



Introducing FAMENA and Department of Industrial Engineering

University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture

PhD. Nedeljko Štefanić, full professor

AIM 2013 Conference
Split, September 20th 2013

University of Zagreb, Croatia



University of
Zagreb

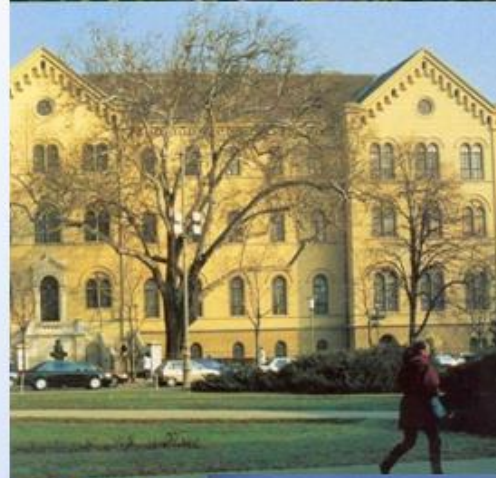
340
years

Founded 1669 as
Neoacademia
Zagrabiensis

Technical faculty
founded 1919.

Today: 29 Faculties, 3
Academies & High
schools

~ 65.000 students



FSB

90

Sveučilište u Zagrebu
90 godina Fakulteta strojarstva
i brodogradnje

University of Zagreb
90 Years of Faculty of Mechanical
Engineering and Naval Architecture

3 COURSES
13 DEPARTMENTS
40 CHAIRS
43 LABORATORIES
433 EMPLOYEES
4 BUILDINGS



Faculty of Mechanical Engineering and Naval Architecture

Studies:

- Mechanical engineering
- Naval architecture
- Aeronautical engineering

Bologna framework (since 2003)

7 sem. + 3 sem. + 6 sem.
B. Sc M. Sc. Ph. D.

Active students: 2400

Employees:

- Teaching/research staff ~ 130
- PhD students ~ 80
- technicians ~ 110
- administration ~ 120





FSB

FACULTY OF MECHANICAL ENGINEERING AND NAVAL ARCHITECTURE

Department of Industrial Engineering

Department of Engineering Mechanics

Department of Aeronautical Engineering

Department of Naval Engineering and Marine Technology

Power Engineering Department

Department of Design

Department of Quality

Department of Materials

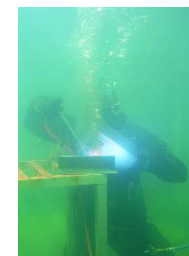
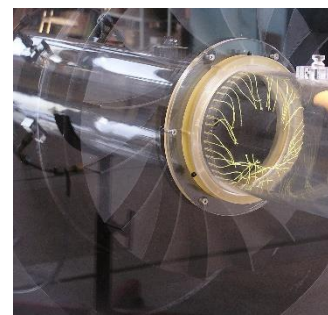
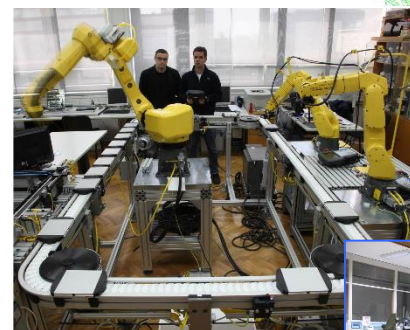
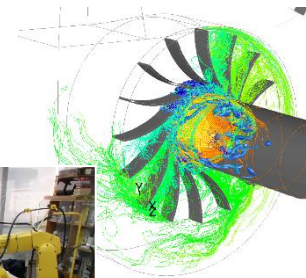
Department of Engines and Transport Machinery

Department of Robotics and Production System Automation

Department of Technology

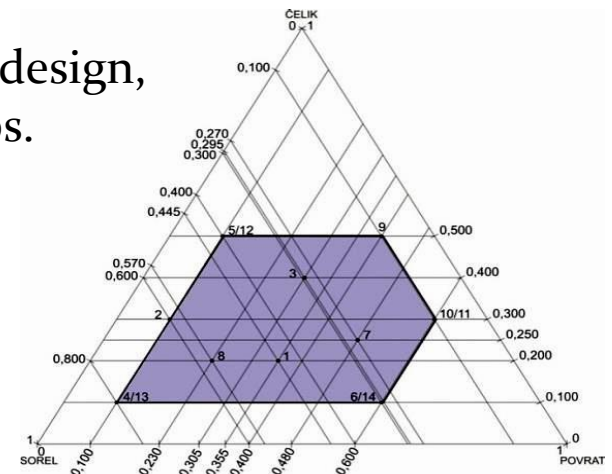
Department of Thermodynamics, Thermal and Processing Technology

Department of Welded Structures



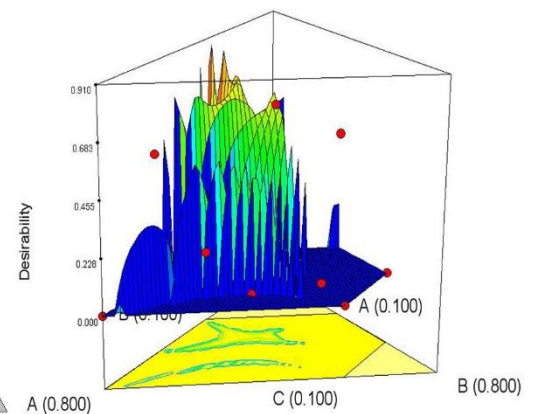
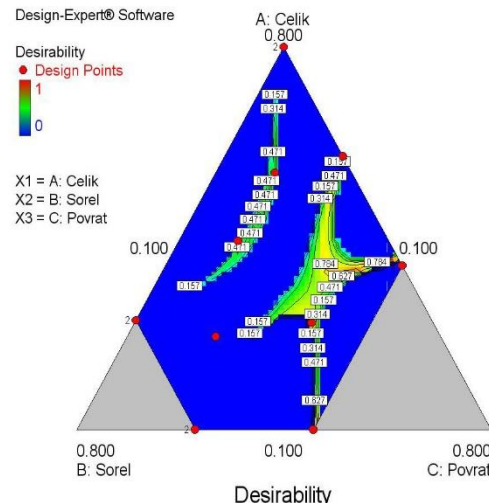
Industrial Engineering Department

- Department of Industrial Engineering, analogous to similar departments at other foreign universities, contains scientific disciplines for research and development, design, implementation and also maintenance and management of production processes for industrial companies.
- Field of industrial engineering includes design of production and business processes of industrial entities, integration of flows of materials, products, information and human resources and management of all factors of production, with the continuous efforts to improve and optimize that process and system.
- This is achieved by using knowledge in production design, production control and defining social relationships.



