

# International Conference

Advanced Manufacturing as the Foundation for a Successful  
Society – Challenges and Opportunities for  
Advanced-industrialization of Serbia / Horizon 2020/2030  
INDUSTRY 4.0.0 Serbian Program

3rd Circular With  
Detailed Program and  
Conference Abstracts

Under Patronage  
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Republic of Serbia  
Ministry of Economy



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Sponsored by:

31st May – 2nd June 2016  
Belgrade, Serbia

  
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Serbia

# International Conference

## Advanced Manufacturing as the Foundation for a Successful Society – Challenges and Opportunities for Advanced-industrialization of Serbia / Horizon 2020/2030 **INDUSTRY 4.0.0 Serbian Program**

31<sup>st</sup> May – 2<sup>nd</sup> June 2016  
Belgrade, SERBIA

Main sponsor



**AbelaPharm**

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**3rd Circular**  
**With Detailed Program and Conference Abstracts**

## Preface from the Conference Presidents

### Objective of the Conference: White paper on main topics !

The main objective of this Conference will be gather leading experts on advanced manufacturing from leading universities and companies around the world in order to learn useful lessons, as well as identify key strengths, weaknesses, opportunities and threats (SWOT) for the development of innovative, modern manufacturing industries in Serbia.

The invitees include policy makers, company managers, as well as representatives of industrial associations and academia from the US, Europe and Asia.

The main outcome of the conference will be a **white paper** by the conference organizers and willing contributing conference participants in which lessons learnt will be compiled, findings. A SWOT analysis will be summarized. Furthermore a tentative, but clear roadmap for advancement of manufacturing in Serbia in the next several decades will be offered.

### Conference Organisation:

Working part of the conference will consist of 3 days. During the first day, the Conference will consist of a series of invited presentations, lectures and panels on various aspects of manufacturing research and practices, offered by top international experts from industry and academe. During the second day of the Conference, a working group of conference organizers and volunteers will focus on the SWOT analysis for the development of innovative, modern manufacturing industries in Serbia (half day SWOT analysis, half day report writing). In parallel, interested conference participants and guests will have an opportunity to attend panels on latest manufacturing research, visit the Department of Mechanical Engineering of the University of Belgrade or tour the city of Belgrade. During the third day, the working group that conducted the SWOT analysis on day 2 will focus on producing a manufacturing roadmap document that will be presented to the Government of the Republic of Serbia (half day discussions, half day report writing). The idea is that this roadmap document will be revisited and updated regularly after conferences of similar scale are held in Belgrade every 2 years.

**Panelists:** Invited experts and representatives from USA, EU, Far East and Serbia.

### Common themes / main topics:

- Manufacturing world-wide - Challenges and Opportunities
- International/national initiatives for manufacturing improvement
- Strategies for manufacturing on global/national level
- Advanced Manufacturing
- Research and education for manufacturing
- What we can do ?
- Roadmap for AM in Serbia – **Industry 4.0.0 Serbian Model.**

### Draft Agenda of Conference:

**Day 1/2:** Lecturing and learning from the best in the world. Take global lessons. Hong-Kong is an example of launching advanced manufacturing (they did a workshop like this and are now acting upon recommendations from that Conference).

**Day 2:** SWOT analysis in the afternoon. Report writing in the afternoon (no need for everyone to be involved - this can be done by a few people, with strong knowledge of local environment). It would be good to have at least one government official in this. Someone who buys into what we are trying to do, believes in and understands the importance of HIGH TECH ADVANCED manufacturing.

**Day 3:** Presenting to government officials (hopefully 90 minutes with the prime minister and high-level of government people).

The greatest value of the Conference refers to the **authors/participants from three continents**. Their high competence and high-quality level of presentations have given the crucial contribution to the Conference.

Special gratitude is owed comes from to the **Honorary Presidents of the Conference, the members of International Program Committee and the Presidents of the Sessions/Panels**, for their personal contribution to the success of the Conference.

A large number of organizations, institutions and individuals contributed to the preparation of the Conference, for which we are especially grateful, so they deserve special acknowledgement: Belgrade Chamber of Commerce, Microelectronica S.A., Bucharest, Romania, CCI France Serbia, GIZ – Belgrade.

A special acknowledgment is extended to the **main patron – Government of the Republic of Serbia, Ministry of Economy, Belgrade, Serbia and main sponsor – AbelaPharm, Belgrade**, who, by its contribution, enables a high level of arrangement and organisation of the Conference. *Our gratitude deserves the other Conference supporters, because without their help this Conference could not be successfully organised.*

Welcome to the Conference of Advanced Manufacturing, June 2016, Belgrade.

**Belgrade, April 20<sup>th</sup> 2016.**

**Prof. Dr. Jun Ni,**  
**Prof. Dr. Dragan Djurdjanovic**  
**Prof. Dr. Vidosav D. Majstorovic,**

## Acknowledgment

The University of Belgrade, Faculty of Mechanical Engineering, wishes to thank all authors, participants, institutions, associations, organizations and companies for their kind contributions and support in organizing the **International Conference "Advanced Manufacturing as the Foundation for a Successful Society – Challenges and Opportunities for Advanced-industrialization of Serbia / Horizon 2020/2030 - INDUSTRY 4.0.0 Serbian Program"**. This Conference will be held as a part of INTERNATIONAL QUALITY CONVENTION, Belgrade - 2016. This Conference will be held between 31<sup>st</sup> May – 2<sup>nd</sup> June, 2016 in Belgrade, Serbia.

## Main Patron

Government of the Republic of Serbia, Ministry of Economy, Belgrade, Serbia.

## Main co-organizer

Belgrade Chamber of Commerce, Belgrade, Serbia

GIZ – Deutsche Zusammenarbeit, Belgrade

## Main Sponsor:

Abela Pharm d.o.o., Belgrade, Serbia.

## Conference Supporters

University of Belgrade, Belgrade

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Company Metalac, Gornji Milanovac

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Company Sloboda, Cacak

Gemont, Belgrade

FRA, Cacak

## National Honorary Committee:

*Prof. Dr. V. Bumbasirevic, Rector, University of Belgrade; Prof. Dr. J. Zivanic, Vice-Rector, University of Kragujevac; Dr S. Mali, Mayor of Belgrade; Prof. Dr. R. Mitrovic, Dean of Faculty of Mechanical Engineering, Belgrade; M. Miletic, President of Belgrade Chamber of Commerce; D. Puric, Assistant Minister, Ministry of Economy; Prof. Dr. B. Vasic, Vice-Dean for cooperation with Industry, Faculty of Mechanical Engineering; Prof. Dr. S. Stupar, Vice-Dean for Research, Faculty of Mechanical Engineering; Prof. Dr. N. Zrnica, Vice-Dean for International Cooperation, Faculty of Mechanical Engineering; Prof. Dr. B. Babić, Chief of Production Engineering Department, Faculty of Mechanical Engineering, Dr. Stephan Heieck, GIZ, Germany.*

## National / International Sponsor/Supporters Honorary Committee:

*D. J. Korčok, Abela Pharm, Beograd; Milena Matijašević, Carlsberg Srbija doo, Belgrade; Jovana Mladenović, Carlsberg Srbija doo, Belgrade; P. Jakovljević, Metalac Holding, Gornji Milanovac; Dr. L. Jalba, Microelectronica S.A., Bucharest, Romania; M. Luković, Company "Sloboda", Čačak; G. Ušendić, Gemont, Belgrade; B. Erčević, IVA 28, Obrenovac, M. Vidaković, FRA, Cacak, T. Knežević, GIZ, Belgrade; Živana Olbina, Factis, Bgd; M. Brkanović, Belgrade, S. Babić, Elektromašinogradnja, Beograd, Nina Todorović, CCFS, Belgrade; Aleksandra Kokanović, CCFS, Belgrade.*

