JOINT REPORT ON

ANALYSIS OF EMERGING ICT TRENDS IN 2017: "INNOVATION IN ICT" AND "INNOVATION WITH ICT" & ANALYSIS OF MAJOR SOCIETAL CHALLENGES IN 2017

INNOVATIVE ICT SOLUTIONS FOR THE SOCIETAL CHALLEGES

INNOSOC VALENCIA 2017 MULTIPLIER EVENT

Prepared by:

InnoSoc
Innovative ICT Solutions for the Societal Challenges

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1. INTRODUCTION

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University of Zagreb Faculty of Electrical Engineering and Computing
INNOSOC Project Coordinator

Innovative ICT Solutions for the Societal Challenges (INNOSOC)

INNOSOC project URL: *http://sociallab.education/innosoc*

INNOSOC project at the official ERASMUS+ dissemination platform: *http://goo.gl/6Y67nW*

INNOSOC project Facebook page: *https://www.facebook.com/innosoc*

INNOSOC project Twitter page: *https://twitter.com/innosoc*

INNOSOC project duration: *1 September 2015 – 31 August 2017 (2 years)*

INNOSOC project budget: *203,389.00 EUR*

INNOSOC project team: *100+ lecturers and students from 11 universities from 8 EU countries*

INNOSOC logo

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Fast proliferation of **information and communication technology (ICT)** caused certain negative side effects for society (e.g., increased energy usage or CO_2 emissions). However, **"innovation in ICT"** and especially **"innovation with ICT"** offer potential solutions for some of the biggest societal challenges[1, 2]. These are reasons why it is of great importance that students understand **how ICT can be utilized to tackle societal challenges**. The *"Innovative ICT Solutions for the Societal Challenges (INNOSOC)"* project is a step forward in that direction, taken by a consortium of 11 universities from 8 European Union (EU) countries.

The main objective of the INNOSOC project is to set up a **transnational multidisciplinary intensive study program in the field of innovations based on ICT** targeting societal challenges defined by Europe 2020[3] and Horizon 2020[4] programs.

The INNOSOC curricula, which will be available as a **multilingual open educational resource (OER)**, consist of four main topic groups:

- **"innovation"** as a core topic;
- intercultural topics, with focus on **"multicultural teams"**;
- ICT topics, with focus on **"innovative engineering based on ICT"**;
- student projects, with focus on **"case studies on how ICT can contribute to innovative societal development"**.

Innovation as a core topic of the INNOSOC curriculum follows the **multidisciplinary approach** that includes innovation processes, intellectual property as well as technology policy issues.

Intercultural part of curriculum uses **interactive approach** and focusses on **multicultural teambuilding** through the exchange of practices from different cultures and by analyzing societal challenges from local, regional and global perspectives.

ICT part of the INNOSOC curriculum explains why **ICT is one of Key Enabling Technologies** and therefore horizontal technology enabling innovative solutions for societal challenges. It includes practical examples tailored specifically for INNOSOC providing knowledge/insights into hot ICT topics – "innovation in ICT" and "innovation with ICT" (e.g., "green", "smart", "inclusive" and "disruptive" ICT).

Student projects elaborate case studies related to the **role of ICT in responding to societal challenges (SCs)** defined by Europe 2020 and Horizon 2020 programs:

[1] Global e-Sustainability Initiative: Smart 2020 *(http://www.smart2020.org/_assets/files/03_Smart2020Report_lo_res.pdf)*

[2] Global e-Sustainability Initiative: Smarter 2020 *(http://gesi.org/SMARTer2020)*

[3] European Commission: Europa 2020 *(http://ec.europa.eu/europe2020)*

[4] European Commission: Horizon 2020 *(https://ec.europa.eu/programmes/horizon2020)*

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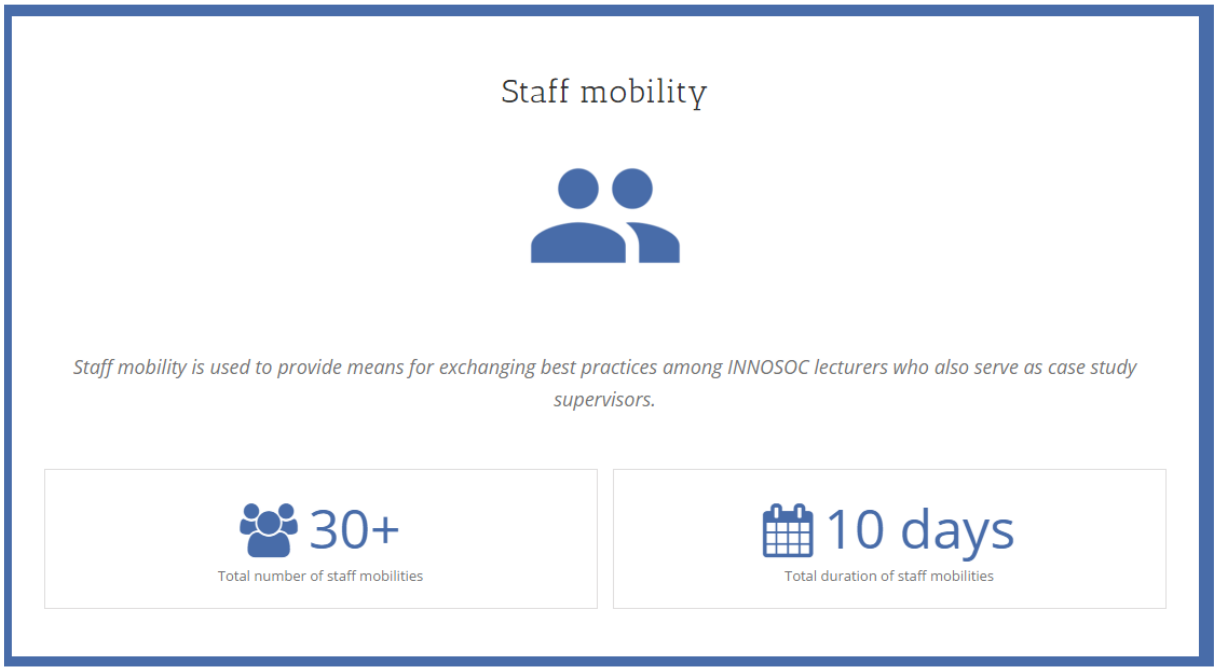
- Health, demographic change, and wellbeing (**SC1 "Health & Ageing"**)
- Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bio-economy (**SC2 "Food"**)
- Secure, clean and efficient energy (**SC3 "Energy"**)
- Smart, green and integrated transport (**SC4 "Transport"**)
- Climate action, environment, resource efficiency and raw materials (**SC5 "Environment"**)
- Europe in a changing world – inclusive, innovative and reflective societies (**SC6 "Society"**)
- Secure societies – protecting freedom and security of Europe and its citizens (**SC7 "Security"**)



INNOSOC staff mobility for lecturers

Student projects are based on the **"blended" mobility approach** and organized in two phases: (i) *preparatory phase* (virtual mobility); and (ii) *execution phase* (physical mobility). Physical mobility is implemented through two **two-week intensive program workshops** hosted by partner universities in 2016 (Zagreb, Croatia) and 2017 (Valencia, Spain). Workshop participants are lecturers and students from partner universities, as well as industry experts from workshop-hosting countries. **The first INNOSOC Intensive Program Workshop was held 18-29 April 2016 in Zagreb (Croatia). The second INNOSOC Intensive Program Workshop will be held 15-26 May 2017 in Valencia (Spain).**

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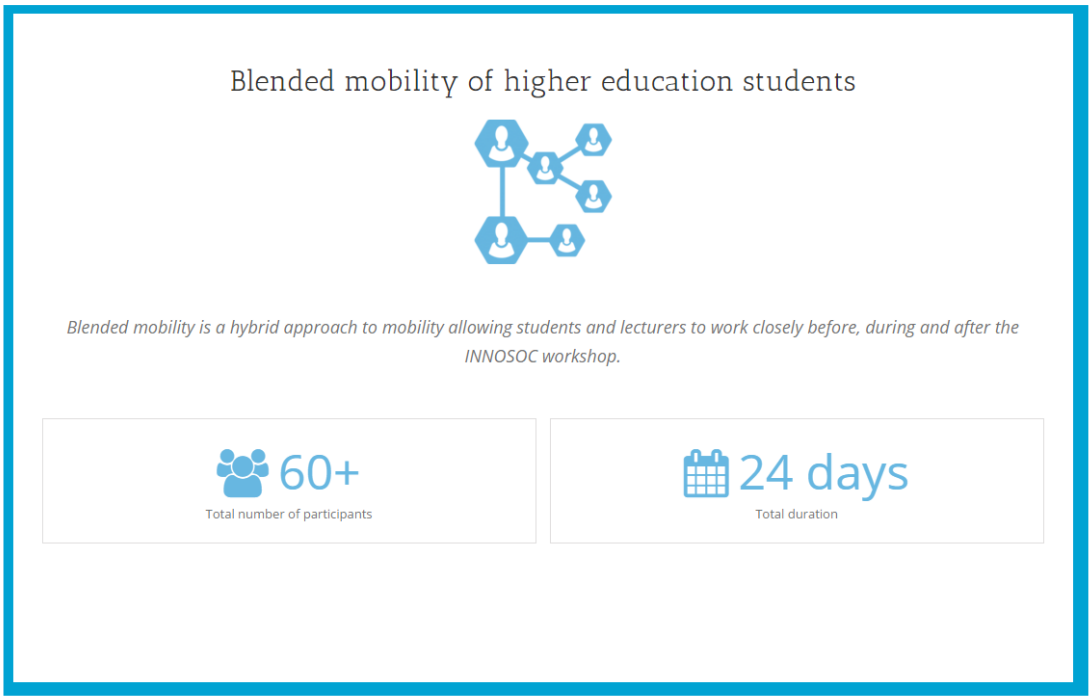

INNOSOC blended mobility for students – combining virtual and physical mobility

The INNOSOC project is funded through the **ERASMUS+ Key Action 2 Strategic Partnership Programme**[5]. ERASMUS+ is the **EU programme for education, training, youth and sport for 2014-2020**, which aims to **boost skills and employability**, as well as to modernize education, training and youth work. ERASMUS+ is based on **transnational partnerships** among education, training and youth institutions and organizations to foster cooperation and bridge the worlds of education and work in order to tackle the skills gaps we are facing in Europe. Specifically, **ERASMUS+ Key Action (KA) 2** is dedicated to **cooperation for innovation** and the exchange of good practices, where companies and higher education institutions work together to share knowledge. Priorities of the KA2 are to: (i) improve achievement in relevant and high-level basic and **transversal competence**; and (ii) develop **open and innovative education**, training and youth work, embedded in the digital era. **Diversity** should be woven into all ERASMUS+ KA2 activities, therefore motivating organizations from different participating countries work together to share and transfer best practices and innovative approaches in the fields of education, training, and youth. Finally, specific ERASMUS+ KA2 sub-program – **Strategic Partnerships in Higher Education** – are aimed at supporting the **development, transfer, and implementation of innovative practices** as well as the implementation of joint initiatives promoting

[5] European Commission: ERASMUS+ program *(http://ec.europa.eu/programmes/erasmus-plus/documents/erasmus-plus-programme-guide_en.pdf)*

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cooperation, peer learning, and exchanges of experience at European level. The INNOSOC project aims to achieve the following general ERASMUS+ program objectives:

- **enhance student teaching practices**, especially for engineering students and especially in fields of transversal skills and entrepreneurial experiences;
- **promote professional development** based on ICT;
- **support the production and adoption of open educational resources (OER)** in diverse EU languages (partners from 8 EU countries will translate and adapt INNOSOC educational resources to their languages, digitalize it and make high-quality European OER visible and accessible to all citizens, in accordance with the "2013 Communication on Opening Up Education initiative"[6];
- **pursue priorities enlisted in general EU strategies** (**"Europa 2020, Innovation Union"** – *"smart, through more effective investments in education, research and innovation"*), as well as specific EU strategies (**"Horizon 2020"** – *"all societal challenges will be covered in INNOSOC case studies"* and **"Education and Training 2020"**[7] – *"enhancing creativity and innovation, including entrepreneurship"* and *"making lifelong learning and mobility a reality"*).

INNOSOC open educational resources will be available in 9 EU languages: English + 8 languages of INNOSOC partners

[6] European Commission: 2013 Communication on Opening Up Education initiative (*http://ec.europa.eu/education/policy/strategic-framework/education-technology_en.htm*)

[7] European Commission: Education and Training 2020 (*http://ec.europa.eu/education/policy/strategic-framework/index_en.htm*)

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Additionally, the INNOSOC project aims to achieve the **specific Croatian higher education objectives** as well:

- **internationalization** of higher education;
- enhance **mobility** rates;
- better **link of education with the labor market.**

The first two specific objectives are achieved through enabling Croatian students to participate in the ERASMUS+ "blended mobility" as well by hosting the INNOSOC Intensive Program Workshop 2016 in Zagreb, while the third specific objective is targeted through the group of topics "Innovation" and entrepreneurial-oriented case studies.

This report complements the 2016 INNOSOC report in a way that these two reports jointly cover emerging ICT trends and major societal challenges which were identified by INNOSOC professors and experts as the most relevant for the period 2016-2017. Consequently, these trends and challenges were set as central topics of the INNOSOC curricula created during the project. More details about that can be found in Section 3. However, before that in Section 2 we will present 11 universities which partnered to create the INNOSOC consortium. Section 4 will give an overview of 8 case studies which are selected for development by the INNOSOC 2017 students. Finally, Section 5 will present intercultural activities included in the INNOSOC curricula.

At the end of the project, the whole INNOSOC curricula will be available as an open educational resource in English, while selected parts of curricula will be translated to 8 INNOSOC languages as well. The whole INNOSOC team hopes that at least parts of the INNOSOC curricula developed during the project will be recognized as relevant and interesting for inclusion in academic study programs not just by INNOSOC universities, but as well as other universities in 8 INNOSOC countries and beyond.

Vedran Podobnik
University of Zagreb Faculty of Electrical Engineering and Computing
INNOSOC Project Coordinator

2. INNOSOC PARTNERS

INNOSOC is a truly international project!
Its consortium consists of 11 members from 8 countries.

University of Zagreb, Faculty of Electrical Engineering and Computing (UNIZG-FER)

University of Zagreb,
Faculty of Electrical Engineering and Computing

CROATIA, Zagreb

Project Coordinator, Steering Committee, Partner

The University of Zagreb (1669), which consists of 34 faculties and academies, is the oldest and biggest university in the South-Eastern Europe. With its comprehensive programmes and over 50,000 full-time students the University of Zagreb is the strongest educational institution in Croatia. Specifically, the Faculty of Electrical Engineering and Computing, through education and innovation in fields of electrical engineering, computer science and information and communication technology, prepares students for leading technological and societal development of Croatia.

How do we innovate at the UNIZG-FER?

As Croatia's leading academic institution, we combine knowledge of our professors, curiosity of our researchers and open-mindedness of our students to foster innovation in our society and economy.

How do we use ICT to tackle societal challenges?

For example, we use ICT to develop innovative mobile applications for persons with complex communication needs (e.g., persons with Down syndrome). For more info check out our ICT-AAC project.

How do we promote intercultural environment?

Intercultural dialogue attracts a lot of attention in Croatia, the youngest member of the EU. This is why at our university we encourage interaction between different cultures, communities and people.

