



## **The External Evaluation Report of a Doctoral Study Domain**

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### **I. Introduction<sup>1</sup>**

In this chapter, the following shall be summarized:

- the context in which this external evaluation report was drafted (**the type of evaluation, the period of the evaluation visit, the composition of the Experts Committee** etc.);
- details about the doctoral school(s) of which the doctoral domain under review is part (number of doctoral advisors, number of students, institutional context, short history etc.);
- details about the doctoral study domain under review (number of students, institutional context, short history etc.).

Due to the restrictions of the pandemic crisis, the evaluation was mainly conducted online. Meetings were organized through the platform Zoom in Romanian but with a simultaneous translator service.

The Doctoral field of Computer Science and Information Technology (CIT) belongs to the Doctoral School of Automatic Control and Computers (SD-AC) that was established in 2012, but there is one researcher that belongs to the Doctoral School of Laser and Accelerator Engineering and Applications (SD-IALA). This doctoral school was established based on the partnership between the Polytechnic University of Bucharest (UPB), the National Research-Development Institute for Physics and Nuclear Engineering "Horia Hulubei" (IFIN-HH), the National Research-Development Institute for Laser, Plasma and Radiation Physics (INCDFLPR) and the National Research-Development Institute for Materials Physics (INCDFM).

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<sup>1</sup> Each time when applicable the information shall be presented gender-wise.



This evaluation report refers to the doctoral field of CIT that belongs to two Doctoral Schools.

Currently, the doctoral field has 20 coordinators from SD-AC plus 1 coordinator from SD-IALA, which makes 21 coordinators. The main research topics cover the following areas: modern computer architectures, cloud and fog computing architectures, security of computer systems and computer networks, data mining, computational linguistics and natural language processing, systems based on Virtual and Augmented Reality, development of IoT solutions and Cyber-physical systems, systems based on machine learning, development of service science and integration of solutions, intelligent robotics, e- Learning systems and computer systems in medicine.

CIT field currently hosts 170 students, and 62 doctoral students graduated from the doctoral program in the last 5 years.

## II. Methods used

This chapter will contain the methods and tools used in the external evaluation process, before and during the evaluation visit, including at least:

- The analysis of the internal evaluation report of the doctoral study domain under review and its

Annexes;

- The analysis of documents made available by the IOSUD, in physical format, during the evaluation visit (if such documents have been requested);
- The analysis of documents, data and information available on the IOSUD/Doctoral School(s) website, in electronic format;
- Visiting the buildings included in the institution's property, comprising (indicative and non- exhaustive list, which shall be changed according to the context):
  - classrooms;
  - laboratories;
  - the institution's library;
  - research centers;
  - the Career Counselling and Guidance Center;
  - lecture halls for students;
  - the student residences;
  - the student cafeteria;
  - sports ground etc.;
- Meeting/discussions with doctoral students in the doctoral study domain under review;
- Meeting/Discussions with the graduates of the doctoral study domain under review;
- Meeting/Discussions with employers of the graduates in the doctoral study domain under review;
- Meeting/Discussions with the school officials of the Doctoral School(s) in which the doctoral study domain under review is operating;
- Meeting/Discussions with the doctoral advisors in the doctoral study domain under review;



- Meeting/discussions with the representatives of the various structures of the IOSUD/Doctoral School(s) in which the doctoral study domain under review is operating:

- The Council of the Doctoral School, the University Senate, the Board of Directors, the Quality Assessment and Assurance Commission, the Quality Assurance Department, the Ethics Commission (including with the student representatives of these structures);
- the Career Counselling and Guidance Center;
- student organizations;
- secretariats;
- various departments/administrative offices (Social/Student residences-Cafeterias etc.);
- Application of questionnaires to doctoral students or academic staff in the doctoral study domain under review.

During the evaluation, the self- assessment report and provided annexes were used as the main elements for the evaluation. This information was complemented with additional documentation, such as the presentations displayed during the online meetings and the physical visit to the educational and research infrastructure.

The online meetings proceeded as scheduled with the different stakeholders: representatives of the institution and of the Council for Academic Doctoral Studies (CSUD), responsible of doctoral domain and the team who drafted the internal evaluation report, doctoral coordinators, PhD students, members of the Ethics Commission, members of the Commission for Quality Evaluation and Assurance, the Directors and persons in charge of the research centers/laboratories, Doctoral Studies Council, employers of doctoral graduates and graduates. The meetings were moderated by the evaluation team, and attendants answered to the question raised by the members of the evaluation panel. In general, all the meeting were satisfactorily carried out and the discussion with attendants helped to clarify the different issues raised by the evaluation members.

### **III. Analysis of ARACIS's performance indicators**

#### ***Domain A. INSTITUTIONAL CAPACITY***

SD-ETI has proven to adopt the institutional framework required by legal regulations to conduct the doctoral studies. The research infrastructure is adequate to support students and supervisors. During the last 5 years, the research production and visibility of the research staff evidence the required quality to support the training program and the research topics within the doctoral field.

#### **Criterion A.1. The administrative, managerial institutional structures and the financial resources**

The doctoral field of CIT has demonstrated that that the administrative and managerial structures have been implemented according to the general legal framework and the specific regulations of the two doctoral schools involved.



Moreover, advisors have proved their capacity to obtain research projects and grants that help to engage doctoral students. Finally, an appropriate percentage of external incomes are reinvested to support students' activities.

*Standard A.1.1. The institution organizing doctoral studies (IOSUD) has implemented the effective functioning mechanisms provided for in the specific legislation on the organization of doctoral studies.*

The doctoral schools of Automatic and Computers (SD-AC) and of Laser and Accelerator Engineering and Applications (SD-IALA) have both implemented satisfactorily the required functioning mechanisms established by the current legislation in Romania. Both doctoral schools have also defined and implemented their specific regulations and internal procedures for the correct management of doctoral studies.