### International Program Committee:

Prof. Dr. J. Ni, University of Michigan, USA; Prof. Dr. D. Djurdjanovic, University of Texas at Austin, USA; Prof. Dr. J. Vanca, TU Budapest, Hungary; Prof. Dr. W. Sihn, TU Vienna, Austria; Prof. H. Hohonoki, Japan; Prof. Dr. David Bourell, University of Texas at Austin, USA; Prof. Dr. Y. Takaya, Osaka University, Japan; Prof. Dr. N. Durakbasa, TU Vienna, Austria; Prof. Dr. D. Banabic, Technical University of Cluj-Napoca, Romania; Dr. M. Janakiram Intel USA, USA; B. Eylon Samsung USA, USA; Dr. L. Jalba, Microelectronica S.A., Romania; Prof. Dr. N. Dragulanesku, University of Politehnica Bucharest, Romania; Prof. Dr. Emilia Assenova, TU Sofia, Bulgaria; Prof. Dr. D. Kramar, University of Ljubljana, Slovenia; Prof. Dr. M. Sokovic, University of Ljubljana, Slovenia; Prof. Dr. R. Mitrovic, University Belgrade, Prof. Dr. Sanja Vranes, University Belgrade; Prof. Dr. V. Majstorovic, University Belgrade, Prof. Dr. B. Vasic, University Belgrade, Prof. Dr. A. Jovovic, University Belgrade, Prof. dr Vesna Spasojević-Brkić, University Belgrade; Prof. Dr. Tatjana Sibalija, Metropolitan University, Belgrade, D. Damjanovic, Schneider Electric Serbia, Belgrade, N. Bjelogrić, RAS, Belgrade; Dr. M. Petrović, RAS, Belgrade; Katarina Obradović-Jovanović, Assistant Minister, Ministry of Economy, Belgrade; Dr. S. Heieck, GIZ Belgrade; J. Kappenmann, GIZ, Belgrade; T. Knežević, GIZ, Belgrade.

### Organized by

The University of Belgrade, Faculty of Mechanical Engineering, Belgrade, Serbia.

### Technical organized by

United Association of Serbia for Quality (**UASQ**), Belgrade, Serbia.

## **CONFERENCE INFORMATION**

**DATE:** 31<sup>st</sup> May – 2<sup>nd</sup> June, 2016.

**VENUE:** Faculty of Mechanical Engineering, str. Kraljice Marije 16, Belgrade / Hall 211 (second floor), Hall CeNT (first floor), Hall 514 (5<sup>th</sup> floor), Hall 518 (5<sup>th</sup> floor), Cocktails / Refreshments: Club CeNT (first floor), Registration desk Club CeNT (first floor).

### **OFFICIAL LANGUAGE**

The official language of the Conference is English.

### **WEB- SITE & E – MAIL**

For further information please visit web-site: [www.mas.bg.ac.rs](http://www.mas.bg.ac.rs) or [www.jusk.rs](http://www.jusk.rs)

E - mail: [vidosav.majstorovic@sbb.rs](mailto:vidosav.majstorovic@sbb.rs) or [jusk@eunet.rs](mailto:jusk@eunet.rs)

### **IMPORTANT DATES**

|                               |                              |
|-------------------------------|------------------------------|
| Early Registration:           | Before May 15th, 2016.       |
| Late Registration:            | After May 15th, 2016.        |
| Welcome Cocktail:             | May 31 <sup>st</sup> , 2016. |
| Opening Session:              | May 31 <sup>st</sup> , 2016. |
| Conference Dinner (informal): | May 31 <sup>st</sup> , 2016. |
| Excursion tour:               | June 1 <sup>st</sup> , 2016. |
| Closing Plenary Session:      | June 2 <sup>nd</sup> , 2016. |
| Farewell Cocktail:            | June 2 <sup>nd</sup> , 2016. |

### **CONFERENCE FEE**

**For all invited Conference Participants Conference Attendance is Fee of Charge.**

### **CONFERENCE (Registration Office)**

**Prof. Dr. Vidosav D. MAJSTOROVIĆ**

**Address: Faculty of Mechanical Engineering, Kraljice Marije 16  
11020 Beograd, PF 35, SERBIA**

Tel: 00 381 (0) 11 33 02 407; Fax: 00 381 (0) 11 33 70 364

E – mails: [vidosav.majstorovic@sbb.rs](mailto:vidosav.majstorovic@sbb.rs)

Web: [www.mas.bg.ac.rs](http://www.mas.bg.ac.rs) or [www.jusk.rs](http://www.jusk.rs)

## International Conference AMP Serbia 2016 - CONFERENCE PLAN

|   |  |
|---|--|
| <b>Date:</b> 31 <sup>st</sup> May, 2016 / Tuesday | <b>Venue:</b> Faculty of Mechanical Engineering, str. Kraljice Marije 16, Belgrade |
|---|--|

Registration desk: **08:00 – 16:30** Registration

| Time          | Hall 211 (Second floor)   |
|---------------|---|
| 09:00 - 10:00 | AMP Serbia 2016 / Session 1: <b>The Opening Ceremony and Plenary Presentation</b><br>Opening addresses<br><br><b>Opening Plenary Presentation:</b><br><b>ADVANCED MANUFACTURING PROGRAM CONFERENCE – Mision, Vision, Strategy, Prof. Dr. Jun Ni, University of Michigan, Ann Arborn, USA.</b> |
| 10:00 - 10:30 | <b>Welcome Cocktails - Club CeNT (first level)</b>  |
| 10:30 - 13:00 | AMP Serbia 2016/ Session 2: <b>Plenary Session/Panel 1 – Advanced Research in Manufacturing – World-wide Approaches, Part 1 - Hall 211 (second floor) - Faculty of Mechanical Engineering, Belgrade.</b><br><b>Introductions Plenary Presentations</b>  |
| 13:00 - 14:30 | <b>Break</b>  |
| 14:30 - 16:00 | AMP Serbia 2016/ Session 3: <b>Plenary Session/Panel 2 – Advanced Research in Manufacturing – World-wide Approaches, Part 2 - Hall 211 (second floor) - Faculty of Mechanical Engineering, Belgrade.</b><br><b>Introductions Plenary Presentations</b>  |
| 16:00 - 16.30 | <b>Coffee Break</b>   |
| 16:30 - 18:00 | AMP Serbia 2016/ Session 4: <b>Plenary Session/Panel 3 – Advanced Research in Manufacturing – World-wide Approaches, Part 3 - Hall 211 (second floor) - Faculty of Mechanical Engineering, Belgrade.</b><br><b>Introductions Plenary Presentations</b>  |

**20:00** AMP Serbia 2016 / **Conference Reception in Mayor City Hall Belgrade (informal dressing).**



## International Conference AMP Serbia 2016 - CONFERENCE PLAN

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|--|--|
| <b>Date: 1<sup>st</sup> June, 2016 / Wednesday</b> | <b>Venue: Faculty of Mechanical Engineering, str. Kraljice Marije 16, Belgrade</b> |
|--|--|

Registration desk: **08:00 – 16:30** Registration / **CeNT** (first level)

| Time        | Hall 211 (Second floor)  | Hall CeNT (First floor)   |
|-------------|--|---|
| 09:00-10:30 | <i>AMP Serbia 2016/ Session 5: <b>Session/Panel 4</b> – Advanced Research in Manufacturing in Serbia - <b>Hall 211</b> (second floor) – Faculty of Mechanical Engineering, Belgrade.</i>                     | <i>AMP Serbia 2016/ Session 6: <b>Session/Panel 5</b> – Advanced Manufacturing in Practice – Exampmples from Serbia - <b>Hall CeNT</b> (First floor) - Faculty of Mechanical Engineering, Belgrade.</i> |
| 10:30-11:00 | <b>Coffee Break</b>  |   |
| 11:00-13:00 | <i>AMP Serbia 2016/ Session 7: <b>Session/Panel 6</b>– Advanced Manufacturing – Policy and Lessons from the neighborhood - <b>Hall 211</b> (second floor) - Faculty of Mechanical Engineering, Belgrade.</i> |   |
| 13:00-15:00 | <b>Break</b>   |   |
| 15:00-17:30 | <i>AMP Serbia 2016/ Session 8: <b>Session 7/ Workshop 1</b> - Framework for White paper, <b>Hall 211</b> (second floor) - Faculty of Mechanical Engineering, Belgrade.</i>                                   |   |

