

The External Evaluation Report of a Doctoral Study Domain

Contents

- I. Introduction
- II. Methods used
- III. Analysis of performance indicators
- IV. SWOT Analysis
- V. Overview of judgments awarded and of the recommendations
- VI. Conclusions and general recommendations
- VII. Annexes

I. Introduction¹

- **Institution:** Romanian Academy
- **Evaluation type:** evaluation of doctoral studies
- **Domain assessed:** Mechanical Engineering
- **Duration of the evaluation:** 25 October - 5 November 2021
- **Evaluators:**
 - Prof. Sorin-Ştefan BIRIŞ, "Politehnica" University of Bucharest - coordinator
 - Prof. Jorg NIEMANN, Dusseldorf University of Applied Sciences, Germany - international expert
 - Nicoleta Daciana GENCĂRĂU, University of Craiova - student representative

The Romanian Academy is an institution organizing doctoral studies (IOSUD) through the Doctoral School "School of Advanced Studies of the Romanian Academy" (SCOSAAR), established according to the Decision of the President of the Romanian Academy of 3.03.2011, at the proposal of the board of the Romanian Academy and the General Assembly of 22.10.2010 and the decision of the board of the Romanian Academy no. 4 / 1.03.2011, pursuant to GD 681/2011. The organization of doctoral studies is based on the SCOSAAR regulations, approved by the board and the General Assembly of the Romanian Academy. SCOSAAR offers the doctoral degree to be obtained in 16 areas of doctoral studies including Mechanical Engineering in the Fundamental Engineering Sciences.

The scientific council of the Romanian Academy (CSUD) comprises:

- the director of CSUD (President of SCOSAAR) - Acad. Bogdan C. Simionescu,
- 8 members proposed by the directors of the 8 departments:
 - Department of Exact Sciences- Acad. Maria-Magdalena Zaharescu
 - Department of Life, Medical and Agricultural Sciences- Acad. Octavian Popescu
 - Department of Humanities - CSII Dr. Marius-Augustin Drăghici
 - Department of Economic, Social and Legal Sciences - Prof. Gheorghe Zaman, mcof RA (deceased)
 - Department of Engineering, Mechanical and Computer Sciences -Prof univ Tudor Sireteanu, mc of AR
 - Iasi-Acad Branch Department. Bogdan C. Simionescu
 - Cluj-Napoca Branch Department- Prof univ. Ioan Bolovan, mc of AR
 - Timisoara Branch Department- CSI Dr. Otilia Costisor

¹ Each time when applicable the information shall be presented gender-wise.

According to the SCOSAAR statutes, the Mechanical Engineering field is part of the doctoral school associated with the "Department of Engineering, Mechanical and Computer Sciences".

The mission of the doctoral programme is to carry out and develop higher education activities at doctoral level and implicitly in-depth scientific research for the benefit and progress of the society by training specialists (PhDs) in Engineering Sciences in the field of Mechanical Engineering. The aim is to educate engineers with competences specific to the professional career in this field in line with the requirements of the labour market as well as transversal competences. According to similar study programmes implemented by prestigious universities abroad students should gain rich professional experience during the doctoral studies and which will be certified with the award of the doctoral degree.

The field of Mechanical Engineering has currently 6 PhD supervisors from IOSUD who are employed on permanent contracts.

The recruitment of doctoral students is based on the process of "Methodology for the organisation and conduct of the admission competition for doctoral studies", followed by an internal evaluation. Over the evaluated period 33 Ph.D. students have been admitted to the field of Mechanical Engineering. 21 PhD students received a grant. Within the period under review 7 PhD degrees have been awarded. All PhDs published articles and participated in national and international scientific events.

The doctoral scientific research is supported by the research laboratories of the Institute of Solid Mechanics of the Romanian Academy:

- "Laboratory for vibration and noise testing and measurement",
- "Materials Testing Laboratory",
- "Ultrasound Laboratory",
- "Mechatronics, Robotics Laboratory" and
- "Tribology, Microtribology, Medical Tribology Laboratory".

In addition there is a collaboration with the ICECON research laboratories. The research laboratories are affiliated to the Mechanical Engineering PhD students. Both, the laboratories and the Ph.D. students benefit from the research infrastructure and the academic/educational support in their individual scientific research programmes. The infrastructure of the five research laboratories is visible both on the laboratories' own websites and on the EERIS platform.

II. Methods used

Basis for the evaluation were the Internal Evaluation Report (IER), the Supplementary Internal Evaluation Report (REI_revised) and the online meetings/visits with stakeholders of the studies. The materials and meetings delivered the information necessary to assess the compliance with ARACIS standards and performance criteria. Additionally, information related to the management of the quality system of the Romanian Academy, public information for students, as well as information related to research centres or scientific activity has been taken from web pages of IOSUD and the institutes.

Findings from the visit to the institution

The evaluator Prof. Niemann did not personally visit the institutions.