The organization of IE Dept.

- ***Chair of Production Design***
 - *Laboratory for Process Planning*
 - *Laboratory for Logistics*
- ***Chair of Production Control***
 - *Laboratory for Production Management*
- ***Chair of Sociology***



History

- Department of Industrial Engineering at the Faculty of Mechanical Engineering and Naval Architecture (FAMENA) is the successor of the Department of the Organization and operates under this name since 1998.
- Scientific, educational and professional activity Department carries out under the branch of production engineering in the scientific field of mechanical engineering and research area of technical sciences.

Design-Expert® Software

Vlačna cvrstoca [Rm]

● Design points above predicted value

○ Design points below predicted value

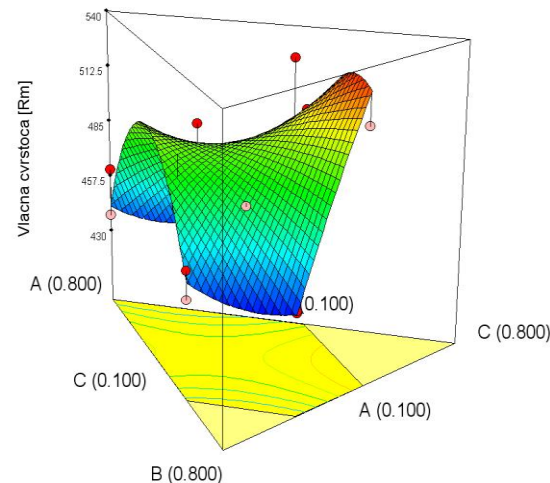
536

434

X1 = A: Celik

X2 = B: Sorel

X3 = C: Povrat



Education

- The academic program is adapted to the Bologna Process, which contains three levels of education: undergraduate part of the study (bachelor degree), graduate study (master degree) and postgraduate study as a doctoral program in six semesters or postgraduate specialist study in a period of three semesters.
 - **Undergraduate study of the module of Industrial Engineering and Management (BS)**
 - **Graduate study of the module of Industrial Engineering and Management (MS)**
 - **Postgraduate specialist study of the module of Industrial Engineering and Management and module PLM**
 - **Postgraduate doctoral study of the module of Industrial Engineering and Management (PhD)**

Research

- In the organized scientific and research program, members of the Department are/were participating in several research projects funded by the Ministry of Science, Education and Sports or funded by the industrial entities.
- **EU TEMPUS project:** Consortium TEMPUS IV JPCR_144959, "Master Studies and Continuing Education Network for Product Lifecycle Management with Sustainable Production", 2009-2011, main researcher in CRO: prof. dr.sc. Predrag Ćosić, coordinator to the EU: prof.dr.sc. Franco Lombardi, Torino.
- **Bilateral project:** The bilateral Slovenian-Croatian project "Virtual Manufacturing – Step to Competivity and Sustainable Development", (2007-2008); project supported Slovenian and Croatian cooperation in science, and it was funded by Ministry of Science, Education and Sports and Slovenian Research Agency (ARSS), Main researcher of the Croatian part of the project: prof. dr.sc. Predrag Ćosić.
- **Scientific projects:**
 - 1. Effects of production process on competitiveness and sustainable development, 2007- , Zagreb, prof.dr.sc. Predrag Ćosić.
 - 2. Intelligent process planning and reengineering, 2004-2006, Zagreb, main researcher: doc. dr.sc. Predrag Ćosić.
 - 3. Dynamic modeling of logistics systems, 2002-2006, main researcher: prof.dr.sc.Čedomir Oluić.
 - 4. New models of managing production and bussines of SME's, 2003-2006, Zagreb, main researcher: prof.dr.sc. Nikola Šakić.
 - 5. Managing producton by using artificial intelligence, 1997-2001, Zagreb, main researcher: prof.dr.sc. Nikola Šakić.
- **Industrial projects**
 - Business improvement of SME applying LEAN system, 2011., prof.dr.sc. Nedeljko Štefanić
 - Pilot project for promotion of entrepreneurship, 2012., prof.dr.sc. Nedeljko Štefanić
 - Lean and green services, 2012., prof.dr.sc. Nedeljko Štefanić
 - Sigma + program (green belts), 2010. - 2011., Končar Power Transformers, prof.dr.sc. Nikola Šakić
 - Sigma + program (black belts), 2011. - 2012., Končar Power Transformers, prof.dr.sc. Nikola Šakić
 - Analysis of process and organization , 2012. , ZGOS d.o.o., prof. dr. sc. Nedeljko Štefanić

Fields of research and education

- **A. Field of production control:**

- Production management (planning and control)
- LEAN and Six Sigma methodology
- Statistical analysis of production process characteristics
- Design and analysis of experiments - experimental optimization
- Establishing, evaluating and improving production strategy
- Maintenance and reliability of technical systems
- Operations research in production engineering
- Multi-criteria decision making
- Information systems for production

Fields of research and education

- **B. Field of production design:**
 - Process planning
 - Work Study and Ergonomics
 - PLM concept
 - Sustainable production
- Engineering logistics (MH, modeling and simulation)
- Facilities design (manufacturing plants, warehouses)
- (Green) Supply Chain Management

Fields of research and education

- **C. Field of sociology:**
 - Sociology in industrial environment
 - Ethics in engineering and sustainable development
 - Information society

Planned actions/projects:

- Establishing a center for production management – Laboratory of PM – knowledge transfer, projects
- Establishing a center for logistics (simulation modeling)
- Project - Decision support in process and production planning for achieving sustainable production
- Establishing a Sociological classroom related to project: Impact of social aspects of organization on employees in the industry



2005

2007

2006

2008

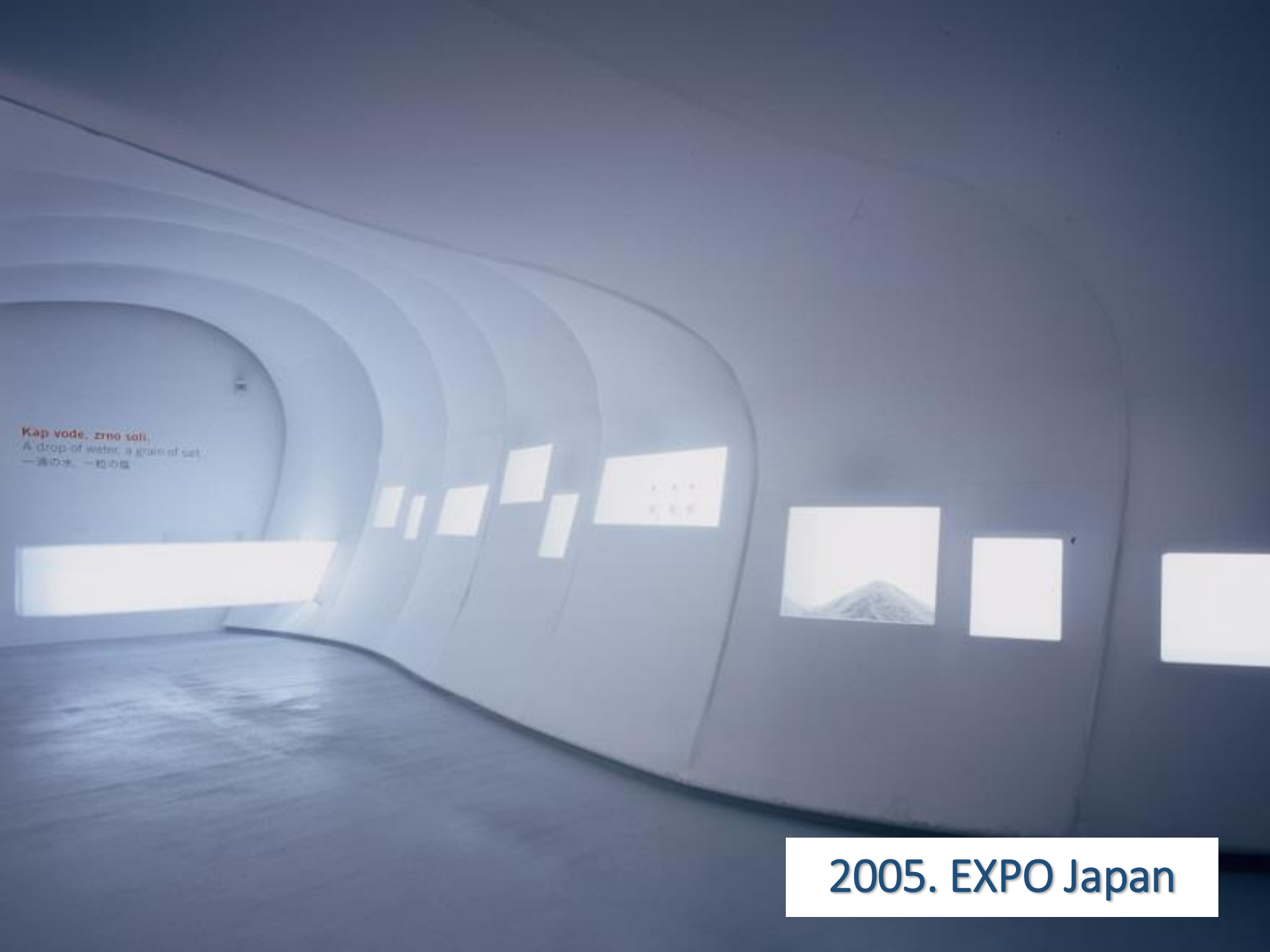
2009

2013

2012



Lean journey



Kap vode, zrno soli.
A drop of water, a grain of salt.
一滴の水、一粒の塩

2005. EXPO Japan



2005. TOYOTA Factory visit



2008. ADRIS Foundation donation



2008. MIT visit (Boston, USA)



24.04.2009. First LEAN seminar in Croatia



LEAN MENADŽMENT INICIJATIVA

17.11.2009. LEAN MANAGMENT INTIATIVE founded



2011. LEAN implementation - KPT



15.11.2011. CREDIZ with TOYOTA



Predavači ...

- **Tetsuya Kaida**
JOV, Toyota Motor Corporation
- **Mr. Jake Cameron**
Senior Manager – Corporate Communications – Toyota Motor Europe
- **Michael Balle, PhD**
Associate researcher at Telecom Paristech, co-founder of the Project Lean Enterprise, co-founder of the French Lean Institute
- **Ms. Carole Favart**
General Manager – European Projects / Kansei Design – Toyota Motor Europe
- **Prof. dr. ing. Joachim Warschat**
Fraunhofer-Institut für Arbeitswirtschaft und Organisation (Institutsdirektor)
- **Prof. dr. sc. Ivica Veža**
Fakultet elektrotehnike, strojarstva i brodogradnje, Split
- **Prof. dr. sc. Nedeljko Štefanić**
Fakultet strojarstva i brodogradnje, Zagreb

Konferencija se održava pod
pokroviteljstvom predsjednika
Hrvatske prof. dr. sc. Ive Josipovića

16. studenog 2011.
Zagreb, Hrvatska
KD Vatroslava Lisinskog

16.11.2011. GALP 2011

Organizaciju konferencije podržavaju:



Popis tvrtki koje su uspješno implementirale Lean i Green
sve je duži, a među ostalima na njemu se nalaze i ...

