University of Belgrade – Faculty of Transport and Traffic Engineering

To the Faculty's Academic Council

Subject: Report on the Doctoral Dissertation completed by
Jovana Kuljanin, Dipl. Ing. in transport and traffic engineering

According to Decision no. 316/4 dated 11th April 2019 by the Academic Council of the Faculty of Transport and Traffic Engineering, we were appointed as members of the Committee for the review, evaluation and defense of the doctoral dissertation by PhD Candidate Jovana Kuljanin, titled

**A model for air transport market competition assessment:
airline and alliance perspective**

(Model za ocenu konkurencije na tržištu vazdušnog saobraćaja: aviokompanije i alijanse)

Upon review of the submitted Dissertation and other accompanying materials, and interviewing the Candidate, the Committee submits the following

REPORT

1. INTRODUCTION

1.1. Chronology of approvals and dissertation completion:

- 7th October 2015 – Registration of the Doctoral Dissertation with the Academic Council;
- 20th October 2015 – The Academic Council formed a Committee for assessing the suitability of the Candidate and the Topic;
- 6th November 2015 – The Academic Council accepted the Committee's positive assessment of the suitability of the Candidate and Topic;
- 23rd November 2015 – Professional Board for Engineering Sciences of the University of Belgrade approved the proposed Doctoral Dissertation topic;

The procedure od accepting the positive assessment by the Committee for assessing the suitability of the Candidate and the Topic was repeated, because Doctoral Dissertation title in English was added because the Dissertation and the defense would be in English. Decisions made in 2015 were annulled and new decisions were made during 2018.

- 13th February 2018 – The Academic Council accepted the positive assessment given by the Committee for assessing the suitability of the Candidate and the Topic;
- 26th February 2018 – Professional Board for Engineering Sciences of the University of Belgrade approved the proposed Doctoral Dissertation topic;
- 3rd April 2019 – The completed Doctoral Dissertation was submitted, along with a request to the Academic Council for the commencement of the evaluation and defense process;
- 9th April 2019 – The Academic Council formed a Committee for the evaluation and defense of the Doctoral Dissertation.

Ms. Kuljanin enrolled in doctoral studies at the Faculty of Transport and Traffic Engineering in October 2012. As at 29th December 2014, she passed all doctoral studies exams with an average mark of 10, submitted the annual paper (4 ECTS credits) and earned 77 ECTS credits (out of 74 ECTS credits required).

1.2. Scientific field of the Dissertation

The topic of the Doctoral Dissertation belongs to the scientific field of Transport and Traffic Engineering, and more specifically to the scientific field of Aircraft Operations and Air Transport Planning and Management, under the jurisdiction of the Faculty of Transport and Traffic Engineering.

The Dissertation was completed under the mentorship of Prof. Dr Milica Kalić, full professor of the Faculty of Transport and Traffic Engineering, University of Belgrade.

1.3. Biography of the Candidate

Ms. Kuljanin was born in 1985 in Smederevo, where she finished elementary school *Branislav Nušić* (2000), earning a Vuk Karadžić Diploma (certificate of excellence) and then graduated from High School of Smederevo, majoring in natural and mathematics sciences (2004) and earning again a Vuk Karadžić Diploma (certificate of excellence). She enrolled at the Faculty of Transport and Traffic Engineering, University of Belgrade in 2004.

Ms. Kuljanin graduated from the Faculty of Transport and Traffic Engineering, Department for Air Traffic and Transport in May 2010, earning a mark of 10 for the thesis titled *Air travel market segmentation: the case study of Jat Airways and Nikola Tesla Airport*, under the mentorship of Prof. Dr. Milica Kalić. Her average mark during the studies was 9.13.

Ms. Kuljanin speaks English (she passed TOEFL test) and basic French.

Internships, advancement and other activities

Together with her colleagues from the Department and Prof. Vojin Tošić, Ms. Kuljanin paid a professional visit to Germany from 24th March to 3rd April 2009; the visit was organized and financed by the DAAD organization (*Deutcher Akademischer Austausch Dienst*).

Ms. Kuljanin interned in the Operating Center of Tivat Airport for one month period (from 15th June to 15th July 2009).

She took part in *Volcanic Ash Crisis* 2010 seminar held in September 2010 atthe Faculty of Transport and Traffic Engineering in Belgrade.

