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Taxonomy of existing courses

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Executive summary

This deliverable is the first work packages in NePRev project. we have already spoken in the previous part D1.1 about available curricula and courses in the field of Next Production Revolution in both Tunisian(ENIT, ENIGA, ISGI and FSJEG) and European Universities (POLIMI, POLITO), but now we will continue in this report the work on existing taxonomy of existing courses according to project partners (ENIT, ENIGA, ISGI, FSJEG POLIMI and POLITO).

Introduction

This report presents the list of available teaching material and methods of each course and it classifies them according to the three focal areas of the master in NPR.These focal areas are:

1. Industry 4.0
2. Energy and environment management
3. Design management innovation and entrepreneurship

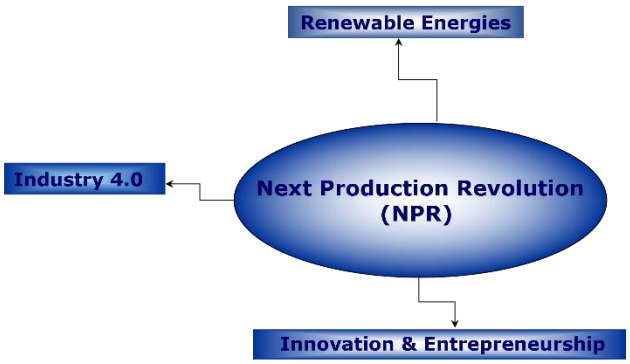

Figure 1. Focal areas of the master in NPR.

List of available teaching material and methods of each course

Teaching is an art includes knowledge and presentation. Teaching demands a desire for learning and techniques of classroom management. Many teachers believe that a low-tech approach better enables them to tailor the educational experience to different types of learners. But Technology plays an ever-greater role in many of

today's classrooms. In the high-tech approach to learning, teachers utilize many different types of technology to aid students in their classroom learning.
Learning resources might include any of the following:

- Textbooks
- Software
- Videos
- Recordings

The different experiences for teaching methods will be considered andcollected in three areas:
First we find:
•Conventional education:
Students can set up face-to-face meetings with their professors to discuss the class, their performance, or a project.
It emphasises:

- Direct instruction and lectures.
- seminar and workshop
- Students learn through listening and observation.

Also as a teaching method we find:
•Participatory learning:
Is a student-centered approach to teaching and learning? It encourages learning in small groups, with concrete information, open questioning and peer teaching. It includes exhibition, assignment, e-collaboration, project work, business case, etc….
The third method is:
•Learning by doing
Learning by doing is an action-based training method. It allows the learner to be an actor in his own learning and to develop skills in real conditions. Indeed, the action has a positive impact on our ability to memorize.
It includes assignment, joint projects/making, technical assistance, tutoring on the job

Taxonomy of existing courses

Table 1 classifies existing courses in some Tunisian and European universities according to the three focal areas of the Master in NPR: « Industry 4.0 », « Renewable Energy », and « Management of innovation & entrepreneurship».

Table 1. Building taxonomy of existing courses in Tunisian and European universities.

Industry 4.0	Renewable Energy	Management of Innovation & Entrepreneurship
- Applications for Product	- Artificial Intelligence and	- Branding and

