MAESTRO

Manufacturing Education for a Sustainable fourth Industrial Revolution

Project No 2019-1-SE01-KA203-060572

Output 5

Exploitation though Synergies in Education

2019-2022

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Project Partners

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Contents

Document heading

Project title:	Manufacturing Education for a Sustainable fourth Industrial Revolution
Output number:	O5
Leading organization:	University of Ljubljana
Output title:	Exploitation though Synergies in Education
Authors:	University of Ljubljana with input from the entire consortium

Intellectual Output 5 as seen in the proposal:

Output description

This activity is targeting the exploitation of the project results within the consortium beyond the duration of the initiative. Single institutions will not have enough resources to maintain excellent learning experiences for student across the whole spectrum of technologies emerging from the fourth industrial revolution. An additional requirement comes from the inclusion of the sustainability dimension. In view of this, cooperation becomes a fundamental part of keeping an excellent education portfolio. Maestro partners will, at this time of the project, know each other's expertise very well. Thus, they will be in position to formulate cooperation requirement that mutually strengthen each institution. The expected results of this will include, but - not be limited to: joined profiles, double degrees, exchange of teaching staff, exchange of students. These activities will, on the long run, promote sharing and dissemination of excellence across the Union. They can also be the base of further cooperation beyond the HE involved in the initiative.

Division of work

UNI-LJ will lead this activity that will include all the partners in relation to their specific technical expertise.

Task 5.1 Evaluation of single partners capabilities and need. This activity will produce a matrix where all the partners will be coupled with different areas of expertise and related proposed learning outcomes. This will allow identifying the cooperation opportunities.

Task 5.2 Suggestion of suitable form of cooperation. Each opportunity identified in T5.1 will be analyzed to identify the most suitable and efficient way of cooperating. From simple online sharing of material, to exchange of teaching staff or even formulation of double degrees.

Intellectual Output 5 in the context of the Project

O1
- Mapping of the Ind 4.0 enabling technology (E)
- Impact of the technology on SDG from UN

O2
- Selection of promising E to include in engineering curricula with enphasis on SDG
- Suggestion of educational unit to develop

O3
- Additional Input C1: workshop on Constructive Alignment
- Formulation of Educational Units following CA based proposed method

O4
- Implementation of the Educational Unit
- Evaluation and improvement

O5
- Final release of Educational Unit
- Teaching and learning package for sharing the educational units as result of C2

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Intellectual Output 5 implementation and results

The first part of the project implementation was the analysis of each partners abilities regarding the selected ILOs, which are given below. We have chosen to analyze only the ones that were part of O4 and are marked with red color.

Partner	Topic	Description
KTH	AR and VR for Assembly	Explain and use suitable AR and VR implementations for assembly on a lean shop floor.
PRZ	Decision Support System	The student shall be able to apply time series analysis techniques to examine the relationship between time series and to search for patterns relevant to support decision-making in the analysed area and interpret the achieved results.
	Lean Manufacturing	Develop a value stream map taking into account economic, social and environmental aspects.
		Analyse a current state value stream map taking into account economic, social and environmental aspects
		Create a future state of the value stream map taking into account IoT solutions.
	Risk Management	Develop model of disease spread using System Dynamics method.
		Analyses the simulation results concerning impact of ICT solutions on disease spread and project risk.
Polito	Life-Cycle Assessment	Compare the environmental performance of different manufacturing approaches by modelling their sustainability through Life-Cycle Assessment and other state-of-the-art methodologies.
UNILJ	Cloud Robotic	Compare various types of communication protocols between robots and a cloud in the context of M2M interaction and select a suitable solution for a given case study scenario.
	UN SDG	Describe the activities relevant to reaching UN SDGs from the perspective of mechanical engineering.
LBORO	Autonomous Robot	The student shall be able to describe perception methods and deliberation techniques of robotic

Partner	Topic	Description
		autonomy and select the suitable method/technique for different application environments.
		The student shall be able to program and develop a successful control logic of an autonomous robot.
UNIPI	AM in medical implants	The student should be able to compare and select among classical polymers, metals and ceramics as well as innovative biodegradable materials in the context of additive manufactured medical prosthesis by minimizing the environmental impact
		The student should be able to design and optimize the environmental impact of AM processes for single medical devices production
	Digital Learning	The student should be able to evaluate the economical and environmental impact of new digital technologies in the current operations of a real Manufacturer case study.
	Cobots	The student should be able to design a shared space between man and robot, considering ergonomic and safety issues focusing on the automation of repetitive or dangerous manufacturing processes.

In order to make the analysis, a list of requirements (general and educational unit specific) was first formed. The result is given below.

1. General:
    a. Lab: physical space and special equipment where the activity is carried out
    b. Personnel: with competences in the specific topic
    c. Material: consumable, equipment, software and data
    d. Resources: financial to implement the activity
    e. Other. Industrial partners to get data, get equipment or implement case study
2. Specific for each implemented unit (on the diagonal of the matrix: phrase it better)
    a. KTH: AR/VR in Lean Assembly:
        i. Lab: Assembly line with multiple station and task. Adaptable to different level of lean implementation. AR/VR equipment
        ii. Personnel: competence in Lean and in AR/VR
        iii. Material: AR/VR software,
        iv. Resources. Financial interest in supporting the activity
        v. Other. Industrial case study or visit (optional)

b. PRZ:
    i. Decision support systems
        1. Lab: computer lab
        2. Personnel: machine learning
        3. Material: open source or commercial software and data
        4. Resources. Financial interest in supporting the activity
        5. Other. Optional company cooperation getting data
    ii. Lean Manufacturing
        1. Lab: no required (white)
        2. Personnel: VSM and sustainability aspects, IoT solutions
        3. Material: Data about manufacturing processes
        4. Resources. Financial interest in supporting the activity
        5. Other. Case studies from companies, company visits
c. POLITO: Life Cycle-Analysis
    i. Lab: not required
    ii. Personnel: LCA
    iii. Material: Software for LCA (see table) and data
    iv. Resources. Financial interest in supporting the activity
    v. Other. Industrial case studies
d. UNIPI: Additive Manufacturing in medical devices
    i. Lab: no required
    ii. Personnel: AM and design of medical devices
    iii. Material: CAD software, AM software and (opt) AM machine
    iv. Resources. Financial interest in supporting the activity
    v. Other. Literature case studies, CAFRE.

An Excel table was prepared, where each partner's resources regarding the execution of a certain ILO were assessed. The partners marked their resource availability as specified below.

L – laboratories	e.g. lab facilities, special purpose classrooms
P – personnel	e.g. professors, teaching assistants, skilled lab technicians, alumni from industy
M – material	e.g. robots, special purpose software
R – resources	e.g. financial
O – Other	e.g. industrial partners, company visits

	fully available
	partially available
	not available

The fields that were marked by orange colour should also have a comment regarding what is available/missing.

The resulting table which is the result of T5.1 is added as a separate file.

The task T5.2 was again executed in the form of a table. The forms of cooperation were first divided between existing and planned. Then various forms of existing and planned cooperation were entered. The resulting table, which is the result of T5.2 is added as a separate file.