Toyota	HP
Porsche	Johnson & Johnson
Baxter International	Deutsche Telekom
Thomson Multimedia	Sony
Texas Instruments	LG
IBM	GlaxoSmithKline



2012. LEAN & GREEN – Novi Feromont



autokreativa.com

autokreativa.com



JAPANESE & NETWORKING

DESCRIPTION: Collaboration between *creative dimensions ZAGREB* and Faculty of Mechanical Engineering and Naval Architecture devolved into **Creation and Innovation Entrepreneurship Competition 2012 (CRIEN 2012)** that was organized by the *dimensions*.

A big number of high quality business plans and projects were received and the best were presented at the final CREIN 2012 event.



The winning team that presented smart refrigerator concept will participate at the nationwide competition that will take place in June 2012.



DESCRIPTION: For two weeks in May, *creative dimensions ZAGREB* became home of the **ORIGAMI ART: bridge between cultures** exhibition.

During that time, **hundreds of origami enthusiasts** came to see works of best Croatian origami artists:

- Goran Konjevod
- Krešimir Rajki
- Sanja Srbiljinović Čuček
- Vlatka Vidaković
- Davor Vinko



DESCRIPTION: autokreativa.com is a **international competition** organized by *creative dimensions ZAGREB* and GLOBAL CREATIVES NETWORK in collaboration with TOYOTA MOTOR CORPORATION. The contest is **open to all creative individuals** (professionals, students and visionaries) and it invites them to share their **future mobility vision**.

Winner of the competition will get the reward from 6,000 USD reward fund and the opportunity to further develop concept with the elite team of engineers from TOYOTA MOTOR CORPORATION (Japan HQ), which can lead to prototype building stage.

Kick-off workshop was held in May 14th at the *dimensions* space.



MEDIA: Innovative project generated a lot of media attention and the project announcement was published in a big number of automotive and general news channels (radio, web and print).



DESCRIPTION: In May 2012, *creative dimensions ZAGREB* became a little bit more Japanese. Beginner Japanese language and culture courses were opened under the helm of Marina Jukić, renowned Japanese language and culture expert.

The courses take place 1 to 3 times per week and they are opened for *creative dimensions ZAGREB* collaborators.

日本語



NETWORKING: We had an interaction with various companies (from startups to big corporations) and professionals. Some of them are:



2012. CREDIZ activities

Lean Educator Conference

A conference dedicated to lean educators, lean pedagogy and lean curriculum enhancement in all settings.

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2012 Lean Educator Conference

Lean Education Kaizen : Sharing Lean Education and Training Knowledge

LEC 2012 has concluded successfully. Thanks to all participants for an excellent event. Check back soon for a complete proceedings, including all abstracts, most presentations, and supplemental materials.

Authors and presentors may submit updated presentations using the presentation upload tab

Two journals will be publishing special sections on topics related to lean training and education soon. Watch this spot for updated announcements.

Next year the conference will be hosted by the Fisher college of business at Ohio State University - October 3-5, 2013 - Mark your calendars!



2012. LEC (Norfolk, USA)

GALP 2012 GREEN AND LEAN PRODUCTION



2. konferencija o Zelenoj i **Vitkoj**
proizvodnji i uslugama

Hypo Centar, 16.11.2012.



2012. GALP 2012

LEAN Case study - KPT

KPT – Value Stream Mapping

OBJECTIVES

- Education on VSM, Process Mapping and LEAN Management
- Skills adopting in process and VSM mapping
- Implementation of acquired knowledge on real example(KPT - CHEVIRE 100 MVA)
- Team approach to process improvement
- LEAN Improvements Team

RESULTS

- VSM Current State
- Spaghetti diagram
- Functional Process Map
- Identified opportunities for improvements
- Defined metrics
- Plan for future activities