Transformation (POLITO) - Advanced Production Systems (POLIMI) - Automatisation et Robotisation de la production (ISGI) - Additive Manufacturing (POLIMI) - Artificial Intelligence (ISGI, ENIT, FSJEG) - Automatisme& IoT (ENIT) - Big Data (ISGI) - Complex networks and systems (POLITO) - Computer Aided Design (ENIGA, ISGI, ENIT) - Computer Aided Manufacturing (ENIT) - Digital Transformation (POLITO) - Design technology (ENIGA) - Digital and Connected World (POLITO) - Deep learning (ENIT) - Enabling Technologies (POLITO) - Engineering tools for industry 4.0 (POLITO) - Induction (POLITO) - International Distribution (POLIMI) - Industry 4.0 Enabling Technologies (POLITO) - Industrial Automation, Communication and Data Management (POLIMI) - Initiation à la CAO VLSI(ENIT) - Industrial Technologies (POLIMI) - Industrial Informarics	Advanced Simulation For the Safety, Reliability and Maintenance of Energy Systems (POLIMI) - Energy economics and markets (POLIMI) - Energy Management Lab (POLIMI) - Energy law (POLIMI) - Electric Conversion of Renewables Energy Sources (POLIMI) - Energy Management (POLITO) - Energy economics (POLIMI) - Energy Saving and Renewables Energy in Building (POLIMI) - Fundamentals of Energy Systems and Technologies (POLIMI) - Financial Risk Management (POLIMI) - Fuels From Fossil and Renewables Sources (POLIMI) - Industrial Eco-Efficiency (POLIMI) - Industrial Project Management B (POLIMI) - Introduction to Renewable Energy (ENIT) - Introduction to Big Data(ENIT) - Management of Energy and Sustainability (POLIMI) - Matematical methods for energy system analysis (POLIMI)	Communication (POLIMI) - Business Intelligence (ISGI,FSJEG) - Blockchain Management (ISGI, FSJEG) - Design Strategy and Economics of Innovation (POLIMI) - Digital Business Innovation (POLIMI) - Digital Marketing (ISGI,FSJEG) - Design Management Lab (POLIMI) - Enterpreneurship Economics and Policy (POLIMI) - E-Logistics (ISGI) - Entrepreneurship and innovation (POLITO, FSJEG) - Economics of Network Industries (POLIMI) - Finance participative (FSJEG) - Lean Management (ISGI, ENIT) - Leadership and Innovation (POLIMI) - Management of Design and Innovation Projects (POLIMI) - Marketing of innovation (FSJEG) - Product Lifecycle Management (POLIMI) - Software Project Management (ISGI) - Supply Chain Management (ISGI, FSJEG) - Social responsibility and business ethics (FSJEG)

(ENIGA) - IoT (ISGI, ENIT,FSJEG) - Introduction to Big Data(ENIT) - Leadership and Innovation (POLIMI) - Logistics Management (POLIMI) - Manufacturing systems engineering (POLIMI) - Management of Design and Innovation Projects (POLIMI) - Machining on CNC machines (ENIGA) - Machine learning (ENIT) - Operations Management (POLIMI) - Programming Language (ENIGA) - Quality Data Analysis (POLIMI) - Re-manufacturing (POLIMI) - Robotics (ISGI,ENIT) - Safety Engineering and Management (POLIMI) - Strategy & Marketing (POLIMI) - Smart Manufacturing Lab (POLIMI) - Smart electricity systems (POLITO) - Technologies for IoT (POLITO)	- Methods for the analysis of innovative energy systems (POLIMI) - Methods for energy and environmental planning (POLIMI) - Operations Risk Management and Resilience (POLIMI) - Programming Language (ENIGA) - Power Production from Renewable Energy (POLIMI) - PV technologies: design and modelling (POLIMI) - Renewable Energy (ENIGA, ISGI, ENIT) - Renewables Energy and Low-Carbon Technologies (POLIMI) - Renewable energy technology (POLITO) - Renewable sources and distributed power generation (POLITO) - Renewable Energy Engineering (POLITO) - Social Innovation (POLIMI) - Smart Grid and Regulation or Renewables Energy Sources (POLIMI) - Smart and flexible energy management (POLITO)	

Most of the existing courses in universities of Tunisian an Italian partner are in the area of « Industry 4.0 ». However, there are a few existing courses in the area of « Management of innovation & entrepreneurship».
This work is carried out according to the databases already provided by the partner universities.

