

# Report of the Expert Panel on the REACCREDITATION of the University Postgraduate (Doctoral) Programme Technological Systems in Traffic and Transport



July, 2016

### **CONTENTS**

INTRODUCTION	3
SHORT DESCRIPTION OF THE STUDY PROGRAMME	6
RECOMMENDATION BY THE EXPERT PANEL TO THE ASHE'S ACCREDITATION COUNCIL	7
RECOMMENDATIONS FOR THE IMPROVEMENT OF THE STUDY PROGRAMME	7
ADVANTAGES OF THE STUDY PROGRAMME	7
DISADVANTAGES OF THE STUDY PROGRAMME	8
EXAMPLES OF GOOD PRACTICE	8
COMPLIANCE WITH THE PRESCRIBED CONDITIONS FOR THE DELIVERY OF A STUDY	•
PROGRAMME	8
QUALITY ASSESSMENT	. 11

#### 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 Technological Systems in Traffic and Transport the basis of the Self-Evaluation Report of the Programme, other documentation submitted and a visit to the Faculty of Transport and Traffic Sciences 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, doctoral candidate, Huddersfield University, UK
- Prof. Ove T. Gudmestad, University of Stavanger, Norway

- Maximilian Lesellier, doctoral candidate, Robotique et de Microélectronique de Montpellier (LIRMM), France
- Massimiliano Ferrucci, doctoral candidate, National Physical Laboratory, KU Leuven, Belgium
- Prof. Hongming Xu, Department of Mechanical Engineering, University of Birmingham,
- 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, employer representative, Končar inženjering za energetiku i transport, d.d., Croatia
- Ana Carolina dos Santos Paulino, doctoral candidate, 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, doctoral candidate, Department of Maritime Studies, Stord/Haugesund University College, Norway.

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

- Professor Kjell Ivar Øvergård
- Professor Aleksander Sładkowski
- Professor Stojan Petelin
- Dr. Gordon Dalton
- Hilde Sandhåland, doctoral candidate.

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

- Iva Žabarović, coordinator, ASHE,
- Ivana Rončević, interpreter at the site visit,
- Translator of the Report, ASHE.

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

- Management,
- Study programme coordinators,
- Doctoral candidates,
- External stakeholders.

#### • Alumni,

The Expert Panel also had a tour of the library, IT rooms, railway simulator, technical equipment for measurement of roads and signs.

#### SHORT DESCRIPTION OF THE STUDY PROGRAMME

**Name of the study programme contained in the licence**: Technological Systems in Traffic and Transport

**Institution providing the programme:** University of Zagreb

Education provider(s): Faculty of Transport and Traffic Sciences

Place of delivery: Zagreb, Vukelićeva 4, Borongajska 83 A

**Scientific area and field**: Technical Sciences, Technology of Traffic and Transport

#### Learning outcomes of the study programme:

- 1. Apply a system of values present when making a critical review of another's scientific work.
- 2. Assess and interpret the optimal protection measures (technological, operational, economic, regulatory) in order to solve environmental problems in traffic.
- 3. Anticipate traffic distribution by branches based on minimizing costs and external costs, taking into account the principles of environmental protection.
- 4. Assess the impact of changes in certain traffic variables on the performance of the transport system
- 5. Identify the targets of strategic transport planning.
- 6. Assess the potential for improvement of specific technological processes, in order to make the entire transport system more efficient.
- 7. Demonstrate the application of appropriate semantic technologies and ontological tools for conceptualizing transport knowledge.
- 8. Connect and use a suitable optimization technique and ITS infrastructure to improve distribution of goods in transport.

Number of doctoral candidates: 212

Number of teachers: 42

Number of supervisors: 22

## 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:

**issue a letter of recommendation** for the period up to three (3) years in which period the higher education institution should make the necessary improvements.

## RECOMMENDATIONS FOR THE IMPROVEMENT OF THE STUDY PROGRAMME

- 1. Align the PhD-program with EU standards so students are allowed to start their PhD-research immediately after enrolment in the PhD-study and to continue the PhD-research at the same time as they are taking the mandatory and elective courses in the PhD-program.
- 2. Increase publications in international peer-reviewed journals.
- 3. Increase support for self-funded or industry-funded PhD-students.
- 4. Ensure that teacher workload is not above the maximum 350 norm hours.
- 5. The Faculty is advised to implement institutional supports so full-time PhD-candidates can finalise the coursework and the research part of the PhD within 4 years. It is suggested to reduce the number of courses the students must take and give more focused courses pertaining to PhD-level education.
- 6. Increasing the number of PhD-theses written in English to increase internationalisation and to increase number of experts who can be part of the evaluation committee.
- 7. Allow students to start their doctoral research at the start of the enrolment into the PhD-program.
- 8. Increase Erasmus+-exchange of PhD-students and of Faculty staff.
- 9. Produce Detailed and systematic Rulebook on postgraduate university study.
- 10. Reduce teaching load for students.

#### ADVANTAGES OF THE STUDY PROGRAMME

- 1. Great contact with industry.
- 2. Good PhD research labs.
- 3. Good career progress and job security within Faculty for PhD students especially ministry funded candidates.
- 4. Management that understands challenges of the program and willing to change (information given during interviews).

5. The Faculty conducts the only program of traffic and transport in the country or in the region.

#### DISADVANTAGES OF THE STUDY PROGRAMME

- 1. The time from enrolment to finalising the PhD-degree is too long.
- 2. Too much course work.
- 3. Too much teaching load for both students and teachers.
- 4. No international journal publication strategy.
- 5. Lack of industry funding due to economic problems in industry.
- 6. Lack of transparency where student fees go.
- 7. Lack of online library facilities.
- 8. PhD-courses are taught in Croatian.
- 9. Average h-index of supervisors is relatively low.
- 10. No PhD students enrolled since 2010 have completed.
- 11. Completion rate of PhD-students are very low between 14 and 41%.

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

- 1. Willingness to invest in modern research equipment.
- 2. Research is relevant to industry as evident in interviews.
- 3. Evaluation of thesis topic is thorough.
- 4. The process of developing and defending the thesis proposal is well.
- 5. Selection process of PhD candidates is public thorough and transparent.

