



**Report  
of the Expert Panel  
on the re-accreditation  
of the university postgraduate (doctoral) programme  
Mechanical Engineering, Naval Architecture, Aeronautical  
Engineering, Metallurgical Engineering**

**Date of the visit to the Faculty of Mechanical Engineering and Naval Architecture  
University of Zagreb:**  
*May 30<sup>th</sup>, 2016*

May, 2016

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## **INTRODUCTION**

The Expert Panel appointed by the Agency for Science and Higher Education (ASHE) created this Report on the Re-accreditation of the University Postgraduate (Doctoral) Programme Mechanical Engineering, Naval Architecture, Aeronautical Engineering, Metallurgical Engineering on the basis of the Self-Evaluation Report of the Programme, other documentation submitted and a visit to the Faculty of Mechanical Engineering and Naval Architecture University of Zagreb.

The Agency for Science and Higher Education (ASHE), a public body listed in EQAR (European Quality Assurance Register for Higher Education) and a full member of ENQA (European Association for Quality Assurance in Higher Education), re-accredits higher education institutions (hereinafter: HEIs) and their study programmes in line with the Act on Quality Assurance in Science and Higher Education (Official Gazette 45/09) and the Ordinance on the Content of a Licence and Conditions for Issuing a Licence for Performing Higher Education Activity, Carrying out a Study Programme and Re-Accreditation of Higher Education Institutions (OG 24/10). In this procedure parts of activities of higher education institutions and university postgraduate study programmes are re-accredited.

Expert Panel is appointed by the Agency's Accreditation Council, an independent expert body, to carry out independent evaluation of post-graduate university study programmes.

The Report contains the following elements:

- Short description of the study programme,
- The recommendation of the Expert Panel to the Agency's Accreditation Council,
- Recommendations for institutional improvement and measures to be implemented in the following period (and checked within a follow-up procedure),
- A brief analysis of the institutional advantages and disadvantages,
- A list of good practices found at the institution,
- Conclusions on compliance with the prescribed conditions of delivery of a study programme,
- Conclusions on compliance with the criteria for quality assessment.

Members of the Expert Panel:

- President of the Expert Panel, Dr. Gordon Dalton, University College Cork, Ireland,
- Prof. Daniele Nardi, Sapienza University of Rome, Italy
- Prof. Karol Kalna, College of Engineering, Swansea University, UK
- Prof. Jens Grabowski, Georg-August-Universität Göttingen, Germany
- Prof. Aurélio Campilho, Faculdade de Engenharia da Universidade do Porto, Portugal
- Prof. Aurelian Francillon, EURECOM - Graduate School and Research Center in Communication System, France
- Prof. Zoltán Fülöp, University of Szeged, Hungary
- Giuseppe Moschetti, Huddersfield University, UK
- Prof. Ove T. Gudmestad, University of Stavanger, Norway
- Maximilian Lesellier, Robotique et de Microélectronique de Montpellier (LIRMM), France
- Massimiliano Ferrucci National Physical Laboratory, KU Leuven, Belgium
- Prof. Hongming Xu, Department of Mechanical Engineering, University of Birmingham, UK
- Prof. Vadim Silberschmidt, Wolfson School of Mechanical, Electrical and Manufacturing Engineering, Loughborough University, UK

- Prof. Sergey V. Utyuzhnikov, School of Mechanical, Aerospace and Civil Engineering, University of Manchester, UK
- Stjepan Sučić, Končar - inženjering za energetiku i transport, d.d., Croatia
- Ana Carolina dos Santos Paulino, University of Strasbourg, France
- Prof. Kjell Ivar Øvergård, Faculty of Technology and Maritime Science, University College of Southeast Norway, Norway
- Prof. Aleksander Sladkowski, Silesian University of Technology, Poland
- Prof. Stojan Petelin, univ. dipl. inž. stroj., Fakulteta za pomorstvo in promet, Univerza v Ljubljani, Slovenia
- Hilde Sandhåland, Department of Maritime Studies, Stord/Haugesund University College, Norway.

The higher education institution was visited by the following Expert Panel members:

- Prof. Ove T. Gudmestad, University of Stavanger, Norway
- Prof. Vadim Silberschmidt, Loughborough University, UK
- Prof. Sergey V. Utyuzhnikov, University of Manchester, UK
- Massimiliano Ferrucci, doctoral candidate, KU Leuven, Belgium

In the analysis of the documentation, site visit and writing of the report, the Panel was supported by:

- Viktorija Juriša, coordinator, ASHE,
- Maja Briški, assistant coordinator, ASHE,
- Vlatka Derenčinović, interpreter at the site visit, ASHE,
- Goran Briški, interpreter at the site visit and translator of the Report, ASHE.