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Universitat Politecnica de Valencia (UPV)

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

Universitat Politecnica de Valencia

SPAIN, Valencia

Steering Committee, Partner

UPV is a public Higher Education Institution actively involved in international cooperation and mobility projects. UPV hosts over 36,000 students and employs over 5,000 people (teaching, research, administrative, services staff). It is the first technological university in Spain according to international rankings (e.g. Shanghai Ranking of World Universities) and offers 33 undergraduate programmes, 73 official Master's degrees and 28 Doctorate programmes.

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How do we innovate at the UPV?

Technical University of Valencia ranks in the top 3 technical universities in Spainand Teelcommunication School provides around 25% of the research at UPV representing only 4% of the staff.

How do we use ICT to tackle societal challenges?

ICT is used widely at UPV, including teaching and reasearch applications, like Sakai facilities, remote teaching, etc.

How do we promote intercultural environment?

UPV is the second university in Spain that welcomes ERASMUS student which gives an idea of the intercultural and plurinational envinroment that the campus provides.

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Hochschule fur Telekommunikation Leipzig (HfTL)

Hochschule für Telekommunikation Leipzig
University of Applied Sciences

Hochschule fur
Telekommunikation
Leipzig

GERMANY, Leipzig

Steering Committee, Partner

HfTL is a private university under the patronage of the HfTL Trägergesellschaft mbH – a wholly owned subsidiary of Deutsche Telekom AG. It has full recognition by the Ministry of Science and Art of the federal State of Saxony, making it the only corporate-funded private university in Germany. HfTL specializes in academic teaching, research and training in the field of information and communications technologies (ICT) and management.

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How do we innovate at the HfTL?

HfTL is the only corporate German university which is specialized on ICT. The study programs are continuously brought in line with the technical and societal development.

How do we use ICT to tackle societal challenges?

As DT as one of the leading ICTelcos set & follows trends in order to facilitate and improve daily life with ICT products, HfTL plays an important role in the relevant field in both education&research.

How do we promote intercultural environment?

HfTL is a globally acknowledged specialized university, offers study programs in ICT for students from all over the world. It is a leading partner of the European network of comparable universities.

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Szechenyi Istvan University (SZE)

Szechenyi Istvan University

HUNGARY, Gyor

Steering Committee, Partner

The university serves and will serve the economy and society of the city and the area with the continuous expansion of the educational spectrum. At our university the students can choose subjects from other programmes and can study simultaneously two undergraduate programmes. An economics student can enrich his/her knowledge by listening in on law or engineering subjects. In addition to the twelve thousand students attending the university full time there are five thousand students learning in correspondence courses and distant learning courses. Most recently we have begun to offer e-distant learning courses.

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How do we innovate at the SZE?

The University provides a unique and innovative training students with high-level, valuable, professional, and practical education, in addition research activity in the region, which serves primarily the engineering focused production activities.

How do we use ICT to tackle societal challenges?

The University – in accordance with the traditions – pursues predominantly applied research. Particular attention is paid to ICT research activities that are multidisciplinary and interdisciplinary projects, which have a social and economic aspect to them and deal with critical problems.

How do we promote intercultural environment?

The university have established a working educational and research co-operation with more than 150 European institutions of higher education, and industrial partners and with numerous international partnerships outside Europe. The University welcomes cca. 500 foreign students.

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University of Telecommunications and Post (UTP)

University of
Telecommunications and Post

BULGARIA, Sofia

Partner

University of Telecommunications and Post trains students in the area of telecommunication technologies, telecommunication informatics, wireless communications and broadcasting, telecommunication networks as well as management of information technology.

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How do we innovate at the UTP?

The University of Telecommunications and Post (UTP) combine knowledge of academic staff and researchers for implementation of innovations in the area of telecommunications, ICT and service management.

How do we use ICT to tackle societal challenges?

UTP develop innovative mobile applications for disabled persons, for smart houses and future trends of implementation of sensor networks for automation and control of industrial processes.

How do we promote intercultural environment?

The University of Telecommunications and Post encourage interaction between different cultures and communities in the area of computer and communication technologies for better social life.

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University of Zilina (UNIZA)

University of Zilina

SLOVAKIA, Zilina

Partner

The University of Zilina was established as the Railway College on 1st September 1953 by the separation from the Czech Technical University in Prague. It has gone through numerous changes during its history. Finally, in 1996, it was renamed from the University of Transport and Communications to the University of Žilina in Žilina. The University as a public university provides education at all three levels of higher education (Bachelor's degree, Engineer/Master's degree and Doctoral degree) in both full-time and part-time forms. Approximately 11 000 students currently study in all forms of study. There are more than 1 500 employees and 650 of them are university teachers.

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How do we innovate at the UTP?

We are unique in Slovakia, offering education in transport and communications. Our faculty offers innovative study programs in ICT based on this tradition, but connected to industry requests too.

How do we use ICT to tackle societal challenges?

Our education and research are inter-disciplinary. We are developing apps, networks, hardware answering specific user demand – smart cities, urban transport, health, secure ICT.

How do we promote intercultural environment?

We finished project oriented to internationalization of our university one year before. We have active contact with non-European universities. In last semesters we had students from Taiwan and Brazil.

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Institut Mines Telecom – Telecom Bretagne (IMT-TB)

In the 30 years since its creation, Telecom Bretagne has affirmed itself as a pioneering "Grande École" in education, research and enterprise. It trains multi-discipline engineers able to assume important responsibilities. Recognised for its dynamism and its very substantial international dimension, Telecom Bretagne has partnerships with more than 100 establishments of higher education and research throughout the world. It collaborates with MIT and the Lausanne École Polytechnique Fédérale on the subject of pedagogic innovation. More than a thousand students, from 50 countries, follow engineering courses on two quite exceptional campuses situated at the heart of very active high-technology clusters.

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How do we innovate at the IMT-TB?

Founded in 1977, Telecom Bretagne is one of the most prestigious graduate engineering schools in France, at the cutting edge of the Information Technology sector in both research & teaching.

How do we use ICT to tackle societal challenges?

We innovate in all areas of Information Technology, including the Internet of Things, Domotics, Medical Imagery, Intelligent transport & Didactics.

How do we promote intercultural environment?

50% international students, study of two foreign languages; 6 months abroad. Intercultural Communication and Management courses: students and staff. Well-established research I/C programme.

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Technical University of Kosice (TUKE)

TECHNICKÁ UNIVERZITA V KOŠICIACH

Technical University of Kosice

SLOVAKIA, Kosice

Partner

Technical University of Košice (TUKE) was established in 1952. The content of education and research at University includes the entire complex of sciences and economics. The TUKE seeks to maintain a cohesive and interdependent relationship between their teaching, research and service activities with accordance to European state of Art. The TUKE has 9 faculties with 17 030 students and 1880 staff. The TUKE has been the first and so far the only university in Slovakia to meet the criteria of the international standard EN ISO 9001:2000 and it received the quality certificate in the area of providing educational and research processes and enterprise activities within a public university (certification by TÜV SÜD Slovakia s.r.o.).

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How do we innovate at the TUKE?

TU support innovations in education (modern ICT infrastructure for students & staff, free wifi everywhere in the campus), excellent research centers. Special support for startups & innovative ideas.

How do we use ICT to tackle societal challenges?

TU have barrier free center for disadvantaged students, e-learning and online documents for students (exams, study results, application forms), internet in the dormitories.

How do we promote intercultural environment?

TU provide support for international students of all 3 levels of study. We have several student organizations: Best, ESN, IAESTE. We organize events for different cultures/nations.

Contact:
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University of Oradea (UO)

University of Oradea

ROMANIA, Oradea

Partner

The mission of the University of Oradea, is to promote knowledge, research and training through partnerships between teachers, students and community. In the last 22 years, the University answered the changes occurred within the national educational policy, demographic changes, requirements of the market economy, local and regional needs and new technologies. All these changes have led to new expectations from students, academic and administrative staff. University of Oradea offers to our students the necessary training to contribute to society development. This training is conducted in 15 faculties which offers a wide range of initial training and postgraduate courses.

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How do we innovate at the UO?

University of Oradea's mission, is to promote knowledge, research and training through partnerships between teachers, students and community.

How do we use ICT to tackle societal challenges?

UO is a creative,energetic,active and innovative university.Professors and researchers are very enthusiastic and determined to experience all the new opportunities offered by informational technology.

How do we promote intercultural environment?

UO promotes intercultural dialogue.The city of Oradea ever since the Middle Ages was a cosmopolitan city inhabited by several nationalities what assures a special diversity.

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University of Debrecen (UNIDEB)

University of Debrecen

HUNGARY, Debrecen

Partner

University of Debrecen is one of Hungary's five elite-research universities, offering the widest choice of majors in the country for over 29,000 students, including 3,741 international students. UD's 1500 lecturers of 14 faculties endeavour to live up to the elite university status and to provide high quality education. Our goal is to train professionals possessing all necessary skills and knowledge to enter the regional, national, or international labour market with a competitive degree. More than 1000 lecturers with doctoral degrees (PhD), 25 doctoral schools, and the volume of internationally renowned research publications and projects attest to the scientific dominance of the university. 139 of the lecturers and researchers are Doctors of the Hungarian Academy of Sciences and 27 are members of the Academy.

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How do we innovate at the UNIDEB?

Strong collaborations are established with companies committed for social challenges. Not only researchers but our students are involved in these activities implying the need of innovative thinking.

How do we use ICT to tackle societal challenges?

Several research groups work on how ICT can be applied in health care systems (e.g. devices and services for health monitoring and prevention, supporting older persons to remain active and healthy).

How do we promote intercultural environment?

Our faculty runs undergraduate and postgraduate programs in English for international students, where also exchange students are welcome. So, real intercultural environment is given for our students.

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Technical University – Sofia (TUS)

Technical University – Sofia

BULGARIA, Sofia

Partner

The Technical University of Sofia is the largest educational and scientific complex in Bulgaria in the field of technical and applied science with an institutional accreditation grade of 9.5 (on the scale of 10) for the period 2012 – 2018. As the first and largest polytechnic center, which supported the establishment of most of the higher technical colleges in the country, it sets the educational standards and national priorities for the development of engineering education and science.

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How do we innovate at the TUS?

We are introducing a system for promoting the students‘ active participation in research and project orientated training for master and PhD students.

How do we use ICT to tackle societal challenges?

Development of algorithms and methods for signal processing in biometric systems and systems using human-computer interface.

How do we promote intercultural environment?

There are three foreign language Faculties: German, French and English providing strong international student and teachers exchange and interaction.

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3. INNOSOC 2017 REPORTS

Ignac Lovrek
University of Zagreb Faculty of Electrical Engineering and Computing
INNOSOC Steering Committee member
Leader of the Working Group for Preparation of Croatian Science and Technology Strategy

Analysis of emerging ICT trends in 2017: "innovation in ICT" and "innovation with ICT"

Introduction

Information and communication technology (ICT) and all other technologies addressing global societal challenges are guided by a common vision of the **human-centric digital age**.

"Innovation in ICT" aspects refer to research and innovation that contribute to the overall development of ICT. ICT is present in all parts of the actual European research and innovation programme Horizon 2020.

"Innovation with ICT" aspects refer to the opportunities offered by ICT in enhancing and enriching the other sectors and contributing to the global societal challenges that are defined in Horizon 2020.

INNOSOC 2016 programme, including the workshop held in Zagreb (Croatia), covered societal challenges and their horizontal dimension with the following activities (see figure below):

- Health, demographic change and wellbeing (**SC1 "Health&Ageing"**):
  - Innovative Solutions for Assistance of Active Daily Life at Home (*Case Study Zg 6*)
  - Recognition of Patterns of Maleficent Objects on Medical Images (*Case Study Zg 8*)

- Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bio-economy (**SC2 "Food"**):
  - Innovations in the food industry (Industrial perspective – *Visit to the institution/company 1*: Kraš, Zagreb – The largest manufacturer of confectionery products in the South-Eastern Europe)

- Secure, clean and efficient energy (**SC3 "Energy"**)
  - Innovative Application of Electric Vehicles in Sustainable Energy Systems of the Future (*Case Study Zg 1*)

- Smart, green and integrated transport (**SC4 "Transport"**):
  - Intelligent Transport Systems and Vehicular Ad hoc Networks (*Case Study Zg 4*)

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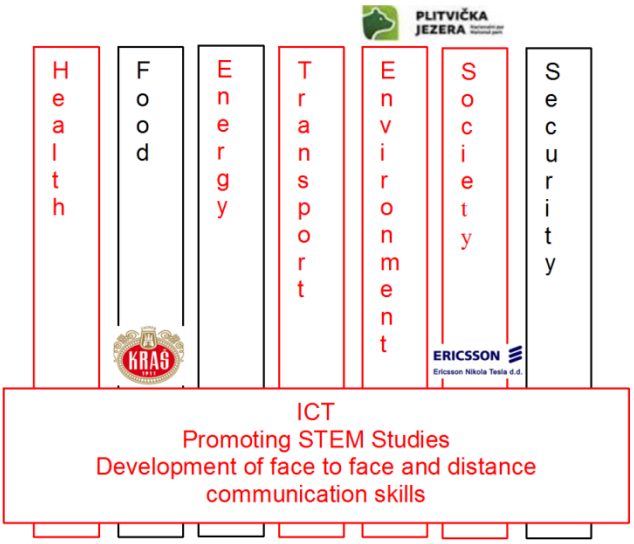
- Climate action, environment, resource efficiency and raw materials (**SC5 "Environment"**):
  - Microwave Sintering (*Case Study Zg 7*)
  - *Visit to the institution/company 2*: Plitvice Lakes National Park

- Europe in a changing world - inclusive, innovative and reflective societies (**SC6 "Society"**):
  - Issues and Challenges of Corporate Social Responsibility and Sustainability in the ICT Sector (*Case Study Zg 2*)
  - Seamless Connectivity for a Digital Life (*Case Study Zg 5*)
  - Technology way towards networked society (Industrial perspective – *Visit to the institution/company 3*: Ericsson Nikola Tesla, Zagreb)

- Secure societies - protecting freedom and security of Europe and its citizens (**SC7 "Security"**): -

- **Horizontal issues**:
  - Development of face to face and distance communication skills
  - Promoting STEM Studies among Young Students (*Case Study Zg 3*)



ICT and societal challenges: INNOSOC 2016 programme

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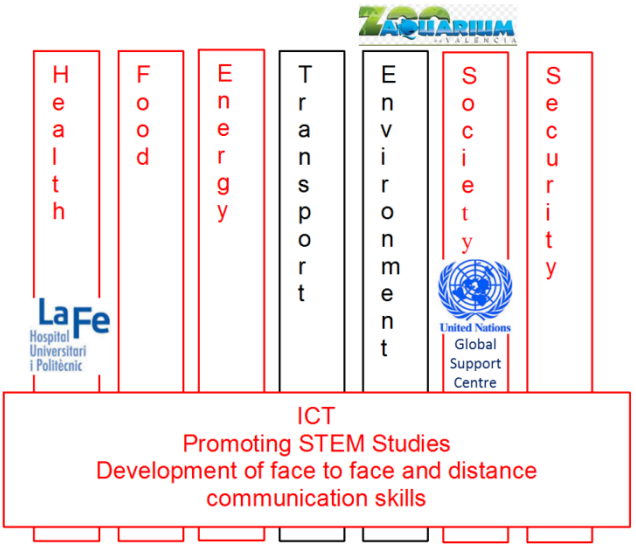
Analysis of global societal challenges 2017

Besides long-term goals related to the each of societal challenge, targeted activities addressed by the **Horizon 2020** projects in the period corresponding to INNOSOC project (2016-2017) are defined as follows:

- **SC1 "Health&Ageing"**: Personalized medicine (active ageing and self-management of health)
- **SC2 "Food"**: Sustainable food security - resilient and resource-efficient value chains
- **SC3 "Energy"**: Energy efficiency' and competitive low-carbon energy
- **SC4 "Transport"**: Mobility for growth, automated road transport and green vehicles
- **SC5 "Environment"**: Greening the economy
- **SC6 "Society"**: Co-creation for growth and inclusion, reversing inequalities and promoting fairness, and understanding Europe – promoting the European public and cultural space
- **SC7 "Security"**: Critical infrastructure protection and digital security

INNOSOC 2017 programme, including the workshop held in Valencia (Spain), covered societal challenges and their horizontal dimension with the activities shown in figure below.