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

Minimal legal conditions:	YES/NO
	notes
1. Higher education institution (HEI) is listed in the Register of Scientific	YES
Organisations in the scientific area of the programme, and has a positive	
reaccreditation decision on performing higher education activities and scientific	
activity.	
2. HEI delivers programmes in the two cycles leading to the doctoral	YES
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).	
3. HEI employs a sufficient number of researchers, as defined by Article 7 of the	YES
Ordinance on Conditions for Issuing Licence for Scientific Activity, Conditions	
for Re-Accreditation of Scientific Organisations and Content of Licence (OG	
83/2010).	
4. At least 50% of teaching as expressed in norm-hours is delivered by teachers	YES
employed at the HEI (full-time, elected into scientific-teaching titles).	
5. Student: teacher ratio at the HEI is below 30:1.	YES
6. HEI ensures that doctoral theses are public.	NO
	(PhD theses
	are not
	available on
	the internet.)
7. HEI launches the procedure of revoking the academic title if it is determined	NO
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.	
Additional/ recommended conditions of the ASHE Accreditation Council	YES/NO
for passing a positive opinion	notes
1. HEI (or HEIs in joint programmes) has at least five teachers appointed to	YES
scientific-teaching titles in the field, or fields relevant for the programme	
involved in its delivery.	
2. In the most recent reaccreditation, HEI had the standard Scientific and	YES
Professional Activity (e.g. Artistic for those in the arts field) marked as at least	
"partly implemented" (3).	
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.	NO 9,63/1
	Panel

	Members
	comments in
	part 1.4 in
	this report.
5. All supervisors meet the following conditions:	YES
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.	
6. All teachers meet the following conditions:	YES
a) holds a scientific or a scientific-teaching position;	
b) active researcher, recognized in the field relevant for the course (table 1,	
Teachers).	
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	YES
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.	
9. For joint programmes and doctoral schools (at the university level):	N/A
cooperation between HEIs is based on adequate contracts; joint programmes	
are delivered in cooperation with accredited HEIs; the HEI delivers the	
programme within a doctoral school in line with the regulations, based on	
contracts in the case of multiple institutions, and the HEIs ensure good	
coordination aimed at supporting the candidates;	
at least 80% of courses are delivered by teachers employed at HEIs within the	
consortium.	

### **QUALITY ASSESSMENT**

		Quality assessment ("high level of quality" or "improvements are necessary") and the explanation of the Expert Panel
1.	RESOURCES: TEACHERS, SUPERVISORS, RESEARCH CAPACITIES AND INFRASTRUCTURE	
		Improvements are necessary
1.1	. HEI is distinguished by its scientific/ artistic achievements in the discipline in which the doctoral study programme is delivered.	The scientific production from the PhD-programme as described in the SER is 277 publications from the 19 dissertations in progress. The number of citations for these publications is low – perhaps because the majority of these publications are papers published in conference proceedings. Of these 277 publications a total of 76 articles are published in A-category journals and a majority of these articles are published in Croatian journals such as Technical Gazette (total of 11 articles) and the Faculty's own journal –PROMET (total of 46 articles). The remaining 19 articles are published in other international journals. The tendency to publish mainly in regional sources ought to be changed to increase the international dissemination of the research as well as increasing the impact of the research from the PhD-program.
		Also, the SER on page 1 inform us that "a total of 42 instructors participate in doctoral teaching Over the last five years, these instructors have published an average of 12.9 articles (median 10), their articles have been cited (SCOPUS) an average of 8.6 times (median 5), and the average h index is 2.5 (median 1)." This indicates that the instructors publish about 2.2 publications per year. This is a rather low number comparing to other PhD-programs. Since the median is lower than the mean we see that a few instructors have much more publications that the average and that the majority has less than the mean publications (e.g. a right-tailed distribution). The mean h-index is also much higher than the median indicating that a few authors increase the average h-value of the total group of instructors. About half of the instructors has a h-index of 1 or lower (e.g. their most-cited article has 1 or more citations, while their second-

most cited publication has 1 or less citations) hence indicating that their research has little impact and is seldom cited.

The number of invited presentations at conferences the last five years (given in the link in the SER on p. 3) show that there is an interest in the research done at the Faculty – beyond what is indicated by the citation rate. However, the majority of these invited lectures have been presented within the former Yugoslavia region. This further indicates that there is work to be done to increase the internationalization of the PhD-programmes.

Recommendation: The Faculty is advised to increase the ratio of publications in international (nonregional) A-level journals.

The citation rate of publications stemming from the PhD-program is also low. There is a need to increase the impact of the research from the PhD-program.

Recommendation: The Faculty is advised to focus more on writing articles in international journals instead of publishing in conference proceedings and in regional journals.

The Faculty's involvement in hosting workshops and conferences are well described in the SER. The conferences/workshops are of relevance to the PhD-program, but it is unclear to what extent the workshops/conferences are regional or international in character and participation.

Recommendation: The Faculty is advised to focus on increasing the international participation and the use of English language in the conferences and workshops hosted by the Faculty.

The faculty's involvement in research projects as described in table 2 in the SER is good.

The use of English language is mentioned in The Strategic Program of Scientific Research at the Faculty for 2015–2020 (appendix 11 in the SER) which clearly describe that "English language will be treated as a standard language of scientific communication" (p. 96 in SER)–thus pointing

to the importance of using a language shared by the majority of the scientific community. Still, a large number of the PhD-theses written at the Faculty is written in Croatian (6 out of 6 dissertations that was checked on the internet was written in Croatian). Recommendation: The Faculty is recommended to ensure that the majority of PhD-theses are written in English so as to increase the availability and the impact of the research done in the PhD Program "Technological Systems in traffic and Transport". (This point is also connected to point 2.2 in this evaluation report). Improvements are necessary More than 50% of the courses are given by own faculty. As mentioned in the SER the workload for 15 of the 42 teachers are above the maximum 350 norm work hours. Thus, a total of 35% of the teachers connected to the PhDprogram has a teaching load that exceeds the maximum norm hours. The workload for teachers and supervisors connected to the PhD-program needs to be reduced so it does not exceed full teaching load. 1.2. The number and workload of teachers Recommendation: The Faculty is advised to reduce involved in the study programme the work load of individual teachers so their ensure quality doctoral education. workload is less than the maximum number of normhours. The number of teachers giving lectures is sufficient. The use of external guest lecturers as described in the SER is good. However, the use of guest lecturers as well as international experts could be increased to further help internationalisation of the PhD-programme. Recommendation: The Faculty is advised that teaching hours of the students is too high. A reduction in course number would reduce teacher as well as student work load. 1.3. The teachers are highly qualified Improvements are necessary researchers who actively engage with the topics they teach, providing a

quality doctoral programme.