KPT – VSM Current Analysis

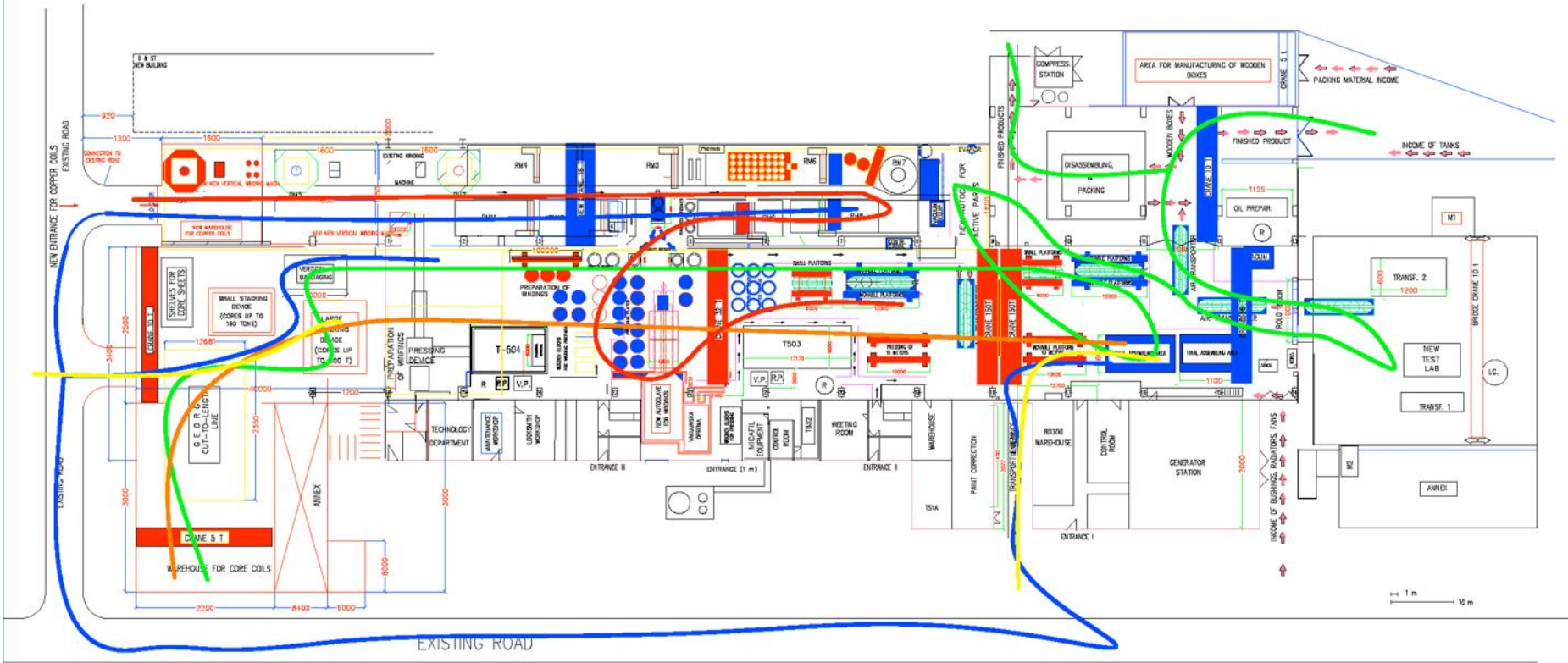
Improvements possibilities

- Space shortage for cut metal sheets
- Too often schedule change what affects efficiency of cutting
- Waiting of active parts assembly
- Production process efficiency 30,7 %
- Preparation of Isolation – finished 2 months before
- Defect isolation parts - rework
- Unsorted isolation material
- 3 – 4 days of inventory in assembly area

Metrics

- Production Cycle Time [Days]
- Processing Time [h, days]
- Overtime Per Employee [h]
- Utilization of Resources [%]
- Work In Process
- Rework Rate [%]

KPT – Spaghetti diagram



KPT – Spaghetti diagram

Analysis

- Reverse material flow
- Unequal material flow in some departments (specially in assembly department)
- Additional transport is needed what causes waiting and disturbance of production process

Metrics

- Transportation routes lenght [m]
- Availability and interdependence of gantry cranes [%]
- Buffer space [m²]

Potential improvements

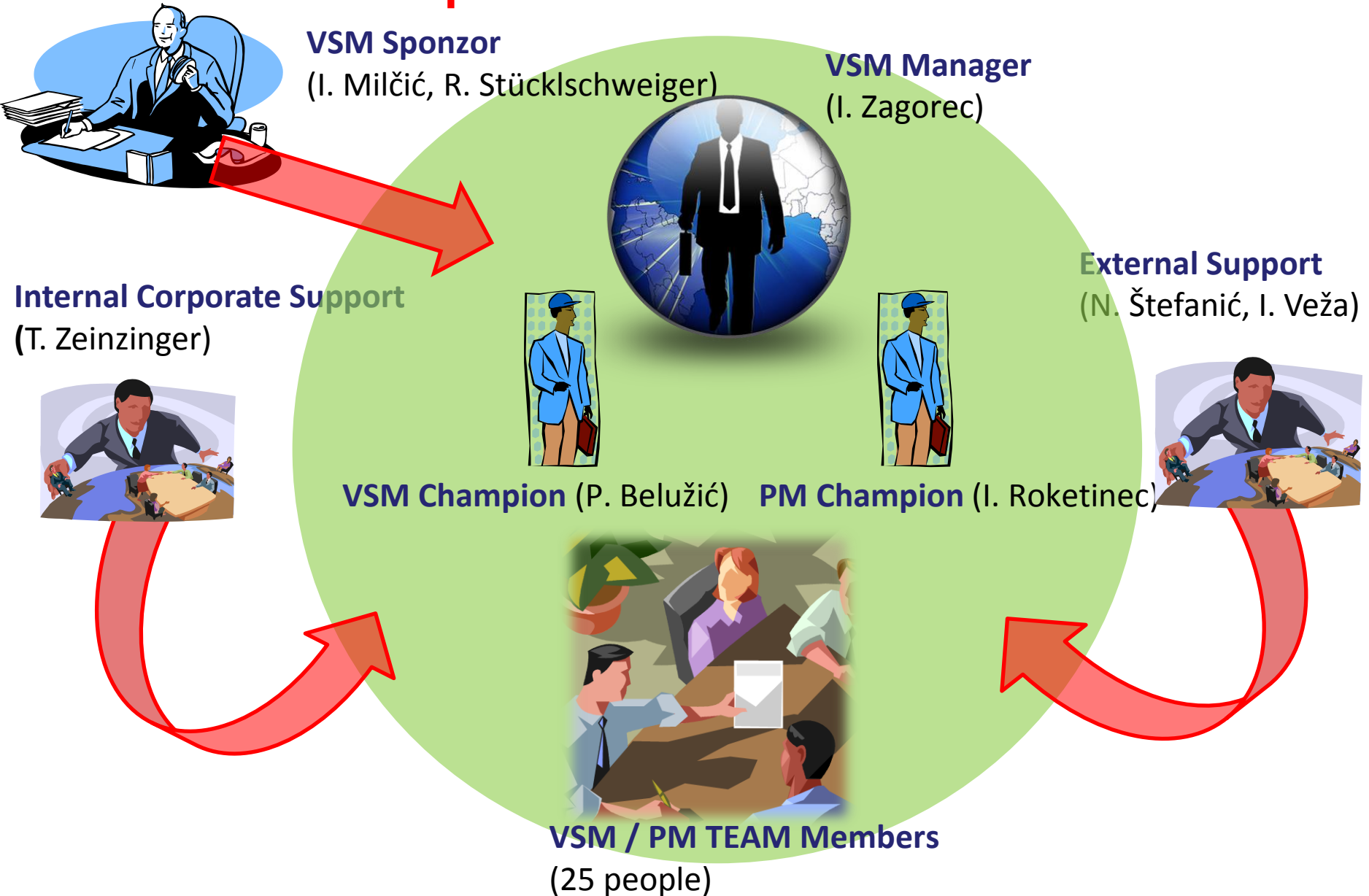
VSM

- Process planning (i.e. Cutting department)
- Work procedures and reporting about defects and disturbances
- Constrained inventory space for parts processed on GEORG)
- Reverse material flow after core bandaging
- Packing of isolation material for wiring department and rework of isolations
- Waiting for assembling active parts
- Assembly line balancing