ICT and societal challenges: INNOSOC 2017 programme

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INNOSOC 2017 workshop in Valencia will include the following case studies, horizontal activities, and visits:

- Health, demographic change and wellbeing (**SC1 "Health&Ageing"**):
  - High-Reliability Healthcare Systems (*Case Study Val 5*)
  - *Visit to the institution/company 1*: Hospital Universitari i Politècnic La Fe

- Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bio-economy (**SC2 "Food"**):
  - Innovations in 3D Printing for Sustainable Food Production, Maritime Preservation and Bioeconomy (*Case Study Val 1*)
  - RFID Operation, Applications, and its Limitations in Agriculture/Food Sector (*Case Study Val 2*)

- Secure, clean and efficient energy (**SC3 "Energy"**)
  - Innovative Applications of ICT in the Energy Sector: An Industry Perspective (*Case Study Val 3*)

- Smart, green and integrated transport (**SC4 "Transport"**): -

- Climate action, environment, resource efficiency and raw materials (**SC5 "Environment"**):
  - *Visit to the institution/company 2*: Aquarium in Valencia, Oceanographic Sea Life Centre

- Europe in a changing world - inclusive, innovative and reflective societies (**SC6 "Society"**):
  - Re-Invention of the Role of Sound in Education (*Case Study Val 6*)
  - Issues and Challenges of Corporate Social Responsibility and Sustainability in the ICT Sector: New challenges for Engineers in the 21st century (*Case Study Zg 2/Val 7*)
  - *Visit to the institution/company 3*: United Nations Global Support Centre in Valencia

- Secure societies - protecting freedom and security of Europe and its citizens (**SC7 "Security"**):
  - Innovating Border Protection Systems with Modern Sensors (*Case Study Val 4*)

- **Horizontal issues**:
  - Development of face to face and distance communication skills
  - Promoting STEM Studies among Young Students (*Case Study Zg 3/Val 8*)

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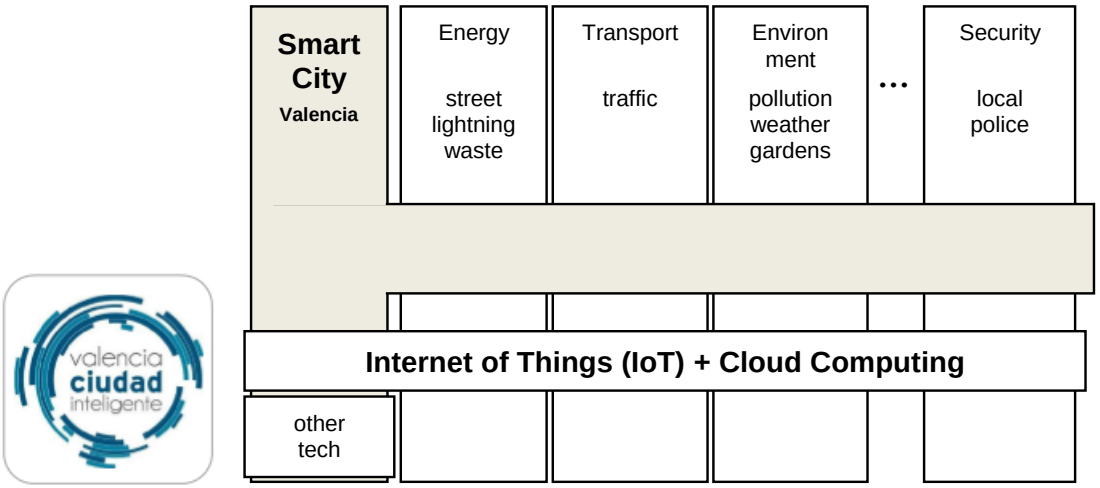
Valencia Smart City

Cities represent areas and communities in which all societal challenges fully reflect. The Valencia City Council has launched the **Valencia Smart City Platform** in 2014 in order to develop and implement municipal service management based on Internet of Things and cloud services.

Two definitions explaining the term **"smart city"** follows:

- "A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, the efficiency of urban operation and services and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects." (International Telecommunication Union - ITU).
- "A smart city is one where the government and citizens are using the best available means, including the ICT, to achieve their shared goals. This often includes economic development, environmental sustainability, and improved quality of life for citizens. A connected city is one where all relevant city systems – transportation, utilities, employment, health care, public safety, education, and others – are capable of communicating with each other to allow coordination and reduce waste." (US Department of Transportation).

Valencia Smart City initial concepts include and integrate solutions related to the following societal challenges: "Energy", "Transport", "Security" and "Environment". In the next phases of the smart city development also "Health&Ageing" and "Society" topics will be included (see figure below).



Smart City Valencia – initial concepts

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Sensing and data collection is based on the equipment installed in busses and street lights, but also individual smartphones offering **citizen participation** and using mobile crowd sensing. **Open data** policy is implemented allowing development of services and applications contributing to different aspects of city life and respecting the lifestyle of its citizens.

Internets of Things, **cloud computing** and other technologies are used for creating solutions for Smart City that have the characteristics of smart systems and cyber-physical systems. Smart City represents a system of interconnected smart systems whose objects ("things" in the Internet of Things, "components" in the cyber-physical system) perform tasks, independently and/or in interaction with other objects.

Smart systems are defined as "self-sufficient intelligent technical systems or subsystems with advanced functionality, enabled by underlying micro-, nano-, and bio-systems and other components. They are able to sense, diagnose, describe, qualify and manage a given situation, their operation being further enhanced by their ability to mutually address, identify and work in consort with each other. "[8]

Cyber-physical systems are defined as "smart systems that include engineered interacting networks of physical and computational components. Cyber-physical systems integrate computation, communication, sensing, and actuation with physical systems to fulfil time-sensitive functions with varying degrees of interaction with the environment, including human interaction." [9]

ICT demonstrates its full potential just in the smart city, whereby the role of the university to link local and global requirements is of a particular importance.

Ignac Lovrek
University of Zagreb Faculty of Electrical Engineering and Computing
INNOSOC Steering Committee member
Leader of the Working Group for Preparation of Croatian Science and Technology Strategy

[8] EpoSS – The European Technology Platform on Smart Systems Integration (http://www.smart-systems-integration.org/public)

[9] Framework for Cyber-Physical Systems, Release 1.0", CPS Public Working Group, National Institute of Standards and Technology, US Department of Commerce, May 2016

INNOSOC Case Study preparation process

INNOSOC Case Studies for the Zagreb 2016 and Valencia 2017 Intensive Program Workshops were selected through the **three-step preparation process**. In the first step, which took place in the period November-December 2015 (for the Zagreb 2016 workshop) and September-October 2016 (for the Valencia 2017 workshop), the *Call for Case Study Proposal* was sent to all 11 INNOSOC partners and each partner could propose up to two Case Studies tackling H2020 societal challenges. The proposals should have been done by filling the specially prepared template, which can be found on the following two pages of this document.

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InnoSoc
Innovative ICT Solutions for the Societal Challenges

INNOSOC Case Study topic proposal

Case Study topic title (*please insert title – max. 8 words*):

Case Study planned to be prepared for Zagreb (2016) or Valencia (2017) (*please choose a year*):

Choose a year

H2020 challenge addressed by the Case Study (*please choose from the drop-down list*):

Choose a H2020 challenge

Brief description of the problem addressed by the Case Study (*please insert 150-250 words*):

InnoSoc
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Brief description of the Case Study ***innovation aspect*** (*please insert 25-50 words*):

Brief description of the Case Study ***intercultural aspect*** (*please insert 25-50 words*):

Brief description of the ***role of ICT*** in the Case Study (*please insert 25-50 words*):

Key links and/or papers describing the Case Study (*please insert 2-3 links and/or papers*):

INNOSOC partner proposing the Case Study topic (*please choose from the drop-down list*):

Choose an INNOSOC partner

Primary contact at the INNOSOC partner proposing the Case Study (*please insert contact info*):

Name:
E-mail:

Lecturers from the INNOSOC partner which will coordinate the proposed Case Study development and come to give a lecture in Zagreb (2016) and/or Valencia (2017) (*please insert info*):

Lecturer name:
Lecturer e-mail:
Lecturer webpage:

After all Case Study proposals were collected, the INNOSOC Steering Committee analysed all received proposals and selected eight Case Studies for the Zagreb 2016 and eight Case studies for the Valencia 2017 Intensive Program Workshop. Some of selected Case Studies were result of merging two related or complementary proposals received from INNOSOC lecturers from different universities. Two Case Studies in 2017 were the same as those in 2016 as those were Case Studies covering horizontal themes ("Issues and Challenges of Corporate Social Responsibility and Sustainability in the ICT Sector: New challenges for Engineers in the 21st century" (Case Study Zg 2/Val 7) and "Promoting STEM Studies among Young Students" (Case Study Zg 3/Val 8)).

In the second step (December 2015 – January 2016 (for the Zagreb 2016 workshop) and October 2016 – November 2016 (for the Valencia 2017 workshop)) of the INNOSOC Case Study preparation process, INNOSOC lecturers that proposed selected Case Studies were asked to extend their proposals by filling the specially prepared template, which can be found on the following four pages of this document.

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InnoSoc
Innovative ICT Solutions for the Societal Challenges

INNOSOC Case Study (selected for Valencia 2017; extended version)

Case Study title (*please insert title – max. 12 words*):

Keywords (*please add 3-8 keywords separated by a semicolon*):

H2020 challenge addressed by the Case Study (*please choose from the drop-down list*):

Choose a H2020 challenge

Introduction to the Case Study (*please insert 200-300 words*):

Introduction should (in a catchy way) describe what is the main problem addressed by the Case Study and explain its relevance. Please do not use very technical vocabulary here but rather aim at a broader audience who are not experts in the field. Please give an example of the real-world problem which is not solved yet and this Case Study will develop a solution for it.

How this Case Study is related to the selected ***H2020 challenge***? (*please insert 100-200 words*):

This section should explain how the Case Study addresses the specific H2020 challenge. You can use a bit more technical vocabulary here. Please use "official" H2020 wording (e.g., take a look here: https://ec.europa.eu/programmes/horizon2020/en/h2020-section/societal-challenges).

How this Case Study is related to the ***INNOSOC project***? (*please insert 200-300 words*):

This section should explain how the Case Study fits in the INNOSOC project frame. You can use a bit more technical vocabulary here. Please use "official" INNOSOC wording (e.g., take a look at the brief project description http://goo.gl/D2INjR or http://sociallab.education/innosoc/about). You can also use ideas/text from the initial Case Study form where you described innovation, intercultural and ICT aspect of the Case Study.

Questions that need answers during the Case Study development (*please insert 5-10 questions*):

This section should present questions which will need to be answered by students in the process of the Case Study development. Example set of questions relevant for the Case Study "Innovative Application of Electric Vehicles in Sustainable Energy Systems of the Future" (Secure, clean and efficient energy) follows:

*****

Questions that need answers include but are not limited to the following:

- *Vehicle taxonomy: what types of vehicles are there? EV, BEV, ICV, FCV, PHEV, … Outline pros and cons (e.g., energy efficiency) for each of them.*
- *How do EVs affect three pillars of sustainable development: economy, environment and social community?*
- *What is the state of the global EV market? Sales, battery costs, incentives, popular cars ...*
- *How does an EV owner use its car? Demand (charging), typical traveling patterns …*
- *What is the state of the EV charging infrastructure? Types of chargers, number of chargers in popular countries…*
- *What is the role of ICT in EVs? In-car applications, communication with charging infrastructure…*
- How can we innovate with EVs? Integration with renewables as energy storage system, vehicle-to-home, vehicle-to-grid, electric charging lanes…

*****

References (key links and/or papers conneceted with the Case Study) (*please insert 5-10 references*):

This section should give main references connected to the Case Study. The role of these references is twofold: i) they support and or elaborate in more details statements given in the remainder of this document; and ii) they are initial reading list for students. Please provide citations according to the IEEE Citation Reference guidelines (http://www.ieee.org/documents/ieeecitationref.pdf). All references should be cited at least once in the text in the remainder of this document by inserting "[x]" mark in the text, where "x" is the number of the reference (same as when you write scientific papers).

[1] Reference 1
[2] Reference 2
…
[10] Reference 10

Knowledge and skills needed for developing the Case Study (please add 3-8 knowledge units and/or skills separated by a semicolon):

Five students (from different partner universities) will be allocated to the each Case Study. Students will bid for Case Studies in the process of student allocation. Students will rank their choices of Case Studies based on two criteria: i) interest for the Case Study topic (students will determine their interest for the topic based on the Case Study description given in this document); and ii) knowledge and skills needed for developing specific Case Study (students will determine their capability for working on the Case Study based on the list of knowledge and skills given in this section). We differentiate two categories of knowledge and skills: "prerequisite" (P) and "desirable, but not necessary" (D). Please mark each knowledge unit and skill with one of these categories (i.e., (P) or (D)).

Example of a knowledge unit: "TCP/IP protocol stack" (P); "wearables for e-health" (D)
Example of a skill: "statistical analysis in the language/tool R" (P); "web-page programming" (D)

Figures describing this Case Study (please insert 2-3 print quality figures; we are going to use these figures in our publications (web/brochures) so please be careful about copyright –insert only figures which are not copyrighted or provide us with source citation or whatever information which allows us to publish these photos (e.g. inserted photo is a photo taken by you and showing your lab); give a one line caption for every inserted figure)

INSERT FIGURE HERE
Figure 1. One line caption

INSERT FIGURE HERE
Figure 2. One line caption

INSERT FIGURE HERE
Figure 3. One line caption

In the last step (January-February 2016 (for the Zagreb 2016 workshop) and November-December 2016 (for the Valencia 2017 workshop)) of the INNOSOC Case Study preparation process, INNOSOC Steering Committee members finalized the preparation of each Case Study selected for the Zagreb 2016 / Valencia 2017 Intensive Program Workshops.

Case Studies were published online and the process of INNOSOC students allocation to Case Studies has started. Four to five INNOSOC students are grouped together to work on Case Study development through their INNOSOC blended mobility. Each student group will be supervised by one or two INNOSOC lecturers who are experts in the Case Study domain. Final results of student work are / will be presented during Zagreb 2016 / Valencia 2017 Intensive Program Workshops in late April 2016 (Zagreb) and May 2017 (Valencia).