Findings from the meeting with the person in charge of the doctoral programme evaluated and the team that produced the internal evaluation report

- The doctoral field evaluated has a good endowment and a scientifically performing teaching staff with a rich activities
- Main threats that could affect activity in the near future are the demographic decline and the competition in the economic and academic environment which affects the attraction of candidates for Ph.D. applications. Also the financial funding for doctoral programmes can not be predicted.
- Even though the number of allocated places for Ph.D. is limited (and low), the competition among applicants is quite high and currently the number of admitted candidates is quite high. Most applicants to the Mechanical Engineering PhD field come from outside
- It is intended to initiate and develop international co-tutelage for the supervision of doctoral students.
- It has been pointed out that the 3-year doctoral training period in the Mechanical Engineering doctoral field is -in general- insufficient, especially in the difficult conditions of recent years.

Findings from the meeting with the members of the IOSUD Doctoral Studies Council (CSUD) and the members of the Doctoral School Council (CSD)

- Currently, the Romanian Academy has a Doctoral School called "School of Advanced Studies of the Romanian Academy" (SCOSAAR).
- According to the organizational chart in the SCOSAAR statutes, the Mechanical Engineering field is part of the doctoral school associated with the "Department of Engineering, Mechanical and Computer Sciences". The organization of doctoral studies differs from the organizational structures of Romanian universities.
- Currently there are scientific collaborations with research institutes and universities in Romania and abroad (e.g. Germany, France, China, USA, Austria, Netherlands, England, etc.);

- Emphasis is put on addressing topics for doctoral theses with practical applicability;
- The panelists pointed out that the 3 year Ph.D. programme is too short taking into account the deep research activities as well as the scientific activities of publications and the writing the theses etc. The panelists proposed a 4 year programme (minimum).
- It is highlighted that PhD students in Mechanical Engineering accept participation in internships and international mobility funded by projects at IMS;
- Many topics of the doctoral theses have a multidisciplinary and interdisciplinary character resulting from the concerns of the doctoral supervisors, the suggestions of the collaborative partners (industry, academia) and the desire of the doctoral students;
- The panelists also underlined the importance and opportunities resulting from co-supervision of PhD students;

Findings from the meeting with teaching staff in the evaluated field

- The teaching staff involved in the Mechanical Engineering field is satisfied with the working environment and career development prospects, and the collaboration within the doctoral school is very good;
- There is a good collaboration between PhD supervisors and PhD students in writing scientific papers published in prestigious journals and in volumes of scientific events;
- PhD supervisors participate largely in national and international research project competitions with a high success rate;
- The international visibility and collaboration might be improved in parallel with attracting foreign students. Increased activities in mobility programmes might be a good source to foster an international mindset and to attract international Ph.D. students.
- Co-tutelage is performed in national collaborations with research partners from e.g. T. Cluj- Napoca, University of Pitesti, "Transilvania" University of Brasov as well as on international level with e.g. Italy, Czech Republic, China, Sweden, etc.
- A modification of the CNATDCU minimum criteria should be considered with regard to publications and conference participations.
- The Ph.D. topics/structure emphasize the applied and interdisciplinary nature of the theses. The topics of the theses meet and address industrial problems

Findings from the meeting with representatives of graduates in the field

- The graduates pointed out the usefulness and the quality of the trainings offered for their later career.
- The graduates also highlighted the excellent collaboration, guidance and tutelage during all Ph.D. stages.
- The graduates consider the programme as an excellent promotion for their career in academia as well as in industrial research centres.

- The graduates mentioned that 3 years to complete the training period and the thesis was not enough to run through the programme.

Findings from the meeting with representatives of employers of graduates in the field

- The meeting was attended by 2 representatives of the employers of graduate-doctoral students in the field of Mechanical Engineering (director of ICECON and the director of the Department of Mathematics and Computer Science at Transilvania University of Brasov). Unfortunately no “industrial stakeholder” was present.
- The Mechanical Engineering Ph.D. graduates are an important source in the search for new talents. The quality of graduates is excellent concerning their technical skills and to carry out research activities on a high level. The quality of this education programme is being recognized.
- ICECON is one of the main “customers” for hiring the graduates and is running a cooperation with the Institute of Solid Mechanics. Both institutes have joint research activities and a long partnership.
- The national/international mobility is seen as an essential part of the educational system to gain different experiences, establish networks, team and research skills. The mobility is part of the personality of the graduates and is a benefit for the later employers.
- The employers emphasized the need/importance to get involved in the definition of Ph.D. topics from the beginning to ensure industrial/practical relevance of the research.
- Employers see increasing activities of employees to additionally qualify with a Ph.D. programme for senior position in research or management (including “team lead”, “head of....”).