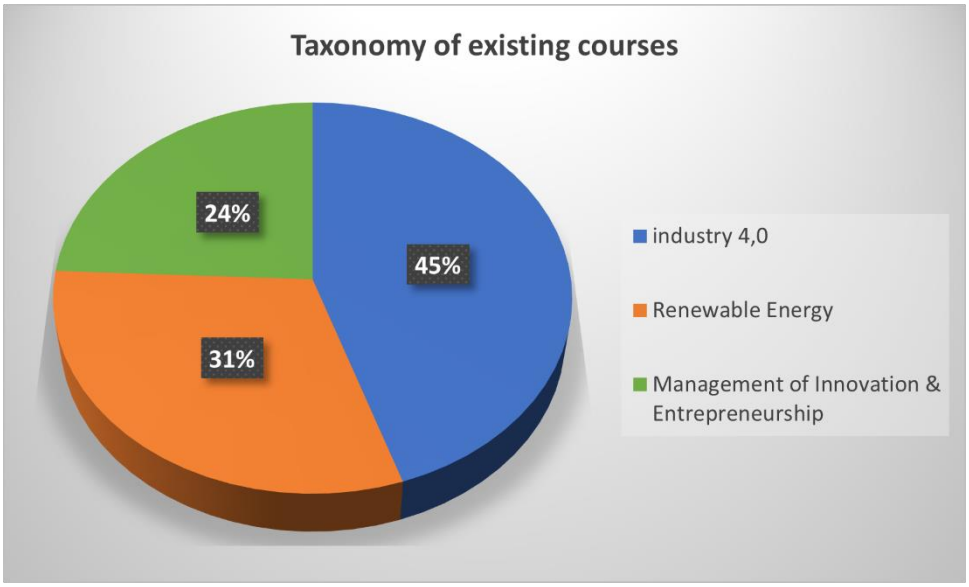

Figure 2. Taxonomy of existing courses in universities from Tunisian and Italian partner.

Figure 3 summarizes in a simple and clear manner the percentage of subjects belonging to the three focal areas in each university of the Tunisian and Italian partners.

We start with the Tunisian partner:

In fact we find that for ENIGA especially for the electromechanical department (it is the most adequate department in terms of courses for the NPR most of the existing courses are part of the first focal area which is : industry 4. 0 And come after that the focal area of renewable energy. The Design management innovation and entrepreneurship is almost non-existent in the training of engineers.

For ISGI, the focal areas of: industry 4. 0 and the Design management innovation and entrepreneurship have very close and important percentage compared to the focal areas of renewable energy which has only less than 10%.

ENIT presents in its training program the three focal areas with different percentages but we see that the focal areas of: industry 4. 0 has the highest percentage.

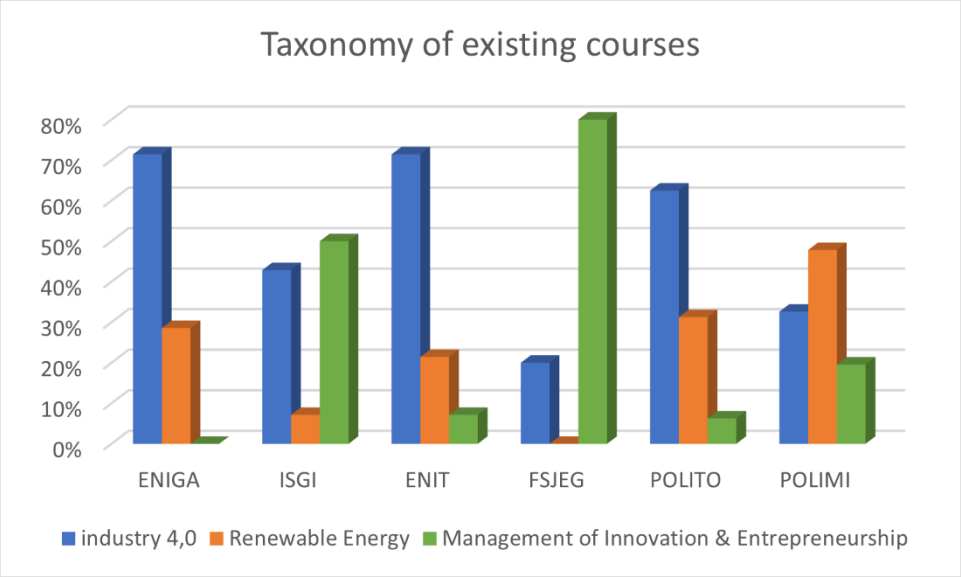

Figure 3. Taxonomy of existing courses according to data that are presented in Table 1.

Most of the FSJEG training programs are focused on the third focal area: the Design management innovation and entrepreneurship.

For the Italian partner presented by the two universities POLIMI and POLITO:

Are not very far from each other almost they present the three focal areas with close percentage.