Ms. Kuljanin interned abroad for 6 months, at the Zurich Airport, in the Capacity Planning (from 1st September 2011 to 1st March 2012). Within the internship, she was engaged in the *Forecasting air travel demand with econometric models* project under the mentorship of Renold Manuel.

In November 2012, Ms. Kuljanin took part in the *Workshop on EU regulations concerning statistical returns in respect of the carriage of passengers, freight and mail by air*, organized by the European Commission in cooperation with the Belgrade Chamber of Commerce. In September 2013 she went to *Summer School on Air Transport Economics*organized by the University of Belgrade, Faculty of Transport and Traffic Engineering and *the German Aviation Research Society* (GARS).

In the first quarter of 2017, Ms Kuljanin paid a study visit to Polytechnic University of Bari (Italy) within y ERASMUS + doctoral student mobility program.

Employment, teaching and academic activities

Ms. Kuljanin was employed with the Faculty of Transport and Traffic Engineering as a teaching assistant in period from November 2012 until April 2014for holding practical exercises in Transportation Networks and CAD of Transport and Traffic Engineering subjects.

At the session of the Faculty's Academic Council held on 26th March 2011, Ms. Kuljanin was elected as research assistant (Decision no. 111/6 dated 28th March 2014) and re-elected in 2018.

Starting from May 2014, Ms. Kulajnin was engaged as a research assistant on a scientific research project financed by the Serbian Ministry of Education, Science and Technological Development, titled *A Support to Sustainable Development of the Republic of Serbia's Air Transport System* (project no. TR 36033, 2011-2019).

Scientific and professional work

Up to date, Ms Kuljanin published and/or presented **24 works** as the author or co-author, viz.:

- **three papers** were published in an international SCI journal,
- **two papers** were publish as chapters in *Springer*international monography,
- **four papers** were published in a national journal,
- **fourteen papers** were presented at international conferences and published in full in corresponding proceedings (EWGT - EURO Working Group on Transportation, ATRS – Air Transport Research Society, INAIR - International Conference on Air Transport, SYMORG, LOGIC, SYMOPIS),
- **one paper** was presented at an international professional meeting.

Projects and studies

Ms. Kuljanin was a member of the team engaged in preparation of **4 projects – 2 national projects and 2 international projects**, viz.:

- Project by the Ministry of Education, Science and Technological Development, Republic of Serbia, titled *A Support to Sustainable Development of the Republic of Serbia's Air Transport System* (project no. 36033, 2011-2019);
- *Support to reviewing implementation of Acceptable Level of Safety Performance (ALoSP) concept in EUROCONTROL Member States and development of an initial definition and guidance*, University of Belgrade – Faculty of Transport and Traffic Engineering and Westminster University, 2017. Ordering entity:EUROCONTROL, Brussels, Belgium;
- *TRANS-TOOLS 3* (FP7 project), research project by the European Union;
- *Air transport sustainability study for Niš Constantine the Great Airport*, Institute of theFaculty of Transport and Traffic Engineering, Belgrade, 2013. Ordering entity: Administration for Economy, Sustainable Development and Environmental Protection,the City of Niš;

2. DISSERTATION DESCRIPTION

2.1. Dissertation contents

The main body of the Dissertation is made up of 9 chapters (222 pages in total), reference literature containing 221 units (24 pages) and 6 appendices (24).

2.2. A brief overview of individual chapters

Chapter 1 contains introductory considerations on the concept of air transport competition and airline competitiveness.The chapter defines the subject matter and the objective of the Dissertation. The introduction underlines the need to develop a model for evaluation of competition, competitiveness and efficiency of airlines, as the last decade brought significant changes in both airline operation (low cost and hybrid business models) and technological development in aircraft (new types of aircraft with longer ranges and lower capacities). The introductory chapter outlines the structure of the Dissertation.

Chapter 2 deals with the concept of competition in more detail, providing necessary definitions of the concept. In addition, the chapter provides an overview of key indicators used for measuring the intensity of market competition. After some general definitions and indicators, the chapter deals with basic concepts of airtransport market competition divided into price competition (ticket price) and non-price competition (flight schedule, flight frequency, quality of airline service).

Chapter 3 provides a review of the selected reference literature related to the problem discussed herein.The literature review is divided into two parts. The first shows the literature dealing with the effects of low cost carriers (LCCs) upon different aspects of full service carriers' (FSCs) operation.An extensive overview of the literature deals with a number of papers in a detailed and systematic manner.The second part of this chapter analyzes the methodology employed in the reference literature according to the complexity of the models applied.