During the visit to the Institution, the Expert Panel held meetings with the representatives of the following groups:

- Management, Dean, Vice-deans and Head of PhD programme,
- Doctoral candidates,
- Teachers and mentors,
- External stakeholders,
- Alumni.

The Expert Panel also had a tour of the library, IT rooms, student register desk and classrooms or laboratories.

### ***SHORT DESCRIPTION OF THE STUDY PROGRAMME***

Name of the study programme contained in the licence: Mechanical Engineering, Naval Architecture, Aeronautical Engineering, Metallurgical Engineering

Institution providing the programme: University of Zagreb

Institution delivering the programme: Faculty of Mechanical Engineering and Naval Architecture, Faculty of Metallurgy, University of Zagreb

Place of delivery: Zagreb and Sisak

Scientific area and field: Technical Sciences – fields: Mechanical Engineering, Naval Architecture, Aeronautical Engineering, Rocket and Space technology, Basic Technical Science and Metallurgy

Learning outcomes of the study programme:

Development of new and relevant knowledge and insights and their application; education of researchers in the selected scientific field; training of doctoral candidates in pursuing independent research and interdisciplinary approach to problems, as well as independent research and critical assessment of other's work; acquisition of knowledge, experience and skills enabling doctors of science to creatively and with the use of science-based methods solve complex technical, technological, production and business problems; internationalisation of research at the University.

Number of doctoral candidates: 230

Number of teachers: 142

Number of supervisors: 30

### ***RECOMMENDATION BY THE EXPERT PANEL TO THE ASHE'S ACCREDITATION COUNCIL***

Upon the completion of the re-accreditation procedure and the examination of the materials submitted (Self-Evaluation Report etc.), the visit to the higher education institution and interviews with HEI members in accordance with the visit protocol, the Expert Panel renders its opinion in which it recommends to the Accreditation Council of the Agency the following:

1. **issue a confirmation on compliance** for performing parts of activities (renew the licence)

### ***RECOMMENDATIONS FOR THE IMPROVEMENT OF THE STUDY PROGRAMME***

1. Not lot of time for real research – students spend half time on teaching. It is recommended to reduce the number of hours by at least 30% to allow more time for research. The number of obligatory modules should be reduced to 4 to allow more focus on the research.
2. More flexibility with the taught element in the study programme. It is recommended to have a wider range of modules.
3. Remove requirement for journal publication before defence – quite difficult for students
4. Develop more international cooperation; Marie Curie scholarships, Horizon 2020, etc.
5. More Erasmus+ mobility
6. Cooperation with industry (lack of communication on both sides and no formal channels) should be improved, e.g. forming advisory board with PhD students, industry representatives.
7. No access to research databases – recommendation is that Faculty engages with the Ministry to seriously address this gap.
8. Recommendation is to introduce decision on choice of topic area of research project at the early stages of the studies.

### ***ADVANTAGES OF THE STUDY PROGRAMME***

1. A considerable number of students have an industrial background and financial support, which is an indication that industry supports PhD students
2. Students consider the programme as a good way to moderate gaps in their knowledge (esp. students from industry)
3. Students publish papers in good quality journals
4. Theses are highly relevant for the industry
5. The completion rate is above the national; former candidates are mostly satisfied with the programme.

### ***DISADVANTAGES OF THE STUDY PROGRAMME***

1. Poor international dimension to the programme in terms of incoming mobility of students and teachers.
2. Insufficient involvement of stakeholders, industry students and supervisors in decision making processes (councils and committees on research strategy)
3. Bureaucratisation – excessive paperwork for students
4. General lack of time to undertake serious research, due to high number of ECTS course work and high number of teaching hours, especially for Faculty funded students.
5. There is not enough experimental work and industry does not want students without this experience. It is recommended to have a better balance of experimental and numerical work so that programme would benefit from this balance

### ***EXAMPLES OF GOOD PRACTICE***

1. Scandinavian style of dissertation; dissertations written in English
2. ISO 17025 Accredited laboratory representing Croatia abroad – LPM Process Measurements