As indicated in the SER tables 1 and 2 the teachers and the mentors (supervisors) have published a number of relevant articles for the program. By checking the links to each person's publication history given in the SER, we compared the total number of book chapters, articles in journals and conference proceedings with peer-review we find that about 65% of all publications are in conference proceedings (1339 out of 2052) and only 31% is in journal articles— many of which is in Croatian journals such as PROMET and Technical Gazette (only 4% is published in book chapters). In the last 5 years the number of A-category journal publications was only 76 (according to appendix 2 in the SER).

The citation rate for these publications is quite low, as is the h-index (< 3) for 38 of the staff mentioned in table 1 and 2. The combination of many conference proceedings in combination with the tendency to publish in regional journals is one probable reason why the research is not cited much.

Recommendation: The Faculty ought to ensure that teachers/researchers focus more on writing articles in international journals instead of publishing in conference-proceedings and in regional journals.

Increasing internationalisation of the publications is an important aspect of increasing citations, improving research quality, and gaining more international funding.

1.4. The number of supervisors and their qualifications provide for quality in producing the doctoral thesis.

#### Improvements are necessary

On page 1 in the SER the number of doctoral candidates are said to be 212, while the numbers of supervisors that have finalised the required mentoring training (as described in SER point 1.4) are 22. This gives a supervisor/candidate ratio of 9.63.

If we count the total available supervisors – which is given as 53 in the SER (point 1.4), the candidate - supervisor ratio is 4. While counting the number of active doctoral candidates as described in table on page 18 of the SER we see that there is a total of 162 active doctoral students, which give a candidate - supervisor ratio of 3.05 – a number higher than the requirement of 3:1.

Recommendation: The Faculty is advised to implement measures to lower the supervisor: candidate ratio or to increase the number of supervisors who are eligible to be supervisors at PhD-level.

Based upon the information in point 1.4 in the SER and discussions with the management and staff during the committee's re-accreditation meeting in Zagreb, we understood that the Faculty only gives a supervisor to the students that have gotten their PhD-research project proposal accepted, and that currently there are only 19 students who are doing doctoral research, giving a student/supervisor ratio of less than 1. The reason why there are a so big discrepancy between the number of enrolled active candidates (162) and the number of candidates doing PhD-research is seemingly the peculiarity of the Croatian PhD-model. In this model, students are enrolled and take mandatory and elective courses on PhD-level in the first three semesters. The candidates first get a supervisor/mentor when their PhDproject proposal is accepted (usually after coursework is finished in the third or fourth semester).

The completion rate of the program is <u>not acceptable</u> as no candidate that has enrolled after 2010/2011 has finished yet (according to table 2 on page 18 in the SER). Also, completion rates of enrolled students prior to 2010/2011 are very low (16 % to 41%). Based upon discussions at the meeting with the faculty, the Panel understood that the dropout-rate was particularly high for the self-funded or industry-funded candidates, while ministry-funded candidates had a much higher completion rate.

Recommendation: The Faculty is advised to implement institutional supports so full-time PhD-candidates can finalise the coursework and the research part of the PhD within 4 years. It is suggested to reduce the number of courses, and with more focused courses pertaining to PhD-level education.

Recommendation: The Faculty must implement measures to improve the success rate of their self-

#### funded students and the industry-funded students.

In addition, the current PhD-model is not in accordance with the classical EU-model for PhD-programs where candidates are accepted into a PhD-program on the basis of background, education, grades and a sufficiently good PhD project proposal. In the EU-model, the candidates get a supervisor at the start of enrolment in the PhD-program and the supervisor guides the student through all parts of the PhD-program. In these programs, the candidate participates in course-work *while at the same time* do research on their PhD-project, hence the candidate does not have to be in the program for almost two years before being given a supervisor or starting their PhD-research.

Recommendation: The Faculty is advised to give students a supervisor/mentor that will supervise the student throughout the whole PhD-study when the PhD-student is enrolled in the PhD-program.

Recommendation: The Faculty is advised to allow students to start their PhD-research as soon as they are enrolled in the PhD-program.

Recommendation: The Faculty is advised to change the enrolment requirements for PhD-candidates, so the proposal for PhD-project and the Plan for conducting the coursework and research work is part of the admission and enrolment requirements for the PhD-program.

## High level of quality

1.5. The HEI has developed methods of assessing the qualifications and competencies of teachers and supervisors.

The formal mechanisms for assessing and monitoring competencies of teachers and supervisors are good, and the work done by the Commission for Postgraduate and Doctoral Studies is well described in the SER.

Especially good is the fact that the Faculty requires a supervisor training program for their mentors/supervisors.

1.6. The HEI has access to high-quality resources for research, as required by

#### Improvements are necessary

the programme discipline.

Laboratories and office infrastructure is of high quality.

The Panel understood that this was due to lack of payment on the governmental level and that the university or faculty are then only partly responsible for this missing part. However, the access to databases needs to improve to be of sufficient quality for a PhD-level.

Recommendations: The Faculty is advised to increase resources to ensure access to research databases and access to sufficient state-of-the-art literature.

## 2. INTERNAL QUALITY ASSURANCE OF THE PROGRAMME

#### High level of quality

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.

According to the SER, the rationale for establishing doctoral studies within the Bologna framework is explained in the proposal for postgraduate doctoral studies "Technological systems in traffic and transport", developed in 2005 based on regulations about establishing and approving doctoral programs, namely the Law of Scientific activities and Higher education (2003 and 2004) and the Rulebook on Criteria for Founding Higher Education Institutions. The national council on higher education evaluated all doctoral programs in the country with the goal of issuing basic accreditation.

During academic year 2012-2013, the Committee for Doctoral Programs of the University of Zagreb, following periodic internal review of doctoral studies, ruled that the Faculty of Transport and Traffic Sciences, after implementing changes recommended by the same Committee, fulfils all conditions for conducting doctoral studies in technological systems in traffic and transport.