**Performance Indicator A.1.1.1.** *The existence of specific regulations and their application at the level of the Doctoral School of the respective university doctoral study domain:*

*(a) the internal regulations of the Doctoral School;*

*(b) the Methodology for conducting elections for the position of director of the Council of doctoral school (CSD), as well as elections by the students of their representative in CSD and the evidence of their conduct;*

*c) the Methodologies for organizing and conducting doctoral studies (for the admission of doctoral students, for the completion of doctoral studies);*

*d) the existence of mechanisms for recognizing the status of a Doctoral advisor and the equivalence of the doctoral degree obtained abroad;*

*e) functional management structures (Council of the doctoral school), giving as well proof of the regularity of meetings;*

*f) the contract for doctoral studies;*

*g) internal procedures for the analysis and approval of proposals regarding the training for doctoral study programs based on advanced academic studies.*

There is a general regulation for the doctoral schools at UPB and a specific regulation for the Doctoral School of Automatic and Computers that are included as part of the complementary documentation of the self-assessment report. The legal framework is also explained in the website of the doctoral school (<http://doctorat.acs.pub.ro/en/>), accessible both in Romanian and English. The specific procedures for conducting elections and for organizing the doctoral studies are also explicitly addressed at this website. The admission procedures of national and international students are clearly established and publicly available as well as the contract for Doctoral Studies. Regarding the procedures to guarantee the quality of advisors, there are procedures to recognize the status of advisor and mechanisms to analyze the suitability of the doctoral study program and research lines. The Doctoral School of Laser and Accelerator Engineering and Applications (SD-IALA) have similar procedures accessible through its website (<https://www.nipne.ro/sdiala/>).

During the meetings with CSUD and the management team of the doctoral



school it was confirmed that the management structures of the Doctoral school are designed and implemented. The website informs about the annual meetings of the doctoral school.

As a recommendation, it is suggested to keep track of the doctoral school meetings using minutes of the meetings with a clear specification of date, attendants, agenda, decisions taken, and questions raised by the attendants. They can be provided as evidence for future evaluations.

***The indicator is fulfilled***

***Performance Indicator A.1.1.2. The doctoral school' Regulation includes mandatory criteria, procedures and standards binding on the aspects specified in Article 17, paragraph (5) of the Government Decision No. 681/2011 on the approval of the Code of Doctoral Studies with subsequent amendments and additions.***

The regulations of the SD-AC and SD-IALA cover aspects such as the acceptance of new leading members of the doctorate, the mechanisms for decisions-making, the procedures for changing the doctoral supervisor, the conditions to interrupt the doctorate program, the ways to prevent fraud in scientific research and the access to research resources. This information is accessible through the website of both doctoral schools.

There are no specific recommendations.

***The indicator is fulfilled***

***Standard A.1.2. The IOSUD has the logistical resources necessary to carry out the doctoral studies' mission.***

The IT system at the level of doctorate schools is fully implemented and keeps the records of students' admissions and progress. Additionally, all PhD supervisors and students are guaranteed the access to anti-plagiarism software, so they can freely use it to check the similarity index of their publications and thesis prior to the review process.

***Performance Indicator A.1.2.1. The existence and effectiveness of an appropriate IT system to keep track of doctoral students and their academic background.***

Doctoral schools have a student management system (<http://studenti.pub.ro/>) where they keep track of admissions and students' progress on the training program and research. Students can upload documents through this website so they can update their profiles, personal information and other data related to their doctoral studies.

Provided documents illustrate how the systems works. There are no specific recommendations.

***The indicator is fulfilled***



**Performance Indicator A.1.2.2.** *The existence and use of an appropriate software program and evidence of its use to verify the percentage of similarity in all doctoral theses.*

Doctoral Schools have access to anti-plagiarism software Turnitin, which is available to all PhD supervisors. Students can access to this software through their supervisors' accounts.

Complementary documents show evidence of the accessibility of Turnitin and how its managed to provide access to students.

During the meetings with supervisors and students, it was confirmed the availability of this anti- plagiarism software.

There are no specific recommendations.

***The indicator is fulfilled***

**Standard A.1.3.** *The IOSUD makes sure that financial resources are used optimally, and the revenues obtained from doctoral studies are supplemented through additional funding besides governmental funding.*

The doctoral field reveals the participation in research projects and grants that engage doctoral students and help to support their training program, publications and participation in conferences.

**Performance Indicator A.1.3.1.** *Existence of at least one research or institutional / human resources development grant under implementation at the time of submission of the internal evaluation file, per doctoral study domain under evaluation, or existence of at least 2 research or institutional development / human resources grant for the doctoral study domain, obtained by doctoral thesis advisors operating in the evaluated domain within the past 5 years. The grants address relevant themes for the respective domain and, as a rule, are engaging doctoral students.*

A total of 12 research grants were obtained by doctoral supervisors of the CTI field in the last 5 years. During the meetings with students and graduates, it was evidenced their participation in such research projects.

There are no specific recommendations.

***The indicator is fulfilled***

**Performance Indicator \*A.1.3.2.** *The percentage of doctoral students active at the time of the evaluation, who for at least six months receive additional funding sources besides government funding, through scholarships awarded by individual persons or by legal entities, or who are financially supported through research or institutional / human resources development grants is not less than 20%.*

64 students have received additional funding besides government funding during the last 5 years, which represents 35.75 % of students. Therefore, the indicator is accomplished.

The self-assessment report lists the funding sources and the number of engaged students. There are no specific recommendations.

***The indicator is fulfilled***



**Performance Indicator \*A.1.3.3.<sup>2</sup>** *At least 10% of the total amount of doctoral grants obtained by the university through institutional contracts and of tuition fees collected from the doctoral students enrolled in the paid tuition system is used to reimburse professional training expenses of doctoral students (attending conferences, summer schools, training, programs abroad, publication of specialty papers or other specific forms of dissemination etc.).*

The amount of doctoral grants reinvested in doctoral students is calculated to be 40%, far beyond the limit of 10%. The calculation considers the co-funding of the University to some projects for doctoral students as well as the co-funding for publications and participation in conferences. The self-assessment report details the quantities reinvested to support students in each case.