Detailed description of the eight INNOSOC 2017 Case Studies is given in the next section of this report, as well as they are available online (http://sociallab.education/innosoc/case-studies/valencia-2017). Detailed description of the eight INNOSOC 2016 Case Studies is given in Section 4 of the INNOSOC 2016 report, as well as they are available online (http://sociallab.education/innosoc/case-studies/zagreb-2016).

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4. INNOSOC 2017 CASE STUDIES

Case study is used and analysed in order to illustrate a thesis or principle in the area of innovation, intercultural and ICT.

Innovations in 3D Printing for Sustainable Food Production, Maritime Preservation and Bioeconomy

Case Study URL: http://goo.gl/jcJ11

Authors: Marianna Zichar

Keywords: 3D printing; food production; maritime preservation; bioeconomy

H2020 challenge addressed by the Case Study: Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy

Introduction to the Case Study

3D printing tends to appear in many fields of our life rather intensively. News inform us regularly who (which organization, research lab or company) printed new types of things (cars, food, house, shoes, instruments, implants, teeth, etc.) somewhere in the world, and maybe they even used a new material [1]. When looking for innovative solutions of different current issues (including those belonging to the H2020 challenges), we cannot forget to explore whether some forms of 3D printing could be used for specific purpose as well.

The primary aim of this case study is to explore innovative applications of 3D printing beyond the traditional usage like reproducing everyday objects. To do so, first the concepts and properties of additive manufacturing [2] have to be clarified comparing it to other producing technologies (injection moulding, CNC (*Computer Numerical Control*) systems, etc.). After understanding capabilities of the additive manufacturing technology, issues relating to the H2020 challenge "*Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy*" will be identified [3]. To mention some emerging issues where this technology can bring a solution: saving coral reefs (and so protecting countless animals that depend on coral) [4], fighting world hunger [5, 6], and replacing fossil derived raw materials which is the main aim of bioeconomy [7]. Education should react to the increasing demand of the industry and introduce the basics of 3D modelling and printing into the education at all levels [8].

Elaborating the case study also gives a great opportunity for students to get to know different kinds of 3D printing technologies, their limits, and current shortcomings. They will explore status of teaching 3D printing at their institutions and define recommendation to make it better. The overall knowledge students will acquire can be used later in other fields of engineering too.

INNOSOC students, supervised by INNOSOC lecturers, will collaborate on providing a possible solution to this Case Study. These activities will be conducted as a part of the ERASMUS+ blended mobility and will be finalized during the INNOSOC Valencia 2017 workshop in late May 2017.

How this Case Study is related to the selected H2020 challenge?

Materials and technologies for 3D printers can be rather various and development keeps going on. This large diversity makes it possible to use 3D printers when looking for solutions for H2020 challenges as well. Ensuring food security goes beyond securing a sufficient supply. It also requires social and economic access to safe and nutritious food, because food consumption has an impact on human health and the environment. Why not to print food? We should sustainably manage and exploit aquatic living resources, which also can be supported by 3D-printed “creatures”. The transition from fossil-based European industries towards low carbon, resource efficient and sustainable ones is of fundamental importance and emergence. Researchers work hard to develop new bio-material applications for cellulose-based compounds for 3D applications to replace fossil derived raw materials.

How this Case Study is related to the INNOSOC project?

Roots of 3D printing come from computer science. Consequently, ICT influences its each **innovative application**. Considering the whole process from the first idea of ”what to print” till touching the just-printed object, there is no phase that does not include ICT. First, a 3D modelling program is needed. Then, a slicing program which creates the code that can be interpreted directly by the printer is needed. Finally, 3D printers are also controlled digitally. The principles of additive manufacturing can be transformed very diversely based on applied **ICT knowledge**.

Beside the theoretical part, students will explore how and in which majors their own universities teach/use 3D printing technology. Fortunately, lots of companies recognize how important is to introduce the state-of the-art at the higher education and support institutions according to their abilities. A comparison can be made about the state of 3D printing in partner countries through applying **intercultural skills**. Nowadays, 3D printing is only at the beginning of its usage, and its further development requires international collaboration. The first step can be to form a group of 4 students from different countries and motivate them for intercultural communication in the field of their would-be profession as well.

Questions that need answers during the Case Study development

Questions that need answers include but are not limited to the following:

- What are the main properties of additive manufacturing?

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- What kind of special materials can be used by 3D printers? Concentrate on materials which can be of great importance regarding to H2020 challenge "*Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy*".
- What are current drawbacks of the additive manufacturing technology?
- Search for additional examples for applying 3D printing regarding to the above mentioned H2020 challenge.
- Compare the two most popular filament types PLA and ABS!
- Try to find "green" printing materials!
- Is 3D printing taught at your university? If yes, for which majors, for what purpose, using what kind of syllabus? What do you think is worth to teach for ICT students?

References

[1] What is 3D printing, A definitive guide to additive manufacturing, Available: *http://downloads.hindawi.com/journals/isrn.mechanical.engineering/2012/208760.pdf*

[2] Kaufui V. Wong; Aldo Hernandez. "*A Review of Additive Manufacturing*", International Scholarly Research Network ISRN Mechanical Engineering, Volume 2012, 10 pages, Available: *https://www.3dhubs.com/what-is-3d-printing#a-brief-history-of-3d-printing*

[3] *HORIZON 2020 - Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy* - Available: https://ec.europa.eu/programmes/horizon2020/en/h2020-section/food-security-sustainable-agriculture-and-forestry-marine-maritime-and-inland-water

[4] Jeremy Deaton (2016, Juin 23) - *3D Printing could save coral reefs* - Available: *http://www.popsci.com/3d-printing-could-save-coral-reefs*

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[6] C. Böttcher (2014, December 4) – *3D printing to the rescue of gastronomy for frail seniors* – Available: http://www.youris.com/Bioeconomy/Food/3D-Printing-To-The-Rescue-Of-Gastronomy-For-Frail-Seniors.kl

[7] TE. Halterman. (2015, Juin 4) - *New research says that a new bioeconomy may be driven by 3D printed cellulose materials* - Available: *https://3dprint.com/70827/3d-printed-cellulose-materials/*

[8] I. Papp; R. Tornai; M. Zichar. "*What 3D technologies can bring into the education: The impacts of* acquiring *a 3D printer*", Proceedings of 7th IEEE Conference on Cognitive Infocommunications, 2016. Wroclaw, pp. 257-261.

Knowledge and skills needed for developing the Case Study

(P: prerequisite; D: desirable, but not necessary)

- Basic ICT knowledge (P)
- Interest in 3D printing (D)
- To be curious and prolific Internet researcher (D)

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Figures describing this Case Study

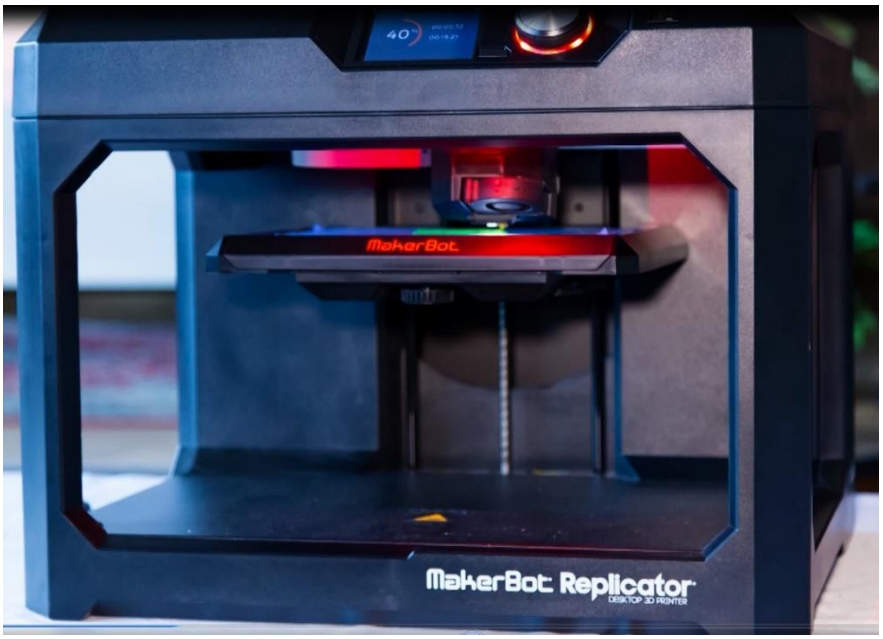

Figure 1. A desktop 3D printer based on the FDM technology

Figure 2. Objects are built up from layers

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RFID Operation, Applications, and its Limitations in Agriculture/Food Sector

Case Study URL: https://goo.gl/ooN61Q

Authors: Mate Liszi, Attila Kovacs

Keywords: precision agriculture; animal identification; food traceability; field-to-fork; semi-active tag; smart packaging; RFID

H2020 challenge addressed by the Case Study: Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy

Introduction to the Case Study

There is a general need for our society to have healthy food supply. In the EU, the food safety is also a growing concern. One way to ensure wholesome food (and animal feed) product is to establish good traceability from field-to-fork. Organizations such as the European Safety Authority (EFSA), which is responsible for food safety, are establishing procedures to collect and analyse data in field of food (feed) in order to identify emerging risks. On the other hand, recent advances in RFID (*Radio-Frequency IDentification*) technology offer vast opportunities for research, development and innovation in agriculture. RFID has been used for years in animal identification and tracking, being a common practice in many farms. Additionally, it has been used in the food chain for traceability control. Implementation of sensors in tags enables the development of new applications in fields, including environmental monitoring, irrigation, specialty crops and farm machinery. However, there are also challenges and limitations that should be faced in the next years, such as [1]: (i) operation in harsh environments (e.g., with dirt and/or extreme temperatures); (ii) huge volumes of data that are difficult to manage; (iii) need of longer reading ranges, due to the reduction of signal strength caused by propagation in crop canopy; (iv) understanding behaviour of the different frequencies and identifying which is the right one for each application; and (v) diversity of standards and the level of granularity.

The aim of the case study is to gather information and to start developing an RFID application which offers cheap, cost effective solution for entrepreneurs who do either livestock breeding or crop farming, including food production and supply chains. The work has to be focused mainly to the above-mentioned farming levels. At the end of the case study solution, proposals need also to address a sustainable, standardisable „field-to-fork“ concept to optimize supply chain with RFID technologies, giving opportunity to overthrow unnecessary long trade routes which are typical of nowadays EU's product flow.

INNOSOC students, supervised by INNOSOC lecturers, will collaborate on providing a possible solution to this Case Study. These activities will be conducted as a part of the ERASMUS+ blended mobility and will be finalized during the INNOSOC Valencia 2017 workshop in late May 2017.

How this Case Study is related to the selected H2020 challenge?

As the world population grows, we, Europeans, have to face bigger problems than producing food, so the time is now to create a solution for automating all processes that can be automated by nowadays technology. The manufacturing industry is highly automated and therefore machines, chemicals, medicines, electronics are made in clean and closed facilities. We somehow forget easily that we eat products given to us by open and dirty fields. Therefore, we have to devote proper attention to what we eat, its safety, and its place of origin, similar as we choose better machines and safer cars. Food security, covering the whole food chain and related services from primary production to consumption, is one of the (if not the) most important aspect of human life because food consumption has an impact on human health and the environment. Advancements in technology will help us to fulfil requirements for assuring food security. The aim is to allow tagging of agricultural products or livestock for better traceability and subsequent big data processing, optimizing the whole agricultural process.

How this Case Study is related to the INNOSOC project?

This case study provides insights in agriculture and food security for engineering students. There are very few engineers working at this field, as an ordinary engineer works, for example, on developing machines, manufacturing processes, plans buildings, factories, or electronic schematics. There will be efforts given to endear agriculture for students alienated from this fantastic world of animals and plants, living beings. Students will have to find compatibilities between agronomics and engineering, with the help of an agricultural engineer, from a country with great agricultural history.

One of the aims of INNOSOC is to set up a transnational multidisciplinary intensive study program in the field of innovations based on ICT targeting societal challenges defined by Europe 2020 and Horizon 2020 programs. In our case combining RF technologies into food chain fulfils the criterion of INNOSOC philosophy. Radio frequency identification (RFID) tags, in combination with ICT, are expected to improve logistics and value chain management. RFID technology can help detect the quality and origin of goods prior to entering a supermarket for sale, or a processing factory, much more efficiently and consequently significantly increase transparency of the flow of goods. This technology has a likelihood of being fully implemented and having a relatively large impact on the food chain by 2025.

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Questions that need answers during the Case Study development

Questions that need answers include but are not limited to the following:

- What are the EU regulations and incentives related to food (feed) traceability?
- What are the key players in the food (feed) chain (from field-to-fork)?
- What are the most common hazards that aimed to be avoid by RFID techniques?
- What are the challenges implementing RFID in food chains?
- What are the advantages of RFID over barcode?
- What are the advantages of RFID over identification brands, tattoos, eartags?
- What are technical parameters of using RFID technologies?
- What is the average stored data in RFID chips?
- How to implement and use tags on animals and plants?
- What procedures needed to be taken to gather information from the tag?
- What is cold chain?
- How to handle the vast number of data?
- What is FEFO? How to implement it in a small shop?
- How could this solutions break the status quo of bad habits of European agriculture and consumer society, as wasting, unnecessary torture to animals, and long polluting truck trade routes?

