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List of existing curricula and courses

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Executive summary

This deliverable is the first work packages in NePRev project. It investigates available curricula and courses in the field of Next Production Revolution in both Tunisian (ENIT, ENIGA, ISGI and FSJEG) and European Universities (POLIMI and POLITO).

The investigation has been done by identification different courses related to NPR. So, taxonomy of existing courses has been created according to project partners (ENIT, ENIGA, ISGI, FSJEG, POLIMI and PLITO).

Introduction

This report presents an evaluation of existing programs and courses in the field of the Next Production Revolution that encompasses three areas of intervention which are: industry 4.0, renewable energies and management of innovation and entrepreneurship, this evaluation is made in Tunisian (ENIT, ENIGA, ISGI and FSJEG) and European universities (POLIMI and PLITO). The deliverable also includes the list of available courses.

It should be noted that this study work is done according to the databases provided by the project partners.

Identification of existing curricula

The proposal of the NePRev project is to design and develop a master program dedicated to the NPR and open to Tunisian and European participants. In this context, the deliverable starts in the first part with an investigation of existing curricula and courses in Tunisian and European Universities related with NPR.

As the first partner of Tunisia, we find the National Engineering School of Gafsa (ENIGA), as it is shown in the first figure 1, we find four main sectors:

1. Electromechanical engineering
2. Energy engineering and environmental technology
3. Industrial chemical engineering
4. Mining engineering

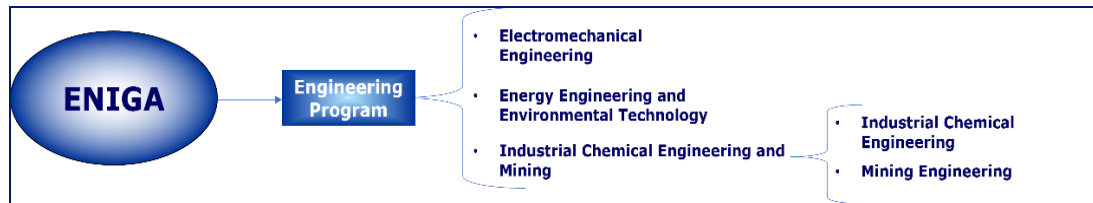Each specialty has a well-defined study plan.

Figure 1. Identification of existing curricula (specialty and study plan)in ENIGA.

Figure 2 identifies, according to the specialty, a set of subject matter related to NPR. The various specialties in general all contain subjects related to NPR which are in relation with: industry 4.0, renewable energies and management of innovation and entrepreneurship, but the department most concerned is that of electromechanical engineering, in this department we find that most of the subjects are classified in the axis of NPR, but this does not prevent to make some modifications in the plan of studies in order to improve the training and to make the students more ready for the master.
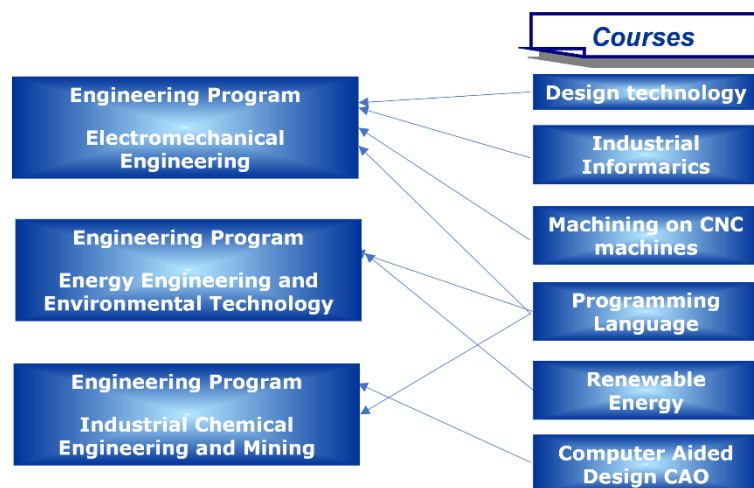

Figure 2. Identification of existing courses in ENIGA related to NPR.