There are no specific recommendations.

***The indicator is fulfilled.***

## **Criterion A.2. Research infrastructure**

The doctoral field has proved to have an adequate research infrastructure to support the research work of doctoral students. Student have also access to the most relevant electronic resources in the field of Computer Science and Information Technology.

*Standard A.2.1. The IOSUD has a modern research infrastructure to support the conduct of doctoral studies' specific activities.*

The doctoral field has proved to have an adequate research infrastructure to support the research work of doctoral students. Student have also access to the most relevant electronic resources in the field of Computer Science and Information Technology.

**Performance Indicator A.2.1.1.** *The venues and the material equipment available to the doctoral school enable the research activities in the evaluated domain to be carried out, in line with the assumed mission and objectives (computers, specific software, equipment, laboratory equipment, library, access to international databases etc.). The research infrastructure and the provision of research services are presented to the public through a specific platform. The research infrastructure described above, which was purchased and developed within the past 5 years will be presented distinctly.*

The infrastructure at the disposal of doctoral students includes the research laboratories of the Automation and Computers faculty, the research spaces organized by the Research Centers of the Automation and Computers faculty, the research center for innovative intelligent products, processes and services (PRECIS), built in 2014/2015,

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<sup>2</sup> The indicators marked with an asterisk (\*) hold a special status, referring exclusively to the evaluation of doctoral studies domains, as per Article 12 from the annex No.1 of the Order of the minister of education No. 3651/12.04.2021 approving the Methodology for evaluating university doctoral studies and the system of criteria, standards and performance indicators used in the evaluation. In case they are not met, the Agency extends a period of maximum 3 years to IOSUD to correct the respective deficiencies.



and the Interdisciplinary Center for Advanced Research for Innovative Materials, Products and Processes (CAMPUS).

More specifically, the PRECIS building represented a big improvement of the infrastructure, with a new research space of 8750 sqm including labs, a conference hall, meeting rooms and offices. The PRECIS datacenter supports the computing and storage services needed for teaching and research. The details of this datacenter as well as the details of the old datacenter has been provided to the evaluation panel and they have enough computation capability to support artificial intelligence research topics.

Students have also online access to international databases and electronic scientific resources relevant in the doctoral field.

Finally, the doctoral school has two collaboration agreements with the Transilvania University of Brasov and with IBM for the partnership operation of infrastructures

There are no specific recommendations.

***The indicator is fulfilled.***

### **Criterion A.3. Quality of Human Resources**

*Standard A.3.1. At the level of each domain there are sufficient qualified staff to ensure the conduct of doctoral study program.*

Almost all the supervisors of the doctoral field meet the standards set by CNATDCU and the majority of them are tenures holders within IOSUD. Therefore, the quality of human resources guarantees the development of the doctoral study program. As a recommendation, it should be avoided an excessive number of PhD students supervised by the same advisors.

***Performance Indicator A.3.1.1. Minimum three doctoral thesis advisors within that doctoral domain, and at least 50% of them (but no less than three) meet the minimum standards of the National Council for Attestation of University Degrees, Diplomas and Certificates (CNATDCU) in force at the time when the evaluation is carried out, which standards are required and mandatory for obtaining the enabling certification.***

95.24% of the doctoral supervisors meet the criteria, so the indicator is more than met.

There are no specific recommendations.

***The indicator is fulfilled.***

***Performance Indicator \*A.3.1.2. At least 50% of all doctoral advisors have a full-time employment contract for an indefinite period with the IOSUD.***

16 out of 21 PhD supervisors of the doctoral field are tenures holders within IOSUD, which means 76.19% of the supervisors. Therefore, the indicator is above the 50% required.

Employee certificates are presented in the complementary documentation. There are no specific recommendations.





**The indicator is fulfilled.**

**Performance Indicator A.3.1.3.** *The study subjects in the education program based on advanced higher education studies pertaining to the doctoral domain are taught by teaching staff or researchers who are doctoral thesis advisors / certified doctoral thesis advisors, professors / CS I or lecturer / CS II, with proved expertise in the field of the study subjects they teach, or other specialists in the field who meet the standards established by the institution in relation with the aforementioned teaching and research functions, as provided by the law.*

The disciplines in the training program are supported by teachers or researchers who have the quality of doctoral / qualified supervisor, professor/CS I or associate professor/CS II with proven expertise in their fields and meet the standards set by the institution.

There are no specific recommendations.

**The indicator is fulfilled.**

**Performance Indicator \*A.3.1.4.** *The percentage of doctoral thesis advisors who concomitantly coordinate more than 8 doctoral students, but no more than 12, who are themselves studying in doctoral programs<sup>3</sup> does not exceed 20%.*

Four PhD supervisors currently coordinate more than 8 PhD students but less than 12. Given that there are 21 supervisors, this gives the value of 19.05% which is below the limit but borderline.

As a recommendation, it is suggested to better distribute PhD students among supervisors to reduce the value of this indicator.

**The indicator is fulfilled.**

**Standard A.3.2.** *The Doctoral advisors within the domain are carrying out a scientific activity visible at international level.*

Doctoral supervisors reveal an active scientific production and international visibility during the last 5 years over the required standards. The majority of the research staff keeps researching and participate in research events.

**Performance Indicator A.3.2.1.** *At least 50% of the doctoral thesis advisors in the evaluated domain have at least 5 Web of Science- or ERIH-indexed publications in magazines of impact, or other achievements of relevant significance for that domain, including international-level contributions that indicate progress in scientific research - development - innovation for the evaluated domain.*

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<sup>3</sup> 3 years for the doctoral university studies with the duration stipulated at Article 159, paragraph (3), respectively 4 years for the doctoral university studies with the duration stipulated at Article 174, paragraph (3) of the Law of national education No.1/2011 with subsequent amendments and additions, with additional extension periods approved as per Article 39, paragraph (3) of the Code of doctoral studies approved by the GD No. 681/2011 with subsequent amendments and additions.