Process Mapping

- Multiplied data input in the system
- Not enough defined demands at the beginning
- Correct and timeliness data input in SAP
- Standardization of Plates marking process
- Managing of direct improvement proposal
- Improvement of design process
- Business process optimization
- Departments communication

ImprovementsTeam



Possible savings calculation

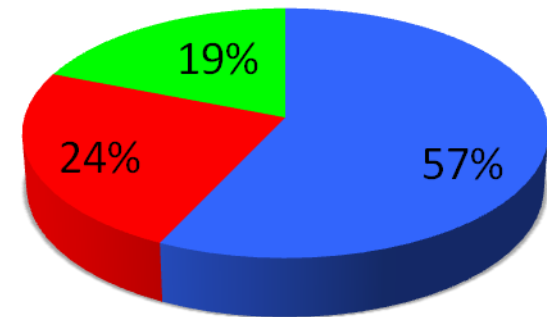
Savings after VSM analysis(world experience)

PCT [days] ↘ 25 % - 40 %

DCT [h] ↘ 25 % - 40 %

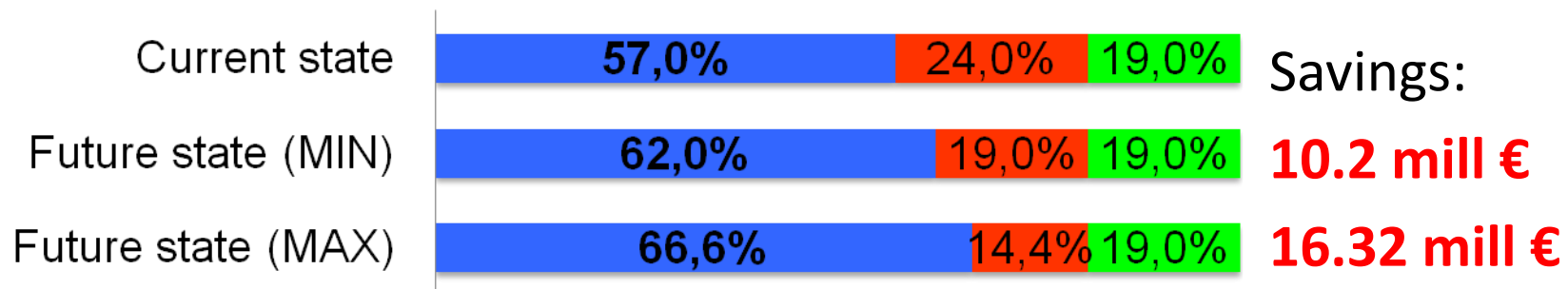
Sales

■ Material ■ Direct labor ■ EBIT



Improvements

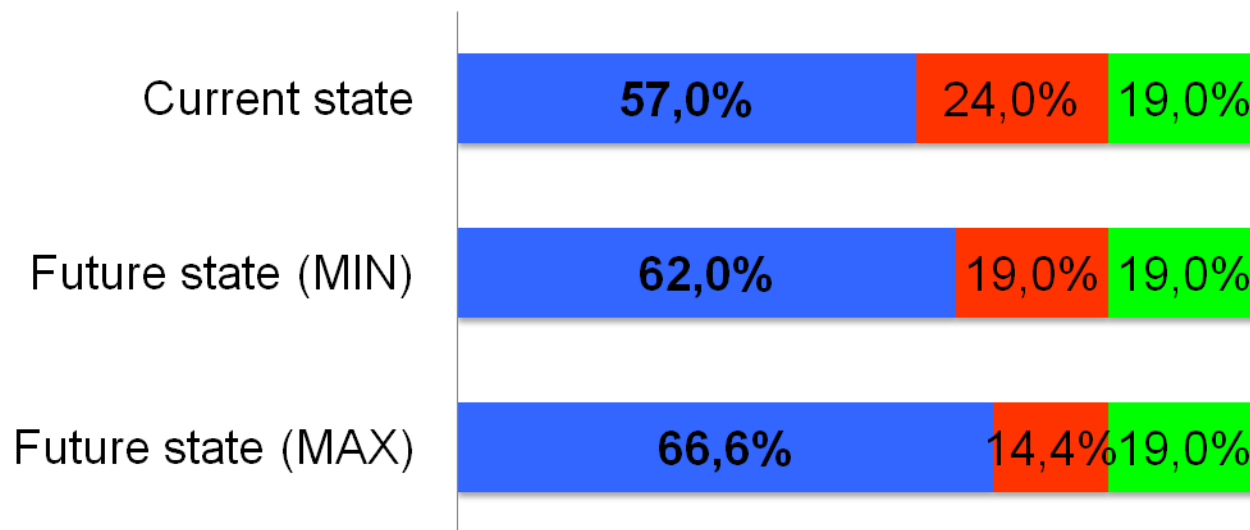
■ Material ■ Direct labor ■ EBIT



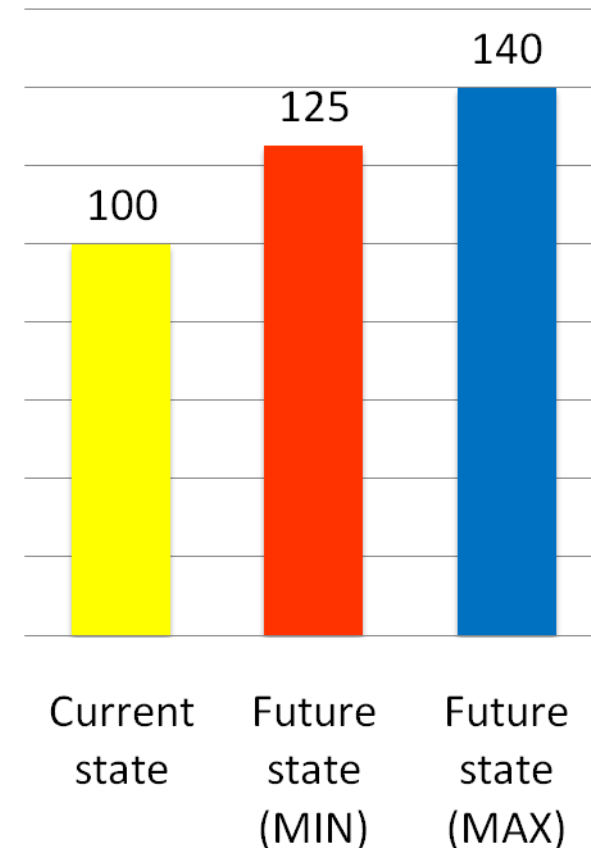
Possible savings calculation

Improvements

■ Material ■ Direct labor ■ EBIT



Produced transformers



Faculty of Mechanical Engineering and Naval Architecture

Project manager: prof. dr. sc. Nedeljko Štefanić

Project associates: Nataša Tošanović, dipl. ing., Miro Hegedić, mag. ing. mech.,

Matija Rossi, Petar Trsljić, Josip Vidaković, Anđelo Živalj, Viktor Mandić, Davor Kolar, Miho Klaić, Tomislav Jaklenec, Izidor Demeter

Entrepreneurs: Dino Brekalo, dipl. ing., Toyota Centar Zagreb, Stjepan Nikolić, dipl. ing., Ina d.d.

GALP

Conference on Green And Lean Production



The only such conference in Croatia and our region

Green and Lean production - the future of manufacturing and services, which provides the status of a socially and environmentally responsible attitude.

The special value of this conference is to meet and share experiences with executives who have implemented green and lean production.

Guest experts from RWTH Aachen University (Lean manufacturing of electric cars) and Loccioni Group (Green production).

Green production is based on the 3R (Reduce, Reuse, Recycle) and makes the company more efficient.



Five principles of Lean management:

1. Value from the customer's viewpoint
2. Value stream
3. Flow
4. Pull
5. Strive for perfection



Newly diagnosed strengths of Lean and Green production are:

- Extraordinary potential to reduce the cost of resources
- Increased customer loyalty
- Greater attractiveness of the product
- Greater possibility of new employment
- Increased capacity growth
- Encourage innovation, proactivity and new technology
- Increase company's profit



TIMES

Tournament In Management and Engineering Skills

- The largest pan-European case study competition for Industrial Engineering and Management students
- 250 teams each year
- SIM - a students' association based on the model of ESTIEM
- Supported by the Faculty of Mechanical Engineering and Naval Architecture, EcoCortec and Jadransko Osiguranje
- TIMES local qualifications - Zagreb, December 12th, 2011
- 25 students, 5 teams, 3.5 hours, one problem
- TIMES semifinal - Ilmenau (DE), January 9th-13th, 2012
- Case studies for Siemens High Voltage Substations, T-Systems Multimedia Solutions, Schaeffler and Bosch



STUDENTS

Introducing students to entrepreneurship on the second and third year through regular and facultative courses:

- Basics of management
- Business systems and management
- Knowledge and change management

Guest lecturers from enterprises:

- Stjepan Nikolić, dipl. ing., Logistic sector director at INA
Lecture: Change management in logistics
- Dino Brekalo, dipl. ing., General director of Toyota center Zagreb
Lecture: Toyota production system - change management



BUSINESS

idea/plan competition

WiFri - know the content of your refrigerator anytime, anywhere!

Winners at the XVI National Conference on Economy and Entrepreneurship for the best business plan in 2012

wireless + refrigerator



ProjectOr

The online catalog of your projects! Sharing knowledge inside a group of people.

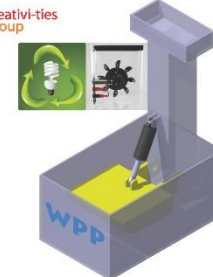


Projector



Wave Power Plant (WPP)

Unlimited energy anywhere on the coast! Small scale prototype for research and simulation.



BEST BUISNESS PLAN, 2013.



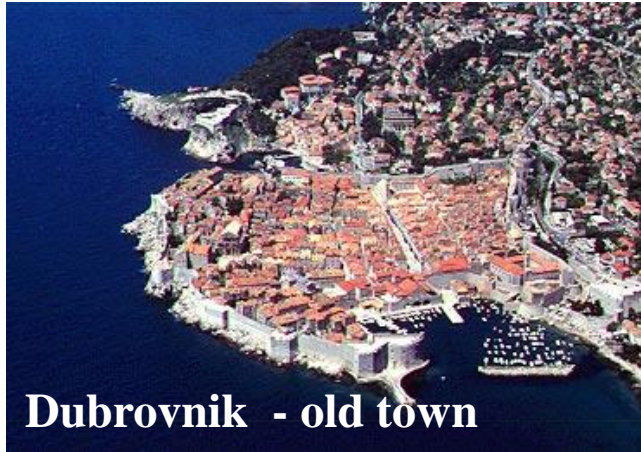
BEST BUISNESS PLAN, 2012.



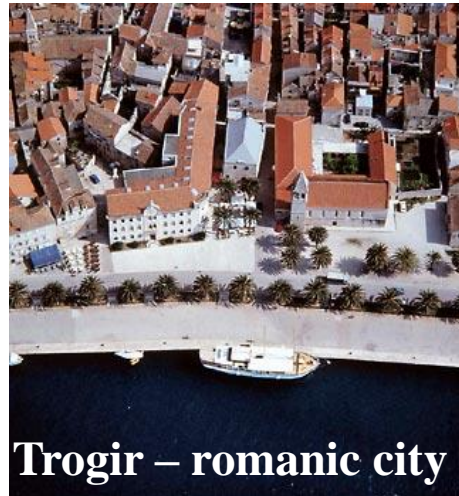
BEST BUISNESS PLAN, 2011.