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Knowledge and skills needed for developing the Case Study

(P: prerequisite; D: desirable, but not necessary)

- Electronics (P)
- RFID (P)
- Cloud technology (P)
- Manufacturing technologies of RFID (D)
- Data pre-procession in cloud technology (D)
- Sensor management (D)
- Understand the field-to-fork concept (D)

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Figures describing this Case Study

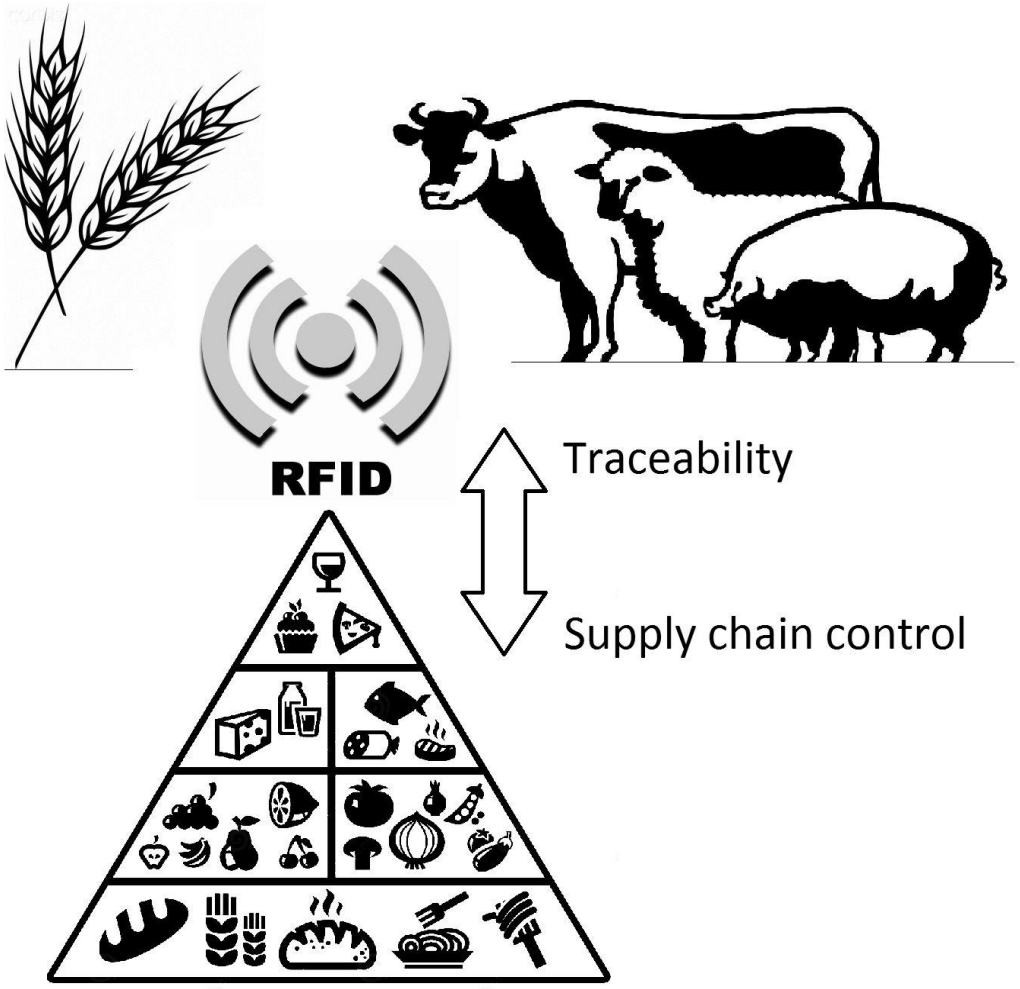

Figure 1. RFID technology allows farmers and traders to continuously control food; on the other hand customers can use food traceability functionality

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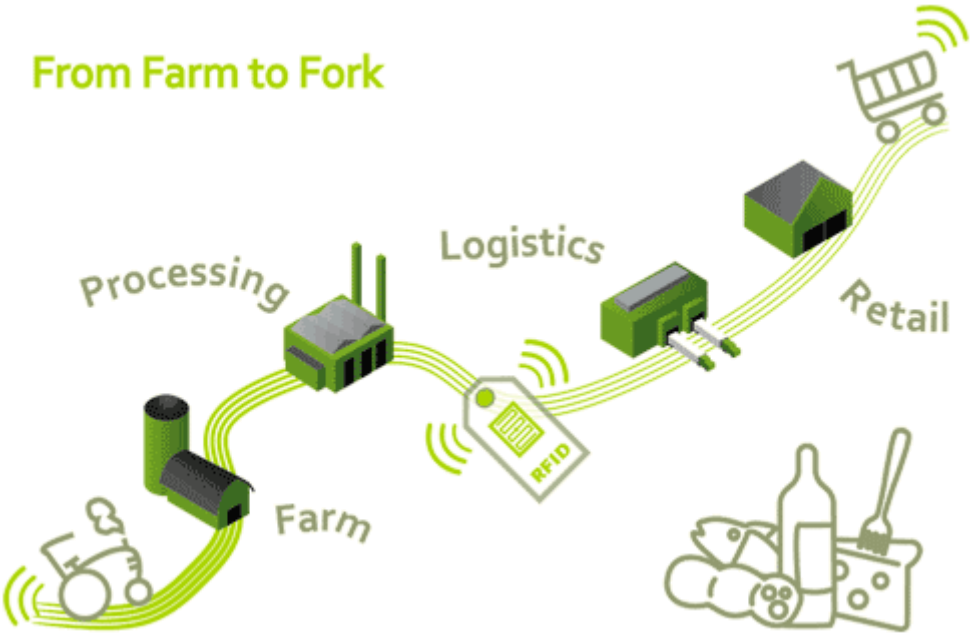

Figure 2. Farm-to-fork concept tracing the whole supply chain from production to retail

Figure 3. Applications of RF sensor tags on food commodities

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Innovative Applications of ICT in the Energy Sector: An Industry Perspective

Case Study URL: https://goo.gl/LTtD4f

Authors: Klaus-Michael Ahrend

Keywords: digitalisation; energy economy; smart grids; data analytics

H2020 challenge addressed by the Case Study: Secure, Clean and Efficient Energy

Introduction to the Case Study

Digital technologies enable Energy companies to improve their services and to transform their business models [1]. A comparison with other industries shows regularly a lack of digital readiness of the Energy Industry. Nevertheless, both private and industrial customers demand for new digital services and a closer cooperation (i.e., integration) in their life and process models.

Existing ICT technologies like Smart Grids, Smart Metering and Smart Home differ in their impact on economic success, ecology and society [3][4][6]. Energy companies as well as ICT manufacturers are unsure, which of those new tools should be implemented soon. Are they all relevant? What does the customer expect? What are effects on profit, ecology and society?

To understand implications of existing and new ICT offerings in the Energy Sector, students will work on a Case Study. Every student will work on selected key questions and will sum up analysis and recommendations. In the final workshop, different working streams will be put together to one big picture.

INNOSOC students, supervised by INNOSOC lecturers, will collaborate on providing a possible solution to this Case Study. These activities will be conducted as a part of the ERASMUS+ blended mobility and will be finalized during the INNOSOC Valencia 2017 workshop in late May 2017.

How this Case Study is related to the selected H2020 challenge?

The Case Study refers to two research areas of the Horizon 2020: “New knowledge and technologies” and “Market uptake of energy and ICT innovation”. On the ground of an overview of existing ICT market offerings the Case Study Solution will: (i) elaborate a feasibility study regarding existing ICT tools using criteria like advantage for customers, investment, return on investment, impact on energy efficiency, impact on society (and additional); and (ii) present a list of potential new ICT technologies that could enhance customer value.

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Findings of the Case Study will help European Energy companies in the process of further introduction of ICT into their business processes. Namely, the Case Study development will result in a usable matrix for effective and efficient usable ICT technologies as well as a list of potential new ICT technologies that are worthwhile to do further research on them.

Impact for Energy companies: Where once size was an important driver of success, now small and medium-sized Energy companies are able to compete both locally and country- or Europe-wide.

Impact for ICT companies: ICT developers, manufacturers and providers will profit from client-focused ranking and new market potentials.

How this Case Study is related to the INNOSOC project?

New ICT solutions in the Energy economy are available for every sector of an Energy company: for the generation of power, for distribution, for sales, for the trading function as well as for Energy-related services. **ICT will innovate the Energy sector**. It will enable further productivity improvements and will **transform the industry** with the emergence of new business models and new players. A crucial outcome is the allowance for consumers and producers of electricity to **connect with one another** in new ways. Another important outcome is the possibility to **connect the offerings (and the data) of Energy companies with those of partner companies**.

With the support of ICT every Energy company can improve its **customer journeys**, the **productivity of its operational processes** and the **efficiency of the usage of energy** (i.e. optimized generation planning, optimized planning of feed-in generation units, usage-depending tariffs). The resulting positive **impacts on the environment** [2] could outweigh the negative resource consumption for introducing ICT.

Regarding **ICT's impact on society**, there are a lot of positive impacts regarding the service offerings, the possibility to include client's suggestions and to improve the client's interaction quality and speed. On the other hand, ICT can reduce the necessity of jobs in the Energy sector. With the variety of the international and intercultural backgrounds of the InnoSoc lecturers and the InnoSoc students the Case study will have a close look on the **intercultural differences** of implementing ICT in European Energy companies.

With the results of the aforementioned Case Study, the InnoSoc project will get further **insights on the societal impacts of ICT usage** in the Energy sector.

Questions that need answers during the Case Study development

Questions that need answers include but are not limited to the following:

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- **Status quo** of ICT technologies: What ICT tools (hardware, software, methods) are on the market – separated for Power Generation, Trading, Grids Operations, Sales, Energy-related Services Sector? What market size do those technologies have?
- **Feasibility study** of current ICT tools: Which impacts have current ICT tools on advantage for customers, investment, return on investment, impact on energy efficiency, impact on society (and additional criteria – within the sustainability segments of economy, environment, society)?
- **Business Models** for ICT services: How could the Business Models of at least 5 main ICT technologies could be described – using the methodology (and graphs) of the Business Model Canvas of Osterwalder/Pigneur [5]?
- **Potentials for new ICT technologies**: Which at least 5 new ICT technologies should be developed to improve the value of the Energy company for its customer (either new services or tools for improved product / service quality)? Have a look on Figure 3.
- **Intercultural differences**: What approach(es) use the Energy companies to implement ICT in different countries? What taxonomy of approaches does exist? What to be recommended?

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Knowledge and skills needed for developing the Case Study

(P: prerequisite; D: desirable, but not necessary)

- ICT Strategy (P)
- Interest in new technologies (P)
- Energy Economy (D)
- Strategic Management / Business Modelling (D)

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Figures describing this Case Study

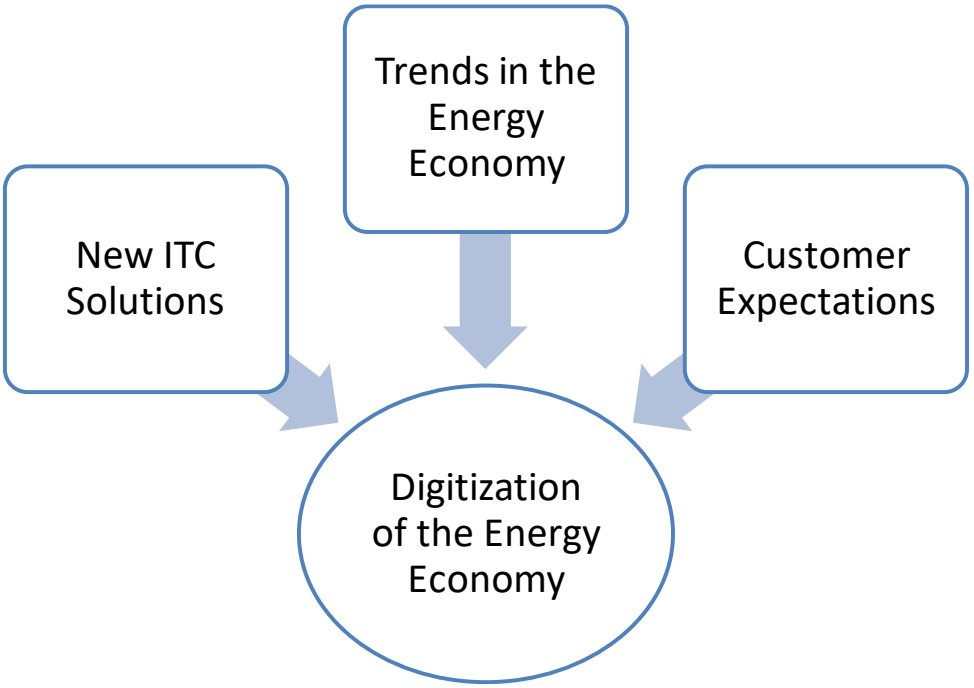

Figure 1. Influencing factors for Digitization of the Energy Economy

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Generation	• Plant Maintenance • Plant Management • Spare-parts Management	• Virtual Power Plant • Peer-to-Peer solutions (with/without Blockchain)
Trading	• Trading Simulation • Portfolio Management • Automated Trading	• Weather data support • Storage optimization • Swarm storage solutions
Distribution	• Digital Grid Management • Smart Metering / Gateway-Administration • Smart Grids • Mobile Workforce Support • Preventive/Predictive Maintenance	• Demand Side Management • Smart Grids Services i.e. for industry parks • Digital Customer interaction (i.e. Apps)
Sales	• Digital customer interaction / journey (Apps, social media etc.) • Load-based tariffs • Individual offerings (based on big data analytics) • Energy Data Management • Energy Management solutions • Bots for Customer Service	• Online Sales Platform (for Energy / Services) • Management/support for Smart Home solutions • Integrated Solar/Storage Systems • Smart Lightning • Cross Selling (i.e. telecomm.)
Supporting Functions	• Automated processes • Document management • Knowledge Management	• Web-Services (i.e. Controlling) • Online recruiting • Open Innovation

Figure 2. Examples for ICT usage in the Energy industry

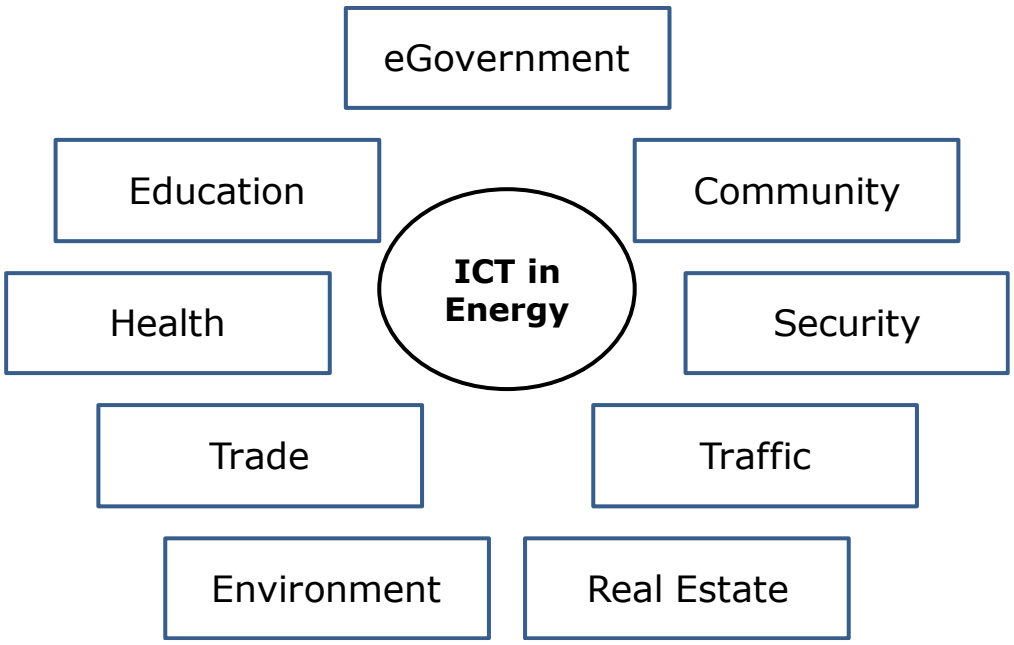

Figure 3. Energy-related ICT as a part of the Digital City

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Innovating Border Protection Systems with Modern Sensors

Case Study URL: https://goo.gl/Zzyn9R

Authors: Filip Tsvetanov

Keywords: innovation; sensors networks; border protection; security

H2020 challenge addressed by the Case Study: Secure societies – Protecting freedom and security of Europe and its citizens

Introduction to the Case Study

The European Union is subjected to continuous interest and pressure from many imigrants seeking illegal crossing of borders. To improve the border security of the European Union, we are working intensively on building innovative systems based on smart sensors and devices for the identification and detection of illegal border crossing.

We seek to increase the reliability and efficiency of border control measures by using integrated wireless networks of intelligent sensors, modern radars, cameras and thermal motion sensors in remote border areas, which are typically difficult to secure and monitor. Such surveillance networks are constructed of battery powered intelligent radio-based sensors to provide a computerized decision-making support to border control authorities. However, one challenge for the employment of such technology is to provide a secure end-to-end encrypted communication of various types of online information, including movement, humidity and temperature. Another challenge is to extend the battery life of the sensors in these continuously monitoring systems (i.e., operating 24/7), e.g., by allowing each sensor to wake up from its sleep mode only when movement is detected or when devices transmit routine checks.

