



University of Novi Sad  
FACULTY OF TECHNICAL SCIENCES  
DEPARTMENT OF PRODUCTION ENGINEERING  
21000 NOVI SAD, Trg Dositeja Obradovica 6, SERBIA



---

UDK 621

ISSN 1821-4932

**JOURNAL OF**  
**PRODUCTION ENGINEERING**

---

Volume 16

Number 1

Novi Sad, March 2013

*Publisher:* FACULTY OF TECHNICAL SCIENCES  
DEPARTMENT OF PRODUCTION ENGINEERING  
21000 NOVI SAD, Trg Dositeja Obradovica 6  
SERBIA

---

*Editor-in-chief:* Dr. Pavel Kovač, *Professor, Serbia*

*Reviewers:* Dr. Miroslav BADIDA, *Prof. Ing. Slovak Republic*  
Dr. Janko HODOLIČ, *Professor, Serbia*  
Dr. Marin GOSTIMIROVIĆ, *Professor, Serbia*  
Dr. Frantisek HOLESOVSKY, *Professor, Czech Republic*  
Dr. Janez KOPAČ, *Professor, Slovenia*  
Dr. Pavel KOVAČ, *Professor, Serbia*  
Dr. Mikolaj KUZINOVSKI, *Professor, Macedonia*  
Dr. Ildiko MANKOVA, *Professor, Slovak Republic*  
Dr. Snežana RADONJIĆ, *Professor, Serbia*  
Dr. Krzysztof ROKOSZ, *Professor, Poland*  
Dr. Branko ŠKORIĆ, *Professor, Serbia*  
Dr. Ljubomir ŠOOŠ, *Professor., Slovak Republic*  
Dr. Miodrag HADŽISTEVIC, *Assoc. Professor, Serbia*  
Dr. Mijodrag MILOŠEVIĆ, *Assist. Professor, Serbia*  
Dr. Đorđe VUKELIĆ, *Assist. Professor, Serbia*

*Technical treatment and design:* M.Sc. Borislav Savković, *Assistant*  
Dr. Mijodrag Milošević, *Assist. Professor*

*Manuscript submitted for publication:* March 10, 2013.

*Printing:* 1<sup>st</sup>

*Circulation:* 300 copies

*CIP classification:*

*Printing by: FTN, Graphic Center  
GRID, Novi Sad*

**ISSN: 1821-4932**

CIP – Каталогизacija u publikaciji  
Библиотека Матице српске, Нови Сад

621

JOURNAL of Production Engineering / editor in chief  
Pavel Kovač. – Vol. 12, No. 1 (2009)- . – Novi Sad :  
Faculty of Technical Sciences, Department for Production  
Engineering, 2009-. – 30 cm

Dva puta godišnje (2012-). Je nastavak: Časopis proizvodno  
mašinstvo = ISSN  
0354-6446  
ISSN 1821-4932

## INTERNATIONAL EDITORIAL BOARD

---

*Dr. Joze BALIĆ, Professor, Slovenia*  
*Dr. Konstantin BOUZAKIS, Professor, Greece*  
*Dr. Miran BREZOČNIK, Professor, Slovenia*  
*Dr. Ilija ČOSIĆ, Professor, Serbia*  
*Dr. Pantelija DAKIĆ, Professor, Bosnia and Herzegovina*  
*Dr. Numan DURAKBASA, Professor, Austria*  
*Dr. Katarina GERIĆ, Professor, Serbia*  
*Dr. Marin GOSTIMIROVIĆ, Professor, Serbia*  
*Dr. Janko HODOLIČ, Professor, Serbia*  
*Dr. František HOLEŠOVSKY, Professor, Czech Republic*  
*Dr. Amaia IGARTUA, Professor, Spain*  
*Dr. Juliana JAVOROVA, Professor, Bulgaria*  
*Dr. Vid JOVIŠEVIĆ, Professor, Bosnia and Herzegovina*  
*Dr. Janez KOPAČ, Professor, Slovenia*  
*Dr. Borut KOSEC, Professor, Slovenia*  
*Dr. Mikolaj KUZINOVSKI, Professor, Macedonia*  
*Dr. Miodrag LAZIĆ, Professor, Serbia*  
*Dr. Stanislaw LEGUTKO, Professor, Poland*  
*Dr. Chusak LIMSAKUL, Professor, Thailand*  
*Dr. Vidosav MAJSTOROVIC, Professor, Serbia*  
*Dr. Miroslav PLANČAK, Professor, Serbia*  
*Dr. Mirko SOKOVIĆ, Professor, Slovenia*  
*Dr. Bogdan SOVILJ, Professor, Serbia*  
*Dr. Antun STOIĆ, Professor, Croatia*  
*Dr. Peter SUGAR, Professor, Slovak Republic*  
*Dr. Branko ŠKORIĆ, Professor, Serbia*  
*Dr. Ljubomir ŠOOŠ, Professor, Slovak Republic*  
*Dr. Ljubodrag TANOVIĆ, Professor, Serbia*  
*Dr. Wiktor TARANENKO, Professor, Ukraine*  
*Dr. Velimir TODIĆ, Professor, Serbia*  
*Dr. Marian TOLNAY, Professor, Slovak Republic*  
*Dr. Andrei TUDOR, Professor, Romania*  
*Dr. Gyula VARGA, Professor, Hungary*  
*Dr. Milan ZELJKOVIĆ, Professor, Serbia*  
*Dr. Miodrag HADŽISTEVIĆ, Assoc. Professor, Serbia*  
*Dr. Milenko SEKULIĆ, Assoc. Professor, Serbia*  
*Dr. Katica ŠIMUNOVIĆ, Assoc. Professor, Croatia*  
*Dr. Aco ANTIĆ, Assist. Professor, Serbia*  
*Dr. Sebastian BALOŠ, Assist. Professor, Serbia*  
*Dr. Igor BUDAK, Assist. Professor, Serbia*  
*Dr. Ognjan LUŽANIN, Assist. Professor, Serbia*  
*Dr. Slobodan TABAKOVIĆ, Assist. Professor, Serbia*  
*Dr. Đorđe VUKELIĆ, Assist. Professor, Serbia*

### *Editorial*

*The **Journal of Production Engineering** dates back to 1984, when the first issue of the **Proceedings of the Institute of Production Engineering** was published in order to present its accomplishments. In 1994, after a decade of successful publication, the Proceedings changed the name into *Production Engineering*, with a basic idea of becoming a Yugoslav journal which publishes original scientific papers in this area.*

*In 2009 year, our Journal finally acquires its present title - **Journal of Production Engineering**. To meet the Ministry requirements for becoming an international journal, a new international editorial board was formed of renowned domestic and foreign scientists, refereeing is now international, while the papers are published exclusively in English. From the year 2011 Journal is in the data base COBISS and KoBSON presented.*

*The Journal is distributed to a large number of recipients home and abroad, and is also open to foreign authors. In this way we wanted to heighten the quality of papers and at the same time alleviate the lack of reputable international and domestic journals in this area.*

*In this journal number are published, reviewed papers from 11<sup>rd</sup> Conference MMA 2012 Advanced Production Technologies in Novi Sad (Serbia) and new papers as well.*

*Editor in Chief*

*Professor Pavel Kovač, PhD,*