Findings from the meeting with doctoral students

- In general the discussions has shown that the students are very satisfied with the training framework and the relationships with PhD supervisors or teachers.
- Access to documentation resources, materials, equipment is considered very good. The guidance and care of the of PhD supervisors is excellent.
- The IMS encourages scientific activity and mobility, especially in the form of publishing articles or participating in conferences. Many of the PhD students completed research internships abroad at universities (3-6 months) or have taken online training courses or are involved in research projects with foreign universities.
- A 360° degree feedback system is currently implemented allowing students to also evaluate their teachers and supervisors at SCOSAAR.
- The Ph.D. topics will be fixed and discussed with the PhD supervisors.
- The students present reported that they got admission via a colloquium consisting of motivational aspects, previous and future research ambitions.

- The doctoral students highlighted the usefulness of the courses in the advanced degree-based training programme.

Findings from meeting with directors/managers of research centres/laboratories

- Those present (directors or heads of research centres and laboratories) were of the opinion that the doctoral field evaluated has a very good endowment.
- IMS laboratories and their equipment are registered on the ERRIS platform which allows their visibility at national and international level. The research laboratories have close collaborations with similar laboratories at other universities in the country and abroad.
- The research labs also include PhD students in the research teams and the research topics are related to the topics of the PhD theses. All laboratories substantially contribute to the funding of PhDs (materials, travel, computing equipment, consumables, equipment maintenance-repair, etc.). There is free access, by appointment, for PhD students to research centres and laboratories.
- The laboratories are also staffed by auxiliary personnel (technicians and laboratory technicians).
- There is a close collaboration with ICECON laboratories.

III. Analysis of ARACIS's performance indicators

Domain A. INSTITUTIONAL CAPACITY

The Doctoral School (Institute of Solid Mechanics) of the Romanian Academy, which manages the field of Mechanical Engineering, has a proven excellent capacity to organize doctoral studies at an appropriate level with an adequate management system. The school provides adequate materials, equipment and financial resources necessary for a stable operation. An information systems allows the registration of doctoral students and a tracking of their academic career. The system also allows to identify plagiarism in scientific theses and papers. The school provides (or generates) research grants and is visible on national and international level to ensure the fulfillment of the mission and objectives.

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

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.

From the analysis of the REI, the REI_revised and its annexes, based on the assessment of the fulfilment of the indicators included in this standard, SCOSAAR, i.e. the Doctoral School of the Institute of Solid Mechanics of the Romanian Academy that manages the field of Mechanical Engineering, has implemented and effectively uses regulations, methodologies, structures and procedures, in accordance with the legislation in force concerning doctoral studies.

The indicator is fulfilled

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;*

See: <https://acad.ro/scosaar/doc2013/doc2013-0910Regulament.pdf>

(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;*

Currently there is no applicable method or process for the elections in operation for both, the election of the position of the director of the CSD or student representatives in CSD. In the SCOSAAR regulations and the organization chart it can be found that the Mechanical Engineering field is part of the PhD School associated with the "Department of Engineering, Mechanical, Computer Sciences". A list of all PhD supervisors of the Mechanical Engineering field is being provided who elect student in the SSC every two years.

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

The recruitment of doctoral students is based on the "Methodology for the organisation and Conduct of the competition for admission to doctoral studies", in force at the time of the internal evaluation, (<http://imsar.ro/wp-content/uploads/2021/10/Metodologie-admission-Doctorate.pdf>, <http://imsar.ro/higher-learning/>), respectively in Annex 3_supplementary. <https://acad.ro/scosaar/doc2021/MetodologiiScosaar/2Metodologi-PhDThesisSupport/2METODOLOGY.pdf>
<https://acad.ro/scosaar/doc2021/MetodologiiScosaar/1Ghid-RedactareTezaDoctorat/GHID-WritingDoctoralThesis.pdf>
<https://acad.ro/scosaar/doc2021/MetodologiiScosaar/3Metodologie-StudentDoctorand/3METODOLOGY.pdf>

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

The regulations are documented here:

<https://acad.ro/scosaar/doc2021/MetodologiiScosaar/6MecanismeRecunoastereCalitatiiConducatorDoctorat.pdf>

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

According to the SCOSAAR regulations and the organizational chart, the Mechanical Engineering field is part of the "Department of Engineering, Mechanical, Computer Sciences" (Annex_2_Supplementary) Meetings at IMS AR are convened regularly twice a year and whenever necessary (According to Supplementary Annex Minutes).

- f) *the contract for doctoral studies;*

Information is provided here: <http://imsar.ro/higher-learning/>

Further: According to the supplementary Annex:Supplementary_Appendix_Contract-with-type-2021, Supplementary_Appendix_Contract-without-stip-2021

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

Information is provided:

<https://acad.ro/scosaar/doc2021/MetodologiiScosaar/8Metodologie-AnalysisApprovalThemes.pdf>

Recommendations:

It is recommended to set-up and publish a transparent methodology for the organisation and execution of elections of the institutional representatives (SSC director, SSC members and students)

The indicator is partially 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.*

By comparing art. 17(5) of GD No 681/2011 on the approval of the Code of Doctoral Studies, with subsequent amendments and additions, with the Regulation on the organization and conduct of doctoral studies in SCOSAAR, the following correspondence is noted:

SCOSAAR and SD-IMec at IMS AR have the necessary logistical resources to fulfil the mission of doctoral studies, i.e. the effective use of a computer system to keep track of doctoral students and their academic career and software to identify plagiarism.