Chapter 4 refers to the evolution of the long haul low-cost business model. The chapter provides an overview of long haul airlines and an overview of the next generation aircraft which enable lower long haul transport costs. The chapter particularly considers North Atlantic routes with strongest airline competition.

Chapter 5 analyzes non-price competition between FCSs and LCCs in the transatlantic market. In addition to exhaustive definition of the market scope the chapter analyzes the following aspects in more detail: flight schedule, flight frequency, departure times, comfort, airlines' image, etc. The chapter particularly analyzes the London–New York and then calculates the route's market concentration index and share in the total number of passengers flown by several airlines operating in this market.

Chapter 6 develops an econometric model for evaluation of LCC competition effects on FSNC's fares and passenger volume in long haul transport. In addition, a sensitivity analysis is carried out in order to examine the application of a capacity increase strategy (number of seats in economy classes) aimed at reducing the effects of LCC competition.

Chapter 7 develops a robust model for assessment of competition in the long haul market. The model determines shares in the total number of passengersbased on flight frequency and air fare

price. The model is based on the application of fuzzy-logic combined with the Bee Colony Optimization metaheuristic in the area of determining the domain of fuzzy sets of input and output variables.

Chapter 8 provides an overview of the current European market. It analyzes efficiency of airlines through application of the non-parametric DEA (Data Envelopment Analysis) method with carefully selected sets of input and output variables. The results show that leading airlines in Europe achieve evident market dominance through economies of scale.

Chapter 9 presents conclusions, scientific and practical contributions of the Dissertation, as well directions for future research.

3. DISSERTATION ASSESSMENT

3.1.Contemporaneity and originality

The Dissertation is an original contribution to the solution of air transport market competition problem.

The need to analyze key elements and strategies in competitive conditions currently prevailing in the market (development of LCCs and new aircraft types to enable long haul transport) has been properly recognized.Factors such as air ticket price, flight schedule, flight frequency, service level, proximity of airports, etc. directly affect both air market shares and ratios between airlines in competitive markets.

The contribution is based on the knowledge of to-date research in this field and the proposed original models for evaluation of airline competition, competitiveness and efficiency.

3.2. Review of reference and used literature

The Dissertation provides an extensive overview and a critical review of the reference literature. An exhaustive review of the literature deals with around 200 papers in a detailed and systematic manner. The literature analyzed herein is relevant for this research field and it includes papers from both recognized international journals and papers from national and international conferences.

3.3.Description and adequacy of applied scientific methods

In addition to general scientific research methods, the Dissertation applies econometric methods and operating research techniques which are appropriate for solution of the problem. The Dissertation applies multiple linear regression, fuzzy logic, bee colony optimization and data envelopment analysis (DEA). The method and techniques that we selected and used in the Dissertation embody adequately chosen and applied scientific methods fully relevant for the subject and objectives of this research.

3.4.Applicability of the results achieved

Models developed are fully applicable and may be of exceptional importance to airlines in network planning, flight frequency determination and ticket pricing on routes with competition.

3.5.Evaluation of the Candidate's capabilities for independent scientific activity

Ms. Kuljanin's affinity, enthusiasm, dedication and strong motivation to perform independent scientific research and to study in detail the to-date research relevant for her doctoral dissertation field and beyond, as well as her exceptional talent to compose scientific papers have resulted in a number of high quality papers.

During preparation of this Dissertation, Ms. Kuljanin demonstrated demonstrated her ability to conduct scientific work independently through implementation of planned research, from ideation to completion of the doctoral dissertation.

Moreover, the Candidate has demonstrated her capability for independent work by having three scientific papers published in a relevant international journal, i.e. *Journal of Air Transport Management*, and by successful presentation of her work at internationally recognized conferences (ATRS, EWGT, INAIR, LOGIC, SYMORG, SYMOPIS).

4. REALIZED SCIENTIFIC CONTRIBUTION

4.1.Overview of realized scientific contributions

The Committee is of the opinion that the Doctoral Dissertation submitted by Ms. Jovana Kuljanin makes original and important scientific contributions, the important ones among which are the following:

- Air transport competition problem has been identified;
- Three original models for evaluation of airline competition, competitiveness and efficiency have been developed;
- The developed models apply various econometric methods and operating research techniques: multiple linear regression, fuzzy logic, Bee Colony Optimization and Data Envelopment Analysis (DEA),
- The proposed models are highly applicable because they enable airline planners to systematically analyze route competition problems, which is of utmost importance to airlines in their network planning, flight frequency setting and ticket pricing.