*The aforementioned doctoral thesis advisors enjoy international awareness within the past five years, consisting of: membership on scientific boards of international publications and conferences; membership on boards of international professional associations; guests in conferences or expert groups working abroad, or membership on doctoral defense commissions at universities abroad or co-leading with universities abroad. For Arts and Sports and Physical Education Sciences, doctoral thesis advisors shall prove their international visibility within the past five years by their membership on the boards of professional associations, membership in organizing committees of arts events and international competitions, membership on juries or umpire teams in artistic events or international competitions.*

19 out of 21 doctoral supervisors have at least 5 significant publications relevant in the doctoral field. Even many of them reveals a high scientific production in high ranked journals and conferences. 15 out of 21 meet the part referred to international visibility, consisting of membership in scientific committees of international publications and conferences, membership in the boards of international professional associations, guest status within the conferences, participation in experts panels held abroad or as a member of some commissions for defending doctoral theses at foreign universities or in co-supervision with a foreign university-

Annexes details the list of publications and events that prove the international visibility. There are no specific recommendations.

***The indicator is fulfilled.***

***Performance Indicator \*A.3.2.2. At least 50% of the doctoral thesis advisors in a specific doctoral study domain continue to be active in their scientific field, and acquire at least 25% of the score requested by the minimal CNATDCU standards in force at the time of the evaluation, which are required and mandatory for acquiring their enabling certificate, based on their scientific results within the past five years.***

20 out of 21 supervisors accomplish the minimal CNATDCU standards. Data is provided in the complementary documentation.

There are no specific recommendations.

***The indicator is fulfilled.***

## **Domain B. EDUCATIONAL EFFECTIVENESS**

*\*general description of domain analysis.*

The educational effectiveness of the doctoral domain is demonstrated by the number of enrolled students each year, with a low dropout rate, and the scientific production, which validates the quality of the research work.



## **Criterion B.1. The number, quality and diversity of candidates enrolled for the admission contest**

The capacity of attraction of external students is above the required limit, but the doctoral field should work on improving this indicator. The selection process is carefully implemented according to the established regulations and its successful implementation is confirmed by the low dropout rate. The training program is monitored by the Quality Assessment and Monitoring Commission and compulsory subjects about Ethics and research methodology are included as part of the training of doctoral students.

*Standard B.1.1. The institution organizing doctoral studies has the capacity to attract candidates from outside the higher education institution or a number of candidates exceeding the number of seats available.*

The capacity of attraction of external students that belong to other higher education institutions is above the required threshold. Yet, as the value of the indicator is close to the limit, it is recommended to take actions for increasing the number of external students.

**Performance Indicator \*B.1.1.1.** *The ratio between the number of graduates of masters' programs of other higher education institutions, national or foreign, who have enrolled for the doctoral admission contest within the past five years and the number of seats funded by the state budget, put out through contest within the doctoral domain is at least 0.2 or the ratio between the number of candidates within the past five years and the number of seats funded by the state budget put out through contest within the doctoral studies domain is at least 1,2.*

This indicator measures the capacity of attraction of graduates coming from other higher education institutions different to the one organizing the doctoral studies. The ratio in the last 5 years is

0.27. Although the value is above the threshold of 0.2, it is close to the limit.

Supplementary documentation details the number of external students enrolled in the doctoral studies in the last 5 years, showing a stable value around 11 external students per year.

As a recommendation, it is suggested to plan actions in order to attract more external students to the doctoral studies.

***The indicator is fulfilled.***

*Standard B.1.2 Candidates admitted to doctoral studies demonstrate academic, research and professional performance.*

The admission procedure considers the candidates' previous academic results, CV and motivation. All the documents submitted are values along with a personal interview by a commission of the doctoral field. It is worth mentioning the low value of the dropout rate, which means that the admission process carried out selected motivated students willing to finish their PhDs.



**Performance Indicator \*B.1.2.1.** Admission to doctoral study programs is based on selection criteria including: previous academic, research and professional performance, their interest for scientific or arts/sports research, publications in the domain and a proposal for a research subject. Interviewing the candidate is compulsory, as part of the admission procedure.

The admission procedure is publicly available at the web site of the doctoral school. The examination for the admission in the Ph.D. study program consists of an oral presentation of the candidate's research activity, of the bibliography studied, and of a scientific direction in which the doctoral thesis would be finalized. This presentation is followed by a clarifying discussion of the candidate with the members of the examination jury in the doctorate domain. A personal interview is carried out at pre- defined time intervals. Candidates are evaluated about their professional level and knowledge in the domain, the capacity to assess major orientations in the proposed research and the capacity to formulate solutions and working out methods and tools (theoretical and experimental) for a research theme.

The admission criteria and all the documents that candidates should submit are clearly stated.

There is also a separate regulation for candidates from non-EU countries.

During the online sessions with students and graduates there was no complain about the admission procedures and it was confirmed that the process takes place according to the established regulations.

There are no specific recommendations.

***The indicator is fulfilled.***

**Performance Indicator B.1.2.2.** The expelling rate, including renouncement / dropping out of doctoral students 3, respectively 4, years after admission<sup>4</sup> does not exceed 30%.

The dropout rate 2 years after admission is calculated to be 4.26%. The indicator reported in the self-assessment report probably refers to an old version of the indicator (this is why they consider 2 years after admission instead of 3 and 4). Anyway, the value is low enough to consider that the dropout rate will be also under the limit for the new version of the indicator.

There are no specific recommendations.

***The indicator is fulfilled.***

## **Criterion B.2. The content of doctoral programs**

The training program is adequate and includes the compulsory subject about Ethics and Intellectual Property and Research Methodology and Scientific Authorship. However, the specific subjects' program should explicitly include the learning outcomes. Students receive a adequate guidance from staff and there is enough human resources to support the required guidance. It is also advisable to increase the number of PhD advisors.