Recommendations:

The indicator is fulfilled

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.*

Within SCOSAAR there is a computer system in the Doctoral Department, called the Single Register, which is updated annually. Also, at the department secretariat (IMS AR) each doctoral candidate has a file in electronic format. (cf. REI_revised, pages 18-19).

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.*

SCOSAAR has a high-performance computer program and qualified personnel to verify the similarity percentage.

Recommendations:

The indicator is fulfilled

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.*

The Department (SD-IM) does not earn any income from doctoral studies as it does not charge any fees for them, except for the registration fee or for the issue of the doctoral diploma (PhD registration fee 100 lei, thesis fee 600 lei paid to IMS, the fee for the issue of the diploma is charged and paid to AR, equivalent to 15 Euro). Some PhD students may

receive scholarships (stipends) from the RA, according to the provisions of Regulation_SCOSAAR_2013.

According to REI_revised p.19 in Mechanical engineering 9 research grants have been/are being carried out In the evaluation period. 5 ongoing research grants and contracts are in place.

Recommendations: Increase the international activities to attract students from foreign countries
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%.*

From the REI_revised it can be stated that the proportion of students who receive other fundings than governmental is 21.43%.

Recommendations: See above, try to attract international students to increase this number and try to attract industry to fund students (part time working models, research contracts etc.)

The indicator is fulfilled

Performance Indicator *A.1.3.3.² *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.).*

At SCOSAAR there are no doctoral grants and no fee-paying doctoral students. Training expenses (participation in conferences, summer schools, courses, internships abroad, publication of scholarly articles or other specific forms of dissemination, etc.) is made from research contracts.

Recommendations: Continue efforts to win research grants and contracts to ensure that funds are allocated for the training of doctoral students at an appropriate level. And/or: Monetize the special research knowledge by offering paid trainings in specific fields to e.g. industrial customers.

The indicator is fulfilled

Criterion A.2. Research infrastructure

² 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.

The IOSUD-AR/ Doctoral School of IMS AR has a modern research infrastructure including high-performance equipment to support the conduct of doctoral studies' specific activities.

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 spaces and the material endowment allocated to the PhD in Mechanical Engineering allow to carry out research activities in accordance with the mission and objectives assumed.

The Institute of Solid Mechanics has 5 research laboratories. All five research laboratories are present on the governmental platform Engage in the Romanian Research Infrastructures System (ERRIS), providing international visibility of the research, development and innovation infrastructure available to the PhD field, in line with the National Strategy for Research, Development and Innovation.

Recommendations: Strengthen and further develop the research infrastructure by continuing the collaboration with ICECON. Consider maybe "virtual research labs" by collaborations with other national/international labs using modern IT network connections to get access/grant access to other labs for research (e.g. sharing computer performance, getting access to high performance computing, doing material analyses via other labs and virtual connections etc. Additionally create service offerings for industrial customers (e.g. analyses/metrology for small/medium sized industry who do not have the equipment).

The indicator is fulfilled

Criterion A.3. Quality of Human Resources

**general description of the criterion analysis.*

Standard A.3.1. At the level of the Mechanical Engineering PhD field there are sufficient qualified staff to ensure the conduct of doctoral study program. All 6 PhD supervisors meet the CNATDCU standards in force. No supervisor supervises more than 8 PhD students at the same time.

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.*



According to REI all 6 PhD supervisors fulfil the national minimum standards for habilitation according to MENCS Order 6129/2016, the percentage being 100%.

Recommendations: Continue efforts to attract new PhD supervisors in Mechanical Engineering
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.*

The internal evaluation report shows that all 6 PhD supervisors are employed with an employment contract for an indefinite period.

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 REI_revised shows that the subjects of the advanced degree programme in Mechanical Engineering are taught by PhD/certified teachers with proven expertise in the field of the subjects taught.

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 programs³ does not exceed 20%.*

REI_revised shows that no PhD supervisor in the department (IMS AR) coordinated more than 7 PhD students concurrently

Recommendations:
The indicator is fulfilled

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

³ 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.

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. 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.*

The revised REI_revised shows that all 6 PhD supervisors demonstrate a minimum of five publications indexed by Web of Science or ERIH and all PhD supervisors demonstrate the international visibility they enjoy.

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.*

The REI_revised shows that all 6 scientific leaders (100%) have obtained more than 25% of the score required by the minimum standards of the field, necessary and mandatory for obtaining the habilitation certificate.

Recommendations:

The indicator is fulfilled.