We find as second partner of Tunisia: the Higher Institute of Industrial Management of Sfax (ISGIS). Studies at ISGIS revolve around three essential components, namely, economics and management, information and communication technologies and innovation management.

ISGI has organized scientific events on the following themes:

o   Innovation management and business: Concepts and practical implications.
o   Transport and industrial logistics: Key factors in the competitiveness of the Tun Company.

ISGIS presents different national licenses as it is already explained in figure 3 also we found Research Master in:

1. Transport and Logistics Science
2. industrial engineering

ISGI presents also three Professional Masters:

1. Professional Master in Integrated Management Quality-Safety-Environment
2. Professional Master Management and maintenance of industrial system
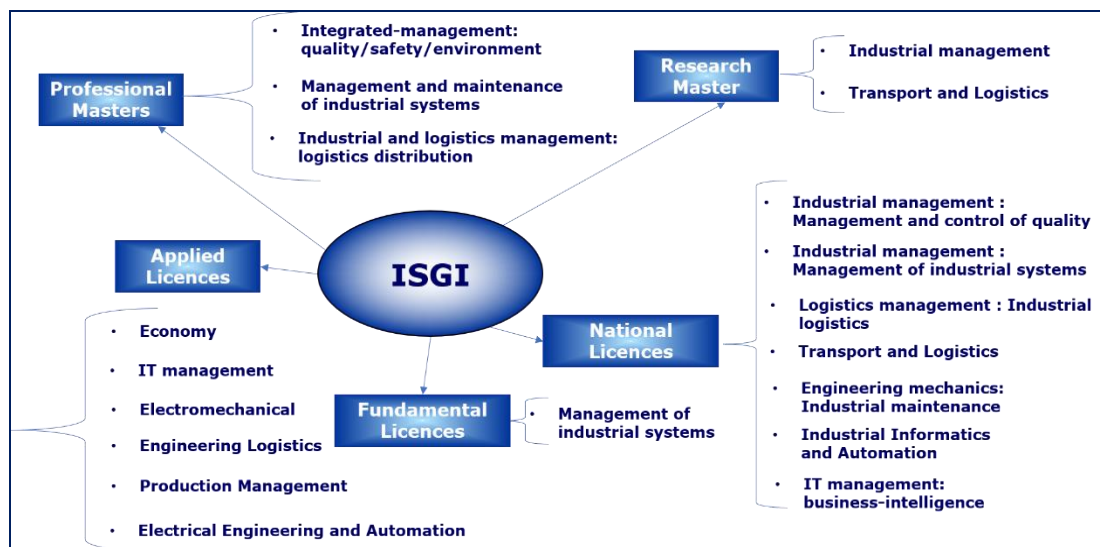3. Professional Master in industrialand logistics Management Logistics Distribution

Figure 3. Identification of existing curricula in ISGI.

From figure 4 we can see that some of the subjects and courses taught at ISGI have a relation with NPR.

Through the study plans of the different specialties that exist in ISGI we have been able to identify at least 12 subjects which scans the 3 axes of NPR, but we find that each specialties touches one or two subjects in relation with NPR, so we don't find a well-defined specialties which includes existing courses in ISGI related to NPR in such a way that we can say that such a specialties is really related with NPR.

We note that the NPR existing courses in ISGI are dispersed in the specialties which make the mission to have an NPR master in one of the existing specialties a little difficult.

