validation via APEL (accreditation of prior and experiential learning) after only three years of professional activities. This could mean that on the legal point of view, after only three years, it could be possible to get a diploma in a shorter duration than in regular student

position, this of course seems not serious from a scientific and academic point of view. If to obtain the master degree this rule appears well adapted, the validation for a doctorate should be non realistic, the usual professional position being not able to give in the majority of the cases a fulltime activity devoted to research like can be a regular student (except the mentioned previous case). That means that only after five to six years, the procedure can be launched; and an exception to the rule is therefore recommended. The new rules may be defined at the level of the academic institution that is expected to deliver the diploma of doctor. It is usually defined and adopted by the scientific council of the Institution.

The second point concerns the scientific quality of the previous research activities. A specific commission must be set-in to appreciate the resume of the candidate and mainly to evaluate the quality of the research production. For example, several papers in scientific and international journals or presentation in international conferences with published proceedings are required for a regular PhD before defence. In this case, the quality of research projects related to the concerned field and the production of patents can be taken into account.

The third point concerns the credits that are obtained during the doctorate studies. As it was well explained in previous paper [13], some additional lectures and complementary courses are organised during doctoral studies, with the goal to prepare the student to the economic world. If this approach appears mandatory to students that have spent all their studies in an academic environment, the consideration is different for candidates that have already a long professional experience in the companies. The candidate in the frame of LLL (and APEL) may have in this case at least a partial exemption. It is usually admitted that only some scientific higher level lectures or dedicated seminars (winter schools, summer schools, etc.) must be attended by the student during the short period of doctorate student position.

This means to set-in a specific procedure able to evaluate the professional experience of the candidate and opening the possibility to deliver the diploma.

#### VI. DIPLOMA ATTRIBUTION IN LLL APPROACH

The procedure must be set-in at the level of the institution, the main goal being to warranty the scientific quality of the diploma and an international recognition. In order to better explain the different aspects, we give the experience got at the University of Rennes 1 (France) for a candidate that applied to a doctorate in the field of electrical and information engineering.

Figure 4 shows the several administrative and legal steps that were followed to set-up the LLL.

The first step consists to understand the European and national regulations related to the project. The project is thus first analysed by the continuing education office that builds a procedure in agreement with the doctoral school management. This procedure should include an evaluation of the candidate and the way to organize the defence and the delivery of the diploma.

This project is then submitted for analysis by the office of legal affairs that has in charge to verify the respect of the European and National regulations in order to respect laws, decrees and ministerial orders.

From the definition of the general frame, the doctoral school management may define in detail a procedure that is in agreement with the scientific field and thus adapted to the discipline of the doctorate; let us notice that big difference remains between human/social sciences and “scientific” ones such as duration of the doctorate, contents and length of the thesis manuscript, scientific production (number of published papers in journals, conference presentation, etc.).

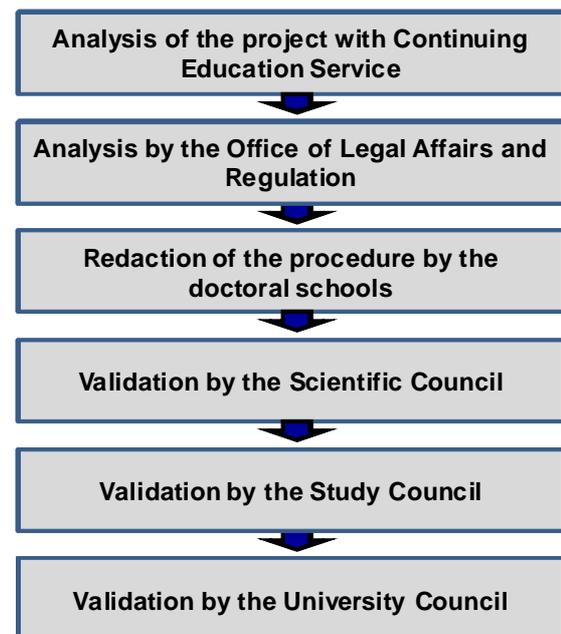


Figure 4. Administrative procedure for validating the LLL at the doctoral level in a French institution.

In addition, we may notice that the continuing education office pays attention to the registration fees to the diploma. The student must be enrolled at the institution that delivers the diploma and the proposed tuitions take into account the work needed for the global procedure. These fees can be paid by the student, but also in the frame of an agreement with the company, by the company. The amount is thus higher than in the case of usual students who are enrolled at least three years.

The last steps are more administrative than academic and scientific because the diploma must

be validated by the institution and these validations are mandatory.

Figure 5 shows the final procedure established for a LLL doctorate in the field of electronics and telecommunication at University of Rennes 1.

An ad-hoc commission is built and made of three members:

- the representative of the continuing education office,
- the director of the doctoral school,
- one expert, at least, of the institution involved in the same scientific specialty.

Let us note that this academic expert can be chosen among the expected supervisor.

The ad-hoc commission first validates and thus accredits the prior and experiential learning in the previous professional experience.

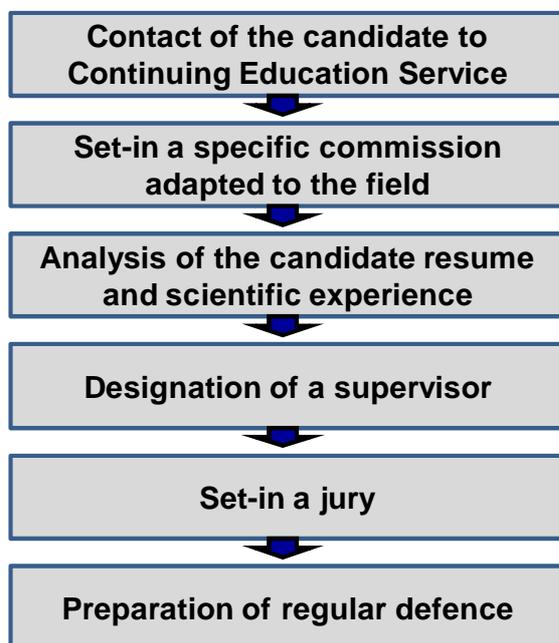


Figure 5. Path for a student applying to a doctorate via LLL. The global procedure may have duration close to one year including the redaction of the manuscript and the evaluation by the reviewers before the defence.