LOCALITIES AND MONUMENTS ON THE UNESCO WORLD HERITAGE LIST



Dubrovnik - old town



Trogir – romanian city



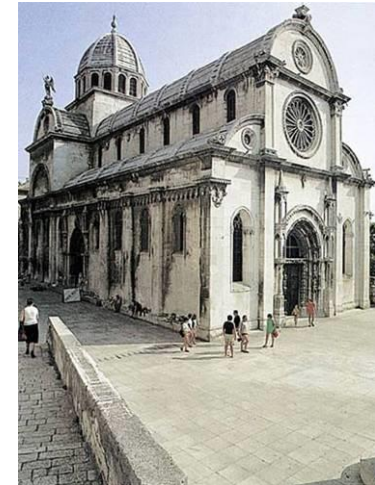
Diocletian`s palace - Split



Plitvice Lakes

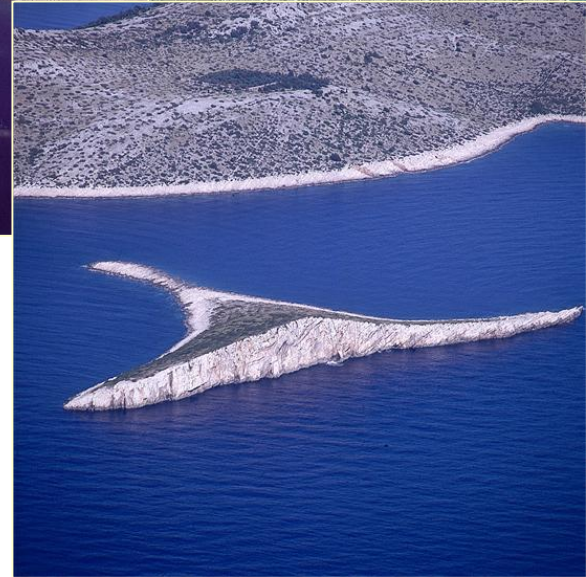
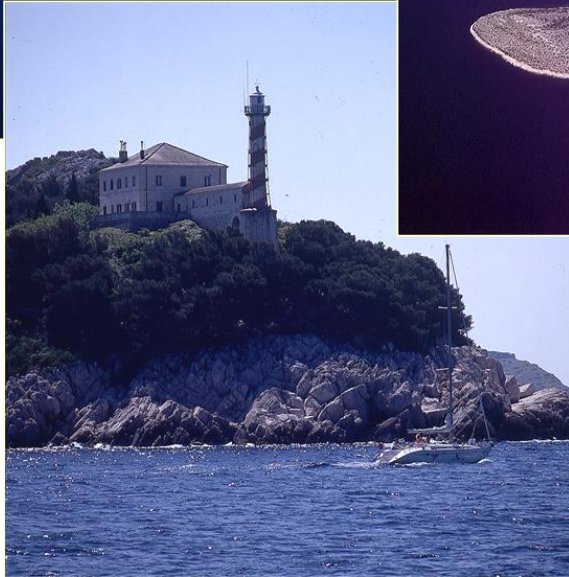
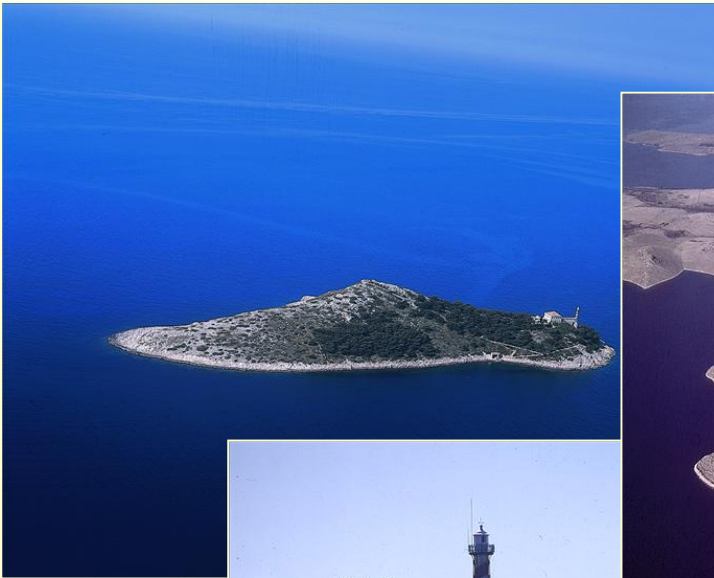


Eufrasian basilica - Poreč



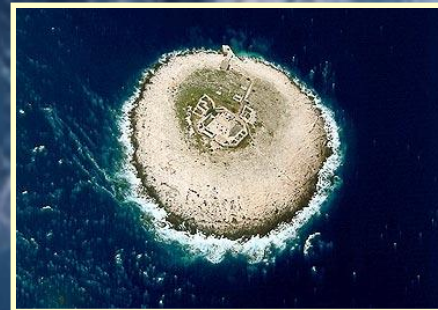
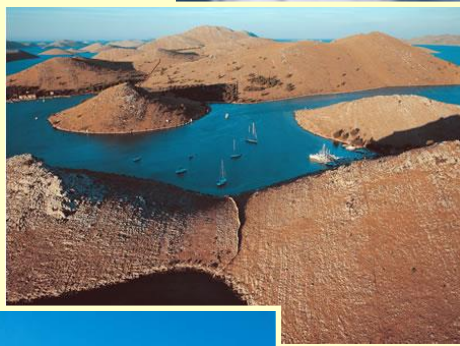
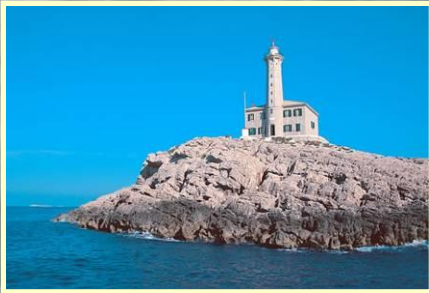
Šibenik cathedral






*"On the last day of the Creation God desired to crown His work,
and thus created Kornati Islands out of tears, stars and breath." (George Bernard Shaw)*

islands - sea



A wide-angle photograph of a large audience seated in a tiered lecture hall. The foreground is filled with graduates wearing black academic regalia and caps, seated at long black desks. Behind them, a large crowd of guests, including men and women of various ages, are seated in the upper tiers of the hall. The hall has a high ceiling with numerous rectangular light fixtures and a wooden-paneled wall on the right side. The overall atmosphere is formal and celebratory.

THANK YOU FOR YOUR ATTENTION!