The program justification is based on strategy documents of the Croatian government "Transport Development Strategy of the Republic of Croatia 2014 – 2030", and the EU documents "White Paper: Roadmap to a Single European Transport Area" and "Smart, Green and Integrated Transport within the framework of the EU

Horizon 2020 program for research and innovation". Improvements are necessary The Faculty of Transport and Traffic Sciences has adopted the following plans and policies: Development strategy for the Faculty for 2012-2017 (FPZ, 2012), - Program Background of the Strategic Program of Scientific Researchers for 2012-2017 (FPZ, 2012), Strategic Program of Scientific Research at the Faculty for 2015-2020 (FPZ, 2014). The SER briefly describes how the programme is aligned with these plans and policies. However, the SER does not explicitly describe the way candidates and supervisors are chosen. The selection of personnel that are going to fulfil the goals for the PhD-program is clearly important. Recommendation: The Faculty should involve self-2.2. The programme is aligned with the funded and industry-funded students in research HEI research mission and vision, i.e. projects. research strategy. The Strategic Program of Scientific Research at the Faculty for 2015-2020 (appendix 11 in the SER) clearly describe that "English language will be treated as a standard language of scientific communication" (p. 96 in SER)-thus pointing to the importance of using a Language shared by the majority of the scientific community. Still, a large number of the PhD-theses written at the Faculty is written in Croatian (6 out of 6 dissertations that was checked on the internet was written in Croatian). Recommendation: The Faculty should ensure that the majority of PhD-theses written at the Faculty are written in English. This is to ensure that the research is available for the larger research community outside of the Croatian-speaking world and to ensure consistency with the Faculty's own strategic program ("The Strategic Program of Scientific Research at the

Faculty for 2015-2020").

#### Improvements are necessary

According to the SER, the doctoral studies program is periodically evaluated in compliance with the University of Zagreb's periodic internal evaluation of doctoral studies. Faculty submit an annual report about the functioning of the doctoral program and prepare a report for periodic internal evaluation of doctoral studies. Most of these suggested changes by the University of Zagreb involved aligning the regulations about doctoral studies at the Faculty with the corresponding university-level regulations.

The Faculty of Transport and Traffic Sciences adopted the ISO 9001 quality system and applied it to undergraduate and postgraduate levels. Once a year doctoral students evaluate their mentors and advisors. This is a good approach, but it is not clear from the SER or from the linked document on the Faculty's website (second link on p.10 in SER) whether the student filled out the questionnaire independent and without influence of the mentor/supervisor.

Recommendation: The Faculty must make clear in the procedure for filling out the evaluation form that the student is to fill out the evaluation form without help or influence from the supervisor.

The Agency for Science and Higher Education previously conducted the procedure of thematic evaluation of doctoral studies by using questionnaires.

In order to evaluate the achievements of doctoral students after they finish their studies, the Faculty asks for responses from the industrial sector and takes into account feedback about the needed competencies of doctoral students.

As mentioned in the SER, the Faculty introduced activities with the aim of modifying the doctoral study program.

Recommendation: Recommendations from reaccreditation of the Agency for Science and Higher Education review 4 years ago need to be completed.

Recommendation: Ensure that the work of aligning

2.3. The HEI systematically monitors the success of the programmes through periodic reviews, and implements improvements.

competencies and qualifications with the Croatian Qualification Framework is finalised (as described in the SER).

#### Improvements are necessary

As described in the SER, the Committee for Doctoral Programs evaluates mentors according to their realized scientific activity and by taking in consideration the results of questionnaire.

The candidate's research performance, as mentioned in table 2, indicates that the production of papers and publications are quite high, however the citations of these works are very low. This might be due to the tendency to publish in regional journals and the low amount of publications in high-impact journals stemming from the PhD-program (only two publications in relatively high-ranking international journals are found in Appendix 2 – and these are also mentioned on page 1 in the SER).

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.

Recommendation: Faculty members and students must focus more on publishing in high-impact journals and less on publishing in regional journals and conferences.

Recommendation: The Faculty should consider finding ways to reward mentors/supervisors whose students publish in high-ranking A-level journals.

Recommendation: Review of supervisors ought to focus more on the impact factor of journals and the h-value of publications coming from students and Faculty members. (this is also connected to point 1.1 in this evaluation).

Students evaluate their mentors and advisors once a year. As mentioned in point 2.2, it is unclear whether the mentor/supervisor can affect the evaluation of him/her. This is unfortunate as the power distance between a mentor and a student quickly can mean that students might not be willing to voice critical comments about their mentors. To ensure that evaluations are independent and given freely by the student, the Faculty must ensure that the evaluation process is done without influence of the

mentor/supervisor.

Recommendation: The Faculty must ensure that the students can fill out the mentor evaluation form (Dr.SC-04) in an independent way without being effected by their supervisor.

Students are allowed to change dissertation topic and/or mentor once during the PhD-program. Administrative assistance is given by the director of doctoral studies.

The review of supervisors also includes the time it takes from approval of dissertation topic to dissertation defence. As follows from Appendix 1 in the SER, the duration of doctoral studies for the PhD-students has increased markedly from 2010 to 2015 (from an average of less than 4 years for the five first PhD-students to an average around 7 years for the five last PhD-students). This might be due to the fact that PhD-students take coursework for several semesters before starting the research part for their PhD-thesis, hence using the time from acceptance of dissertation topic to dissertation defence does not give a good indication of the actual throughput of PhD-students. The Faculty needs to implement a model which evaluates the actual total time a PhD-candidate uses on the whole PhD-program. The Faculty ought also ensure that the PhD-program conforms with common EU-standards where students starts their research work at the time of the enrolment into the PhDprogram and that the students take PhD-level courses the first two-three years of the PhD-study. This point is connected to point 3.1 and 3.4 in this evaluation.

Recommendation: The evaluation of supervisors should include also the total time a PhD-student uses from enrolment to dissertation defence.

Recommendation: There is also a need to have a better review of the failure rates of candidates, especially for self-funded and industry candidates.

2.5. HEI assures academic integrity and freedom.

#### Improvements are necessary

Various documents are available:

- The Handbook of Disciplinary Responsibilities of Students of the Faculty of Transport and Traffic Sciences,
- The Code of Ethics of the Faculty of Transport and Traffic Sciences,
- The Code of Ethics of the University of Zagreb,
- European Charter for Researchers and Code of Conduct for the Recruitment of Researchers,

These documents aim to prevent:

- cheating on exams;
- direct or indirect offer of bribes in the form of money and plagiarism.