After this fundamental step, a supervisor is nominated; he will follow the last part of the thesis work, more especially the redaction of the manuscript, the possible complementary courses, the preparation of the defence, and the defence. The defence is organized differently according to the national regulations, as reported in the outputs of the EIE-Surveyor thematic network [3]. Nevertheless, everywhere in Europe, at least two external reviewers are selected and nominated by the President, Rector, or Director of the academic institution. These reviewers, after having agreed to do this task, must give the green light for the defence. They are somewhere a warranty of the scientific quality of the work. The attribution of the diploma is based on the written reports in the majority of the cases and finally proposed by the

jury to the President or Director of the academic institution.

This procedure was validated by University of Rennes 1 at mid 2010. The first candidate had applied at autumn 2010; he defended his thesis in January 2011. In practice, the proposed procedure takes about one year or a little bit less. This is a reasonable duration in comparison with the usual total duration of the doctorate.

## VII. CONCLUSION AND EXTENSION OF THE APPROACH TO ELLEIEC NETWORK ACTIVITIES

This mentioned reflexion is a starting point for European harmonization of doctorate studies in the frame of LLL and more especially in Electrical and Information Engineering. Of course, the first objective is to warranty the quality of the doctoral studies in such a field that means a high level of competencies in the dedicated domain. The doctoral studies and the institution delivering the doctorate are now evaluated. In France the new Evaluation Agency [15] is expected to evaluate the doctoral schools and the research units each five years. The criteria of the evaluation include the quality, the organisation of the validation of complementary courses and probably in a short future the capability to develop lifelong learning at this higher education level. A study on this evolution in Europe, in the field of electrical and information engineering has started in the frame of ELLEIEC network [8] issued of the EAEEIE association [16]. After the analysis of the situation of doctoral studies in all the European countries in the frame of EIE-Surveyor project [3], the second step will consist to analyse the differences between the lifelong learning approaches and how a European citizen could have access to the doctoral diploma whatever his (or her) European country origin and his (or her) institution. Of course, if some differences will remain, the most important point will be to ensure a quality of the diploma with an international recognition and available throughout the world.

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## REFERENCES

- [1] The Bologna Declaration on the European space for higher education: an explanation, 1999. [online]: <http://europa.eu.int/comm/education/policies/educ/bologna/bologna.pdf>

- [2] THEIERE Thematic Harmonisation in Electrical and Information Engineering in Europe; Nr. 10063-CP-1-2000-1-PT-ERASMUS-ETNE
- [3] EIE-Surveyor, reference point for electrical and information engineering in Europe, Project Nr. 22597-CP-1-2005-1-FR-ERASMUS-TNPP, <http://www.eie-surveyor.org/>
- [4] J.M. Thiriet *et al.*, Overview of Bologna Process Implementation in Europe In Electrical and Information Engineering (Bachelor, Master, Doctoral studies), Surveyor report, New Trends of Doctoral Studies in Europe: Special Considerations for the Field of Electrical and Information Engineering, ISBN 2-9516740-3-1, pp.15-21, 2009
- [5] London *Communiqué*, Towards the European Higher Education Area: responding to challenges in a globalised world, 18 May 2007, § 2.11.
- [6] J.-M. Thiriet, M. Robert, M. J. Martins, O. Bonnaud, EIE-Surveyor: a new Thematic Network dedicated to competences and accreditation in Electrical and Information, Engineering, Oral communication; EAEEIE'06; Craiova (Romania) ; 1-2 June 2006
- [7] O. Bonnaud, M. Hoffmann, New challenges of doctoral studies in Europe in the field of electrical and information engineering, Bologna Handbook. C4-4-4, N°12, 2009. Pp2-23
- [8] ELLEIEC: Enhancing Lifelong Learning for the Electrical and Information Engineering Community. Project number: 142814-LLP-1-2008-FR-ERASMUS-ENW.
- [9] Official Journal of the European Union No L327 of 24 November 2006
- [10] <http://dictionary.bnet.com/definition//Lifelong+Learning.html?tag=col1;rbDictionary>
- [11] <http://resources.glos.ac.uk/apply/apl/index.cfm>.<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:327:0045:0068:EN:PDF>
- [12] O. Bonnaud, Accreditation and functioning of French doctoral schools following the Bologna process in Electrical and Information Engineering, Oral communication; EAEEIE'06; Craiova (Romania) ; 1-2 June 2006, pp. 361-366.
- [13] O. Bonnaud, Complementary formations of Doctorate in Electrical and Information Engineering: Internal Credits or ECTS? Oral communication; EAEEIE'10; Palanga (Lithuania) 28-30 June 2010, Electronics and Electrical Engineering ISSN 1392 – 1215, 2010. No. 6(102)
- [14] <http://college-ed.univ-rennes.eu/>
- [15] The new French Agency for Assessment of Research (AERES) is now operational. [http://www.ambafrance-au.org/article.php?id\\_article=2227](http://www.ambafrance-au.org/article.php?id_article=2227)
- [16] European Association for Education in Electrical and Information Engineering, <http://www.eaeie.org>