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| <b>Date: 1<sup>st</sup> June, 2016 / Wednesday</b> | <b>Place: Institute "Mihajlo Pupin", Belgrade.</b>  |
| 11:00-13:00  | <i>AMP Serbia 2016/ <b>Excursion tour</b> – Institute "Mihajlo Pupin", Belgrade. (<a href="http://www.pupin.rs">http://www.pupin.rs</a>). For details please contact: <a href="mailto:jusk@eunet.rs">jusk@eunet.rs</a>, as soon as possible, because number of participants are limited (min 8, max 12). Host of excursion tour is Center for Robotics, Belgrade. Detailed information on Reception Desk.</i> |

**20:00** AMP Serbia 2016 / Conference Dinner (informal dressing).

## International Conference AMP Serbia 2016 - CONFERENCE PLAN

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| <b>Date:</b> 2 <sup>nd</sup> June, 2016 / Thursday | <b>Venue:</b> Faculty of Mechanical Engineering, str. Kraljice Marije 16, Belgrade |
|--|--|

Registration desk: **08:00 – 11:00** Registration

| Time        | Hall 211 (Second floor)   |
|-------------|---|
| 10:00-12:00 | <b>Session 9 - Discussion and presentation final document – White paper:</b> Advanced Manufacturing Research, Practices and Opportunities – Horizon 2020/2030 – INDUSTRY 4.0.0. Serbian model |
| 13:00-14:00 | Farewell Cocktails in Club CeNT (first level)   |

## International Conference AMP Serbia 2016 - CONFERENCE PROGRAM

|   |  |
|---|--|
| <b>Date:</b> 31 <sup>st</sup> May, 2016 / Tuesday | <b>Venue:</b> Faculty of Mechanical Engineering, str. Kraljice Marije 16, Belgrade |
|---|--|

Registration desk: 08:00 – 16:30 Registration

| Time        | Hall 211 (Second floor)   |
|-------------|---|
| 09:00-10:00 | <p style="text-align: center;"><i>AMP Serbia 2016 / Session 1: The Opening Ceremony and Plenary Presentation</i></p> <p style="text-align: center;"><b>Conference/Session Speaker – Mrs Gordana Stijačić, TV Journalist</b></p> <p><b>Opening addresses</b></p> <ul style="list-style-type: none"> <li>• Faculty of Mechanical Engineering, <b>Prof. Dr. R. Mitrović, Dean</b></li> <li>• University of Belgrade, <b>Prof. Dr. V. Bumbasirević, Rector</b></li> <li>• City of Belgrade, <b>Dr S. Mali, Mayor</b></li> <li>• Belgrade Chamber of Commerce, <b>M. Miletić, President</b></li> <li>• GIZ Belgrade, <b>Dr. S. Heieck, Manager</b></li> <li>• Main Sponsor-Abela Pharm, <b>MSc. D. J. Korčok, General Manager</b></li> <li>• Ministry of Economy, <b>Dr Z. Seritić, Minister, Oppening Conference</b></li> </ul> <p><b><u>Opening Plenary Presentation:</u></b></p> <p style="text-align: center;"><b>ADVANCED MANUFACTURING PROGRAM BELGRADE CONFERENCE – Mision, Vision, Strategy, Prof. Dr. Jun Ni, University of Michigan, Ann Arborn, USA;</b></p>  |
| 10:00-10:30 | <b>Welcome Cocktails - Club CeNT (first level)</b>  |
| 10:30-13:00 | <p style="text-align: center;"><i>AMP Serbia 2016/ Session 2: Plenary Session/Panel 1 – Advanced Research in Manufacturing – World-wide Approaches, Part 1 - Hall 211 (second floor) - Faculty of Mechanical Engineering, Belgrade.</i></p> <p style="text-align: center;"><b>Introductions Plenary Presentations</b></p> <p><b><u>Chairmen Session:</u></b></p> <p><b>Prof. Dr. Jun Ni</b>, University of Michigan, Ann Arborn, USA;<br/> <b>Prof. David Bourell</b>, University of Texas, Austin, TX, USA.<br/> <b>Prof. Yasuhiro Takaya</b>, Osaka University, Japan;<br/> <b>Prof. Jozsef Vanca</b>, TU Budapest, Hungary;<br/> <b>Prof. Wilfried Sihn</b>, TU Vienna, Austria;</p> <p><b><u>Keynote Speakers:</u></b></p> <ol style="list-style-type: none"> <li>1. <b>Prof. Dr. Jun Ni</b>, University of Michigan, Ann Arborn, USA; <b>MANUFACTURING AROUND OF THE WORLD – STRATEGIES AND POLICY.</b></li> <li>2. <b>Prof. David Bourell</b>, University of Texas, Austin, TX, USA; <b>ADDITIVE MANUFACTURING AS ADVANCED MANUFACTURING</b></li> <li>3. <b>Prof. Dr. Yasuhiro TAKAYA</b>, Osaka University, Japan; <b>ADVANCED MANUFACTURING IN JAPAN - METROLOGY, INDUSTRIAL MEASUREMENT, OPTICAL/PHOTONIC MEASUREMENT</b></li> </ol> |

|             |   |
|-------------|---|
|             | <p>4. Prof. Dr. Jozsef Vanca, TU Budapest, Hungary; <b>CHALLENGES OF CYBER-PHYSICAL PRODUCTION SYSTEMS – A HUNGARIAN VIEW</b></p> <p>5. Prof. Dr. Wilfried Sihn, TU Vienna, Austria; <b>INDUSTRY 4.0 – FUTURE OF PRODUCTION IN EUROPE</b></p>   |
| Time        | Hall 211 (Second floor)   |
| 13:00-14:30 | Break   |
| 14:30-16:00 | <p>AMP Serbia 2016/ Session 3: <b>Plenary Session/Panel 2 – Advanced Research in Manufacturing – World-wide Approaches, Part 2 - Hall 211 (second floor) - Faculty of Mechanical Engineering, Belgrade.</b></p> <p style="text-align: center;"><b>Introductions Plenary Presentations</b></p> <p><b>Chairmen Session:</b></p> <p><b>Prof. Dr. Numan Durakbasa</b>, TU Vienna, Austria;<br/> <b>Jay Lee, IUCRC</b>, USA;<br/> <b>Prof. Dr. Sanja Vraneš</b>, "Mihajlo Pupin" Institute, Belgrade, Serbia.<br/> <b>Prof. Dr. Dorel Banabic</b>, University of Cluj-Napoca, Romania;</p> <p><b>Keynote Speakers:</b></p> <p>1. Prof. Dr. Numan Durakbasa, TU Vienna, Austria; <b>ADVANCED METROLOGY IN AUSTRIA AND THE WORLD.</b></p> <p>2. Prof. Dr. Jay Lee, IUCRC, USA; <b>INDUSTRIAL BIG DATA ANALYTICS IN MANUFACTURING THROUGH INDUSTRY/UNIVERSITY COLLABORATIVE INNOVATION PARTNERSHIP</b></p> <p>3. Prof. Dr. Sanja Vranes, "Mihajlo Pupin" Institute, Belgrade, Serbia; <b>ADVANCED RESERACHES AT THE "MIHAJLO PUPIN" INSTITUTE.</b></p> <p>4. Prof. Dr. Dorel Banabic, University of Cluj-Napoca, Romania; <b>INDUSTRY 4.0 – APPLICATIONS IN METAL FORMING</b></p> |
| 16:00-16.30 | Break   |
| 16:30-18:00 | <p>AMP Serbia 2016/ Session 4: <b>Plenary Session/Panel 3 – Advanced Research in Manufacturing – World-wide Approaches, Part 3 - Hall 211 (second floor) - Faculty of Mechanical Engineering, Belgrade.</b></p> <p style="text-align: center;"><b>Introductions Plenary Presentations</b></p> <p><b>Chairmen Session:</b></p> <p><b>Dr. Mani Janakiram</b>, Intel, USA;<br/> <b>Ben Eynon</b>, Samsung Austin Semiconductors, Austin, USA;<br/> <b>Prof. Hideaki Hohonoki</b>, COHO Consulting, Japan;<br/> <b>Dr. S. Heieck</b>, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Serbia;<br/> <b>Dr. Catalin Jalba</b>, Microelectronica SA, Romania.</p> <p><b>Keynote Speakers:</b></p> <p>1. Dr. Mani Janakiram, Intel, USA; <b>HOW SUPPLY CHAIN IS TRANSFORMING THE INDUSTRY.</b></p> <p>2. Ben Eynon, Samsung, USA; <b>INTERACTIONS BETWEEN HIGH TECH INDUSTRY AND CITIES</b></p>   |