**COMPLIANCE WITH THE PRESCRIBED CONDITIONS FOR THE DELIVERY OF A STUDY PROGRAMME**

<b>Minimal legal conditions:</b>	<b>YES/NO notes</b>
1. Higher education institution (HEI) is listed in the Register of Scientific Organisations in the scientific area of the programme, and has a positive reaccreditation decision on performing higher education activities and scientific activity.	YES
2. HEI delivers programmes in the two cycles leading to the doctoral programme, i.e., first two cycles in the same area and field/fields (for interdisciplinary programmes), and employs a sufficient number of teachers as defined by Article 6 of the Ordinance on the Content of a Licence and Conditions for Issuing a Licence for Performing Higher Education Activity, Carrying out a Study Programme and Re-Accreditation of Higher Education Institutions (OG 24/10).	YES
3. HEI employs a sufficient number of researchers, as defined by Article 7 of the Ordinance on Conditions for Issuing Licence for Scientific Activity, Conditions for Re-Accreditation of Scientific Organisations and Content of Licence (OG 83/2010).	YES
4. At least 50% of teaching as expressed in norm-hours is delivered by teachers employed at the HEI (full-time, elected into scientific-teaching titles).	YES
5. Student: teacher ratio at the HEI is below 30:1.	YES
6. HEI ensures that doctoral theses are public.	YES
7. HEI launches the procedure of revoking the academic title if it is determined that it has been attained contrary to the conditions stipulated for its attainment, by severe violation of the studying rules or based on a doctoral thesis (dissertation) that has proved to be a plagiarism or a forgery according to provisions of the statute or other enactments.	YES
<b>Additional/ recommended conditions of the ASHE Accreditation Council for passing a positive opinion</b>	<b>YES/NO notes</b>
1. HEI (or HEIs in joint programmes) has at least five teachers appointed to scientific-teaching titles in the field, or fields relevant for the programme involved in its delivery.	YES
2. In the most recent reaccreditation, HEI had the standard Scientific and Professional Activity (e.g. Artistic for those in the arts field) marked as at least "partly implemented" (3).	YES
3. The doctoral programme is aligned with the HEI's research strategy.	YES
4. The candidate : supervisor ratio at the HEI is not above 3:1.	YES
5. All supervisors meet the following conditions: a) PhD, elected into a scientific title, holds a scientific or a scientific-teaching position and/or has at least two years of postdoctoral research experience; b) active researcher in the scientific area of the programme, as evidenced by publications, participation in scientific conferences and/or projects in the past five years (table 2, Supervisors and candidates); c) confirms feasibility of the draft research plan upon admission of the candidate (or submission of the proposal); d) ensures the conditions (and funding) necessary to implement the candidate's research (in line with the draft research plan) as a research project leader, co-leader, participant, collaborator or in other ways; e) trained for the role before assuming it (through workshops, co-supervisions etc.); f) received a positive opinion of the HEI on previous supervisory work.	YES
6. All teachers meet the following conditions: a) holds a scientific or a scientific-teaching position; b) active researcher, recognized in the field relevant for the course (table 1, Teachers).	YES
7. The supervisor normally does not participate in the assessment committees.	YES
8. The programme ensures that all candidates spend at least three years doing independent research (while studying, individually, within or outside courses), which includes writing the thesis, publishing, participating in international conferences, field work, attending courses relevant for research etc.	YES

<p><b>Additional comment:</b></p> <p>More time for research is needed.</p>	
<p>9. For joint programmes and doctoral schools (at the university level): cooperation between HEIs is based on adequate contracts; joint programmes are internationally recognized, and delivered in cooperation with accredited HEIs; the HEI delivers the programme within a doctoral school in line with the regulations (it is based on contracts in the case of multiple institutions, and the HEIs ensure good reaccreditation aimed at supporting the candidates); at least 80% of courses are delivered by teachers employed at HEIs within the consortium.</p>	<p>YES</p>



## QUALITY ASSESSMENT

	Quality assessment (“high level of quality” or “improvements are necessary”) and the explanation of the Expert Panel
<b>1. RESOURCES: TEACHERS, SUPERVISORS, RESEARCH CAPACITIES AND INFRASTRUCTURE</b>	
<p>1.1. HEI is distinguished by its scientific/ artistic achievements in the discipline in which the doctoral study programme is delivered.</p>	<p><b>High level of quality</b>  Faculty of Mechanical Engineering and Naval Architecture and Faculty of Metallurgy of the University of Zagreb have a long-standing tradition of postgraduate education, started in 1921. Since 2007-08, the postdoctoral research training is undertaken according to the Bologna requirements. The Faculties have a suitably qualified staff, engaged in research in the relevant areas. In the reported period they published nearly 360 papers in journals indexed in Current Contents and more than 300 other journal papers.</p> <p>The staff is engaged in international research activities and collaboration. They cooperate with over 130 international institutions. They (co)organised a number of international scientific events, including some of high standing and visibility in respective areas, e.g. ECCOMAS, IFC etc.; there are 60 members of international research associations, they also participate in management of divisions of some of them. The staff members also have been partners in some 40 international projects within the framework of various programmes funded by EU (COST, TEMPUS, Frameworks and Horizon 2020) and other bodies.</p> <p>A strong example of high international standing of the Faculty is Europe-wide collaboration and global recognition of its metrology laboratories.</p> <p>These opportunities, provided by the international links of the staff should be used more actively in the doctoral programmes.</p>
<p>1.2. The number and workload of teachers involved in the study programme ensure quality doctoral education.</p>	<p><b>High level of quality</b>  In total, 142 staff are involved in supervision of postgraduate researchers. 129 supervisors are staff members of the two Faculties at Zagreb, making 91% of the total, significantly higher than the requested threshold of 50%.</p> <p>The teaching workload of supervisors is controlled, using a special formula.</p>
<p>1.3. The teachers are highly qualified researchers who actively engage with the topics they teach, providing a quality doctoral programme.</p>	<p><b>High level of quality</b>  A special body of the Faculty controls the quality of supervisors – both external and internal. The used metrics are the number of papers published in the last five years and a list of participation in national and international research projects. This should guarantee a high level of qualification of the supervisors of PhD researchers. Most supervisors have a reasonable track record of publications in the last five years; still a small minority does not</p>