Domain B. EDUCATIONAL EFFECTIVENESS

At the Doctoral School for the doctoral field of study Mechanical Engineering the topics, content and methods as well as the didactic and research processes are organized to achieve the results stated in the mission and objectives. PhD graduates have competences at EQF/CNC level 8. Scientific articles or other relevant contributions by PhD students have significant original contributions to the field of Mechanical Engineering. The field of Mechanical Engineering has the capacity to attract at least 20% of applicants from other institutions.

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

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.

IOSUD AR through IMS AR has the capacity to attract at least 20% of the candidates from other institutions. The number of applications was higher than the number of available seats.

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.

From the existing data the ratio between the number of applicants in the last five years (33) and the number of places funded from the state budget (21) offered for doctoral studies in Mechanical Engineering is 1.57. Since the RA does not have a Bachelor's or Master's degree, it follows that 100% of the candidates are graduates of other universities.

Recommendations:

The indicator is fulfilled.

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

All admitted candidates run through an evaluation procedure to demonstrate academic research history and professional ambitions for future research.

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 analysis of the documents as well as the online interviews showed that the selection of students is being performed on a competitive basis by interviews and presentations of the candidates.

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 admission⁴ does not exceed 30%.

From the existing data in the REI_revised and from interviews, the average drop-out rate 3 years after admission is 5.5%. Therefore, the rate of dropouts of PhD students in Mechanical Engineering is below 30%.

⁴ 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.

Recommendations:

The indicator is fulfilled

Criterion B.2. The content of doctoral programs

**general description of the criterion analysis.*

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.

From the analysis of the 5 indicators, it can be seen that the training programme based on advanced undergraduate studies includes disciplines relevant to the scientific research training of PhD students, including a discipline dedicated to ethics in scientific research.

Throughout the doctoral training period, doctoral students are advised by mentoring committees consisting of a sufficient number of suitably qualified and experienced doctoral supervisors and researchers. The interviews showed that the skills learned are considered very valuable from both students and later employers.

All indicators are fulfilled.

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 programme includes methodological subjects of scientific research and academic ethics and integrity, as well as disciplines relevant to training in scientific research in the doctoral field of Mechanical Engineering. The offer of disciplines is made annually. After attending the activities which are included in the training programme, PhD students are required to obtain a total of 30 credits. The curriculum also includes the discipline "Applied Engineering Statistics".

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.*

The discipline "Ethics and Academic Integrity" is introduced in the training program for PhD students

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 activities⁵.

The knowledge, skills, responsibility and autonomy is being specified in REI_revised. Online discussion have shown that the qualifications have been acquired and are highly appreciated by students and employers.

Recommendations: It is recommended to consider an extension of the trainings in accordance with later career ambitions of the students. It might be considered to prepare the students with additional training modules for management positions and team leadership as well/or for technical leadership positions

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.

The Scientific Council of the Department establishes a mentoring committee for each doctoral student that monitors and guides the work throughout the doctoral studies. The committee provides support to doctoral students both in the preparation phase of examinations and scientific reports, and for the dissemination of the results of doctoral research, as well as in the phase of elaboration and completion of the doctoral thesis

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 ratio of PhD students to the total number of supervising teachers/researchers is 33:21=1.57:1

Recommendations:

The indicator is fulfilled

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

**general description of the criterion analysis.*

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

⁵ 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.



The results obtained by doctoral students during their doctoral internship are disseminated through publication in indexed journals, volumes of international conferences indexed by ISI or BDI, etc. Doctoral students also participate in prestigious national/international events. Articles or other relevant achievements of PhD students have significant original contributions in the field of Mechanical Engineering.

All indicators are fulfilled

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.*

All 5 selected articles are judged to have significant original contributions to the field of Mechanical Engineering

Recommendations: Increase the number of articles in high profile journals

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.*

7 PhD students completed their PhD studies in the field of Mechanical Engineering in the period. Their number of presentations during this period is 32. This means a ratio of 4.57

Recommendations: More publications shall be considered

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.*

For Mechanical Engineering, a significant number of external scientific referees are used in the PhD thesis committees.

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.*

From the "List of reviewers from another institution" it can be seen that the number of doctoral theses assigned to a particular reviewer from a higher education institution other than the evaluated IOSUD does not exceed two (2) for theses coordinated by the same doctoral supervisor in one year.



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.*

7 doctoral theses have been defended in the last five years (not 10 minimum). However, the maximum value of the ratio between the number of PhD theses assigned to a given scientific advisor from outside the IMS AR and the number of PhD theses defended in the same field of doctoral studies in the doctoral school is $0.295 < 0.3$

Recommendations:

The indicator is fulfilled

Domain C. QUALITY MANAGEMENT

The Doctoral School effectively applies policies and procedures for internal quality assurance. It provides doctoral students with access to the resources necessary for doctoral studies. The school has defined a strategy for increasing the internationalization of doctoral studies and publishes these information and data on its website. The degree of internationalisation of doctoral studies is considered to be good. The low number of theses carried out in international cotutelle might be improved.

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

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.