3. Prof. Hideaki Hohonoki, Japan; **NEW WAVE IN DIGITAL MANUFACTURING, ITS TREND AND INFLUENCES IN JAPAN**

4. Dr. S. Heieck, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Serbia; **GIZ PROJECTS IN SERBIA – INDUSTRY POLICY**

5 Mădălina Florescu, Luminița Cătănuș, Igor Bectoraș, Cătălin Jalbă, Microelectronica SA, Romania; **THE ROLE OF MANUFACTURING IN GENERATING INNOVATION AND HOW CAN WE TAKE FULL ADVANTAGE OF SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENTS**

**20:00** AMP Serbia 2016 / Conference Reception in Mayor City Hall Belgrade (informal dressing).

## International Conference AMP Serbia 2016 - CONFERENCE PROGRAM

|   |  |
|---|--|
| <b>Date:</b> 1 <sup>st</sup> June, 2016 / Wednesday | <b>Venue:</b> Faculty of Mechanical Engineering, str. Kraljice Marije 16, Belgrade |
|---|--|

Registration desk: 08:00 – 16:30 Registration / CeNT (first level)

| Time        | Hall 211 (Second floor)   |
|-------------|---|
| 09:00-10:30 | <p><i>AMP Serbia 2016/ Session 5: Session/Panel 4 – Advanced Research in Manufacturing in Serbia - Hall 211 (second floor) - Faculty of Mechanical Engineering, Belgrade.</i></p> <p><b><u>Chairmen Session:</u></b></p> <p><b>Prof. Dr. Vidosav Majstorović</b>, University of Belgrade, MEF, Serbia.</p> <p><b>Prof. Dr. Radivoje Mitrović</b>, Dean MEF, Belgrade;</p> <p><b>Prof. Dr. Dragan Djurdjanović</b>, Department of Mechanical Engineering, University of Texas, Austin, TX, USA.</p> <p><b>Prof. Dr. Jaroslav Zivanić</b>, Vice-Dean, University of Kragujevac, Serbia;</p> <p><b>Prof. Dr. Branko Vasić</b>, Vice-Dean, MEF, Belgrade, Serbia.</p> <p><b>Prof. Dr. Aleksandar Jovović</b>, MEF, Belgrade, Serbia.</p> <p><b>Prof. Dr. Vesna Spasojević-Brkić</b>, MEF, Belgrade, Serbia.</p> <p><b><u>Keynote Speakers:</u></b></p> <ol style="list-style-type: none"> <li>1. <b>Prof. Dr. V. Majstorović</b>, University of Belgrade, MEF, Prof. Dr. Tatjana Sibaliija, Metropolitan University, Belgrade; <b>INDUSTRY 4.0.0 SERBIAN MODEL.</b></li> <li>2. <b>Prof. Dr. Radivoje Mitrović</b>, Dean MEF, Belgrade; <b>MECHANICAL ENGINEERING EDUCATION/RESEARCH IN SERBIA</b></li> <li>3. Prof. Dr. Dragan Djurdjanovic, <i>Department of Mechanical Engineering, University of Texas, Austin, TX, USA;</i> <b>INTELLIGENT MAINTENANCE AND ADVANCED MANUFACTURING</b></li> <li>4. <b>Prof. Dr. Jaroslav Zivanić</b>, Vice-Dean, University of Kragujevac, Serbia; <b>ENGINEERING EDUCATION ON UNIVERSITY "KRAGUJEVAC".</b></li> <li>5. <b>Prof. Dr. Branko Vasić</b>, Vice-Dean, MEF, Belgrade, Serbia; <b>ADVANCED MAINTENANCE IN MANUFACTURING.</b></li> <li>6. <b>Prof. Dr. Aleksandar Jovović</b>, MEF, Belgrade, Serbia; <b>PROCES INDUSTRY – MANUFACTURING INDUSTRY RELATIONSHIP.</b></li> <li>7. <b>Prof. Dr. Vesna Spasojević-Brkić</b>, MEF, Belgrade, Serbia; <b>SERBIAN INDASTRY – STATE OF THE ART.</b></li> </ol> |

| Time        | Hall CeNT (First floor)  |
|-------------|--|
| 09:00-10:30 | <p><i>AMP Serbia 2016/ Session 6: <b>Session/Panel 5</b> – Advanced Manufacturing in Practice – Exampmles from Serbia - <b>Hall CeNT</b> (First floor) - Faculty of Mechanical Engineering, Belgrade.</i></p> <p><b>Chairmen Session:</b></p> <ol style="list-style-type: none"> <li>1. <b>Dragoljub Damjanović</b>, Schneider Electric Serbia, Belgrade;</li> <li>2. <b>Petrašin Jakovljević</b>, Company Metalac, Gornji Milanovac;</li> <li>3. <b>Bojan Ercević</b>, IVA28, Obrenovac;</li> <li>4. <b>Andrej Beslać</b>, Carlsberg Serbia, Serbia;</li> <li>5. <b>Milovan Luković</b>, Company Sloboda, Cacak</li> </ol> <p><b>Keynote Speakers:</b></p> <ol style="list-style-type: none"> <li>1. Dragoljub Damjanović, Schneider Electric Serbia, Belgrade; <b>ADVANCED ENERGY MANAGEMENT.</b></li> <li>2. Petrasin Jakovljević, Company Metalac, Gornji Milanovac; <b>COMPANY METALAC AS LEADER OF SERBIAN METALWORKING INDUSTRY.</b></li> <li>3. Bojan Ercević, IVA28, Obrenovac; <b>IVA28 AS DIGITAL MANUFACTURING.</b></li> <li>4. Andrej Beslać, Carlsberg Serbia, Serbia; <b>CARLSBERG ADVANCED PRODUCTION.</b></li> <li>5. Milovan Luković, Company Sloboda, Cacak; <b>ADVANCED PRODUCTION IN PRACTICE – ONE EXPIRIENCE</b></li> </ol> |
| 10:30-11:00 | <p><b>Coffee Break</b></p>   |
| 11:00-13:00 | <p><i>AMP Serbia 2016/ Session 7: <b>Session/Panel 6</b>– Advanced Manufacturing – Policy and Lessons from the neighborhood - <b>Hall 211</b> (second floor) - Faculty of Mechanical Engineering, Belgrade.</i></p> <p><b>Chairmen Session:</b></p> <ol style="list-style-type: none"> <li>1. <b>Dusan Purić</b> Assistant Ministar, Ministry of Economy, Belgrade;</li> <li>2. <b>Milivoje Miletić</b>, President of Belgrade Chamber of Commerce;</li> <li>3. <b>Dr. Edvard Jakopin</b>, Ministry of Economy, Belgrade;</li> <li>4. <b>Prof. Dr. Mirko Soković</b>, University of Ljubljana, Slovenia;</li> <li>5. <b>Dr. Stephan Heieck</b>, GIZ Belgrade, Germany;</li> <li>6. <b>Prof. Dr. Emilia Assenova</b>, TU Sofia, Bulgaria;</li> </ol> <p><b>Keynote Speakers:</b></p> <ol style="list-style-type: none"> <li>1. <b>Dusan Purić</b>, Assistant Ministar, Ministry of Economy, Belgrade; <b>STATE POLICY IN INDUSTRY DEVELOPMENT – STATE OF THE ART.</b></li> <li>2. <b>Milivoje Miletić</b>, President of Belgrade Chamber of Commerce; Velimir Radojevic, Chamber of Commerce Belgrade; <b>INDUSTRY IN BELGRADE – POSSIBILITIES FOR DEVELOPMENT.</b></li> </ol>  |