	<p>have any journal papers indexed in WoS (CC and SCI-Expanded) in this period, but they all have other publications.</p> <p>The number and quality of publications for staff members varies significantly.</p>
<p>1.4. The number of supervisors and their qualifications provide for quality in producing the doctoral thesis.</p>	<p><b>High level of quality</b></p> <p>All the supervisors are supposed to have a position of assistant, associate or full professor, or full professor without term limits.</p> <p>With the total number of supervisors 142 and 230 PhD researchers, the candidate-supervisor ratio is well below the requested level of 3:1.</p> <p>The current system of appraisal or promotion of the staff does not take into consideration performance or completion rates of PhD researchers supervised by them. Promotion of staff should include a criterion accounting for progression of supervised PhD researchers, including the student pass or completion rate.</p>
<p>1.5. The HEI has developed methods of assessing the qualifications and competencies of teachers and supervisors.</p>	<p><b>High level of quality</b></p> <p>There exists a formal procedure of assessment of qualification and competences of the supervisors based on the number of research publications in the area of their specialisation, as well as in leading, or participating in, national and international scientific and technological projects in the last five years (see also pos. 1.3).</p>
<p>1.6. The HEI has access to high-quality resources for research, as required by the programme discipline.</p>	<p><b>Improvements are necessary</b></p> <p>The Faculties have a large number of research laboratories – 51 in total, with most of them accessible to PhD researchers, even outside the standard hours. There are specialised computer classes, with all the PhD students getting their access to the IT infrastructure at the beginning of their studies.</p> <p>The Library of Faculty of Mechanical Engineering and Naval Architecture has a collection of some 20000 books and about 400 journals; there are also over 60000 books held in departments that are centrally processed by the library. The collected titles relate both to the specialist areas – mechanical, aeronautical and naval engineering and metallurgy – and generalist topics, relevant to the study areas. Two reading rooms of the Library are available to students from 8am to 9pm. The Library was the first in Croatia to launch a digital repository of doctoral dissertations. The Library of the Faculty of Metallurgy has comparable resources and facilities, with more than 11000 books (its opening hours are less generous than those of another faculty).</p> <p>Still, the available resources are not always fully sufficient for implementation of high-end PhD research projects. This was named as a reason for the PhD students choosing (or even transferring to) theoretical or computer-based research rather than implementing programmes of experimental studies, important for future specialists in engineering fields. For the latter, they need more advanced facilities that they could find</p>

	<p>partially at their academic partners and/or collaborating industrial companies. PhD researchers consider a need for such special means in implementation of their experiments as hindrance and drain on their time. The supervisors also mentioned a lack of funds and different financial regimes for different PhD students as a reason of complications with acquiring equipment necessary for experimental studies. Another obstacle was absence of access to some international online bibliographic sources (e.g. Scopus) at the moment of the visit due to the lack of governmental funds for this.</p>
<p><b>2. INTERNAL QUALITY ASSURANCE OF THE PROGRAMME</b></p>	
<p>2.1. The HEI has established and accepted effective procedures for proposing, approving and delivering doctoral education. The procedures include identification of scientific/ artistic, cultural, social and economic needs.</p>	<p><b>Improvements are necessary</b>  The main objective of the programme is to align the study programmes of the Doctoral Study of Mechanical Engineering and Naval Architecture with the Regulations on Doctoral Studies at the University of Zagreb since 20 April 2010. The programme reflects the changes in the courses and focuses on rationalization of the doctoral education by joining the doctoral study of the Faculty of Metallurgy. Economic justification is provided in detail in the existent Detailed Overview of Doctoral Programme Mechanical Engineering, Naval Architecture, Aeronautical Engineering, Metallurgical Engineering.</p> <p>The students are mostly satisfied with the programme, but have complained on excessive coursework and limited access to journal publications.</p>
<p>2.2. The programme is aligned with the HEI research mission and vision, i.e. research strategy.</p>	<p><b>High level of quality</b>  The programme is fully aligned with the University of Zagreb Research Strategy. It should strongly promote the strategic aims of the University of Zagreb in terms of fulfilling the fundamental strategic objective of the Research Strategy, as well as immediate objectives outlined in this strategic document. All study modules are research-focused, whereas certain scientific topics are closely linked to current scientific projects run at both Faculties with financial support of national science foundation.</p> <p>The study modules are fully aligned with the University of Zagreb Research Strategy and Scientific Research Strategy of the Faculty of Metallurgy of the University of Zagreb for the period 2013-2016.</p>
<p>2.3. The HEI systematically monitors the success of the programmes through periodic reviews, and implements improvements.</p>	<p><b>Improvements are necessary</b>  The quality indicators of the programme are:  – Scientific production of teachers and doctoral students  – Quality of teaching  – Relevance and quality of doctoral dissertations</p>