The institutional framework allows, for the field of Mechanical Engineering, conducting the internal quality assessment and assurance process based on its own procedures. Evaluation mechanisms have been implemented aiming at identifying the needs as well as the overall level of satisfaction of doctoral students with the doctoral programme. Mechanisms are in place to collect feedback from doctoral students and, based on their analysis an action plan will be developed and implemented.

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;*

Doctoral advisors are being evaluated on an annual basis.

(b) *the infrastructure and logistics necessary to carry out the research activity;*

The IMS AR ensures access for doctoral students to its material, teaching and research base, as stipulated in the Doctoral Studies Contract. The research laboratories are

equipped with the equipment and logistics specific to the field, necessary for carrying out the scientific work of doctoral students at the highest standards. There are also laboratories registered on the ERRIS platform. In order to carry out scientific activities, PhD students can use the facilities offered by the IMS AR Research Laboratories as well as in the research laboratories of ICECON Bucharest (institutional partnership agreement). The members of the research laboratories are PhD coordinators, teachers who are members of the supervision committees and PhD students.

(c) *the procedures and subsequent rules based on which doctoral studies are organized;*
Defined rules and regulations are in place and enforced

d) *the scientific activity of doctoral students;*

The students research activities are published on national/international events and publications. Defined indicators are in place and measured.

e) *the training program based on advanced academic studies of doctoral students;*

There is no defined operational procedure available for the evaluation and monitoring of the training programme.

f) *social and academic services (including for participation at different events, publishing papers etc.) and counselling made available to doctoral students.*

IMS AR supports from research projects the participation of PhD students in various scientific events, the publication of scientific articles

Recommendations: Develop operational procedures for internal evaluation and monitoring of SCOSAAR's advanced degree-based training program for doctoral students.

The indicator is partially 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.*

Currently there seems to be no procedure in place to evaluate the satisfaction of doctoral students towards the learning environment. The school is currently developing/implementing a 360 degree feedback system that allows to measure and evaluate student needs and satisfaction.

Recommendations: Develop a procedure to evaluate the satisfaction of doctoral students with the learning environment and periodically produce a report on the needs and satisfaction of doctoral students to improve the doctoral program.

The indicator is (currently) partially fulfilled

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

In order to ensure transparency of information and accessibility to learning resources, SCOSAAR and IMS AR use several types of online resources. These can be found at <https://acad.ro/scosaar/scosaar.html> and <http://imsar.ro/higher-learning/>. On these platforms all the necessary information is available including for PhD students and supervisors. The information is also constantly updated and the aim is to make the transmission of data more fluid, the presentation of information more transparent and to limit the number of meetings with the secretariat.

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

SCOSAAR and IMS AR publish on their websites information relevant and helpful to candidates in the field of Mechanical Engineering.

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.*

For the Mechanical Engineering doctoral program of SCOSAAR, IMS AR publishes on the web- site <http://imsar.ro/higher-learning/> information all information listed above.

Recommendations:

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.

SCOSAAR and IMS AR provide PhD students with access to research infrastructure, software systems, relevant academic databases for documentation, including for Mechanical Engineering.

All indicators are fulfilled

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.*

SCOSAAR provides access to the services. All doctoral students have free access to platforms with academic databases relevant to the fields of organised doctoral studies

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.*

Each PhD student has access, upon request and with the agreement of the PhD supervisor, to an electronic system for checking the degree of similarity with other existing scientific or artistic creations.

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.*

From the online discussions with PhD students and supervisors, it can be assumed that all PhD students of Mechanical Engineering have access to the scientific research laboratories and other facilities of IMS AR under the PhD contract. Experimental research and computational applications are supervised by the PhD supervisor.

Recommendations:

The indicator is fulfilled

Criterion C.3. Internationalization

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

At SCOSAAR and IMS AR partnership agreements with universities and research institutes from abroad are in place for the mobility of PhD students and supervisors. For the field of Mechanical Engineering, internationalisation is supported through various measures (inviting foreign experts to thesis committees, participation in international research projects, participation in international scientific events, participation in training periods abroad, etc.).

All indicators are fulfilled

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.

13 PhD students in the field of Mechanical Engineering, representing 39% of the PhD students, carried out a training period abroad or another form of mobility, such as participation in international scientific conferences. Five out of the seven PhD students who completed their PhD studies during the period evaluated carried out training periods abroad or participated in international scientific conferences (71.4%).

Recommendations: Increase the number of trainings abroad for doctoral students to a level of min. 1 activity/mobility abroad per year.

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.*

From the revised REI_revised (p. 26) and the online meetings PhD students were supported to participate in courses and lectures given by leading experts at international academic institutions (e.g. Cina, India etc.) International co-tutelage of Ph.D. theses is still underdeveloped.

Recommendations: increase number of co-tutelage doctorates

The indicator is partially 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.).*

The internationalization of the activities in the doctoral studies is supported in particular by the international collaboration of the Institute of Solid Mechanics in which both IMS AR doctoral students and those from the partners are involved: Yanshan University (Qinhuangdao, China), University of New Mexico (New Mexico, USA).