Sensors transmit real-time data (e.g., automated number plate recognition, face recognition, gait recognition and complex activity recognition). Suspicious events (or even non-suspicious events such as false alerts caused by wild animals) can direct the operator's attention and are saved in the database for post-hoc analysis. The employment of surveillance wireless networks based on radio-controlled and long-lasting battery-fed sensors offers an efficient way towards an effective control of illegal immigration, drug trafficking, and other security breaches along the borders of European Union.

One possible approach to solving this Case Study is the design and building of sensor networks of intelligent sensors and actuators for tracking, monitoring and prevention of illegal crossing of European borders.

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INNOSOC students, supervised by INNOSOC lecturers, will collaborate on providing a possible solution to this Case Study. These activities will be conducted as a part of the ERASMUS+ blended mobility and will be finalized during the INNOSOC Valencia 2017 workshop in late May 2017.

How this Case Study is related to the selected H2020 challenge?

The relationship of the Case Study with the challenges of the H2020 is its connection with topics of Border Security and External Security.

The Case Study covers the application of new technological solutions and building the next generation of information and communication systems from multiple sensor networks. Sensor networks, built on the borders, may have different functions such as sensor networks to detect smuggled goods, sensor networks to detect movement of people, network surveillance, etc. The multitude of sensor networks can be built from countries with a common border. Each sensor network can collect, transmit and process information on the state border by cloud structures. This information can be analysed to take preventive or real measures of various border guard services of the Member States of the European Union.

How this Case Study is related to the INNOSOC project?

This Case Study will lead to intercultural communication between project participants. It focuses on building intercultural team building, which will discuss challenges for the application of innovative sensor networks to increase border security and protect people in EU. Furthermore, it will discuss the impact of innovative sensor networks on reducing illegal immigration flow conveyance of smuggled goods across the border, human trafficking, as well as specific issues related to energy consumption and security of transmitted data in sensor networks. Implementation of innovations in the design, modelling, simulation and practical construction of sensor networks with intelligent sensors and actuators and a new generation of systems will create a "smart borders" for protection and security of EU citizens.

Data collected by the sensors is large in size (i.e., Big Data). Resource constrains include limited amount of energy, restricted communication bandwidth and limited processing and storage of data in each sensor node. A new paradigm which has to be used is the application of cloud computing in the work of wireless sensor networks (WSN) or Sensors Cloud computing. This computing paradigm enables the use of sensor networks set up by EU Member State by acquiring right of access to services in Sensor Cloud. The sensor cloud consists of various WSNs, but provides a homogeneous user access to data in the cloud in real time (Figure 2). The Sensor Cloud must quickly resolve various user tasks to meet the needs of different users at the same time. This feature of sensing clouds requires development of optimal scheme in WSNs. Construction of optimal scheme depends on the location and density of the sensors in the network, what relates to the efficiency of energy resources use.

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Questions that need answers during the Case Study development

Questions that need answers include but are not limited to the following:

- What is the role of ICT for border security?
- What innovative technologies are used for increasing security of your national borders?
- What are challenges for the energy performance of sensor networks for security at the borders?
- What is the market situation in the appropriate components and intelligent sensors and actuators for sensor networks for border security?
- Justify the choice of an appropriate structure for cloud data sharing for specialized sensor networks.
- Who do you think are the most appropriate types of sensors for building sensor networks for border security? Give substantiated proposals.

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Knowledge and skills needed for developing the Case Study

(P: prerequisite; D: desirable, but not necessary)

- Sensor networks (P)
- Wireless engineering (D)
- Network security (D)
- Cloud technology (D)

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Figures describing this Case Study

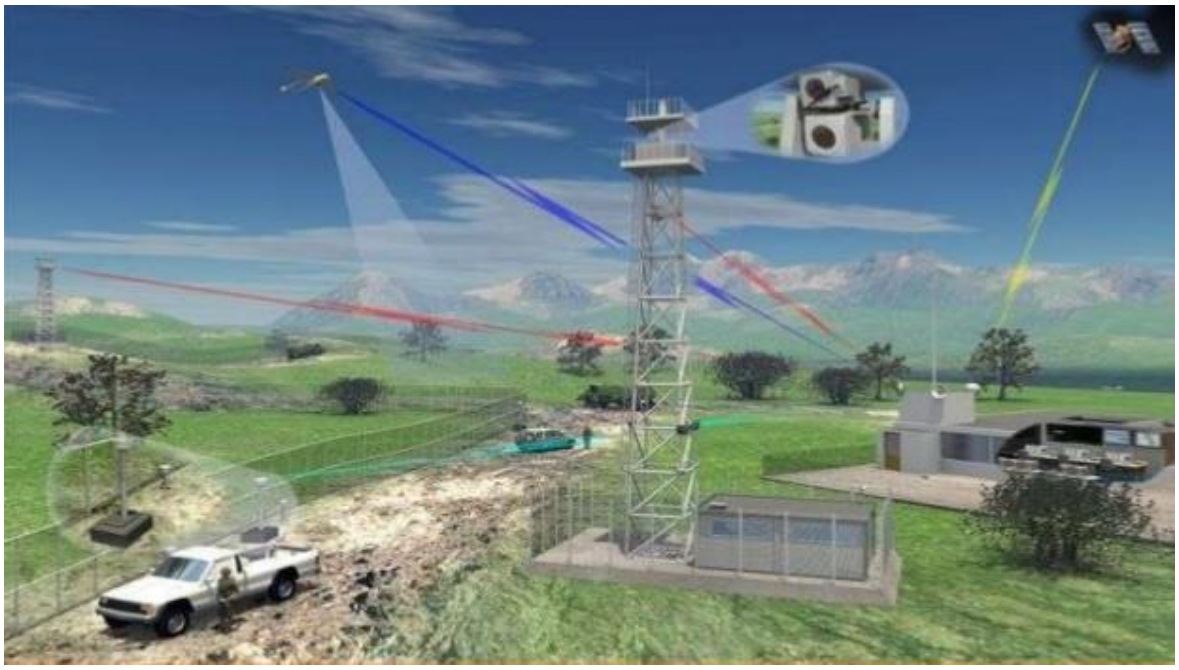

Figure 1. Wireless system for border security

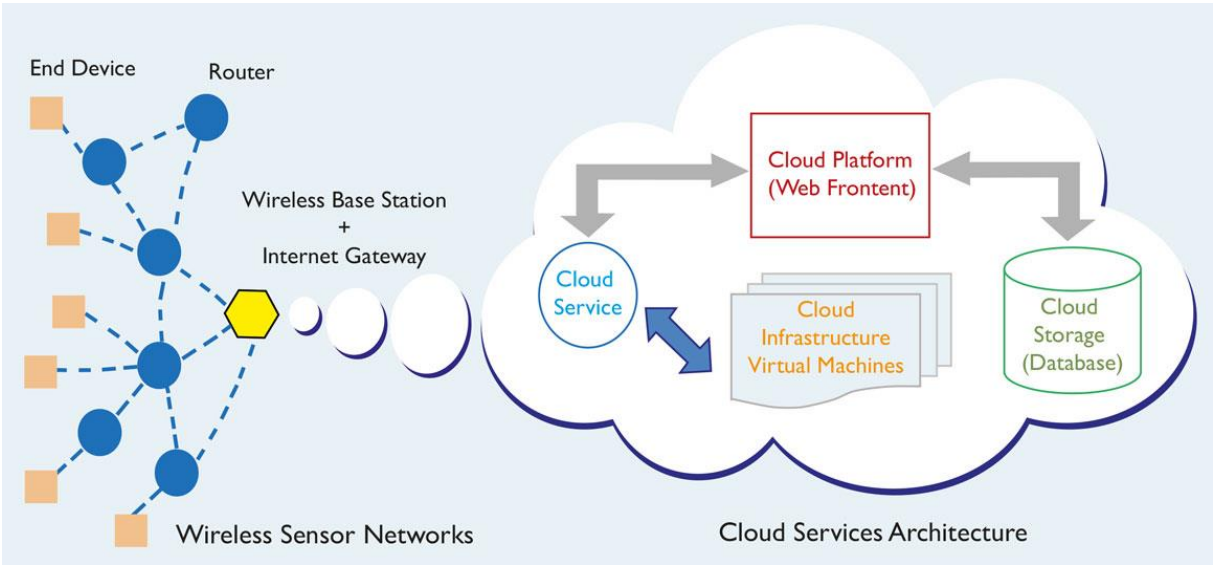

Figure 2. Integration WSN with Cloud computing

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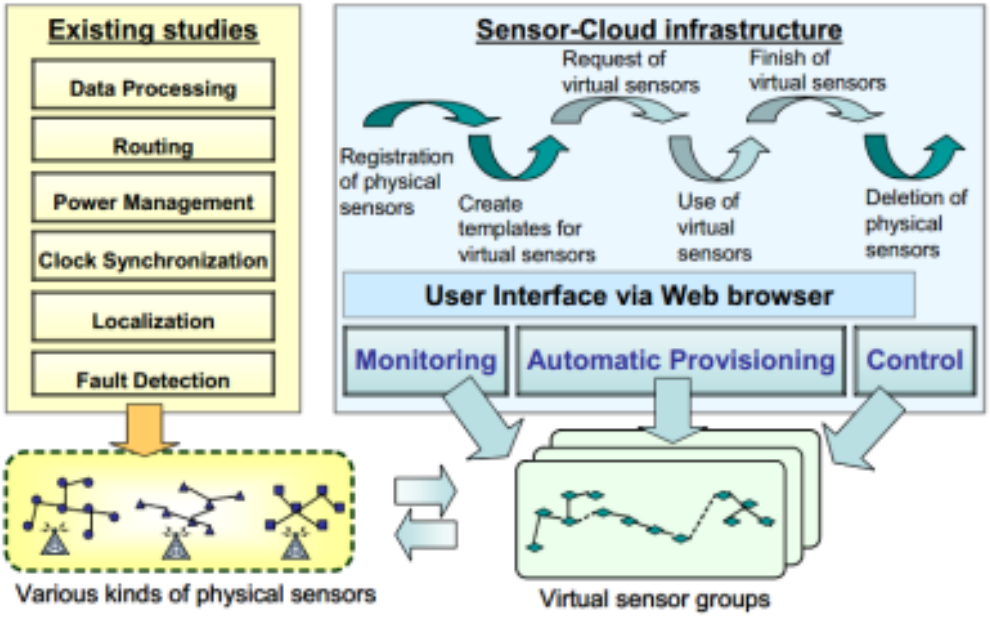

Figure 3. Structure of Sensor Cloud

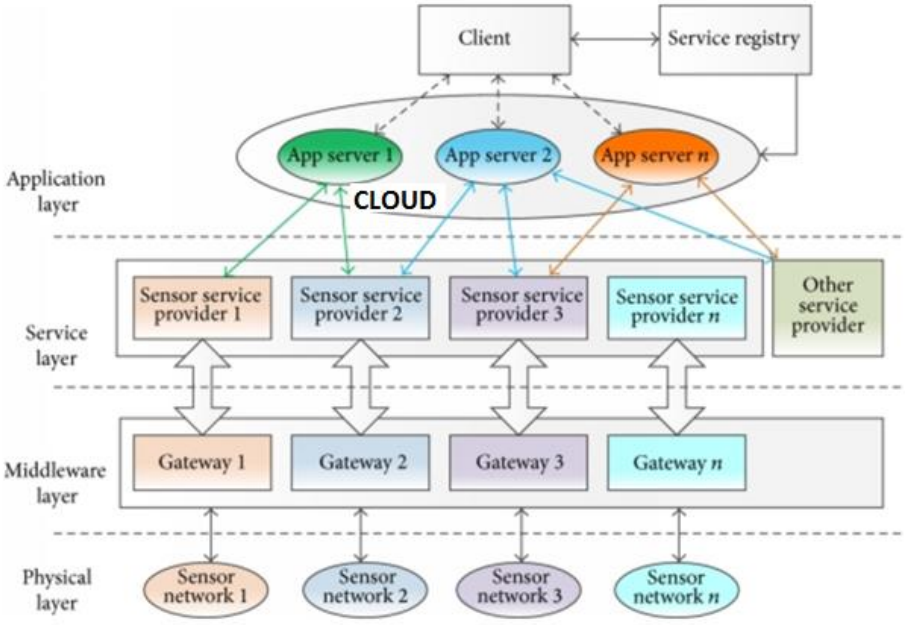

Figure 4. Architecture of sensors network with cloud structure

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High-Reliability Healthcare Systems

Case Study URL: https://goo.gl/Tkvbrb

Authors: Miroslav Kvassay

Keywords: reliability; healthcare; complex systems; uncertainty

H2020 challenge addressed by the Case Study: Health, Demographic Change and Wellbeing

Introduction to the Case Study

Reliability analysis plays a key role in development of high-reliability healthcare systems. The first works dealing with the analysis of such systems were published in 1960s and 1970s. These works assumed that only **medical equipment and devices are important** from reliability point of view. This further implied that reliability of healthcare systems could be increased just by increasing reliability of medical devices.

Nowadays, medical devices are perfectly functioning systems with minimum faults, but **healthcare systems are not high-reliable** and, according to information presented in [1][2], a medical error [3] is one of the leading causes of death in the US. In case of the EU, it is estimated that **8-12% of patients** admitted to hospital suffer from **adverse events** whilst receiving healthcare [4]. One of the main reasons is that a healthcare system is composed not only of medical devices [5] but also of medical staff [1][6]. The staff as a part of a healthcare system can be examined using methods of **human reliability analysis**. This approach is used in the analysis of healthcare systems from 1960s but **it has not resulted in high-reliability healthcare**. A reason for this can be a fact that human errors for a healthcare system have been considered independently of medical devices. However, they are not independent problems. For example, a medical error can be caused by incorrect functioning of a medical device that can results from human medical error. In [7], a **new approach for reliability analysis of healthcare systems** has been considered: the reliability analysis has to be based on joint evaluation of all principal parts (components) of healthcare system, i.e. medical devices and medical staff.

INNOSOC students, supervised by INNOSOC lecturers, will collaborate on answering how this approach can be further developed and used in transforming healthcare systems into highly reliable systems accessible for everyone. These activities will be conducted as a part of the ERASMUS+ blended mobility and will be finalized during the INNOSOC Valencia 2017 workshop in late May 2017.

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How this Case Study is related to the selected H2020 challenge?

The Horizon 2020 challenge dealing with Health and other aspect of Wellbeing aims to improve quality of healthcare and develop better health for all. One of the possible solutions to these goals is development of approaches that result in increase of reliability of healthcare systems in such a way that they will become highly reliable systems.

One of the main benefits of high-reliability healthcare systems is **improvement of health monitoring** and **treating and managing disease**. However, the main problem behind development of such systems is their complexity. Healthcare systems are composed of many elements differing in their nature. Because of that, creation of a mathematical model that takes into account all relevant factors is not a straightforward task and requires a lot of effort and testing.

A good mathematical model allows us to investigate reliability and propose approaches that can be used to increase reliability of the healthcare system with high confidence. Results of such analysis can be very useful in development of new more reliable **models of healthcare**. Testing of these new models can **improve our understanding of the causes and mechanisms underlying health** and their realization/deployment can **deliver perfect healthcare** to everyone.