In this case it may be possible to create or revise the study plans to be suitable for the NPR master.
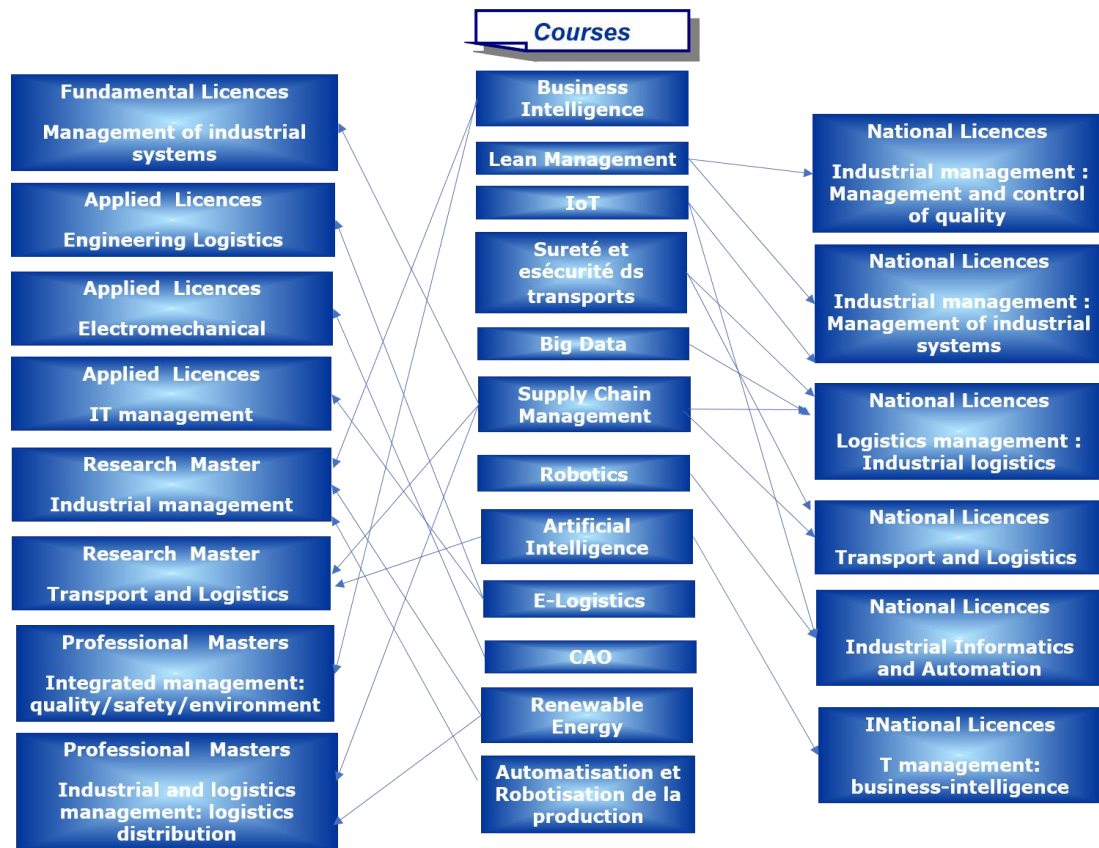
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Figure 4. Identification of existing courses in ISGI related to NPR.

Tunisia's third partner is ENIT the National Engineering School of Tunis.

Engineering training at ENIT is provided in nine specialties: 1 Civil Engineering, 2 Hydraulic and Environmental Engineering, 3 Electrical Engineering, 4 Industrial Engineering, 5 Mechanical Engineering, 6 Computer Science, 7 Telecommunications. 8 Advanced Techniques, 9 Modeling for Industry and Services for each specialty we have subjects to teach and which are part of the NPR we can notice this from figure 5

The National Research Master Diploma at ENIT is obtained for 10 specialties

Research Master in:

1. Automatic
2. Civil engineering
3. IT: Systems, Networks and Services
4. Information System Techniques
5. Modeling in Hydraulics and Environment
6. Mathematical Modeling and Scientific Computing
7. Communication Systems
8. Electrical Power Systems
9. Systems, Signals and Data

10. Information Processing and Life Complexity

There are also two professional masters:

1. Master Program Innovation Management (DICAMP) Accredited by the internationally renowned agency ASIIN
2. International Master Program on Renewable Energy Systems for Africa: TEchnology And Management (IMPRESA-TEAM)
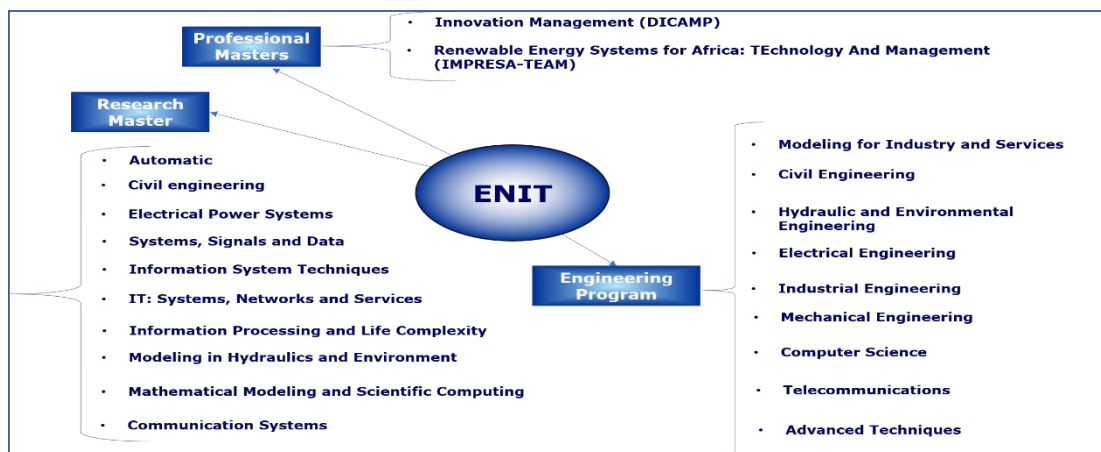

Figure 5. Identification of existing curricula in ENIT.

By studying the study plans of the various engineering and master's training specialties, we were able to identify 15 subjects related to NPR which are presented in Figure 6.

And by examining the presence of these subjects in different specialties which exist at ENIT , we can notice that two specialties are in strong relation with NPR more than the others and which are:

1. Electrical Engineering
2. Industrial Engineering

The students of these two specialties have encountered several subjects of NPR in their training which makes the preparation for the master easier.
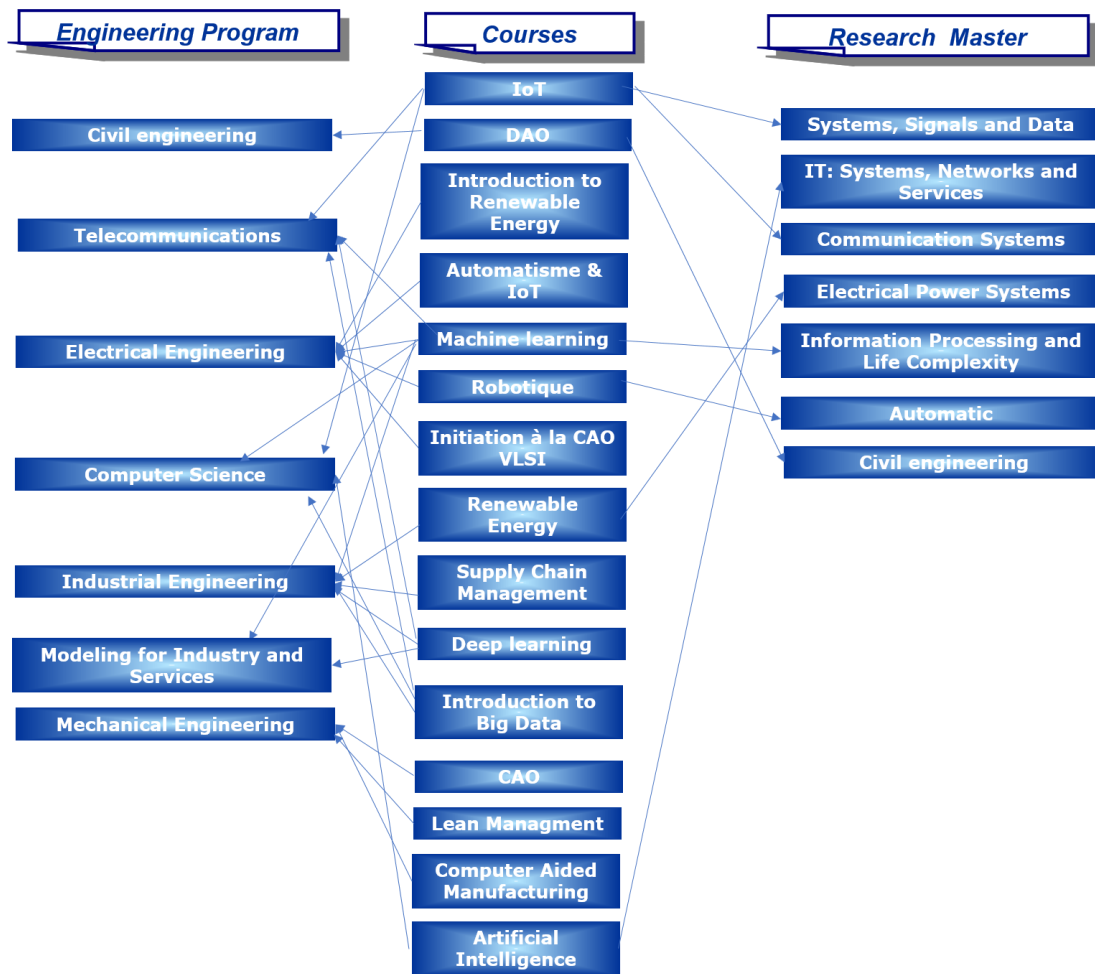
Figure 6. Identification of existing courses in ISGI related to NPR.

Tunisia's fourth partner is Faculty of Legal, Economic and Management Sciences of Jendouba FSJEG, It has as it is described in Figure 7:

1. Fundamental licence :

Basic License in Private Law (LFDPR), Basic License in Public Law (LFDPU) ,Fundamental license in Finance, Basic degree in accounting sciences, Fundamental license in Marketing ,Basic degree in Money, finance & banking, Basic degree in Economics & international finance, Basic License in Applied Computer Science in Management (LFIAG)

2. Applied license

Applied License in Corporate and Business Law (LADEA), Applied License in Accounting and Financial Techniques (LATCF) , Applied License in Management (LAGE), Applied License in Project Analysis and Economic Consulting (LAAPCE), Applied License in International Trade Techniques (LATCI), Applied License in

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Economics & Quantitative Management (LAEGQ), Applied License in Insurance Techniques (LATA)

3. RESEARCH MASTER:

Management IT research master: Knowledge data and distributed systems, Research Master in Money, Finance & Banking, Research masters in private law, Research masters in public law

Marketing research master, Management research masters, Research masters in finance, Research Master in Economic Policies for Regional Development

4. PROFESSIONAL MASTER

Professional Master in Corporate and Business Law, Professional Master in E-Commerce, Professional master's degree in accounting-control-auditing, Professional master's degree in banking and insurance.

Figure 7. Identification of existing curricula in FSJEG.

Figure. 8 shows subjects which are taught in FSJEG and which are related to the NPR.

FSJEG is in the process of updating the various subjects and which are planned in relation to NPR and in the following figure 8 we already find a 10 subjects in relation to the axis of NPR.