|             |   |
|-------------|---|
|             | <p>3. Dr. Edvard Jakopin, Ministry of Economy, Belgrade; <b>INDUSTRY POLICIES</b></p> <p>4. Prof. Dr. Mirko Soković, Doroteja Zlobec, University of Ljubljana, Slovenia; <b>ADVANCED MANUFACTURING IN SLOVENIA.</b></p> <p>5. Dr. Stephan Heieck, GIZ Belgrade, Germany; <b>ADVANCED MANUFACTURING POLICY</b></p> <p>6. Prof. Dr. Emilia Assenova, TU Sofia, Bulgaria; <b>ADVANCED MANUFACTURING IN BULGARIA.</b></p> |
| 13:00-15:00 | <b>Break</b>  |
| 15:00-17:30 | <p><i>AMP Serbia 2016/ Session 8: <b>Session/ Workshop 2 - Framework for White paper, Hall 211</b> (second floor)</i><br/><i>- Faculty of Mechanical Engineering, Belgrade.</i></p> <p><b>Workshop Chairmen</b></p> <p>1. Prof. Dr. Jun Ni</p> <p>2. Prof. Dr. D. Djurdjanović</p> <p>3. Prof. Dr. V. Majstorović</p> <p>4. D. Purić</p> <p>5. M. Miletić</p>   |

**20:00** AMP Serbia 2016 / Conference Dinner (informal dressing).



## International Conference AMP Serbia 2016 - CONFERENCE PROGRAM

|   |  |
|---|--|
| <b>Date: 2<sup>nd</sup> June, 2016 / Thursday</b> | <b>Venue: Faculty of Mechanical Engineering, str. Kraljice Marije 16, Belgrade</b> |
|---|--|

Registration desk: 08:00 – 10:00 Registration

| Time        | Hall 211 (Second floor)   |
|-------------|---|
| 10:00-12:00 | <p><b>Session 8 - Dissusion and presentation final document – White paper:</b> Advanced Manufacturing Research, Practices and Opportunities – Horizon 2020/2030 – INDUSTRY 4.0.0. Serbian model</p> <p><b>Session Chairmen</b></p> <ol style="list-style-type: none"><li>1. Prof. Dr. R. Mitrović</li><li>2. Prof. Dr. D. Djurdjanović</li><li>3. D. Purić</li><li>4. M. Miletić</li><li>5. V. Majstorović</li></ol> <p><b>WITE PAPER FRAMEWORK – PRESENTATION.</b></p> |
| Time        | Hall CeNT (First floor)   |
| 13:00-14:00 | Farewell Cocktails in Club CeNT (first level)   |

**Welcome to Belgrade to the Conference of Advanced Manufacturing 2016 !**

# Conference Abstracts

## ADVANCED MANUFACTURING IN JAPAN Metrology, Industrial Measurement, Optical/Photonic Measurement

**Prof. Dr. Yasuhiro Takaya**

*Department of Mechanical Engineering, Graduate School of Engineering, Osaka University, Suita, Osaka, Japan*

### ABSTRACT

Generally, metrology, measurement science and technologies, and industrial measurement techniques are the most important basics for the progress in advanced manufacturing. These are also key factors to identify SWOT for the development of innovative, modern manufacturing industries.

Background and strategies for the advanced manufacturing is summarized, which is referred to "White Paper on Manufacturing Industries (Monozukuri)" issued by Ministry of Economy, Trade and Industry (METI), Ministry of Education, Culture, Sports, Science & Technology (MEXT), and Ministry of Health, Labour and Welfare (MHLW) in Japan. The manufacturing industry, which accounts for 20% of Japan's GDP, creates new innovation and technology, and has a powerful ripple effect on other industries, is continuously important. Research and development for the most advances measuring and analysis techniques and equipment, and the continuous development and shared use of the most advanced, large-scale research and development infrastructure have been promoted and the continuous of the most advanced, - have been promoted.

New developments and visions of the future in the manufacturing industry is focused on the manufacturing in a "Data-Driven Society". The Internet of Things (IoT), which organizes all things using data and connects them to the Internet, is actualized by sensor technology, battery technology, the miniaturization and speeding up of data processors, and also by the spreading of cloud technology that accumulates huge amounts of data. Japan, which is the greatest robotics superpower in the world, proclaimed that it will lead the world with the robots of the IoT era and realize a "Robot Revolution". In-machine/on-machine measurement technologies for machining tools are taken as a key technology to realize the intelligent machining tool, that is a kind of a robot, driven by "Robot Revolution". For instance, the on-machine measurement system for fabricating a steam turbine rotor for power generator mounted on a large CNC lathe is introduced.

The resent notable topic on metrology in Japan is introduced. The Measurement Law was revised that the national standard of length was changed from Iodine stabilized He-Ne lasers to the optical frequency comb. Femtosecond ultrashort pulses are considered to be a group of many modes arranged at equal intervals on the frequency axis and are called a "comb" due to their resemblance to the teeth of a comb. This is, in a way, "ruler of optical frequency". The accuracy of products in advanced manufacturing is governed by the national standard. In addition, the rapid progress in optical/photonic measurement techniques, which is the driving force of innovations for industry and nanotechnology and the life sciences, are introduced briefly.

**Key words:** Advanced Manufacturing, Metrology, Industrial Measurement.

## CHALLENGES OF CYBER-PHYSICAL PRODUCTION SYSTEMS – A HUNGARIAN VIEW

**Prof. Dr. József Váncza**

*Head of the Engineering and Management Intelligence Laboratory  
Institute for Computer Science and Control  
Hungarian Academy of Sciences*

### ABSTRACT

Cyber-physical systems are organizations of collaborating computational entities which are in intensive connection with the surrounding physical world and its on-going processes, providing and using, at the same time, data-accessing and data-processing services available on the Internet. Cyber-physical production systems (CPPS), relying on the newest and foreseeable further developments of computer science, information and communication technologies on the one hand, and of manufacturing science and technology, on the other hand, are meant to lead to the 4<sup>th</sup> industrial revolution (noted also as Industry 4.0). By definition, a CPPS consists of autonomous and cooperative elements and sub-systems that are getting into connection with each other in situation dependent ways, on and across all levels of production, from processes through machines up to production and logistics networks.

Modelling, planning and controlling the operation of CPPSs and forecasting their emergent behaviour raises a series of research problems. One must face the challenges of operating sensor networks and handling big bulks of noisy and partial data. Novel modes of man-machine communication and collaboration are to be realized. Exploring fundamental questions like design and emergence, autonomy and cooperation, optimization and responsiveness, trust and security should go hand in hand with the evolution of CPPSs. These investigations require multi-disciplinary research over a broad range of contemporary information and communication technologies, organizational, management and network sciences, as well as production informatics and engineering.

The talk discusses the above grave challenges of CPPS and summarizes the results of a survey on how companies – with a special focus on Hungary – are prepared to respond to them. Next, a new strategic initiative is presented for establishing a Centre of Excellence for CPPS that pursues coordinated activity in the directions of basic and applied research, technology transfer, education and training, as well as ecosystem formation.