In the SER, it is not described a procedure for revoking the PhD-degree from someone who have been given the degree based upon a work which is in breach with research ethics (and where this have been found out after the candidate has finalised the dissertation defence). Examples of such breaches of research ethics can be plagiarism discovered after dissertation defence, unethical data analysis or the forgery of scientific data.

Recommendation: The Faculty must ensure that a procedure for revoking academic degrees due to breaches of research ethics and unethical conduct is in place.

Also related to this point – all scientific publications aim to clearly describe the new knowledge produced in a simple, thorough and consistent way. However, during the evaluation of the PhD-theses presented by the Faculty, the Panel identified a number of theses which did not explicitly describe the contributions of the thesis in a short and concise form.

Recommendation: Doctoral dissertations must include an explicit description of the scientific contribution of the research work described in the dissertation.

2.6. The process of developing and defending the thesis proposal is transparent and objective, and includes a public presentation.

#### High level of quality

The process of developing and defending the thesis proposal is well defined using three forms:

- DR.SC.-01 Request for Approval of the Dissertation Topic,
- DR.SC.-02 Evaluation of the Dissertation Topic and
- DR.SC.-03 Decision on Approval of the Dissertation Topic.

According to SER (last sentences of item 2.6): »After the University Senate has approved topic and mentor, the student can begin research work«. It is not clear when the topic and mentor are approved (at the end of the first year or at the end of second year of the study at postgraduate doctoral program).

Recommendation: Students need to begin with research as soon as possible after they enrol in the PhD-program and not after two years or more after entering into doctoral program.

#### High level of quality

The doctoral student must have at least one manuscript published or accepted in a category-A indexed journal and two articles published at an international scientific-expert meeting with international peer review. The scientific articles must be from the field of the doctoral dissertation.

2.7. Thesis assessment results from a scientifically sound assessment of an independent committee.

Evaluation of the Dissertation Topic compares the final dissertation with the stated hypotheses, objectives (goals), methodology and expected original scientific contribution of the project. Evaluation must specify original scientific contribution and new findings.

The Dissertation Assessment Committee has 3 or 5 members of whom at least one is external member. Members of the Committee for Dissertation Assessment must be scientists with the rank of assistant professor (scientific associate) or higher or the foreign equivalent. At least 2 members of the 3-member Committee (or 3 members of the 5-member Committee) must have the rank of full professor (tenured or untenured) or the equivalent scientific rank.

The majority of Doctoral theses are written in Croatian

(with the published works mainly written in English). This precludes the evaluation committee from being truly international, as only academics who can read Croatian are eligible as evaluators.

Recommendation: Ensure that the majority of PhDtheses can be assessed by foreign non-Croatian speaking researchers.

Recommendation: It is recommended that doctoral students publish scientific article category A (SCI) relevant to the area before defending doctoral thesis.

#### Improvements are necessary

Students are well informed about:

- publish all scientific articles in the on-line database Croatian Scientific Bibliography (CROSBI) as well as into the internal database of the doctoral studies program,
- important dates and events related to their doctora
- information about conferences and meetings as w
   University Office for Doctoral Studies or other facu
- announcements of postgraduate student mobility of
- doctoral scholarships, funding for research stays at
- "information days" for doctoral students,
- deadlines for completing doctoral studies.

Recommendations: Panel concluded that the courses were not advertised internationally very well, and not in English, thereby not attracting an international candidates.

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 successfully).

2.8. The HEI publishes all necessary

accessible outlets and media.

information on the study programme,

admissions, delivery and conditions

for progression and completion, in

#### Improvements are necessary

Doctoral tuition fees go directly towards the following expenses:

- teaching fees for instructors in the doctoral program,
- fees for participating on committees, public defence of the dissertation topic,
- fees to student advisors and mentors,

	- administrative costs and overhead.
	In accordance with the Contract of Rights and Responsibilities of Postgraduate Doctoral Students, Faculty does indeed include students in research on various projects (Horizon 2020, FP7, IPA, ERDF, national projects Croatian Foundation for Science, Ministry of Science, Education and Sport and university projects) and in that way helps to finance doctoral research.  Recommendation: The Panel concluded that there was not great transparency as to where the funds from the student fees were used. There was a lack of funding for online journal publications.
	Improvements are necessary
2.10. Tuition fees are determined on the basis of transparent criteria (and real costs of studying).	The fees for three years doctoral study are 70,000.00 kuna (7,452.00 EURO). Doctoral students employed by the Faculty are entirely relieved of paying tuition, and doctoral students working on scientific and technical projects at the Faculty pay 25% of the full tuition. Around 7% of Ph.D. students pay full tuition. The Faculty try to cover additional expenses of doctoral research works.  Recommendation: Actual school fee needs to be announced every year and has to be comparable to other HEI.
3. SUPPORT TO DOCTORAL CANDIDATES AND THEIR PROGRESSION	
	Improvements are necessary
3.1. The HEI establishes admission quotas with respect to its teaching and supervision capacities.	According to SER, the HEI currently has 212 doctoral candidates and 53 available supervisors. Hence, the candidate - supervisor ratio is 4:1 which is above the legal recommendation. However, according to SER, the number of active doctoral candidates is 162 which gives a candidate - supervisor ratio of 3.05. In both cases the number is higher than the legal recommendation of 3:1.

With the current arrangement at the HEI, the doctoral candidates will be assigned a supervisor after the courses are completed and the topic of the dissertation is approved (currently 22 supervisors are supervising 19 doctoral candidates). According to practise in other comparable EU countries, the doctoral candidates are assigned a supervisor upon admission to a doctoral program. In this way, the supervisors provide support to the doctoral candidates in the entire process, including selection of topic, design of the doctoral project, selection of relevant courses, research activities and writing of thesis.

Recommendation: In order to align with other comparable EU-countries, it is recommended that the doctoral candidates are assigned a supervisor upon admission. In order to carry out this arrangement, it is necessary for the HEI to establish admission quotas which ensures that the candidate - supervisor ratio do not exceed the legal recommendation of 3:1 upon admission of the candidates.

The supervisors reported in the interview that supervision of doctoral candidates does not exempt the supervisors for other duties. This implies that supervision of doctoral candidates adds to the total workload.

Recommendation: It is recommended that the HEI ensure that supervision of doctoral candidates is included in the total workload.