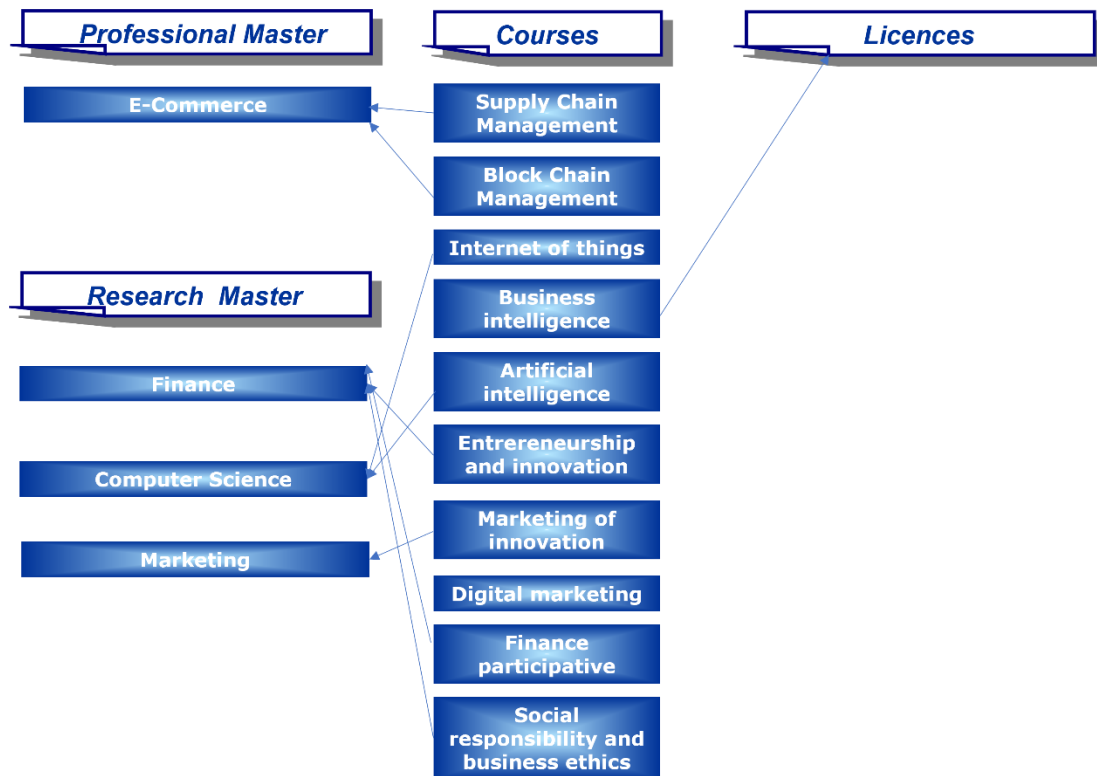The modification of its study plans is already in progress.

Figure 8. Identification of existing courses in FSJEG.

Our first partner from Italy is POLIMI: Politecnico di Milano which is a scientific-technological university which trains engineers, architects and industrial designers.

Politecnico di Milano offers study programmes at all levels (bachelor, Master of Science, specializing masters and postgraduate programmes, Ph.D.) in Architecture, Design and Engineering.

Politecnico di Milano is structured as follows:

Campuses: which are Como, Cremona, Lecco, Mantova, Milano bovisa, Milano Leonardo and Piacenza

And four Schools:
1. School of Architecture Urban Planning Construction Engineering
2. School of Design
3. School of Civil, Environmental and Land Management Engineering
4. School of Industrial and Information Engineering

The different disciplines presented by each school are already detailed in the figure 9. We can subdivide the training in two:

1. LAUREA (EQUIVALENT TO BACHELOR OF SCIENCE)
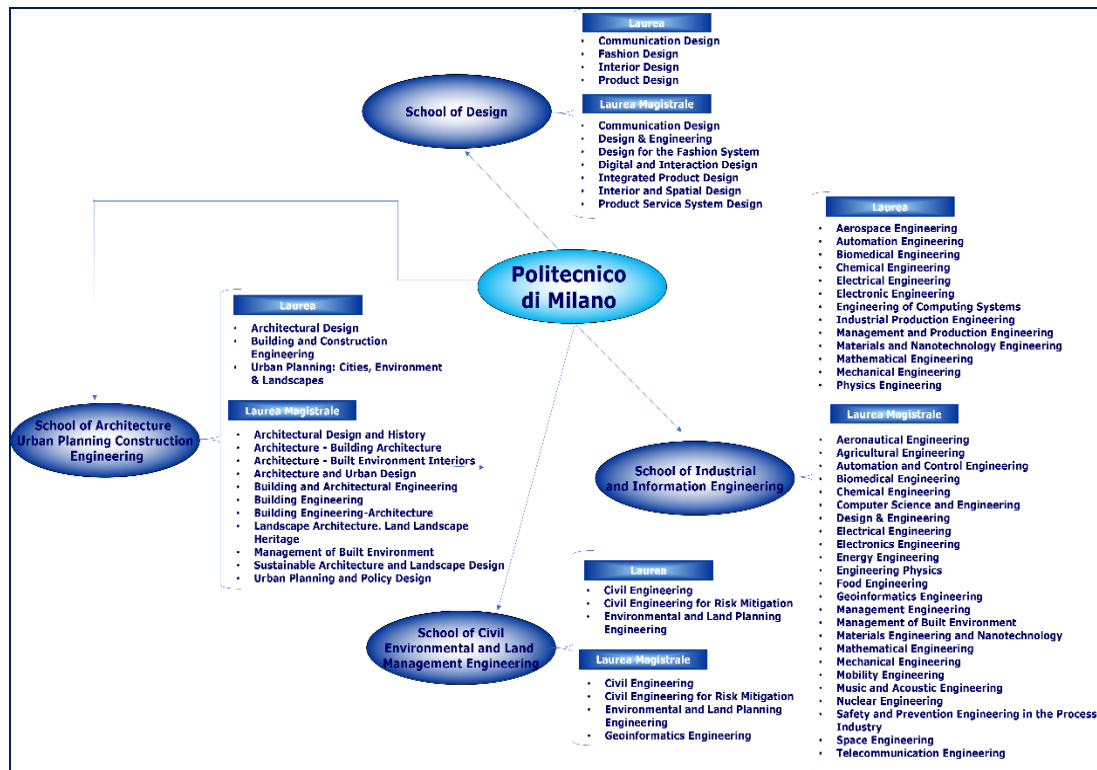2. LAUREA MAGISTRALE (EQUIVALENT TO MASTER OF SCIENCE)

Figure 9. Identification of existing curricula in Politecnico di Milano.