	<ul style="list-style-type: none"> <li>- Statistical data on duration of study</li> <li>- Statistical data on the number of new holders of doctoral degrees in relation to the number of doctoral students annually</li> <li>- International cooperation accomplished</li> <li>- Mobility of doctoral students</li> <li>- Employability of Doctors of Science.</li> </ul> <p>Students' feedback is taken into account in preparing the Committee's annual report via a standard survey. A more specific feedback from students is needed.</p>
<p>2.4. HEI continuously monitors supervisors' performance and has mechanisms for evaluating supervisors, and, if necessary, changing them and mediating between the supervisors and the candidates.</p>	<p><b>Improvements are necessary</b></p> <p>The doctoral candidate is assigned a mentor appointed by the Postgraduate Studies Committee at the latest within three months after submitting the dissertation topic.</p> <p>Once a year, the mentor shall submit a report on the doctoral student's performance to the Faculty Council. Prior to the appointment of a mentor, the report is submitted by the study adviser.</p> <p>In order to ensure the quality of the dissertation, co-mentoring should be enabled where applicable. If the doctoral candidate would like to obtain a dual doctoral degree, co-mentoring is mandatory.</p> <p>The doctoral candidate has the right to change the mentor or the dissertation topic just once. More flexibility should be provided.</p> <p>More measures for monitoring supervisors' performance are needed, such as evaluation of supervisors by doctoral candidates.</p>
<p>2.5. HEI assures academic integrity and freedom.</p>	<p><b>High level of quality</b></p> <p>The academic degree of a Doctor of Science can be withdrawn if it is established that it has been obtained contrary to the prescribed conditions for its award, serious violation of the rules of study or on the basis of a doctoral dissertation that is a result of plagiarism or falsification.</p> <p>The students complained on the demand that all the results listed in the research plan must be achieved, despite the fact that that it is impossible to guarantee a successful result in academic research; however, we are of the opinion that the demands in general are reasonable.</p>
<p>2.6. The process of developing and defending the thesis proposal is transparent and objective, and includes a public</p>	<p><b>High level of quality</b></p> <p>The Committee for Dissertation Topic Evaluation and Mentor Proposal propose the assessment of the original scientific contribution, the evaluation of the financial and organizational</p>

<p>presentation.</p>	<p>feasibility of research and the mentor within three months from the date of filing the application. The institution that pays for the doctoral student's tuition costs is entitled to participate in the selection of the dissertation topic.</p> <p>The thesis topic and the mentor are examined by the Postgraduate Studies Committee. The Faculty Council approves the proposed topic and confirms the proposed mentor by the time the doctoral candidate enrolls into the 4th semester.</p> <p>Five thesis proposals from the past five years as well as signed assessment templates were provided to the panel.</p> <p>The students complained on excessive paperwork with the proposal that must consist of eight pages. We do not agree to the complaint and suggest that a carefully drafted proposal is a sound start of a PhD research activity.</p>
<p>2.7. Thesis assessment results from a scientifically sound assessment of an independent committee.</p>	<p><b>High level of quality</b></p> <p>The Doctoral study is completed when all prescribed obligations are fulfilled and the dissertation is drawn up and presented in public. The requirements include one journal paper, two international conferences attended and two presentations delivered at the doctoral candidates' workshop. The total assessment is based on ECTS credit points.</p> <p>The procedure of defending the doctoral thesis is clearly formulated. The thesis guidelines are available on the website. The Dissertation Defence and Assessment Committee must include at least one external examiner. In the past five years, 83 doctoral theses have been successfully defended.</p> <p>Five theses, as well as thesis records from the past five years, were provided to the panel. The theses are of a good quality. The panel especially welcomed the Scandinavian style of some of them.</p>
<p>2.8. The HEI publishes all necessary information on the study programme, admissions, delivery and conditions for progression and completion, in accessible outlets and media.</p>	<p><b>High level of quality</b></p> <p>All necessary admission information is published both in Croatian and English in the Official Gazette of the Republic of Croatia, on the Faculty's website and in daily press.</p>
<p>2.9. Funds collected for the needs of doctoral education are distributed transparently and in a way that ensures sustainability and further development of doctoral education (ensures that candidates' research is carried out and supported, so that doctoral education can be completed</p>	<p><b>High level of quality</b></p> <p>The SER explains what tuition fees are spent on, and the panel checks if this complies with the regulations on using own and dedicated funds, i.e., to insure further development of the doctoral programme.</p> <p>Funds collected from tuition fees enter the doctoral study fund</p>