4.2.Critical analysis of research results

The scientific contributions listed under 4.1 represent the improvements to scientific knowledge as compared with research results published so far in this field.

In addition to its scientific contributions, the Disserattion may be practically applied because it enables consideration (by airlines) of various effects intrinsic in any strategy aimed at fighting off competition.

In addition to airlines, regulatory authorities may also benefit from the models thus developed, as their role is to support healthy competition in their national markets.

4.3. Verification of scientific contribution

Scientific contributions resulting from this Doctoral Dissertation have been verified through publishing a part of the research (three papers were published in a relevant international journal, while several papers were published in a national journal or reported at conferences).

Moreover, results of this Dissertation were used for implementation of a scientific-research project of the Serbian Ministry of Education, Science and Technological Development (record no. TR 36033).

CategoryM22:

Kuljanin, J., Paskota, M, Kalić, M., 2018. Methodological framework for the investigation on the rapidly growing air travel market – An application of multivariate statistical analysis, Journal of Air Transport Management, Vol. 72, pp. 86-91. (**$IF_{(2017)}$=2,038**). ISSN 0969-6997

Kuljanin, J., Kalić, M., Caggiani, L., Ottomanelli, M., 2019. A comparative efficiency and productivity analysis: Implication to airlines located in Central and South-East Europe, Journal of Air Transport Management.DOI: https://doi.org/10.1016/j.jairtraman.2019.01.009 (**$IF_{(2017)}$=2,038**). ISSN 0969-6997

Category M23:

Kuljanin, J., Kalić, M., 2015. "Exploring characteristics of passengers using traditional and low-cost airline: A case study of Belgrade Airport", Journal of Air Transport Management, Vol. 46, pp. 12-18. (**$IF_{(2015)}$=1,084**). ISSN 0308-1060

Category M33:

Kuljanin, J., Kalić, M., Renold, M, 2018. The impact of low cost carrier on competition in long haul market: London-New York route, SymOrg2018, Златибор, Србија.

Category M51:

Kuljanin, J., Kalić, M., Caggiani, L., Ottomanelli, M., 2017. „Airline efficiency performance in the turbulent period before and after economic crisis", Tehnika Saobraćaj 72 (5), str. 725-732.

Kuljanin, J., Kalić, M., Mijović, N., Renold, M., 2018. „The impact of low-cost carrier on traditional airline' fares on intercontinental routes", Tehnika Saobraćaj 73, str. 117-123.

5. CONCLUSIONS AND RECOMMENDATIONS

The Committee concludes that the Doctoral Dissertation titled **"A model for air transport market competition assessment: airline and alliance perspective"** by Candidate Jovana Kuljanin, Dipl. Ing., fully satisfies the criteria required for this type of work. It represents an original scientific contribution in the field of transport and traffic engineering as well as air transport.

Based on the Doctoral Dissertation itself, scientific contributions, applied scientific methods, models developed and results obtained, the Committee also concludes that the Candidate Jovana Kuljanin, Dipl. Ing., has exhibited the ability to perform independent scientific-research work. The scientific-research maturity of the Candidate Jovana Kuljanin, Dipl. Ing., is corroborated by her conversancy with various scientific disciplines (transport and traffic engineering, transport economics, statistics and operational research), integration of knowledge from diverse disciplines, her motivation and her commitment.

The Committee recommends to the Academic Council that the Doctoral Dissertation titled **"A model for air transport market competition assessment: airline and alliance perspective"** by Candidate Jovana Kuljanin, Dipl. Ing., be accepted, publicized and recommended for final adoption to the Professional Board for Engineering Sciences, University of Belgrade.

In Belgrade, 11/04/2019

The Committee:

D. Sc. Milica Kalić, Full Professor
University of Belgrade – Faculty of Transport and Traffic Engineering

D. Sc. Boris Begović, Full Professor
University of Belgrade – Faculty of Law

D. Sc. Michele Ottomanelli, Full Professor
Polytechnic University of Bari, Italy

D. Sc. Radosav Jovanović, Associate Professor
University of Belgrade – Faculty of Transport and Traffic Engineering

D. Sc. Manuel Renold, Associate Professor
Zurich University of Applied Sciences, Switzerland