**Key words:** Cyber-Physical System, Manufacturing, Centre of Excellence.

## INDUSTRY 4.0 FUTURE PRODUCTION IN EUROPE

Univ.-Prof. e.h. DI Dr. Ing. Dr. h.c. Wilfried Sihm

*TU Vienna, Austria.*

### ABSTRACT

After the first water- and steam powered manufacturing plant in 1784, the introduction of mass production using electrical energy in 1870 and the first digitization of the production through utilization of electronics and IT in the 1970s, currently a fourth industrial revolution - commonly referred to as Industry 4.0 - is taking place.

Merging physical objects with the virtual world on the "Internet of Everything", as the basis of Industry 4.0, leads to Cyber-Physical Systems (CPS). The specified application of CPS in the manufacturing industry results in Cyber-Physical Production Systems. The resulting complexity gets supported by modern Information and Communication Technology (ICT). Industry 4.0 enables new business models, new accesses to manufacturing processes and is intended to strengthen Europe's production industry. Europe has recognized the importance of the propagated fourth industrial revolution and started a variety of digitizing manufacturing initiatives across most member states.

A study of PwC and Strategy& shows that by 2020, European industrial companies will invest €140 billion annually in Industry 4.0 applications and in five years, more than 80% of companies will have digitized their value chains.

Industry 4.0 is often used in context with the term "Internet of Everything" (IoE). IoE is understood as the linking of things, processes, data, services and people on the internet or in simple terms as the intersection of "Internet of Things", "Internet of Services" and "Internet of People". Industry 4.0 takes place in all areas of our life - not only in factories - and it is driver for new business models and shows new added value potentials. A study realized from the McKinsey institute shows a total potential impact of \$3.9 trillion-11.1 trillion per year in 2025, but only if we use the full potential of the IoT.

Also Austria has reacted to the challenges and initiated some Industry 4.0 activities, for example the construction and lasting operation of a virtual and physical Pilot-Demonstration Factory where industrial and scientific partners work together to implement, test and modify the work results in a real environment. Another example is the Fraunhofer Austria Phase-Model for a successful implementation of Industry 4.0 applications. However, these were just a few of many promising Industry 4.0 activities and they will be followed by many more.

**Key words:** Manufacturing, Industry 4.0, Internet of Things.

## MICRO - NANO MANUFACTURING METROLOGY AS A PART OF ADVANCED MANUFACTURING

**Prof. Dr. Numan M. Durakbasa**

Department for Interchangeable Manufacturing and Industrial Metrology,  
Institute for Production Engineering and Laser Technology,  
Vienna University of Technology, Vienna, Austria;

### ABSTRACT:

Together with the current trend towards advanced manufacturing, new challenges have emerged through the demand of complex shapes and functional topographies on the micro/nanoscale and increasing efficiency and functionality. Increasing demand for quality, reliability and safety on the one hand and competition and cost consciousness on the other hand are requirements in modern production engineering. In order to overcome these challenges, advanced metrology techniques are required. To meet high-level demands both from industrial and from private customers in the future, manufacturing enterprises must be flexible and agile enough to respond quickly to product demand changes also according to technological developments especially in the field of precision engineering at micro, nano and femto scale production based on advanced production metrology. Meanwhile, the manufacturers use the technical means, tools and methods to ensure the consistency of product characteristics including functionality. Therefore, the concept of the Geometrical Product Specifications and Verification (GPS) is introduced to provide the workpiece characteristics as results of several kinds of manufacturing processes and the characteristics of specific machine elements as well as several types of standards dealing with the fundamental rules of specification, global principles, definitions, geometric characteristics that occur at several steps of manufacturing as design, development of product, production, metrology and quality assurance.

New levels of manufacturing precision are the key requirements to enable advanced machining processes that demand improved techniques of metrology. New models for alternative configurations of future industrial organisations in general which are usually applied and especially for small and medium sized enterprises (SMEs) need to be investigated. The applications of advanced metrology techniques comprising both optical and non-optical methods, surface metrology for product characterization and supportive international standards are presented. Furthermore, innovative strategies with foreseeable future trends are discussed as a significant part of strategic research methodology.

**Key Words:** high precision metrology, micro/nano femto technology, functionality, efficiency, Geometrical product specification and verification (GPS)

## INDUSTRY 4.0-APPLICATIONS IN METAL FORMING

Prof. Dr. ing. Dorel BANABIC

Tehnickal University of Cluj-Napoca, Romania.

### ABSTRACT

During the last decade, the added value of EU industry has lost 10% as compared to the industrial contribution of emerging countries. In response to that decrease, EU elaborated an ambitious programme called *Industry 4.0*, with the aim of initiating a new industrial revolution. Material processing technologies have evolved in a disruptive manner during the time. Three major industrial revolutions can be identified when analyzing this evolution: first revolution – characterized by the extensive use of water and steam power, second revolution – characterized by the transition to electric power, and third revolution – characterized by the massive involvement of computers and data processing in industrial activities.

The *Industry 4.0* programme marks the beginning of the fourth industrial revolution, which will be characterized by the use of cyber-physical systems in manufacturing. The main consequence of this approach will be the development of an intelligent manufacturing environment having the capability of communicating and making optimal decisions in an autonomous manner. The major economic and political challenge consists in allowing all industrial domains to take advantage from the digital innovation in products, manufacturing processes and business models. One may expect that material forming technologies will participate in this industrial revolution together with other manufacturing technologies. The case examples of the metal forming processes are presented.

**Key words:** Metal forming, Cyber-Physical Manufacturing, Industry 4.0.

## INDUSTRIAL BIG DATA ANALYTICS IN MANUFACTURING THROUGH INDUSTRY/UNIVERSITY COLLABORATIVE INNOVATION PARTNERSHIP

**Prof. Dr. Jay Lee**

*Ohio Eminent Scholar, L.W. Scott Alter Chair, and Distinguished Univ. Professor  
Univ. of Cincinnati, USA.*

### ABSTRACT

In today's competitive business environment, companies are facing challenges in dealing with big data issues for rapid decision making for improved productivity. Many manufacturing systems are not ready to manage big data due to the lack of smart analytics tools. U.S. has been driving the Cyber Physical Systems (CPS), Industrial Internet, and Advanced Manufacturing Partnership (AMP) Program to advance future manufacturing. Germany is leading a transformation toward 4th Generation Industrial Revolution (Industry 4.0) based on Cyber-Physical Production System (CPPS).

It is clear that as more predictive analytics software and embedded IoT are integrated in industrial products and manufacturing systems, predictive technologies can further intertwine intelligent algorithms with Machine-to-Machine (M2M) intelligence to predict product and production performance degradation and autonomously manage and optimize productivity and supply chain performance.

The presentation will address the trends of predictive big data analytics and CPS for future manufacturing.

First, predictive analytics and Cyber-Physical System (CPS) enabled product manufacturing and services will be introduced.

Second, advanced predictive analytics technologies for predictive manufacturing and maintenance in lean production and service with case studies will be presented. Finally, NSF IMS Center and its industry/ university collaboration innovation model and lessons learned will be discussed.

**Key words:** Big Data, Advanced Manufacturing, Innovation, Partnership.



## HOW SUPPLY CHAIN IS TRANSFORMING THE INDUSTRY

Dr. Mani Janakiram

*Director of Supply Chain Intelligence and Analytics at Intel Corporation*

### ABSTRACT

Supply chain has become increasingly critical for any industry to succeed and it is a competitive advantage for progressive companies. No matter what the type of the industry is, it needs a vibrant supply chain to ensure viable operation and profitability. Intel Supply Chain is regarded as one of the top 10 supply chain companies in the world by a leading research and advisory company due to their operational excellence and innovative approaches. I will outline the opportunities and challenges in the future.