successfully).	<p>and can be spent for doctoral study purposes according to an annual plan proposed by the Postgraduate Studies Committee and adopted by both competent bodies.</p> <p>The panel welcomed the fact that students have an access to the fund to participate at national and international conferences. The procedure of this is known to all students.</p>
2.10. Tuition fees are determined on the basis of transparent criteria (and real costs of studying).	<p><b>High level of quality</b> The tuition fees are clearly explained.</p>
<b>3. SUPPORT TO DOCTORAL CANDIDATES AND THEIR PROGRESSION</b>	
3.1. The HEI establishes admission quotas with respect to its teaching and supervision capacities.	<p><b>High level of quality</b> The Postgraduate Studies Committee maintains records of the number of admitted candidates assigned to each mentor. The committee also maintains data regarding those candidates who defended their doctoral thesis. The HEI has established an institutional structure to communicate quality information regarding the mentors to various levels of the institute by way of dedicated documents. The competence of each mentor is determined by published papers in the corresponding research topic; this competence is confirmed by three bodies within the university: The Faculty Council, the Technical Area Council, and the University Senate. Total mentor workload is evaluated and maintained by the Human Resources Committee.</p>
3.2. The HEI establishes admission quotas on the basis of scientific/ artistic, cultural, social, economic and other needs.	<p><b>High level of quality</b> The document Detailed Overview of the Doctoral Study Programme, points 2.1 to 2.5, highlights the needs for doctoral study. Admission quotas with respect to the needs of society are based on a research strategy of the University and a research and development strategy of the Faculty.</p>
3.3. The HEI establishes the admission quotas taking into account the funding available to the candidates, that is, on the basis of the absorption potentials of research projects or other sources of funding.	<p><b>High level of quality</b> The HEI requires applicants to submit a Financing Plan that outlines the predicted costs of performing the PhD studies and research activities. Preference is given to applicants with sources of funding other than their own, <i>i.e.</i> is financed through projects or industry. The ratio of candidates who complete their PhD studies to the total number of candidates admitted into the programme is relatively low and the HEI has outlined a strategy to improve this statistic by, e.g. ensuring that more high quality candidates are admitted and that they are provided with funded research projects. The panel members found that a substantial number of PhD candidates who attended the meeting were supported by industry, which indicates that the HEI is indeed pursuing its goal. The panel encourages the HEI to continue these</p>

	positive efforts to increase the number of successful candidates.
3.4. The HEI should pay attention to the number of candidates admitted as to provide each with an advisor (a potential supervisor). From the point of admission to the end of doctoral education, efforts are invested so that each candidate has a sustainable research plan and is able to complete doctoral research successfully.	<b>High level of quality</b> The HEI ensures that candidates are provided with a study adviser until he/she has been assigned a mentor. Yearly reports are submitted by both the mentor/adviser and the candidate to the Postgraduate Studies Committee, which then submits a Work Report to the Faculty Council and University using the appropriate University form.
3.5. The HEI ensures that interested, talented and highly motivated candidates are recruited internationally.	<b>Improvements are necessary</b> The HEI provides an English language website for interested students to learn about the institution's PhD programme from abroad. High quality candidates are ensured by prioritizing those candidates with higher undergraduate and graduate grades. The panel recognizes these efforts and encourages the HEI to continue pursuing the available mechanisms to attract international candidates.
3.6. The selection process is public and based on choosing the best applicants.	<b>High level of quality</b> The criteria for the best applicants are provided in the Ordinance, which establishes procedures for publishing calls for admission. If the applicant does not fulfil all conditions in the Ordinance, yet shows potential for their fulfilment prior to admission, the HEI will conditionally evaluate the applicant's application. The applicant is interviewed by the Committee prior to admission. After being admitted, a candidate is provided a clear outline of all conditions for completing the PhD studies. This information is made public in Croatian through the HEI's online website.
3.7. The HEI ensures that the selection procedure is transparent and in line with published criteria, and that there is a transparent complaints procedure.	<b>High level of quality</b> Information on the applicants whose application has been approved is published on the institution's website, together with the names of the persons responsible for the positive referral of the candidate. The Admission Interview Committee provides information to rejected applicants on the strengths and weaknesses of their applications, and provides recommendations for research plans. No additional information on the applicant complaints procedure was provided.
3.8. There is a possibility to recognize applicants' and candidates' prior learning.	<b>High level of quality</b> The HEI recognizes previous learning and achievements by awarding up to 36 ECTS credits for attending lessons and 24 ECTS credits for those candidates who have a Master of Science degree in mechanical engineering, naval architecture, aeronautical engineering, or metallurgy. The HEI allows recognition of previously published papers and previously awarded awards, given that these are related to the topic of the doctoral thesis. Candidates are given the opportunity to request recognition of other achievements.