During the interviews with the doctoral candidates, the quality of supervision was described as good. However, two candidates described the feedback on "not approved" thesis as unsatisfactory.

Recommendation: It is recommended that HEI ensures that feedback on "not approved" thesis is justified in a way that helps the candidate to implement necessary improvement in order to get the thesis approved.

According to the SER, the obligations of doctoral candidates, supervisors and research teams are described in steering documentation within the HEI.

Improvements are necessary

According to the SER, the enrolment quota has been 30 candidates the last 5 years. The HEIs enrolment quota is defined based on the need for postdoctoral researchers at the Faculty, the availability of positions within the industry and public sector, the need of joint projects involving the Faculty and the industry and the number of applicants. In general, it seems like the HEI has close cooperation with the industry, which gives a great opportunity to identify future needs of doctoral candidates in private sector. Further, according to SER, the HEI highlight that the admission quotas may be adjusted relative to the completion rate of students in the doctoral program. However, according to SER (p. 18), no doctoral candidate has completed their thesis since the academic year of 2009/2010.

Recommendation: The HEI should identify factors that influence the doctoral candidates' ability to complete their thesis according to plan, and if necessary revise their admission quotas in order to release resources to existing candidates.

#### Improvements are necessary

During the interviews, the management reported that it was difficult to get adequate national funding for doctoral programs in Croatia. This is also stated in the SER where the HEI points out that national strategic goals as described in "Industrial strategy for the Republic of Croatia 2014-2020" and "Strategy of Education, Science and Technology" (October 2014) have not been operationalized in any national documents in a way that allow the institutions to implement them in their research and develop activities. Further, during the interviews, the external stakeholders reported that following the economic crisis they did not have the necessary funding to fund a doctoral candidate. This implies that self-paying students largely will fill up the admission quota.

Recommendation: We acknowledge that lack of national funding restricts the funding available to the candidates. This, however, should be taken in to consideration when the HEI establish the admission

3.2. The HEI establishes admission quotas on the basis of scientific/artistic, cultural, social, economic and other needs.

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.

quotas for the doctoral program.

Recommendation: Even though the HEI reports to have established an enrolment process that includes interviews with the candidates, the HEI should pay further attention to the selection process of self-funding candidates. A more rigours selection process may increase the success rate for self-paying students.

According to interviews with the management, the HEI currently has 29 ERASMUS agreements. However, in the last generation students only four students have applied for ERASMUS funding.

Recommendation: It is recommended that the HEI encourage the students to utilize the opportunity to apply for funding via ERASMUS.

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.

#### Improvements are necessary

According to SER, each doctoral candidate is assigned a study advisor at the time of enrolment, which assists the candidate in developing an individual plan. According to SER, the individual plans include, but are not limited to: selection of courses, applying for the thesis topic and research activities. However, to our knowledge the candidates will be able to defend their thesis topic after most of the course work is completed.

Recommendation: It is recommended that the thesis topic is defended earlier in the process. If the topic of the thesis is approved before the coursework is completed, it will guide the candidates' choice of courses, and allow the candidates to start their research activities on an earlier stage.

3.5. The HEI ensures that interested, talented and highly motivated candidates are recruited internationally.

#### Improvements are necessary

The HEI reports to have no doctoral candidates from other countries than Croatia. This might be explained by the fact that the recruitment of candidates mainly occurs through national channels and e-mail contact with undergraduate students. In addition, the courses are done in Croatian language (except ERASMUS courses which are done in

		English).
		Recommendation: It is recommended that the HEI seek doctoral candidates through international channels. In order to seek candidates from outside former Yugoslavia, it is a prerequisite that PhD-courses are taught in English.
		High level of quality
	The selection process is public and based on choosing the best applicants.	According to the SER, applicants are evaluated based on their undergraduate performance, the interest in scientific research (expressed in their motivation letter), their publication history, published student work and recommendations from the professors and potential supervisors. In addition, the HEI perform interviews with the applicants.
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.	High level of quality
,		According to the SER, names of selected applicants and their advisors, dates of enrolment and deadline for complain is published on the postgraduate studies website. Further, applicants who are not selected receive a written explanation on the decision.
38 '	. There is a possibility to recognize applicants' and candidates' prior learning.	High level of quality
;		According to the SER, the doctoral candidates will receive credit for previous academic achievements. This is governed in the Regulation of Doctoral studies at the Faculty of Transport and Traffic Sciences.
		High level of quality
;	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.	According to the SER, the regulation of doctoral studies regulates the condition for enrolment and duration of study, supervision, obligation and rights, teaching duties, procedure for taking the qualifying exam, procedure for approving the thesis topic, procedure for defending the dissertation, procedure for publishing/archiving the dissertation, graduation from the doctoral program and methods for ensuring quality in doctoral research. In addition, the doctoral candidates sign a contract that

regulates right and duties of the doctoral candidate.

#### Improvements are necessary

The HEI provide financial support to all the doctoral candidates who publish category-A articles that are co-authored by the supervisor, other students at the Faculty or co-authors outside Croatia. In addition, the HEI pay some of the cost of articles co-authored with representatives from institutions within Croatia.

According to the SER, the HEI completely covers the costs of participating in the international conferences ZIRP and POVA. Participation in these conferences has resulted in 83 published conference proceedings the last 5 years.

Recommendation: It is recommended that the ability to get financial support from the Faculty is restricted to the above-mentioned conferences.

During the interviews with the doctoral candidates, it became apparent that the candidates were dissatisfied with the institutional access to scientific articles.

Recommendation: It is recommended that the HEI, in cooperation with the doctoral candidates, identify how the institutional access to scientific articles should be extended, and establish a plan on how it should be financed.

The high failure rate for self-paying and industry funded candidates may reflect insufficient institutional support. In particular, the number of teaching hours for doctoral candidates and the number of courses that the candidates themselves have to complete are high. When it comes to the number of teaching hour, the candidates reported in the interview to have up to 300 hours teaching duties each year (the number of hours referred to was actual teaching hours and not norm hours). The students also reported that the high number of courses that they have to complete influence their ability to successfully finish their thesis according to plan. According to SER, the candidates have to complete 11 courses including 6 required courses and 5 elective courses – in total 34 ECTS. The comprehensive teaching duties for some of the candidates

3.10. There are institutional support mechanisms for candidates' successful progression.

and the high number of courses may help to explain the high failure rate.