But the clearest thing is that industry 4. 0 andrenewable energy occupies a very important place in the training

These results are following the collection of information and study plans from the various partners

Most of the existing courses are in the area of « Industry 4.0 ». However, there are a few existing courses in the area of « Management of innovation & entrepreneurship». We can conclude that students should have an in-depth knowledge in Industry 4.0 and Renewable energy. We must deepen their skills in Innovation & Entrepreneurship also.
A Review of available teaching material and teaching methods is presented in Table 2:

Table 2. List of teaching materials and teaching methods.

Teaching materials	Teaching methods
Teaching material provided by the teacher: Print: Textbooks, pamphlets, handouts, study guides, manuals Audio: Cassettes, microphone Visual: Charts, real objects, photographs, transparencies Audiovisual: Slides, tapes, films, filmstrips, television, video, multimedia Electronic Interactive: Computers, graphing calculators, tablets	- Traditional: theoretical lessons, practices in class - Participative: presentation and discussion of examples of strategies implementation in real cases - Learning by doing: Group work with case studies, projects, practices in labs

Teaching methods will be assessed at the level of partner universities (ENIT, ENIGA, ISGI, FSJEG POLIMI and POLITO).Lecture notes, the available books, the practice materials and educational-labs will be considered for Teaching methods as well and the different experiences that are collected and analyzed.

Figure 4 presented the Teaching methods at some of the Tunisian and Italian university partnership that provided information about the different method used.

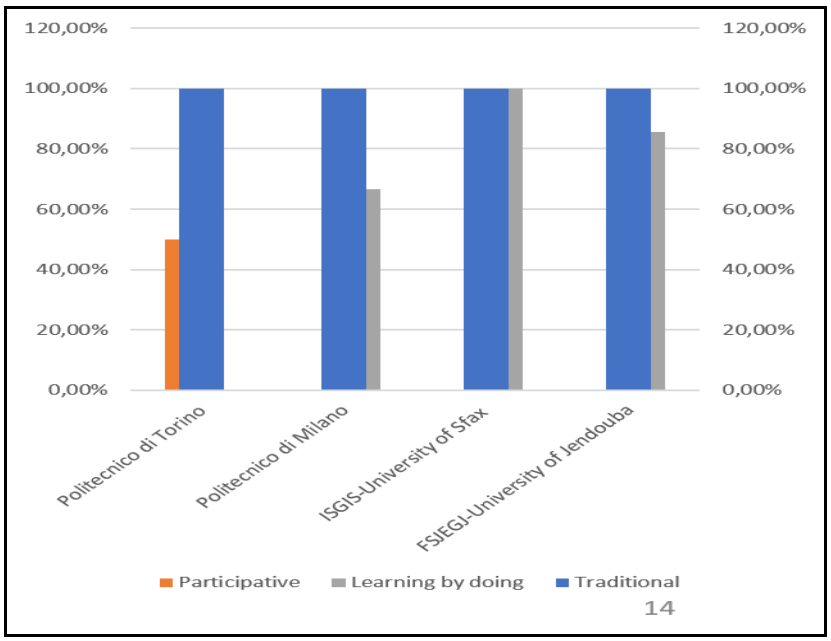

Figure 4. Teaching methods at the university partnership.

As observed in Figure 4, most classroom teachers were themselves taught in the old industrial model of teaching. That's why, we need to:

- establish strategies to lead a university transformation and engage teachers in innovative practices.

- equip teachers with the skills and knowledge to prepare and implement modern teaching practices in classrooms.
- utilizes virtual class rooms in the learning.
- Teaching with the Internet of Things (IoT):
    - With the IoT, students are able to attend any class, at any time, from any device, providing them with greater flexibility to receive content and knowledge whenever and wherever they wish.
    - The IoT offers better learning experiences for students allowing them to connect with experts from around the world and create robust, hybrid learning environments.
    - Students can enrich their coursework with relevant video, activities, assessments, and conversations with students and faculty members from all around the world.

Conclusion

In this deliverable, we presented in a first time, a List of available teaching material and methods of each course . The different experiences for teaching methods will be considered and collected in three areas:Conventional education, the Participatory learning and Learning by doing.
In a second time, we presented a taxonomy of existing of courses basing on focal areas and teaching methods.