**Key words:** Supply chain, Industry, Excellence.

## THE ROLE OF MANUFACTURING IN GENERATING INNOVATION AND HOW CAN WE TAKE FULL ADVANTAGE OF SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENTS

Mădălina Florescu, Luminița Cătănuș, Igor Bectoraș, Dr. Cătălin Jalbă

*Microelectronica S.A. România*

### ABSTRACT

Advanced manufacturing means a family of activities that: depend on the use and coordination of information, automation, computation, software, sensing, and networking; make use of cutting edge materials and emerging capabilities enabled by the physical and biological sciences, for example nanotechnology, chemistry, and biology. This involves both new ways to manufacture existing products, and especially the manufacture of new products emerging from new technologies.

*Today, it is increasingly apparent that technology innovation is tied to manufacturing knowledge, so that to innovation.*

In this respect, Advanced Manufacturing

- has the potential to create and retain high-quality jobs;
- has long-term ability to innovate and compete in the global economy The loss of the manufacturing activities will undermine the capacity to invent, innovate, and compete in global markets.

Individual companies cannot justify the investment required to develop many important new technologies or to create the infrastructure to support advanced manufacturing. Private investment must be complemented by public investment. Key opportunities to overcome market failures include investing in the advancement of new technologies with transformative potential, supporting shared infrastructure, and accelerating the manufacturing process through targeted support for new methods and approaches.

To ensure that the national economy attracts manufacturing activity and remains among leaders in knowledge production, we recommend two strategies:

(1) Create a fertile environment for innovation so that the State economy provides the best environment for business. We believe this can be accomplished through tax and business policy, robust support for basic research, and training and education of a highskilled workforce;

(2) Invest to overcome market failures, to ensure that new technologies and design methodologies are developed within the country, and that technology based enterprises have the infrastructure to flourish inside the country.

Strengthen science, technology, engineering and mathematics (STEM) education is a fundamental step that must be taken into deep consideration.

**Key words:** Advanced Manufacturing, Innovation, Technological Development.

## NEW WAVE IN DIGITAL MANUFACTURING, ITS TREND AND INFLUENCES IN JAPAN

Prof. Hideaki Hohnoki

*COHO Consulting*

### ABSTRACT

A digital technology had started to be applied to manufacturing industries in Japan by introducing NC machinery, which had taken an active part in FA (Factory Automation) system during the high-growth years of the Japanese economy. The digitalization continues ever after by creating new designing system such as CAD/CAM/CAE towards introducing PLM (Product Lifecycle Management). This technology has made a significant contribution to product innovation by which we could get the right product at the right time, i.e. to get the product matched the needs of a market.

The recent trend of highly-sophisticated digital technologies bring entire change in manufacturing industry in the near future, which means that the digital technologies and equipment, 3D printer as a leading example, encourage the sophisticated and diversified public demand (i.e. mass customization) in manufacturing, multi and continuous machine system in hardware, local production for local consumption and upper process dominance in manufacturing process (1). Digital manufacturing works only by digital data and its system, that is to say, those digital data is extracted from our real society and is returned there with additional value such as analysis, judgements etc. On the other hand digital technologies are reforming manufacturing industries using software from simple hardware production towards hardware with some related service which naturally places high value on market mind. From recent IoT trend perspective it is presented to the discussion about the importance to consider about "product – service – market" coordination and its enhancement (2).

SME have fulfilled an important and constructive part during past high-growth period and made a solid contribution to Japanese economy until now. Among all the industries in Japan, 99.7% of the companies are SME. In this perspective, it is also presented about the influences and major challenges facing SME in product, in new network technologies as well as in new waves in advanced digital manufacturing.

**Key words:** Digital Technologies, Digital Manufacturing, SMS.

## ADVANCED MANUFACTURING IN SLOVENIA

Mirko Sokovic<sup>1</sup>, Doroteja Zlobec<sup>2</sup>

<sup>1</sup>University of Ljubljana, Faculty of Mechanical Engineering, <sup>2</sup>Ministry of Education, Science and Sport, Republic of Slovenia

### ABSTRACT

Slovenian policy and successes of researchers in the field of advanced manufacturing will be in the focus of the presentation.

Slovenian researchers have strong experience with European programmes for research and innovation since FP6. Big change from FP7 to Horizon 2020 was challenge for all EU research community and Slovenian researchers are one of those who performed even better in the new EU programme. Some statistics will be present and funded project with Slovenian participation in the Factories of the Future and SPIRE Calls, which are relevant for the conference.

As an EU member, Slovenia is also eligible for the European cohesion funds and Slovenian Smart Specialization Strategy is implementing document in the areas of research, development and industrial policy. It provides a basis for focusing development investment on areas where Slovenia has a critical mass of knowledge, capacities and competencies, and where the innovation potential for positioning in the global markets it is visible. One of the priority areas in this document is (S)INDUSTRY 4.0, which emphasizes the Factories of the Future through optimization and automation of production and manufacturing processes, including Key Enabling Technologies. First Calls with topics from (S)INDUSTRY 4.0 have been announced but there are not completed yet, so the experience from previous period will be presented: the so-called Competence Centres.

National system for funding of Research and Development in Slovenia will be present in a nutshell with focus on the field of advanced technologies.

Presentation will be concluded with a success story of Slovenian company Kolektor.

**Key words:** Advanced Manufacturing, (S)INDUSTRY 4.0, Innovation.

## ADVANCED MANUFACTURING IN BULGARIA

Assoc. Prof. Dr. Emilia Assenova

*The Society of Bulgarian Tribologists, Sofia*

### ABSTRACT

The economy of Bulgaria functions on the principles of the free market, having a large private sector and a smaller public one. Bulgaria is an industrialized upper-middle-income country. The lev is the strongest and most stable currency in Eastern Europe. Bulgaria's economy accelerated and expanded at the fastest rapidity in nearly five years in Q4 (a Software platform that provides communication and intelligence solutions to Investor Relations). The result came on the back of a significant improvement in both total consumption and fixed investment. Moreover, the Bulgarian government increased public spending thanks to EU funds. Looking at the external sector, Bulgaria's exports rebounded substantially in 2015 and thus contributed positively to overall economic growth.

Solid economic activity carried over into the beginning of 2016. The strongest sectors are energy, mining, metallurgy, machine building, agriculture and tourism. Among the primary industrial exports are production of iron and steel, machinery and refined fuels. Low productivity and competitiveness on the European markets due to inadequate R&D funding and a lack of a clearly defined development policy remain a significant obstacle for further foreign investment and economic growth. We will focus on the following trends:

Way out of these obstacles and post crises deficiency and shortages could be found in the Strategic assessment of National development program. It follows the line Science-Business- Manufacturing followed by the Ministry of economy and the Ministry of Education and Science. A National platform "Science to business" was launched in 2011 re the Program Horizon 2020. End 2014 it continued in the development of National Research Strategy 2020. Recently, in April 2016, new opportunities for education, science and innovation in Bulgaria arise with the competition launched by the Ministry of education and science for development of Centers for excellence and competence, realizing the link Science-Business- Manufacturing. Over EUR 670 million will be invested in promoting the sector. Operational Program Science and Education for Smart Growth (SESG) is new to Bulgaria and was one of the first programs approved by the European Commission in 2015. It will finance scientific research and innovation, general and higher education in the country in the period 2014-2020. The program has two overall strategic goals: strengthening research and innovation, and enhancing education and social inclusion at all levels.

The following priorities are underlined: (i) *Developing hubs (centers) of high-quality research and innovation*: Funding of up to EUR 243 million will be dedicated to research of regional and national significance and will support the specialization of researchers. SESG is expected to create 11 new centers of excellence and competence, support 20 regional laboratories and pilot centers, and involve over 1,500 researchers in activities under the program. SESG is expected to create 11 new centers of excellence and competence, support 20 regional laboratories and pilot centers, and involve over 1,500 researchers in activities under the program. It will give the young people the opportunity to develop specific knowledge, skills and competencies. Some 30,000 students will receive scholarships while 850 students will be involved in mobility programs, (ii) *Ecologically orientated production of small and medium enterprises (SMEs)*: The Bulgarian Chamber of Commerce and Industry, in cooperation with 10 other members of Enterprise Europe Network – technological and research institutes and chambers of commerce and industry, is implementing projects to reduce the impact on the environment of SMEs. The projects consider waste management and suitable metal and plastic surface treatment in the production of machine and device components consistent with the principles of green tribology.