<p>3.9. Candidates' rights and obligations are defined in relevant HEI regulations and a contract on studying that provides for a high level of supervisory and institutional support to the candidates.</p>	<p><b>Improvements are necessary</b></p> <p>The HEI has established a set of rights and obligations for accepted candidates. An institutional support structure exists to provide students with high quality supervision. The information regarding this support structure is made available to candidates via online platforms and provided at admission interview and through the Postgraduate Studies Registry. The expert panel notes that, in their meeting with students, there were comments that the amount of paperwork required to progress in the doctoral studies could be revisited and reduced by the HEI.</p>
<p>3.10. There are institutional support mechanisms for candidates' successful progression.</p>	<p><b>High level of quality</b></p> <p>The HEI provides support to candidates in ensuring that minimum required results are achieved and the quality of research is monitored throughout the doctoral study. Due to the relatively recent (one year old), newly adopted study programme, the HEI does not have five-year information for implementation. The HEI provides candidates with the option of performing their studies full or part-time. A mechanism for candidates to provide feedback on the quality of supervision and institutional support is available. Interdisciplinary studies are accommodated given a discussion with candidates and supervisors; in these cases, students have access to modules outside of their faculty. Coursework and training is provided in English for non-Croatian speaking candidates. The doctoral study is customized for the research of the candidate; co-supervision is provided in the case the candidate's research includes disciplines from more than one faculty. Previous experience and coursework is recognized through the ECTS credit system. Opportunities to attend conferences and ensure mobility are provided by the HEI and announced on the institute's website.</p>
<p><b>4. PROGRAMME AND OUTCOMES</b></p>	
<p>4.1. The content and quality of the doctoral programme are aligned with internationally recognized standards.</p>	<p><b>Improvements are necessary</b></p> <p>The quality is assessed on the basis of the programme as it was delivered to the panel.</p> <p>The programme is in principle of acceptable quality as it is research-oriented and focused on the candidate's independent work (it provides for at least three years of independent research experience, as regulated by the Croatian Qualifications Framework, CroQF). However, as many of the candidates are working as teaching assistants with limited available time to work on their research, improvements are necessary to ensure that the program in reality implements the acceptable quality for all candidates.</p> <p>Teaching is included as required by the needs of candidate's research and enables the candidate to acquire generic skills and international experience.</p> <p>The programme is meeting an acceptable international standard of doctoral education in the relevant discipline as</p> <ul style="list-style-type: none"> <li>- the programme - and programme content - is comparable to</li> </ul>



	<p>programmes at international HEIs, with respect to programme objectives, admission criteria, admission procedures, programme duration, specialisations, volume of teaching and the ratio between teaching and research. The number of compulsory ECTS course work limits the time to undertake serious research;</p> <ul style="list-style-type: none"> <li>- there is a comparable supervision procedures;</li> <li>- there is comparability of thesis formats and assessment committees, however, it might be advantageous for students, in particular those employed by industry, to prepare a thesis based on papers presented and submitted at conferences and in journals (Scandinavian model of PhD);</li> <li>- there is comparability with international HEIs in complying with national and international professional standards.</li> </ul> <p><i>Recommendations</i></p> <p>For those who are working as teaching assistants, however, the available time to work on their research is marginal and more focus should be on available time for research.</p> <p>Of concern, however, is that the theme for the thesis often is decided after a long introductory period and therefore, the research may not reach excellent results as there is insufficient time for the specialization.</p> <p>The programme should strive for higher degree of internationalization and increased cooperation with industry.</p>
<p>4.2. Programme learning outcomes, as well as the learning outcomes within it, are aligned with the level 8.2 of the CroQF. They clearly describe the competencies the candidates will develop during the doctoral programme, including the ethical requirements of doing research.</p>	<p><b>High level of quality</b></p> <p>The HEI documented that its programme meets the CroQF level 8.2 by quality descriptions of the programme learning outcomes. The re-accreditation panel assessed that the following skills and competencies are acquired:</p> <ul style="list-style-type: none"> <li>- research competencies (interviews with candidates, review of programme description and submitted theses demonstrated the quality of acquired research competencies, such as collecting information and sources, critical reading and identifying biases, etc.);</li> <li>- project planning and management competencies (developing research proposals, organising research, timely identification of potential issues and budgeting);</li> <li>- competencies in research methodologies (using relevant hardware and software, statistical analyses, statistical inference, making conclusions based on quantitative data);</li> <li>- reading and writing skills (speaking and listening, presenting data and conclusions to non-experts);</li> <li>- teaching and assessment skills;</li> <li>- competence in demonstrating individual professional and ethical authority;</li> <li>- readiness to accept ethical and social responsibility for performing research successfully, delivering socially useful research results and readiness to face new social and economic</li> </ul>