Recommendation: It is recommended that the HEI reduce the total number of mandatory and elective courses to a total of 6. In order to align with comparable EU countries, it is further recommended to reduce the total number of required ECTS from 34 to 30.

It is further recommended that the HEI pay attention to the candidates teaching duties. In order to be able to complete the thesis successfully, it is important that the HEI establish a standard for maximum hours of teaching duties. The standard should ensure that the candidates have sufficient time for their research activities and writing of the thesis.

#### 4. PROGRAMME AND OUTCOMES

#### Improvements are necessary

The program, which was presented to the Expert Panel, meets the requirements of training doctors at the European level as well as at the national level (Croatian Qualifications Framework). Minimal training is stated to be 3 years, which allows the candidate to acquire generic (transferable) skills and international experience. However, PhD-candidates does not start their research work before the dissertation topic is accepted – which usually happens in the third or fourth semester. Hence, a student who finalised the research work in three years would have only 1 ½ years of research training.

4.1. The content and quality of the doctoral programme are aligned with internationally recognized standards.

Recommendation: It is recommended that the Faculty implements procedures to accept dissertation topics during the first 3-6 months after the enrolment the student into the PhD-program. This would allow the student to start their research work quickly after the enrolment so they can obtain the necessary research training which is consistent with 150 ECTS credits (equivalent to 2.5 years of full-time research).

As stated in the SER point 2.3, the Faculty is working to change the existing teaching plan and doctoral program. The Faculty has started to process of aligning the system of competencies and qualifications with the Croatian

Qualifications Framework.

Recommendation: Finalise the work to ensure correspondence between learning outcomes at program level as well as for course descriptions with the Croatian Qualification Framework.

The self-evaluation contains a reference to the criteria for admission of students to train on level 3 (doctoral students). These criteria also clearly stated on the Faculty webpage:

http://www.fpz.unizg.hr/studiji.asp?m=poslijediplomskistudiji.

The duration of courses is at least 3 years, including lecture training during the first year. During specified period student is required to study 6 required courses as well as 5 elective courses, which student selects from among 14 elective possibilities. The number of courses is very high and the credits given per course are low.

Recommendation: The Faculty is advised to reduce the number of required and elective courses to a maximum of 6 courses which are sized so they together give 30 ECTS credits.

These courses are given in appendix 14 of self-evaluation and correspond to the level of training for considered specialty. Thus, the students have enough time also to conduct their own research.

Among the courses directly related to the consideration speciality for students is offered studying of general methodological subjects, which will help in planning and conducting of research, for example: 4002. Scientific and Research Activities Methodologies, or 4015. Technological Projects Management.

Faculty's Rules and Regulations of Doctoral Studies clearly define the roles and tasks of the supervisor. The Faculty Council decides on the number of doctoral students that a mentor can supervise at the same time. Participants of the Panel did not find a significant excess of the number of students at one of the supervisors.

Every year the student prepares an individual plan, an example of which is given in Appendix 12: PhD candidate's individual plan. This plan is developed in cooperation with the supervisor, it marks the process of its execution, and

adjustments are made if necessary.

After the end of the academic year, each student has to prepare a report (form DR.SC.-04 - Annual Progress Report of the Doctoral Candidate), which is firstly evaluated by the research supervisor, and then confirmed by the Committee on Postgraduate and Doctoral Studies or Council of the Faculty.

Panel members familiarized themselves with the procedure adopted for the preparation of the PhD thesis defence, its preliminary assessment, directly with the defence process and the related documentation that has been presented in full. Panel members had the opportunity to get acquainted with the separate PhD theses. As a result of discussions, it was found that both the procedure of defence and the content of theses correspond to the national and international professional standards.

Specialization "Technological Systems in Traffic and Transport" requires interdisciplinary research. It is not surprising therefore that large enough list of PhD theses had two scientific co-supervisors. Appendix 15 of self-evaluation: "Abstracts of interdisciplinary doctoral theses" contains summaries of some works that are interdisciplinary studies.

The programme length does not align to EU standards and the Bologna process which is 3 year term duration for thesis completion. Average number of years in Zagreb was 6 years.

Recommendation: The time from enrolment to dissertation defence needs to be reduced.

Recommendation: Students ought to publish in international peer-reviewed journals as part of their PhD- work. Some of the theses lacked sufficient international journal publications and many tended to contain many regional journals as well as conferences.

4.2. Programme learning outcomes, as well as the learning outcomes of modules or subject units, 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

#### Improvements are necessary

The Panel participants evaluated the training program as a corresponding to higher level (high quality programme). Part 4.4. of the self-evaluation, "The doctoral programme ensures the achievement of learning outcomes and competencies aligned with the level 8.2 of the CroQF", gives a clear description of the basis for such an assertion.

requirements of doing research.

Here are learning outcomes, which correspond to the reality.

Similarly, we can confirm the success of the lectures, which are based on the methods of teaching described in the section 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". Most supervisors have the title of full professor or doctor with a sufficiently great experience research work, three out of the 22 supervisors are Assistant Professors.

Recommendations: The Panel finds that the number of courses was too many, and too wide ranging, leading to candidates taking too long to complete their thesis. It is recommended that the number of compulsory and elective courses are reduced in number and that the size of the course in ECTS-credits are increased so a total of 6 courses is sufficient for getting 30 ECTS credits as required according to EU standards for PhD-level education.

Panel members interviewed the doctoral candidates who have shown successful possession of knowledge. This can be determined by becoming familiarized with the work of doctoral students in the laboratories, their participation in the projects.

It is clear that the project of planning and management competencies (developing research proposals, organising research, timely identification of potential issues, budgeting, leading a research group) is the responsibility of supervisors, however doctoral students are involved in this process.

Based on the analysis of completed theses, it can be concluded that the PhD students can use relevant hardware and software, statistical analyses, statistical inference, making conclusions based on quantitative data, etc.

Based on interviews with doctoral candidates, it could be concluded that only some of them have the experience of teaching. These were the best trained future teachers. Nevertheless, the readiness to accept ethical and social

responsibility for performing research successfully, delivering socially useful research results as well as potential social impact, readiness to face new social and economic challenges, etc. has been shown by all PhD students.