**Key words:** Advanced Manufacturing, Centre of Excellence, Innovation.

## SERBIAN INDUSTRY CONTEXT - THE STATE OF THE ART

Prof. Dr. Vesna Spasojević Brkić

*University of Belgrade, Faculty of Mechanical Engineering, Kraljice Marije 16, 11020, Belgrade, Serbia*

### ABSTRACT

It seems that contextual theory concept in 90s years of previous century becomes replaced with quality management approach, but today we are witnessing that new version of ISO 9001 through clause 4.1 returns its importance, but without clearly defined guidelines how to integrate those facts in QMS. In that aim this survey assumes the model of interdependence of critical factors of QMS from contextual factors: environment (heterogeneity, uncertainty, complexity, restrictiveness etc.), demographic variables (size and age), strategy (cost based leadership, analysis strategy and innovation strategy), management style (management tendency to micro-involvement), organisational structure (hierarchy levels, management range, formalization and technocratic specialization), technology (automation, technological and IT level) and behavior of employees (collectivism, motivation and proactivity). Statistically proved model based on data collected in 111 Serbian industrial companies gives new theoretical knowledge, but also explains Serbian industry problems and gives recommendations for their solution.

Serbian industry should accept the environment and demographic variables as hardly changable, with environment as less strong and statistically significant factor, and to find the possibilities for quality and business performance improvement in other groups of contextual factors. One of surprising results of this survey is the fact that strategy herein is not influenced by environmental variables. Also, strategy contains mostly of cost cutting and analytical elements with smaller part of innovation elements. The influence of the environment, even in present unfavorable conditions where strategy answer does not exist, can be mitigated by selecting proper strategical elements and its further impact through technology and organizational structure. Large companies that act according to the model are supposed to have good results. SMEs in unsuitable environmental conditions should reduce its impact through proactive management and adequate employee behavior, while SMEs in suitable environment can respond with manufacturing digitalization variables and corresponding organizational structure. Flattering the structure is not beneficial solution, but quality circles are proposed to combine organic and mechanistic principles.

**Key words:** Serbian Industry, Contextual factors, SME.

## INDUSTRY 4.0.0 SERBIAN MODEL

Prof. Dr. V. MAJSTOROVIĆ<sup>1,\*</sup>, Prof. Dr. Tatjana ŠIBALIJA<sup>2</sup>,

<sup>1)</sup> University of Belgrade, Faculty of Mechanical Engineering, Belgrade, Serbia

<sup>2)</sup> Metropolitan University, Faculty of Information Technology, Belgrade, Serbia

### ABSTRACT

Cyber-physical systems (CPSs) are enabling technologies which bring the virtual and physical worlds together to create a truly networked world in which intelligent objects communicate and interact with each other. Together with the internet and the data and services available online, embedded systems join to form cyber-physical systems. CPSs also are a paradigm from existing business and market models, as revolutionary new applications, service providers and value chains become possible.

The merging of the virtual and the physical worlds through CPSs and the resulting fusion of manufacturing processes and business processes are leading the way to a new industrial age best defined by the INDUSTRIE 4.0 project's "smart factory" concept.

The deployment of CPSs in manufacturing systems gives birth to the "smart factory". Smart factory products, resources and processes are characterized by CPSs; providing significant real-time quality, time, resource, and cost advantages in comparison with classic manufacturing systems. The smart factory is designed according to sustainable and service-oriented business practices. These insist upon adaptability, flexibility, self-adaptability and learning characteristics, fault tolerance, and risk management.

Full digitalisation of manufacturing and factories is one of key topics in Industry 4.0. Cyber-Physical Manufacturing requires digital development of all major entities and functions in a factory and their integration in an end-to-end digital chain, across all levels of production, using ICT- based solutions.

The paper shows the concept of Serbian Industry 4.0.0 Model based on cyber-physical manufacturing metrology model (CPM<sup>3</sup>) and an integrated approach to manufacturing quality.

**Key words:** Industry 4.0, Manufacturing, ICT, Modeling, Manufacturing Metrology, Quality.

## REGIONALNA INDUSTRIJSKA SPECIJALIZACIJA U KONTEKSTU NOVE INDUSTRIJSKE POLITIKE SRBIJE REGIONAL INDUSTRIAL SPECIALIZATION IN THE CONTEXT OF NEW SERBIAN INDUSTRIAL POLICY

Dr. Edvard Jakopin, Ministarstvo privrede, Beograd.

### REZIME

Koncept industrijske otpornosti regiona postao je popularan nakon globalne recesije, obuhvata više faza: povratak u ravnotežu, prilagođavanje i oporavak. Koncept regionalne otpornosti pokušava, iz različitih naučnih disciplina (ekonomija, sociologija, i dr) da odgovori na pitanje: zašto neki regioni uspevaju da prebrode recesione talase i sačuvaju životni standard, a drugi ne. Primarni su faktori aglomeracije, ljudskog kapitala i institucije. U kontekstu nove industrijske politike Srbije izuzetno je važno testiranje industrijske otpornosti pre i posle globalne recesije i identifikovanje ključnih regionalnih industrijskih grana u kontekstu regionalne specijalizacije.

Za zemlju u tranziciji sa izraženim regionalnim socijalno-ekonomskim neravnomernostima, kakva je Srbija, veoma je bitno istražiti industrijsku otpornost regiona. Regionalna politika i podsticajni mehanizmi mogu da budu efikasni samo ako raspolažu sa regionalnim performansama tokom ekonomskih ciklusa. Institucionalne intervencije ne daju iste efekte u različitim regionima, zbog čega je i bitno da se sagledaju svi faktori regionalne otpornosti. Recesija nije podjednako žestinom pogodila sve regione, neki regioni su bili otporniji od drugih. Istraživanje je imalo za cilj da identifikuje regionalne industrijske kapacitete koji mogu da objasne karakteristične performanse ovih regiona.

U kontekstu redefinisavanja industrijske politike Srbije neophodno je preispitati postojeće institucije, politike i mere. Regionalna industrijska transformacija ka većoj otpornosti se povećava valorizacijom endogenih resursa i zajedničkim institucionalnim delovanjem podsticajne, obrazovne, naučno-tehnološke i inovativne politike. U narednom periodu ključna će biti privredna transformacija ka preduzetničkoj ekonomiji, ka dinamičkim strukturama preduzeća, u fokusu su inovacije i preduzetništvo kao genetarator privrednog razvoja. Menja se tradicionalni model preduzetništva /ekonomija obima, tradicionalne industrijske grane, upravljanje 'odozgo'. Novi preduzetnici nisu kopije velikih globalnih kompanija, već su pokretači novih inovativnih procesa.

Specijalizacija regiona u Srbiji nalazi se u početnoj fazi. Iako je sasvim očigledan uticaj multiplikovanog efekta koji država dobija industrijskom specijalizacijom regiona podsticajna politika je suočena sa brojnim ograničenjima, od nezavršenih strukturnih promena u privredi, neizgrađenosti osnovne privredne infrastrukture, nerazvijenog javno-privatno dijaloga i partnerstva između vlade, privrede i naučno-istraživačkih institucija na lokalnom, regionalnom i nacionalnom nivou.

Regionalni privredni rast zavisi prvenstveno od stepena regionalne specijalizacije, odnosno, od stepena otpornosti i konkurentnosti industrijskih grana koje mogu da budu generator regionalnog razvoja. Prepoznavanje takvih grana koje su izdržale probu vremena je polazište nove regionalne politike Srbije.

**Ključne reči:** *Industrijska specijalizacija, Industrijska politika, Region.*