Recommendations: to intensify internationalisation actions by including international experts in committees for the supervision or defence of doctoral theses, theses carried out in international co-tutelle, etc.

The indicator is fulfilled

IV. SWOT Analysis

<u>Strengths:</u>	<u>Weaknesses:</u>
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<ul style="list-style-type: none"> -Excellent infrastructure -Highly qualified staff -Good co-operations with academic partners -Good visibility in scientific community national/international -Large number of international collaborations in research projects. 	<ul style="list-style-type: none"> -Attraction of foreign students for Ph.D. programme -No doctoral grants, low number of scholarships -Small number of regular lectures held by international experts from abroad -Reduced number of long term mobilities
<p><u>Opportunities:</u></p> <ul style="list-style-type: none"> -Broad areas of research -Industrial relevance of research activities might be more monetarized -Large expertise might be used for the design of services for industry (e.g. training, metrology) -Collaborations might be extended to virtual research networks by using digital tools to extend research capacity. -Extension of mechanical engineering towards business related aspects: Potentials of new research fields in "industrial engineering". -Modification of educational programme during doctoral stages towards later job profile: Managerial competences for team leading and/or scientific/technical team leading 	<p><u>Threats:</u></p> <ul style="list-style-type: none"> - Predictability of research funds -Changes in legislation -Decreasing interest of young researchers in Ph.D. programmes due to financial issues -Economic development of industry -Difficult funding situation for students

V. Overview of judgments awarded and of the recommendations

No.	Type of indicator (PI, PI *, CPI)	Performance indicator	Judgment	Recommendations
1.	PI	<p>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:</p> <ul style="list-style-type: none"> 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 	Partially fulfilled	It is recommended to set-up and publish a transparent methodology for the organisation and execution of elections of the institutional representatives (SSC director, SSC members and students)

No.	Type of indicator (PI, PI *, CPI)	Performance indicator	Judgment	Recommendations
		<p>doctoral studies);</p> <p>d) the existence of mechanisms for recognizing the status of a Doctoral advisor and the equivalence of the doctoral degree obtained abroad;</p> <p>e) functional management structures (Council of the doctoral school), giving as well proof of the regularity of meetings;</p> <p>f) the contract for doctoral studies;</p> <p>g) internal procedures for the analysis and approval of proposals regarding the training for doctoral study programs based on advanced academic studies.</p>		
2.	PI	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.	Fulfilled	
3.	PI	A.1.2.1. The existence and effectiveness of an appropriate IT system to keep track of doctoral students and their academic background.	Fulfilled	
4.	PI	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.	Fulfilled	
5.	IP	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.	Fulfilled	<i>Increase the international activities to attract students from foreign countries</i>
6.	PI *	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	Fulfilled	<i>See above, try to attract international students to increase the number and try to attract industry to</i>

No.	Type of indicator (PI, PI *, CPI)	Performance indicator	Judgment	Recommendations
		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%.		<i>fund students (part time working models, research contracts etc.)</i>
7.	PI *	A.1.3.3. 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.).	Fulfilled	<i>Continue efforts to win research grants and contracts to ensure that funds are allocated for the training of doctoral students at an appropriate level. And/or: Monetize the special research knowledge by offering paid trainings in specific fields to e.g. industrial customers.</i>
8.	CPI	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	Fulfilled	<i>Strengthen and further develop the research infrastructure by continuing the collaboration with ICECON. Consider maybe “virtual research labs” by collaborations with other national/international labs using modern IT network connections to get access/grant access to other labs for research (e.g. sharing computer performance, getting access to high performance computing, doing material analyses via other labs and virtual connections etc. Additionally create service offerings for industrial customers (e.g. analyses/metrology for small/medium sized industry who do not have the equipment).</i>
9.	CPI	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	Fulfilled	<i>Continue efforts to attract new PhD supervisors in Mechanical Engineering</i>

No.	Type of indicator (PI, PI *, CPI)	Performance indicator	Judgment	Recommendations
		force at the time when the evaluation is carried out, which standards are required and mandatory for obtaining the enabling certification.		
10.	PI *	A.3.1.2. At least 50% of all doctoral advisors have a full-time employment contract for an indefinite period with the IOSUD.	Fulfilled	
11.	PI	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.	Fulfilled	
12.	PI *	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 does not exceed 20%.	Fulfilled	
13.	CPI	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. 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	Fulfilled	

No.	Type of indicator (PI, PI *, CPI)	Performance indicator	Judgment	Recommendations
		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.		
14.	PI *	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	Fulfilled	
15.	PI *	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.	Fulfilled	
16.	PI *	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.	Fulfilled	
17.	PI	B.1.2.2. The expelling rate, including renouncement / dropping out of doctoral students 3, respectively 4, years after admission does not exceed 30%.	Fulfilled	
18.	PI	B.2.1.1. The training program based on	Fulfilled	<i>Strengthen and further develop the</i>