Recommendations: The Panel concluded that all the candidates had to do extensive teaching hours: mostly tutorials, but some lectures as well. It is recognised that some teaching hours experience is invaluable for transferable skills, but the hours must not be overloaded. It was recommended that the number of teaching hours be reduced to allow candidates to complete thesis in shorter time.

4.3. Programme learning outcomes are logically and clearly connected with teaching contents, as well as the contents included in supervision and research.

#### High level of quality

Interviews with candidates and alumni and analysis of finished PhD thesis demonstrate that learning outcomes are logically and clearly aligned with individual courses, supervisory work and research correspond to high level of quality.

4.4. The doctoral programme ensures the achievement of learning outcomes and competencies aligned with the level 8.2 of the CroQF.

#### Improvements are necessary

The Expert panel was presented with all finished and defended PhD theses in recent years. Experts from institutions listed in the registry of Ministry of Science, Education and Sport of Republic of Croatia (AAI@EduHR) can choose and look at examples of theses. It should be noted that the level of publications which have been published as a result of research is not uniform. Examples of publications are given in Appendix 2 (self-report): Acategory scientific articles (2011.-2016.), Faculty of Transport and Traffic Sciences. Thus the most part of the publications are articles in proceedings of regional conferences.

One can argue that the minimum requirements associated with the publishing of research results are observed in all works. Expert panel also checked all the additional documentation related to the process of preparation and defence of the theses.

Recommendation: Panel recommends more

international journal publications.

Recommendation: The Panel recommends that more theses should be written in English, in order to be more widely read and to allow foreign experts in the evaluation committee.

#### Improvements are necessary

In the section 1.6 of self-report "The HEI has access to high-quality resources for research, as required by the programme discipline" noted, that the Faculty of Transport and Traffic Sciences have 17 laboratories distributed among the various departments, including one shared laboratory and one authorized laboratory. The Expert Panel was shown the use of these laboratories in doctoral training and how they were used to carry out research projects under the guidance of supervisors. The panel commends the quality of resources and labs at the Faculty.

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.

Panel experts analysed the programme and course structure from point of view of used methods (ex-cathedra teaching, individual work with the supervisor, discussion groups, workshops etc.). It was found that the learning groups are small enough, each doctoral student has the opportunity to gain knowledge related to the subject of his dissertation. Used methods for education are appropriate for achieving intended learning outcomes.

Recommendation: The Panel recommends that the number of courses should be reduced. The current number of courses (as many as 11) is too many for the students to undertake, resulting in PhD taking too long to complete and resultant dropouts as well as research starting too late in the program.

Recommendation: It is recommended that the Faculty reduce the total number of mandatory and elective courses to a maximum of 6. Courses should be re-sized so these 6 courses are sufficient to give the required ECTS credits.

Recommendation: In order to align with comparable EU countries, it is further recommended to reduce the

	total number of required ECTS from 34 to 30.
4.6. The programme enables acquisition of general (transferable) skills.	High level of quality  During the site-visit, Panel experts had the opportunity to meet with employers - representatives of various companies belonging to the transport industry. These executives and managers have confirmed the industry's interest in top-level specialists, which are the doctoral students of the Faculty of Transport and Traffic Sciences. A similar conclusion can be made on the basis of analysis of doctoral training program.  Most doctoral students involved in the practices, working in different transport companies. Accordingly, doctoral students receive practical experience and have the opportunity to apply their knowledge in real conditions. The Faculty of Transport and Traffic Sciences has signed cooperation agreements with a number of Croatian companies and organizations, for example, ALTPRO, Croatia Airlines, Croatian Air Traffic Control, Aircraft Technical Center, Croatian Ministry of Defense, etc.
4.7. Teaching content is adapted to the needs of current and future research and candidates' training (individual course plans, generic skills etc.).	In section 4.1 it was noted that students, in addition to the 6 required courses, must choose 5 courses from the offered 14. Thus it can be argued that the program of doctoral training is flexible and customizable to the needs of the specialist training in the chosen direction of research.  However, any educational program must weigh the number and size of learning items with the time and resources available to the institution and student. The number of mandatory courses is 6, which is more than half of the total number of courses required. It can be argued that this amount is too much as the student loose the possibility to take more and perhaps better fitting elective courses.  Hence it can be argued that the Faculty needs to strike a balance between flexibility of the candidate uses to finalise these courses.

## Recommendations: The recommendations for 4.5. are also valid for this point.

The individual doctoral plans are sufficiently flexible and in consultation with the supervisor can be changed during the preparation of the PhD theses.

#### Improvements are necessary

Section 2.2. of the self-evaluation report, "The programme is aligned with the HEI research mission and vision, i.e. research strategy", noted the importance of international cooperation and, in particular, expanding mobility opportunities for doctoral candidates. On the basis of meetings with Faculty leadership, supervisors and doctoral students, it can be concluded, that the Faculty systematically provides information on opportunities for candidate mobility, encourages and achieves it; ensures means to attract and attracts international faculty and excellent candidates to the programme.

4.8. The programme ensures quality through international connections and teacher and candidate mobility.

Recommendations: Unfortunately, the mobility program used in a limited extent. The main problem is the level of centralized financing of mobility programs, which is insufficient. As a result, the individual thesis of students who were able to take the opportunity of mobility, have a substantially higher level of scientific research. The management of the Faculty recognizes the need to expand activities in this direction.

The Faculty applies to international projects (Horizon 2020, FP7, IPA, ERDF). At the same time, part of doctoral students involved in international projects, but with limited success in this area.

The above conclusion was made on the basis of the data presented in the self-report. In particular, it was noted that this year, five mobility grants covering conference registration fees were awarded to students at the Faculty of Transport and Traffic Sciences from a University of Zagreb call for doctoral student mobility. Clearly, this level of mobility is insufficient when compared with the total number of doctoral students who study at the

present time at the Faculty.

The Faculty is actively expanding international cooperation with foreign HEI. List of Erasmus+ partner institutions for the 2014/2021 period consist from 28 universities and faculties (http://www.fpz.unizg.hr/oms/?page id=129).

Recommendation: More theses should be written in English, in order to enable international researchers to read the thesis.

Recommendation: Thesis format option could also adopt the new European method of thesis by peer review international journal publications, usually consisting of 3 approved journal publications as the core of the thesis.

Recommendation: The Faculty should increase the number and length of Erasmus+ student exchange on PhD-level.