*Standard B.2.1. The training program based on advanced university studies is appropriate to improve doctoral students' research skills and to strengthen ethical behavior in science.*

The training program is adequate and includes the compulsory subject about Ethics and Intellectual Property. However, the specific subjects' program should explicitly include the learning outcomes. Students receive a adequate guidance from staff. Although there is enough human resources to support the required guidance, it is recommended to increase the number of PhD advisors to effectively handle the admitted students.

***Performance Indicator B.2.1.1. The training program based on advanced academic studies includes at least 3 disciplines relevant to the scientific research training of doctoral students; at least one of these disciplines is intended to study in-depth the research methodology and/or the statistical data processing.***

The training program consists of 5 compulsory subjects: two specialized disciplines (8 ECTS each) established by the doctoral supervisor, and three specific subjects on Research Methodology and Scientific Authorship (4 ECTS), Ethics of Scientific Research and Intellectual Property (6 ECTS).and Project Management (4 ECTS). As stated by the indicator, one of the disciplines is about research methodology. All of them are relevant in the context of the doctoral domain. The curricula of the three specific disciplines have been provided to the commission.

There are no specific recommendations.

***The indicator is fulfilled.***

***Performance Indicator B.2.1.2. At least one discipline is dedicated to Ethics and Intellectual Property in scientific research or there are well-defined topics on these subjects within a discipline taught in the doctoral program.***

There is a compulsory discipline dedicated to Ethics of Scientific Research and Intellectual Property. Its curriculum was provided as complementary documentation.

There are no specific recommendations.

***The indicator is fulfilled***

***Performance Indicator B.2.1.3. The IOSUD has mechanisms to ensure that the academic training program based on advanced university studies addresses „the learning outcomes”, specifying the knowledge, skills, responsibility and autonomy that doctoral students should acquire after completing each discipline or through the research activities<sup>5</sup>.***

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<sup>4</sup> 3 years for the doctoral university studies with the duration stipulated at Article 159, paragraph (3), respectively 4 years for the doctoral university studies with the duration stipulated at Article 174, paragraph (3) of the Law of national education No. 1/2011 with subsequent amendments and additions.



The Quality Assessment and Monitoring Commission is responsible of analyzing, in conjunction with the PhD advisor, the learning plan for each PhD student. The aim is to finish the training program within the first 3 months of the doctoral degree program. The commission also collects feedback information from students once they finish de training program.

The disciplines' curricula detail the competencies, skills and abilities that doctoral students should acquire after completing the subjects. The complementary material in the cloud provides as an example the curricula of the compulsory disciplines of the training program.

As a recommendation, the disciplines' curricula should explicitly address the learning outcomes that students are expected to achieve. Currently, they include the competences. But while competences generally describe the desirable knowledge, learning outcomes are a more specific description of what students will be able to do in some measurable way.

### ***The indicator is fulfilled***

***Performance Indicator B.2.1.4.*** All along the duration of the doctoral training, doctoral students in the domain receive counselling/guidance from functional guidance commissions, which is reflected in written guidance and feedback or regular meeting.

Students are under the close guidance of their advisors and the guidance commissions. This point is demonstrated by the number of joint publications of the doctoral student with at least one of the members of the guiding commission. The guiding commission works with the doctoral supervisor to define the structure and content of the research program and assists the doctoral student during the entire doctoral program.

During the meetings with students and graduates, it was confirmed that they keep regular meetings with the advisors and, in general, they were satisfied with the tutoring activities.

There are no specific recommendations.

### ***The indicator is fulfilled***

***Performance Indicator B.2.1.5.*** For a doctoral study domain, the ratio between the number of doctoral students and the number of teaching staff/researchers providing doctoral guidance must not exceed 3:1.

The value of this ratio is 2,75:1, which is below the limit. Nevertheless, and given the number of doctoral students admitted in the field of CTI every year (last year it was 41), it is advisable to increase the research staff of the doctoral field. Otherwise, the number of students per PhD advisor will increase to much in the near future.

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<sup>5</sup> Or by what the graduate should know, understand and to be able to do, according to the provisions of the Methodology of 17 March 2017 regarding inscription and registration of higher education qualifications in the National Register of Qualifications in Higher Education (RNCIS) approved by the Order No.3475/2017 with subsequent amendments and additions.



As a recommendation, the doctoral school should consider increasing the number of PhD advisors to reduce the ratio.

***The indicator is fulfilled***

### **Criterion B.3. The results of doctoral studies and procedures for their evaluation.**

Productivity of doctoral students that finished their PhD over the last 5 years is adequate, with many publications in high ranked journal and conferences that guarantee the quality of research. Foreign researchers regularly participate in the evaluation commissions with no over-representation of a specific researcher.

*Standard B.3.1. Doctoral students capitalize on the research through presentations at scientific conferences, scientific publications, technological transfer, patents, products and service orders.*

The scientific production of the doctoral field is high. Provided documentation proves that there are joint publications in high ranked journals and conferences between students and supervisors, and they are related to the topic of the doctoral field.

***Performance Indicator B.3.1.1.*** For the evaluated domain, the evaluation commission will be provided with at least one paper or some other relevant contribution per doctoral student who has obtained a doctor's title within the past 5 years. From this list, the members of the evaluation commission shall randomly select 5 such papers / relevant contributions per doctoral study domain for review. At least 3 selected papers must contain significant original contributions in the respective domain.

The website of the doctorate school has a complete list of the publications generated by PhD students and graduates ordered by supervisors (<http://doctorat.acs.pub.ro/en/scientific-production/scientific-articles/>). Many of them are published in high ranked journals (JCR Q1). The selection of a sample of publications reveal that they are related to the topics of research of the doctoral field with novel contributions in the area.

There are no specific recommendations.

***The indicator is fulfilled***

***Performance Indicator \*B.3.1.2.*** The ratio between the number of presentations of doctoral students who completed their doctoral studies within the evaluated period (past 5 years), including posters, exhibitions made at prestigious international events (organized in the country or abroad) and the number of doctoral students who have completed their doctoral studies within the evaluated period (past 5 years) is at least 1.