How this Case Study is related to the INNOSOC project?

In the frame of the Case Study, the approach for investigation of reliability of complex systems proposed in [7] will be tested using examples of healthcare systems from [1][5]. The approach is based on modern methods of reliability analysis, such as logical differential calculus, and data mining, such fuzzy decision trees. One of the main questions is how to extend this approach in such a way that it allows taking into account uncertainties occurring in the investigated system [8]. The testing performed in the frame of the Case Study should help to solve this problem, and the obtained results should be used in its further improvement. Successful completion of this and other issues can result in a complex **innovative** approach that allows designing high-reliability healthcare systems delivering **perfect healthcare to anyone**.

High-reliability healthcare represents one of the key aspects of wellbeing. However, “wellbeing” is a very subjective term influenced by **culture** and **environment**. Students participating in the case study will present their views on wellbeing. Their ideas and attitudes will be very useful in further development of more general approach that allows improve reliability of healthcare systems considering also **cultural** and **social background** [9].

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Healthcare systems represent complex systems composed of many non-homogeneous elements whose behaviour contains some kind of uncertainty. Typically, a healthcare system is composed of four types of components that can be identified as hardware, software, human factor and organizational element [7]. Because of that, models of healthcare systems are very complicated, and their analysis can be done only using fast algorithms running on computer. This implies that **ICT resources** play a key role in the analysis and improvement of healthcare systems.

Questions that need answers during the Case Study development

Questions that should be answered include but are not limited to the following:

- What is a system from reliability point of view? What is a complex system?
- What are impacts of medical error?
- How is a high-reliability organization defined?
- Which methods are used in human reliability analysis? What are their specifics?
- What are specifics of human reliability analysis in medicine?
- How can structure of a healthcare system be defined from reliability point of view?
- What are specifics of data from healthcare systems?
- How can the data for reliability analysis of healthcare systems be collected?
- Which methods can be used for reliability analysis of healthcare?
- How can healthcare reliability be improved?

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Knowledge and skills needed for developing the Case Study

(P: prerequisite; D: desirable, but not necessary)

- Probability theory (P)
- Basics of reliability analysis (D)
- Basics of fuzzy logic (D)
- Data mining (especially decision trees) (P)
- To have interest in Internet research (D)
- To be interested in improvement of healthcare (D)

Figures describing this Case Study

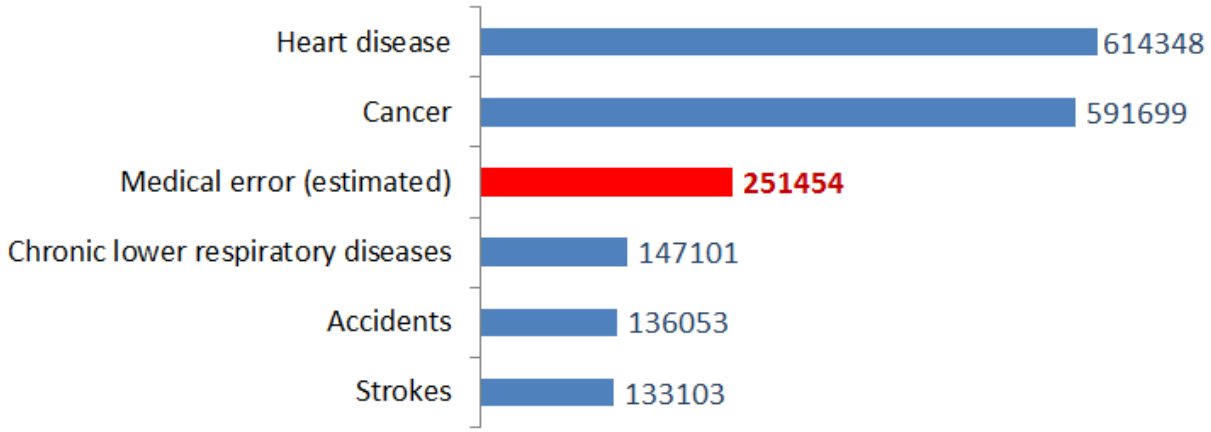

Figure 1. Medical error as the third leading cause of death (according to [3])

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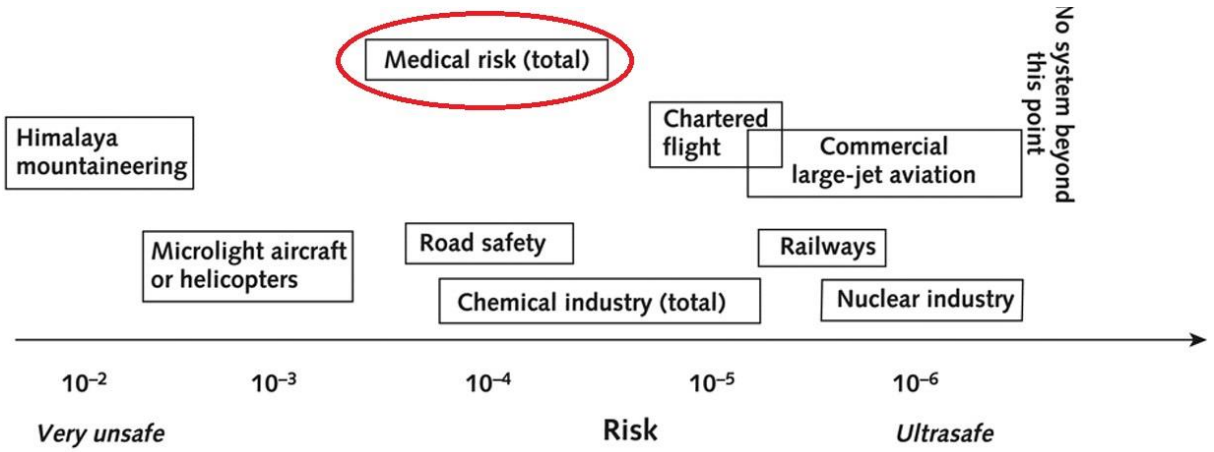

Figure 2. Medical systems as an unsafe system (according to [10])

Figure 3. Surgery as a complex system and its model for reliability analysis

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Re-Invention of the Role of Sound in Education

Case Study URL: https://goo.gl/178XAS

Authors: Carlos Hernandez Franco

Keywords: sound; education; telecommunications; radio 3.0

H2020 challenge addressed by the Case Study: Europe in a changing world - Inclusive, innovative and reflective societies

Introduction to the Case Study

Our society has changed dramatically in a very short time and the children of audio-visual culture fill the classrooms. Nowadays, the tradition of formal education continues to base their educational activities in written language, inherited from our parents, children of a printing time, relegating oral education and sound, to a third or fourth level, although this has a long-lived tradition and even more decisive in our development [1][2]. The primacy of the visual in our times has relegated the sound education to a place almost non-existent. However, we also “see through sound” [3].

The sound and speech are the main means of expression and communication for the human beings. The sound is essential for language development and is our main tool to access knowledge and to establish close relationships with the environment [4]. In fact, we take part of the three-dimensionality of space that frames our vision screen, with echoes and interference and noise that reality returns. The ear is involved in 90% of the incoming information that our brain receives, making an enormous impact on the rest of the senses and on our bodies as well [5]. This perception causes our own interpretation of the reality, in which the sonic seems to have a fundamental importance, role, function.

The Case Study proposes the realization of a "sound walk" in the Campus of Vera (UPV) that allows us to "look" the environment with the ears and to be aware of the impacts that we produce in the same [6]. For this we will use a digital recorder, a mixer, microphones, laptop and an audio editing program (Audacity) [7].

The sound content created will be broadcast using the “Spreaker” platform or another one proposed by students [8].

INNOSOC students, supervised by INNOSOC lecturers, will collaborate on providing a possible solution to this Case Study. These activities will be conducted as a part of the ERASMUS+ blended mobility and will be finalized during the INNOSOC Valencia 2017 workshop in late May 2017.

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How this Case Study is related to the selected H2020 challenge?

The way of doing things changes. The world changes. Europe changes with it. And in this constant and multi-faceted change the Technologies play a fundamental role. The hyper-connected and highly digitized societies in which we live must be inclusive, innovative and at the same time reflective of this whole process. Never before was it so difficult to guarantee this balance.

Technologies for all: inclusion. Sustainable technologies: respect for the environment.

Recording the sounds of a certain environment can make us aware of it, for example, the areas of noise or silence that define it. Then, all of this sonic material can be processed, stored and released almost instantaneously and globally through the Internet. Costs, ease of use, etc., are aspects that should characterize technologies, avoiding creating digital divides between people, groups of people, countries and regions.

How this Case Study is related to the INNOSOC project?

ICT is fundamental in all the functional aspects of our society. Likewise, ICT can put the local value in the people hands and enable the development of the human intellect and its capacities, facilitating tasks and establishing networks of collaboration between people. Students participating in this Case Study will be able to understand new forms of usability of Telecommunications. In this case, innovative ICT solutions for the societal challenges are coming from the sound and its broadcast using Internet.

Typically, students mainly address technical curricula in the Telecommunication sector. To a lesser extent, they address economic aspects. And rarely, the social aspects linked to ICT are analysed. That is, the use by diverse profiles of people, associated costs, etc. And in no case, they analyse other creative uses of these technologies and that could even be possible career opportunities in the future.

In this Case Study, students will collaboratively expand their knowledge about techniques of recording, processing, storage and distribution of sound. They should also take into account the creative aspect when using these media.

In other words, they should make a “sound walk” through the University Campus looking for those sounds that they will then use in a “radio program” that they will broadcast over the Internet, combining “communication” and “information”.

Questions that need answers during the Case Study development

Questions that need answers include but are not limited to the following:

- Which distributors of audio equipment and components do you know?
- Which are the main features and characteristics of a digital audio recorder?

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- Have you used programs for audio compression?
- What are the main features and characteristics of a mixer?
- Which programs for audio processing and sound effects do you know?
- What platforms for the distribution of sound content in streaming do you know?

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[6] Audacity, audio editing program. www.audacity.es

[7] Behringer. www.music-group.com/brand/behringer/home

[8] Creating your own Podcast. www.spreaker.com

Knowledge and skills needed for developing the Case Study

(P: prerequisite; D: desirable, but not necessary)

- To be familiar with the use of software to compress audio (P)
- To have interest in sound (D)
- To be familiar with the use of Audacity (D)
- To enjoy working in group (D)
- To be familiar with the use of platform to streaming audio content (D)

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Figures describing this Case Study

Figure 1. The "Sound walk"

Figure 2. Processing the sonic material

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Figure 3. "Streaming" the sound content using the "Spreaker" platform

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Issues and Challenges of Corporate Social Responsibility and Sustainability in the ICT Sector: New challenges for Engineers in the 21st century

Case Study URL: https://goo.gl/1udpwQ

Authors: Lutz Buechner

Keywords: corporate social responsibility; sustainability; innovation; responsibility of the ICT industry; societal responsibility; European society; extended profile of engineers

H2020 challenge addressed by the Case Study: Europe in a changing world - Inclusive, innovative and reflective societies

Introduction to the Case Study

Sustainable development *is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts [1]:*

- *the concept of* ***needs****, in particular the essential needs of the world's poor, to which overriding priority should be given; and*
- *the idea of* ***limitations*** *imposed by the state of technology and social organization on the environment's ability to meet present and future needs.*

The **ICT sector is a major driver for growth and innovation** in Europe. Around 5% of the total European GDP and 20% of productivity growth in the other sectors is related to the ICT sector. The share of ICT services is 80%, while 20% of the sector's turnover is caused by ICT manufacturing. ICT is a young, complex, growing and dynamic sector. From the perspective of **sustainable development** there is less attention paid to this industry then there is to other manufacturing industries such as automotive, energy, transport. However, research has revealed that there are major problems in the production of ICT hardware and the development of ICT software [2].

Corporate Social Responsibility (CSR) and **Sustainability** are terms which are used around the globe but nobody really knows what it is about and how we are affected by them. Climate change, biodiversity, natural resources and many other topics can be subsumed under these terms.

To explain the dimension it is necessary to understand that both **vertically** (human beings, corporations, governments) and **horizontally** (family, community, region, state, global society) it is clear that "something" has to be done.

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INNOSOC students, supervised by INNOSOC lecturers, will collaborate on finding the relationships (e.g., from the perspective of challenges, chances and risks) between ICT as such and all relevant actors impacting the sustainable development, by analysing their responsibility towards individuals as well as regional and global societies [3]. These activities will be conducted as a part of the ERASMUS+ blended mobility and will be finalized during the INNOSOC Valencia 2017 workshop in late May 2017.

How this Case Study is related to the selected H2020 challenge?

About 60 million people around the globe have actually the status of **refugees**. Europe is specially effected by the situation in the Near and Far East as well as Africa. Besides that millions of people are on their way because of economic reasons.

Not only Europe but Europe at its first faces huge challenges in **reducing inequality** and **social exclusion**. Around 80 million people are at **risk of poverty** and 14 million young people are not in education, employment or training. We have not yet overcome the economic crisis which has led to **unemployment rates** of 12% in general and 20% among the youth.

This is why Europe has not only to develop new ideas, strategies and governance structures for overcoming the **crisis in Europe**, but has to take the responsibility for other underdeveloped parts of the world as well. **Inequity** is not a European phenomenon but a global one. This is why Europe has a cross-border responsibility.

In order meet these challenges the actors of the ICT sector have to take responsibility for the natural resources, the climate, poverty, employment, education and training, living conditions and others. They have to build up a credible **social responsibility** and develop *Corporate Sustainability Management* systems.

How this Case Study is related to the INNOSOC project?

INNOSOC focuses on **innovation**. Innovation is more and more related to the idea of limitations imposed by the **state of technology** and **social organization** and neglects environment's ability to meet present and future needs. This means that ICT is a driver of innovative technical development but has to consider the principles of a **sustainable global development**. The overall aim is the elimination of inequity within Europe and worldwide, to improve living conditions by respecting that **we have "just one world"**.

This is why while studying innovative technical ideas and projects it is important to understand the general **theoretical background of innovative solutions**.

Engineers besides sales managers have to take more and more responsibility for the consequences of innovative solutions.

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Questions that need answers during the Case Study development

Questions that need answers include but are not limited to the following:

- What is the meaning and the importance of ICT in today's world?
- Why is Sustainability a key issue in the ICT sector in general?
- Which key elements of ICT play which role in the sustainability debate?
- What are the challenges and risks of innovative ICT?
- Which role plays social responsibility for the actors involved in ICT?
- Which ICT tools can help to solve social problems in Europe and globally?
- How does this soft skill approach influence the profile of the ICT engineer of the 21st century?
- Corporate Sustainable and social Responsibility of ICT companies – *Sincerity* or *Greenwashing*?