No.	Type of indicator (PI, PI *, CPI)	Performance indicator	Judgment	Recommendations
		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.		<i>research infrastructure by continuing the collaboration with ICECON. Consider maybe “virtual research labs” by collaborations with other national/international labs using modern IT network connections to get access/grant access to other labs for research (e.g. sharing computer performance, getting access to high performance computing, doing material analyses via other labs and virtual connections etc. Additionally create service offerings for industrial customers (e.g. analyses/metrology for small/medium sized industry who do not have the equipment).</i>
19.	PI	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.	Fulfilled	
20.	PI	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.	Fulfilled	<i>It is recommended to consider an extension of the trainings in accordance with later career ambitions of the students. It might be considered to prepare the students with additional training modules for management positions and team leadership as well/or for technical leadership positions</i>
21.	PI	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.	Fulfilled	
22.	CPI	B.2.1.5. For a doctoral study domain, the ratio	Fulfilled	

No.	Type of indicator (PI, PI *, CPI)	Performance indicator	Judgment	Recommendations
		between the number of doctoral students and the number of teaching staff/researchers providing doctoral guidance must not exceed 3:1.		
23.	CPI	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	Fulfilled	<i>Increase the number of articles in high profile journals</i>
24.	PI *	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.	Fulfilled	<i>More publications shall be considered</i>
25.	PI *	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.	Fulfilled	
26.	PI *	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.	Fulfilled	
27.	PI	C.1.1.1. The Doctoral school in the respective	Partially	<i>Develop operational procedures for</i>

No.	Type of indicator (PI, PI *, CPI)	Performance indicator	Judgment	Recommendations
		<p>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:</p> <p>a) the scientific work of Doctoral advisors;</p> <p>b) the infrastructure and logistics necessary to carry out the research activity;</p> <p>c) the procedures and subsequent rules based on which doctoral studies are organized;</p> <p>d) the scientific activity of doctoral students;</p> <p>e) the training program based on advanced academic studies of doctoral students;</p> <p>f) social and academic services (including for participation at different events, publishing papers etc.) and counselling made available to doctoral students.</p>	fulfilled	<i>internal evaluation and monitoring of SCOSAAR's advanced degree-based training program for doctoral students.</i>
28.	PI *	<p>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.</p>	Partially fulfilled	<i>Develop a procedure to evaluate the satisfaction of doctoral students with the learning environment and periodically produce a report on the needs and satisfaction of doctoral students to improve the doctoral program</i>
29.	CPI	<p>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:</p> <p>a) the Doctoral School regulation;</p> <p>b) the admission regulation;</p> <p>c) the doctoral studies contract;</p> <p>d) the study completion regulation including the procedure for the public presentation of the thesis;</p> <p>e) the content of training program based on advanced academic studies;</p> <p>f) the academic and scientific profile, thematic areas/research themes of the Doctoral advisors within the domain, as well as their institutional contact data;</p> <p>g) the list of doctoral students within the domain with necessary information (year of</p>	Fulfilled	

No.	Type of indicator (PI, PI *, CPI)	Performance indicator	Judgment	Recommendations
		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.		
30.	PI	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.	Fulfilled	
31.	PI	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.	Fulfilled	
32.	PI	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.	Fulfilled	
33.	PI *	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.	Fulfilled	<i>Increase the number of trainings abroad for doctoral students to a level of min. 1 activity/mobility abroad per year.</i>
34.	PI	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.	Fulfilled	<i>increase number of co-tutelage doctorates</i>

No.	Type of indicator (PI, PI *, CPI)	Performance indicator	Judgment	Recommendations
35.	PI	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.).	Fulfilled	Intensify internationalisation actions by including international experts in committees for the supervision or defence of doctoral theses, theses carried out in international co-tutelle, etc.

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

- The PhD in Mechanical Engineering has a clear and well-defined mission and the objectives respond to the demands of the labour market and society in general.
- The PhD in Mechanical Engineering at IMS AR has a very competent and experienced faculty, with high-level scientific activity and a good international visibility;
- Doctoral students are satisfied with the learning environment and the social-cultural facilities, they appreciate positively the relationships with tutors and the access to the research infrastructure, and they are optimistic about their career prospects;
- Collaborations with the socio-economic environment are good, but also with research institutes in the field on national and international level
- The equipment and research facilities are very good and serve as the basis for high quality research;
- The Mechanical Engineering PhD field has opportunities to foster collaboration with other institutes and to expand its networks by establishing additional virtual IT-based structures
- the school and the institute might intensify the implementation of internationalisation on the levels of permanent lectures and Ph.D. co-tutelage
- The Doctoral School of Mechanical Engineering meets all the requirements for a high quality education;
- With only three exceptions all other performance indicators are rated as **FULFILLED**.

Düsseldorf, 20.11.2021

Prof. Dr.-Ing. Jörg Niemann