There are 28 doctoral students who completed their doctoral studies in the period



2016-2020 with about 70 presentations, so the value of the indicator is higher than 1.

There are no specific recommendations.

***The indicator is fulfilled***

*Standard B.3.2. The Doctoral School engages a significant number of external scientific specialists in the commissions for public defense of doctoral theses in the analyzed domain.*

The doctoral school keeps contact with international experts that regularly participates in the public defense of doctoral theses. Additionally, they are distributed over the defended doctoral thesis so that there no over representation of a specific foreign researcher.

***Performance Indicator \*B.3.2.1. The number of doctoral theses allocated to one specialist coming from a higher education institution, other than the evaluated IOSUD should not exceed two (2) in a year for the theses coordinated by the same doctoral thesis advisor.***

Supplementary documentation of the 28 theses defended by PhD students in the field of Computers & Information Technology reveals that external examiner from other higher education institutions different to UPB regularly participate as members of the evaluation commission and that any of them have more than 2 participations.

There are no specific recommendations.

***The indicator is fulfilled***

***Performance Indicator \*B.3.2.2. The ratio between the doctoral theses allocated to one scientific specialist coming from a higher education institution, other than the institution where the defense on the doctoral thesis is organized, and the number of doctoral theses presented in the same doctoral study domain in the doctoral school should not exceed 0.3, considering the past five years. Only those doctoral study domains in which minimum ten doctoral theses have been presented within the past five years should be analyzed.***

The ratio between the number of doctoral theses assigned to a external experts coming from a higher education institution different to UPB and the number of doctoral theses defended in the doctoral field is below 0.3. Supplementary documentation in the cloud lists the thesis defended by the 28 graduates in the last 5 years and their respective evaluation commissions.

There are no specific recommendations.

***The indicator is fulfilled***

## **Domain C. QUALITY MANAGEMENT**





The quality assurance system has been designed and implemented following the legal framework, the general framework for doctoral studies elaborated by the Quality Service of IOSUD UPB and the internal procedures of the doctoral schools. The transparency and accessibility of information is guaranteed through the doctoral schools' websites, that record all the legal framework, procedures and updated information of interest to doctoral students. Finally, the internationalization of the doctoral school is supported by the agreements with foreign institutions and co-supervision agreements.

### **Criterion C.1. Existence and periodic implementation of the internal quality assurance system**

There is a defined framework for Quality Assurance, with procedures that have been implemented. The framework includes procedures for collecting information about students and advisors, the training program and the infrastructure. There are also procedures to detect deficiencies and an Action Plan to handle the detected deficiencies, with a specific person responsible to keep track of the actions and a deadline.

*Standard C.1.1. There are an institutional framework and procedures in place and relevant internal quality assurance policies, applied for monitoring the internal quality assurance.*

There is a defined framework for Quality Assurance, with procedures that have been implemented. The framework includes procedures for collecting information about students and advisors, the training program and the infrastructure. There are also procedures to detect deficiencies and an Action Plan to handle the detected deficiencies, with a specific person responsible to keep track of the actions and a deadline.

***Performance Indicator C.1.1.1. The Doctoral school in the respective university study domain shall demonstrate the continuous development of the evaluation process and its internal quality assurance following a procedure developed and applied at the level of the IOSUD, the following assessed criteria being mandatory:***

- (a) the scientific work of Doctoral advisors;*
- (b) the infrastructure and logistics necessary to carry out the research activity;*
- (c) the procedures and subsequent rules based on which doctoral studies are organized;*
- d) the scientific activity of doctoral students;*
- e) the training program based on advanced academic studies of doctoral students;*
- f) social and academic services (including for participation at different events, publishing papers etc.) and counselling made available to doctoral students.*

The general framework for doctoral studies is defined by the operational procedure "Internal evaluation and monitoring of the evolution of doctoral schools", elaborated by the Quality Service of IOSUD UPB. The SD-AC has implemented this



general framework in a set of procedures for monitor the evolution of the doctoral school. The Commission for evaluation and internal quality monitoring in SD-AC (CEMSD) has 3 members: one scientific leader from the two doctoral domains of the school and one doctoral student. There is a self-evaluation score sheet that every year both supervisors and students must submit to CEMSD. This commission also is in charge of collecting questionnaires related to the students satisfaction and every year elaborates the Annual Report for the evaluation and monitoring of the evolution of the doctoral school, which analyzes all the procedures and activities developed for the year. This report contains the action plan to remedy the detected deficiencies.

The meetings with PhD supervisors and students confirmed that the procedures are implemented, and information is collected.

There are no specific recommendations.

***The indicator is fulfilled***

***Performance Indicator \*C.1.1.2. Mechanisms are implemented during the stage of the doctoral study program to enable feedback from doctoral students allowing to identify their needs, as well as their overall level of satisfaction with the doctoral study program in order to ensure continuous improvement of the academic and administrative processes. Following the analysis of the results, there is evidence that an action plan was drafted and implemented.***

The Operational Procedure for the Internal Evaluation and Monitoring of the Evolution of the Doctoral Schools defines the doctoral satisfaction assessment questionnaires for the training program and for the scientific research program. They collect information about students' needs and their level of satisfaction. Specific forms for assessing the satisfaction of doctoral students regarding the advanced training program and the scientific research program are provided as evidence. There is also a specific form for the action plan where, for each detected deficiency, there is a definition of the measures to prevent such deficiency, a deadline for the implementation of the selected strategy a responsible to keep track of the changes. All the information about regulations, advisor and research lines is available through the website of the Doctoral School of Automation and Computers AD-AC (<http://doctorat.acs.pub.ro/>) and the Doctoral School of Engineering and Applications of Lasers and Accelerators SD-IALA (<https://www.nipne.ro/sdiala/>). The content is well structured, and information can be easily found. However, the website of SD-IALA should be available in English.

There are no specific recommendations.