	challenges.
4.3. Programme learning outcomes are logically and clearly connected with teaching contents, as well as the contents included in supervision and research.	<p><b>Improvements are necessary</b> SER and interviews with candidates (and alumni) demonstrated that:</p> <ul style="list-style-type: none"> <li>- learning outcomes are logical and aligned with individual courses, supervisory work and research (acceptable level of quality)</li> <li>- More flexibility should, however, be allowed in selecting courses aligned with candidates' research needs. (See also 4.5)</li> </ul>
4.4. The doctoral programme ensures the achievement of learning outcomes and competencies aligned with the level 8.2 of the CroQF.	<p><b>High level of quality</b> The quality and level of achieved learning outcomes was assessed (level 8.2 of the CroQF.) The re-accreditation panel assessed the programme, its quality assurance procedures and a sample of theses, and checked that the programme enables candidates to acquire competencies at the level 8.2 through reviewing the submitted theses (the panel identified that some of the sample theses are of high quality).</p> <p>The programme submitted:</p> <ul style="list-style-type: none"> <li>- a sample of theses;</li> <li>- a sample of candidates' publications (especially high-impact publications coming out of doctoral research);</li> <li>- a sample of seminar papers, conference presentations etc.</li> </ul>
4.5. Teaching methods (and ECTS, if applicable) are appropriate for level 8.2 of the CroQF and assure achievement of clearly defined learning outcomes.	<p><b>Improvements are necessary.</b> The quality of teaching methods was assessed. A combination of courses are delivered <i>ex-cathedra</i> and some are arranged as colloquia, research, experimental or laboratory work.</p> <p>The panel looked at programme and course structure and descriptions and assessed that the methods used (<i>ex-cathedra</i> teaching, individual work with the supervisor, discussion groups, workshops etc.) are appropriate for achieving intended learning outcomes.</p> <p>The courses required should, however, be more aligned with the research needs of the candidates, more flexibility in selecting relevant courses and reduction in ECTS course load is recommended.</p>
4.6. The programme enables acquisition of general (transferable) skills.	<p><b>Improvements are necessary</b> The programme provides for acquisition of generic (transferable) skills, e.g. through workshops or other forms of support for development of business and managerial skills, presentation, writing and project management skills, applying for funding etc.</p> <p>The HEI documented that candidates are informed of opportunities to participate in internal and external trainings and that the acquisition of these skills is assessed within the programme. More efficient use of EU funding would represent an excellent possibility for international exchange. The panel also</p>

	<p>encourage even more collaboration with industry.</p> <p>Furthermore, there is a shortcoming in possibility to perform testing and experimental work during the study. Numerical methods are given much focus while industry is often requesting persons with skills to work in laboratories.</p>
<p>4.7. Teaching content is adapted to the needs of current and future research and candidates' training (individual course plans, generic skills etc.).</p>	<p><b>Improvements are necessary</b></p> <p>Courses delivered are not sufficiently flexible and adapted to individual academic needs and research plans.</p> <p>Even better contact with stakeholders and stakeholders' needs are encouraged.</p>
<p>4.8. The programme ensures quality through international connections and teacher and candidate mobility.</p>	<p><b>Improvements are necessary</b></p> <p>The programme must strive to improve its quality through internationalisation and mobility:</p> <ul style="list-style-type: none"> <li>- internationalisation of the doctoral programme will be achieved by providing opportunities for and using research staff mobility;</li> <li>- it should systematically provide more information on opportunities for candidate mobility (Erasmus+ funding).</li> </ul> <p>It was noted that the HEI is acquainted with the European Charter of Researchers and Code of Conduct and implements its principles.</p> <p>Evidence for this criterion presented:</p> <ul style="list-style-type: none"> <li>- evidence on encouraging candidates to participate in national conferences;</li> <li>- opportunities to write the thesis in a foreign language.</li> </ul> <p>Following activities could improve the programme:</p> <ul style="list-style-type: none"> <li>- opportunities to replace the thesis by publication in internationally recognized outlets.</li> </ul>