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- http://www.ericsson.com/thecompany/sustainability-corporateresponsibility
- http://www.csrwire.com/reports
- http://www.telekom.com/corporate-responsibility
- http://www.orange.com/en/content/download/23330/480379/version/3/file/Orange_2013_CSR_report.pdf
- http://ec.europa.eu/information_society/activities/sustainable_growth/index_en.htm

Knowledge and skills needed for developing the Case Study

(P: prerequisite; D: desirable, but not necessary)

- Interdisciplinary interest for economic issues (P)
- Interest for general approach to innovative ICT (P)
- Interest for development of the EU (D)

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- Interest for global correlations (D)
- Interest for their professional future as engineer in the 21st century (P)
- Being aware that the students are developing their future and are responsible for the next generations (P)

Figures describing this Case Study

Figure 1. Three pillars of sustainability – People, Planet, Profit

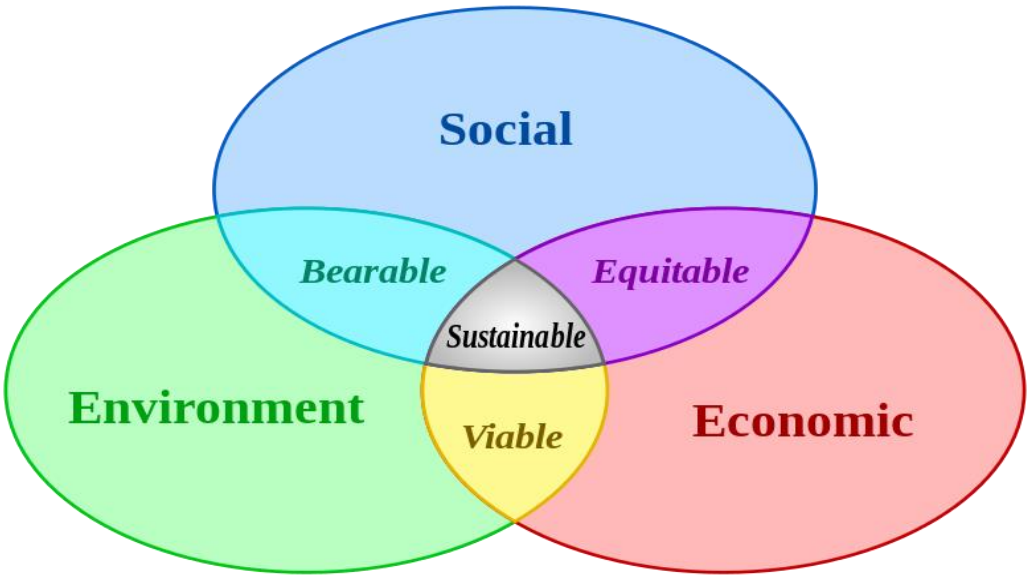

Figure 2. Sustainability from three perspectives: Social, Environmental and Economic

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Promoting STEM Studies among Young Students

Case Study URL: https://goo.gl/BLFqrp

Authors: Carmen Bachiller

Keywords: science, technology, engineering, mathematics, promotion, young students, vocation

H2020 challenge addressed by the Case Study: Europe in a changing world - Inclusive, innovative and reflective societies

Introduction to the Case Study

The study of **Science, Technology, Engineering and Mathematics (STEM)** has suffered a strong decrease during the last decade in Western Countries [1]. Causes of this decrease are very diverse, but it seems necessary to take actions to improve the perception that future students have about these studies and to introduce technology to high school classrooms.

Despite that the number of ICT jobs decreased a 10% in Europe during the period 2006-2010, it is expected that Europe will require one million of ICT professionals in a short future. Moreover, it is a fact that a good development in ICT is crucial to face economic or social crisis. Nevertheless, two main factors that contribute to maintaining, or even worsening, this situation are: (i) setup of **high school studies**; and (ii) perception pupils have regarding **technological studies** [2].

On the one hand, the balance among Arts, Humanities and Social Sciences, and Science and Technology in secondary studies and Baccalaureate is not uniform neither agreed in all European countries. In some high schools the **Science and Technology** Baccalaureate is not fully completed due to a lack of material resources (a science laboratory is far more expensive than a conventional classroom). Moreover, Technology and Computing syllabuses are sometimes optional and programs of Mathematics and Physics are less extensive than during the 90's and 2000's decades.

Additionally to this scenario, students have a negative perception of technological studies: **difficult** and **poorly paid**. Finally, but not less important, society perceives that ICT professionals are nerds and media presents them as funny strange people without glamour. This is completely obvious if we make the comparison between *The Bing Bang Theory* and *CSI* characters where both characters are supposedly scientists. It is even worse if compared with the image of other professionals as lawyers, doctors or brokers [4]. Moreover, STEM studies are **less attractive to girls** - only a 10% to a 20% of ICT students are women, and those numbers are not increasing throughout the time [5].

INNOSOC students, supervised by INNOSOC lecturers, will collaborate on answering how to reverse this situation by the promotion of STEM vocations among Secondary and High Schools students

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[3][6]. The key idea is that University students, who are closer to these young students in age and culture, develop **new strategies of promotion**. These activities will be conducted as a part of the ERASMUS+ blended mobility and will be finalized during the INNOSOC Valencia 2017 workshop in late May 2017.

How this Case Study is related to the selected H2020 challenge?

One challenge for Europe is to become an **international player** with a specific importance without losing the values that characterize our civilization [1]. These values will lead to **inclusive, innovative and reflective societies**.

In order to succeed in this field, it will be crucial that new generations, who are digital natives and users in European society, deeply dominate the technological languages as well. These technological skills will make European society independent of external factors and will allow us to develop **social policies, integration and international cooperation** which are our own. Giving young people skills in STEM disciplines will allow EU to tackle H2020 challenges, since most of them are connected with an advanced technology development. Access to STEM disciplines for the most disadvantaged groups of population should also be ensured, as a way to promote their development and integration, in that way actively working to eliminate the **digital gap** inside the EU. Finally, the **downward trend of girls** going for technological vocations should be reversed. Poor technological skills will take them to a worse professional and social development thus improving the **gender wage gap** and inequality level.

How this Case Study is related to the INNOSOC project?

"Innovation" as a core INNOSOC topic. STEM skills are tools for innovation. Anybody can have a very innovative idea than can improve people's life, but to develop and make this idea real a huge amount of knowledge and work is needed. In our time both knowledge and work will be related to STEM skills in one way or the other. The innovation perspective of this case study could be recognized in focus on the technological culture that is needed to make innovation real.

Intercultural topics, with focus on "Multicultural teams". Different STEM students from different countries will discuss situations in their countries and ideas to promote the STEM studies. It is expected that they focus on: i) *gender gap* of these studies; and ii) *access to the ICT resources* in different communities.

ICT topics, with focus on "Innovative engineering based on ICT". ICT resources are crucial to promote STEM studies: audio visual information, social networks, open access platforms, information and courses, on-line studies, multiple platforms and non-traditional teaching and learning strategies.

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Student projects, with focus on "Case studies on how ICT can contribute to innovative societal development". University students enrolled in STEM studies will raise ideas to encourage Secondary and High School students to follow the STEM-based careers. Their view is very valuable since they are closer in age and culture.

Questions that need answers during the Case Study development

Questions that need answers include but are not limited to the following:

Knowing the State of the Art.

- Which is the current situation of STEM studies in your own country? Has it improved or decreased in the last 10 years?
- How is the access to STEM studies from Secondary/High School studies in your own country?
- What is the percentage of girls addressing these studies in your own country?
- What is the perception that young students have about scientists and engineers?

Designing strategies.

- How can STEM studies be more attractive to young students and girls in particular?
- What is the most appropriate age for the promotion actions?
- Which promotion actions are more effective?
- Are ICT tools effective for promotion?

Hands on.

- What problems (economic, temporal, logistic, social, personal resources, knowledge, skills…) occur during promotion actions?
- How can benefits of actions be measured?
-

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Knowledge and skills needed for developing the Case Study

(P: prerequisite; D: desirable, but not necessary)

- To have a previous knowledge on the situation of STEM studies in the student country as well as interests and vocations of young students (P)
- To be sensitive to gender and socio-economic inequality aspects (P)
- To have a previous knowledge and skills on ICT resources (P)
- To be innovative, curious, proactive and open-minded (D)
- To be prepared to work in multi-disciplinary and multi-cultural teams (D)

Figures describing this Case Study

Figure 1. Young students in a demonstration of SoundCool http://soundcool.org, an application of electronic music developed in collaboration with the Technical University of Valencia (UPV)

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Figure 2. A class of (In)Security in wireless networks given by a Telecommunication Engineering student to High School students

Figure 3. Young student using a Tenori-on app in an electronic music demonstration

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5. INNOSOC INTERCULTURAL CURRICULA

An interactive approach which focuses on multicultural team-building through exchange of practices from different cultures and by analyzing societal challenges from local, regional and global perspectives.

INNOSOC Intercultural Curricula: Student Practical Work

Intercultural part of the INNOSOC curriculum uses **interactive approach** and focusses on **multicultural teambuilding** through the exchange of practices from different cultures and by analyzing societal challenges from local, regional and global perspectives.

During the virtual mobility phase of the INNOSOC blended mobility (i.e., two months prior to the Intensive Programme workshop) INNOSOC students are given a set of practical assignments they need to work on, either in groups or individually. Deliverables from these assignments are used by INNOSOC professors during the physical mobility phase of the INNOSOC blended mobility (i.e., during the Intensive Programme workshop) as a part of teaching materials. Some deliverables are published on the INNOSOC website (e.g., short videos with which students from each university present themselves and their university), while others are used only internally due to privacy reasons (e.g., student CVs).

More details about specific assignments, as well as links where assignment deliverables are published (if they are made publicly available) are given below.

INNOSOC 2017 Communication Skills – Activity 1

Objective: How to give a *succinct* and *convincing* presentation of an institution **in English** and **in their own language**.

Modality: One group per institution. Create a *three-minute video* (maximum), showing the strengths of their school/university. Please do not use promo/official video materials of your institution. You should make your own video instead! Convince their chosen audience (recruiters or future students). What we expect to learn from the video:

- General information
- Strengths
- What makes your university special

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Guidelines: Three links to help you – of course, you can find some others:

- Heidelberg: https://www.youtube.com/watch?v=TFiXJ9C-JsQ
- Top of the 15 best universities: https://www.youtube.com/watch?v=UReja_i7WIA
- How to make a good video: https://www.youtube.com/watch?v=0z6IlBVnUzU

Format: https://support.google.com/youtube/troubleshooter/2888402?hl=en
https://support.google.com/youtube/answer/1722171

Clip resolution: 720p or above

Max duration: 3 minutes

NOTE: You are **not allowed to use copyrighted materials** (i.e., music, audio files or videos)! If you use it in the video the following can happen:

- the video will be removed from our YouTube channel;
- our YouTube channel will be deleted;
- you, your institution and INNOSOC team members will face criminal charges.

Therefore, we kindly ask you to familiarize yourself about copyright before you make the video: https://support.google.com/youtube/topic/2778546?hl=en&ref_topic=2676339

All clips from 2016 and 2017 are / will be available through the official INNOSOC Youtube channel: https://www.youtube.com/channel/UCDT12zqcO8kf8VN87Kp1YWA.

INNOSOC 2017 Communication Skills – Activity 2

Objective: Knowing how to present the strengths and weaknesses of one's team

Modality: **One group per a Case Study team:** inter-institutional, multicultural group. Create a *document (video,* or any animation, or any other attractive form you would like), showing the strengths and the weaknesses of their INNOSOC Case Study team. Your document should include:

- Presentation of the team
- Introduction of members of the team
- Explanation how do you manage with the strengths and weaknesses of each other to solve the Case Study challenge?

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We will upload your documents on the on the INNOSOC web page so other students will be introduced to your Case Study group before you meet face-to-face in Zagreb.

NOTE: The same note regarding the use of copyright-protected materials from the first activity (i.e., where you made a video about your institution) applies to this activity as well. You are not allowed to use any copyrighted materials in your content.

All deliverables from INNOSOC 2016 students are available through the webpage of their Case Study group which is located here: https://sociallab.fer.hr/innosoc/case-studies/zagreb-2016. All deliverables from INNOSOC 2017 students will be available through the webpage of their Case Study group which is located here: https://sociallab.fer.hr/innosoc/case-studies/valencia-2017.

INNOSOC 2017 Communication Skills – Activity 3

Objective: Knowing how to write a convincing CV

Modality: Individual task. Create a CV in English.

Guidelines: Three links to help you (of course, you can find some others):

- A great website about writing a proper CV in English: http://www.kent.ac.uk/careers/cv.htm#is
- Templates: http://www.theguardian.com/careers/cv-templates
- More templates: http://www.cvtips.com/resumes-and-cvs/cv-example.html

We will share your CVs with other INNOSOC students and professors before you meet face-to-face in Zagreb.

INNOSOC student CV are used only internally and are not publicly available due to privacy issues.

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The image of the other in the INNOSOC partner countries: Multicultural workforce – challenges and stalemates

As the economy expands to become increasingly more global, society and workplaces are more **diverse** than ever before. To succeed in a **multi-cultural workplace**, it is essential that you are able to work with and adapt to the work styles and habits of people of varying ages and cultural identities. To be a successful job candidate you must be able to demonstrate a sensitivity and awareness to other people and cultures.

Globalization, mobility and desire for employees to have an international career brought to the attention of companies from Europe the topic called management of cultural differences. Organizations can be heterogeneous (multicultural) on multiple lines: **gender**, **race**, **ethnicity**, **religion**.

Diversity has its benefits: creativity, innovation, better marketing abroad and for ethnic minorities, better decisions. But diversity has also costs: interpersonal conflict, communication difficulties and team collaboration.

Issues of multiculturalism start from the natural behavior of people to seek, to search for those who are similar to them and to feel threatened or uncomfortable in the presence of other ways of thinking and behavior. In their defense, these employees revive all the negative **stereotypes** about other employees to diminish their status.

To make a multicultural environment successful, it needs first of all to make the people, the individuals to be multicultural: to communicate in foreign languages, to be **tolerant** and to learn as much as they can from other cultures. Especially is important to learn about aspects of non-verbal communication, authority, social organization, negotiation, time perception, modes of interaction.

The second ingredient is that the organization, company must move from passive phase of recognizing diversity to an active management of cultural differences, what will provide **equal opportunities** to all.

Thirdly, a strong organizational culture based on mutual **respect**, common code with strict behavior and communication rules and their constant involvement in supporting the management can eliminate many of the possibilities of conflict based on cultural differences.

Think through your personal, professional, and academic history for examples of when you demonstrated these essential skills.

Please always remember that diversity and multiculturalism is not just in reference to a person's race or religion, it includes traditions, thoughts, and perspectives as well.

It is very important to show/communicate through your behavior, your way of thinking, even your resume to future hiring managers that you demonstrate a respect and appreciation for differing views and a sensitivity to those who may be different than you.

During the course we will try to explain in a more detailed way, what multiculturalism is, how we can handle it and how we can use it for our benefit.

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Please prepare 2 preparatory essays:

1. *A maximum 2 page long essay about "the image of the other" in your home country (motherland).* Please try to make an essay, where "the other" in your home country is coming from a country from the INNOSOC partnership. If you cannot find a minority form the INNOSOC partnership, please focus on a minority which is the most problematic in your home country.
2. *A maximum 2 pages long essay about the "image of the native" from the minority point of view.* Please try to make an essay, where the minority in your home country is coming from a country from the INNOSOC partnership + if you choose a certain minority in the first essay please keep it and analyze the "natives" from this point of view.

At the end of courses and practical activities we will check again our preparatory essays and you will be asked to write in maximum 1 page what would you change or what is changed in your perception, mentality about the "image of the other" and about the usefulness of multiculturalism and multicultural studies.

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