***The indicator is fulfilled***

## **Criterion C.2. Transparency of information and accessibility of learning resources**

All the information about regulations, advisor and research lines is available through the website of the Doctoral School of Automation and Computers AD-AC (<http://doctorat.acs.pub.ro/>) and the Doctoral School of Engineering and Applications of Lasers and Accelerators SD-IALA (<https://www.nipne.ro/sdiala/>). The content is



well structured, and information can be easily found. However, the website of SD-IALA should be available in English. Students have also access to the electronic resources through international databases and UPB library, to anti-plagiarism software and labs and equipments required for their research.

*Standard C.2.1. Information of interest to doctoral students, future candidates and public interest information is available for electronic format consultation.*

All the information about regulations, advisor and research lines is available through the website of the Doctoral School of Automation and Computers AD-AC (<http://doctorat.acs.pub.ro/>) and the Doctoral School of Engineering and Applications of Lasers and Accelerators SD-IALA (<https://www.nipne.ro/sdiala/>). The content is well structured, and information can be easily found. However, the website of SD-IALA should be available in English.

**Performance Indicator C.2.1.1.** *The IOSUD publishes on the website of the organizing institution, in compliance with the general regulations on data protection, information such as:*

- (a) the Doctoral School regulation;*
- (b) the admission regulation;*
- (c) the doctoral studies contract;*
- (d) the study completion regulation including the procedure for the public presentation of the thesis*
- (e) the content of training program based on advanced academic studies*
- (f) the academic and scientific profile, thematic areas/research themes of the Doctoral advisors within the domain, as well as their institutional contact data*
- (g) the list of doctoral students within the domain with necessary information (year of registration; advisor)*
- (h) information on the standards for developing the doctoral thesis*
- (i) links to the doctoral theses' summaries to be publicly presented and the date, time, place where they will be presented; this information will be communicated at least twenty days before the presentation*

The website of the doctoral school includes information about the doctoral school regulations, admission regulations, the regulations for completing the studies, including the procedure for public defense of the thesis, the content of study programs, the scientific profile and research interests/topics of the doctoral supervisors and the list of doctoral students. All the information is available in Romanian and English at <http://doctorat.acs.pub.ro/>

The summaries of the doctoral theses to be defended publicly, as well as the date, time, place where they will be defended, at least 20 days before the defense, are available at the URL <https://upb.ro/doctorat/teze-de-doctorat/>

The other doctoral school that covers the doctoral domain SD-IALA has its own webpage at <https://www.nipne.ro/sdiala/>

As a recommendation, the SD-IALA website should be also available in English.

***The indicator is fulfilled***



*Standard C.2.2. The IOSUD/The Doctoral School provides doctoral students with access to the resources needed for conducting doctoral studies.*

Students have access to the electronic resources through international databases and UPB library, to anti-plagiarism software and labs and equipments required for their research.

***Performance Indicator C.2.2.1. All doctoral students have free access to one platform providing academic databases relevant to the doctoral studies domain of their thesis.***

UPB participates in the ANELIS Plus 2020 National Project (<http://www.anelisplus.ro>) to benefit from online access to scientific electronic resources. The list of available electronic resources relevant to the doctoral domain of CSI are: Science Direct, Springerlink Journals, IEEE All-Society, Clarivate Analytics, SCOPUS, Wiley Journals and Emerald Journals. Students can also access the ROLiNeST catalog, the largest virtual catalog of bibliographic references in Romania.

During the meetings it was confirmed that both advisors and students have access to electronic databases.

There are no specific recommendations.

***The indicator is fulfilled***

***Performance Indicator C.2.2.2. Each doctoral student shall have access, upon request, to an electronic system for verifying the degree of similarity with other existing scientific or artistic works.***

All PhD supervisors have access to the software Turnitin and offer all PhD students, upon request, access to verify the similarity of their works. Through the online meetings, students confirm its availability.

There are no specific recommendations.

***The indicator is fulfilled***

***Performance Indicator C.2.2.3. All doctoral students have access to scientific research laboratories or other facilities depending on the specific domain/domains within the Doctoral School, according to internal order procedures.***

All doctoral students have permanent access to the research laboratories available at the doctoral schools. In the case of shared resources (e.g., cloud platforms), access should be planned in advance. There is a specific procedure to access the HPC Center from the NCIT Research Center of the A&C Faculty of UPB (<https://cluster.grid.pub.ro/index.php/home>), which is one of the most high-performance computing platforms in Romania

There are no specific recommendations.

***The indicator is fulfilled***

### **Criterion C.3. Internationalization**



The internationalization of the doctoral school is supported by the agreements with foreign institutions so that local students can have internships abroad, by the co-supervision agreements and by the participation in public support commissions for doctoral and habilitation theses in prestigious foreign universities.

*Standard C.3.1. There is a strategy in place and it is applied to enhance the internationalization of doctoral studies.*

The internationalization of the doctoral school is supported by the agreements with foreign institutions so that local students can have internships abroad, by the co-supervision agreements and by the participation in public support commissions for doctoral and habilitation theses in prestigious foreign universities.

**Performance Indicator \*C.3.1.1.** *IOSUD, for every evaluated domain, has concluded mobility agreements with universities abroad, with research institutes, with companies working in the field of study, aimed at the mobility of doctoral students and academic staff (e.g., ERASMUS agreements for the doctoral studies). At least 35% of the doctoral students have completed a training course abroad or other mobility forms such as attending international scientific conferences. IOSUD drafts and applies policies and measures aiming at increasing the number of doctoral students participating at mobility periods abroad, up to at least 20%, which is the target at the level of the European Higher Education Area.*

The doctoral domain of CTI keeps ERASMUS agreements with other Higher Education Institutions. 2 students have completed internships abroad and 100 presentations were made at conferences and scientific events. 47,22% of students have done mobilities in the last 5 years.

Data about ERASMUS agreements and mobilities are provided in the supplementary documentation.

There are no specific recommendations.

***The indicator is fulfilled***

**Performance Indicator C.3.1.2.** *In the evaluated doctoral study domain, support is granted, including financial support, to the organization of doctoral studies in international co-tutelage or invitation of leading experts to deliver courses/lectures for doctoral students.*

Supplementary documentation shows that there are 4 co-supervision agreements in the field of Computers and Information Technology already finished and 5 in progress.

There are no specific recommendations.

***The indicator is fulfilled***

**Performance Indicator C.3.1.3.** *The internationalization of activities carried out during the doctoral studies is supported by IOSUD through concrete measures (e.g., by participating in educational fairs to attract international doctoral students; by*



including international experts in guidance committees or doctoral committees etc.).

There are 9 international experts from prestigious universities in Europe who were members in the commissions for public support of doctoral theses in the field of CTI. Also, The PhD supervisors in the field of Computers and Information Technology participated in public support commissions for doctoral and habilitation theses in prestigious foreign universities (in Europe). Evidence is provided in the supplementary documentation.

There are no specific recommendations.

**The indicator is fulfilled**

#### IV.SWOT Analysis

<p><b><u>Strengths:</u></b></p> <ul style="list-style-type: none"> <li>- The dropout rate is quite low, which means that the admission process is carefully implemented and motivated students are finally admitted.</li> <li>- The high volume and quality of the research production</li> </ul>	<p><b><u>Weaknesses:</u></b></p> <ul style="list-style-type: none"> <li>- The capacity of attraction of external students remains low and should improved.</li> </ul>
<p><b><u>Opportunities:</u></b></p> <ul style="list-style-type: none"> <li>- The presence of many technological companies able to support and fund PhDs closely related to their activities</li> <li>- European actions, such as Marie Curie, represent an opportunity to attract talent.</li> </ul>	<p><b><u>Threats:</u></b></p> <ul style="list-style-type: none"> <li>- The low number of PhD advisor given the number of students admitted each year. It is recommended to increase the number of advisors to prevent an excessive work load.</li> </ul>

#### V.Overview of judgments awarded and of the recommendations

No	Type of indicator (*, C)	Performance indicator	Judgment	Recommendations
1		A.1.1.1	Fulfilled	<p>it is suggested to keep track of the doctoral school meetings using minutes of the meetings with a clear specification of date, attendants, agenda, decisions taken and questions raised by the attendants.</p> <p>They can be provided as evidence for future evaluations</p>

2		A.1.1.2	Fulfilled	
3		A.1.2.1	Fulfilled	
4		A.1.2.2	Fulfilled	
5		A.1.3.1	Fulfilled	
6	*	A.1.3.2	Fulfilled	
7	*	A.1.3.3	Fulfilled	
8	C	A.2.1.1	Fulfilled	
9	C	A.3.1.1	Fulfilled	
10	*	A.3.1.2	Fulfilled	
11		A.3.1.3	Fulfilled	
12	*	A.3.1.4	Fulfilled	it is suggested to better distribute PhD students among supervisors to reduce the value of this indicator
13	C	A.3.2.1	Fulfilled	
14	*	A.3.2.2	Fulfilled	
15	*	B.1.1.1	Fulfilled	it is suggested to plan actions in order to attract more external students to the doctoral studies
16	*	B.1.2.1	Fulfilled	
17		B.1.2.2	Fulfilled	
18		B.2.1.1	Fulfilled	
19		B.2.1.2	Fulfilled	
20		B.2.1.3	Fulfilled	the disciplines' curricula should explicitly address the learning outcomes that students are expected to achieve. Currently, the include the competences. But while competences generally describe the desirable knowledge, learning outcomes are a more specific description of what students will be able to do in some measurable way
21		B.2.1.4	Fulfilled	
22	C	B.2.1.5	Fulfilled	the doctoral school should consider increasing the number of PhD advisors to reduce the ratio
23	C	B.3.1.1	Fulfilled	
24	*	B.3.1.2	Fulfilled	
25	*	B.3.2.1	Fulfilled	
26	*	B.3.2.2	Fulfilled	
27		C.1.1.1	Fulfilled	
28	*	C.1.1.2	Fulfilled	
29	C	C.2.1.1	Fulfilled	the SD-IALA website should be also available in English



30		C.2.2.1	Fulfilled	
31		C.2.2.2	Fulfilled	
32		C.2.2.3	Fulfilled	
33	*	C.3.1.1	Fulfilled	
34		C.3.1.2	Fulfilled	
35		C.3.1.3	Fulfilled	

*The recommendations contained in the report shall be resumed in the indicators' analysis. Other general recommendations may be made that do not fit within a particular indicator.*

*VERY IMPORTANT!!! – Each identified weakness must be correlated with at least one recommendation to improve the situation!*

## **VI. Conclusions and general recommendations**

*Several important issues raised during the evaluation are resumed and some general conclusions are drawn on the quality of the education provided within the doctoral study domain under review; the Experts' Panel also presents general assessments about the institution. Other general recommendation may also be presented, which cannot be related to a specific indicator and have not been presented at point V.*

*A decision is proposed, together with the reasons for granting it (if the Experts' Panel members do not reach a consensus, each of them can propose and argue his/her own decision).*

## **VII. Annexes**

*The following types of documents shall be attached:*

- The detailed schedule of the evaluation visit – MANDATORY.*
- The survey questionnaire applied to doctoral students or academic staff in the doctoral study domain under review, the results - optional (e.g., in graphic form) and their interpretation - if applicable.*
- Scanned documents – any document requested from the IOSUD during the evaluation visit and received, which is not found in the internal evaluation file received before the visit and referred to in the report.*
- Pictures – if relevant issues are raised regarding the condition of the student residences, cafeterias, premises for teaching and learning activities, library etc.*
- Screenshots/Print screens of the Doctoral School/IOSUD website proving specific claims in the report, accompanied by the date when they were accessed and saved.*
- Any other documents relevant to the evaluation process referred to in the report.*

*Sergio Toral Marín*