For the School of Industrial and Information Engineering in POLIMI we take a look at the specialty of Energy Engineering from the Laurea Magistrale as it is presented in Figure 9.
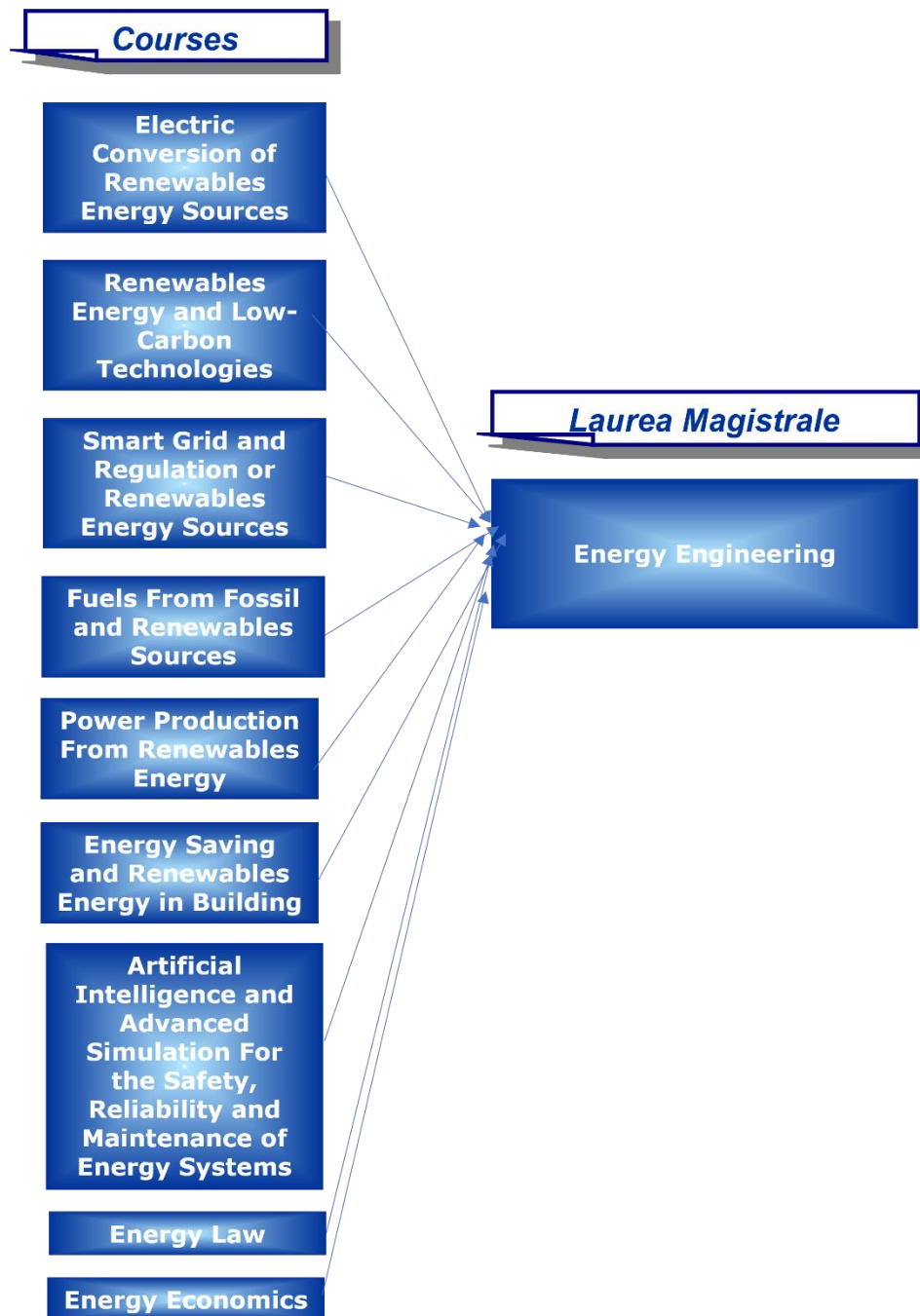
Figure 10. Identification of existing courses in Plitecnico di Milano (Energy Engineering) related to NPR.

So through the Identification of existing courses in Plitecnico di Milano for the School of Industrial and Information Engineering presented in Figure 10 we can easily note that according to the study plan of the specialty Energy Engineering (from LAUREA MAGISTRALE (EQUIVALENT TO MASTER OF SCIENCE))we can identify 9 subjects in relation to NPR and more precisely with the axis of renewable energy.

Our second partner from Italy is the Politecnico di Torino that has been one of the most prestigious public institutions at both the International and the Italian levels concerning education, research, technological transfer and services in all sectors of architecture and engineering.

It is almost the same structure as POLIMI besides POLITO also includes schools:

1. Doctoral school
2. Specializing Master and Lifelong Learning school
3. Architectural and Landascape Heritage post-graduates specialisations
4. Alta Scuola Politecnica

We can subdivide the training into:

1. BACHELOR's degree program
2. MASTER 's degree program
3. Specializing master

As schowm in Figure 11.

Figure 11. Identification of existing curricula in Plitecnico di Torino.

By examining the different study plans and by identifying the different specialties and subjects which have a relation with NPR we then find that 11 subjects related to NPR are presented in figure 12.

We can easily note that according to the study plan of the specialty Energy Engineering and electric Engineering (from LAUREA and LAUREA MAGISTRALE) that

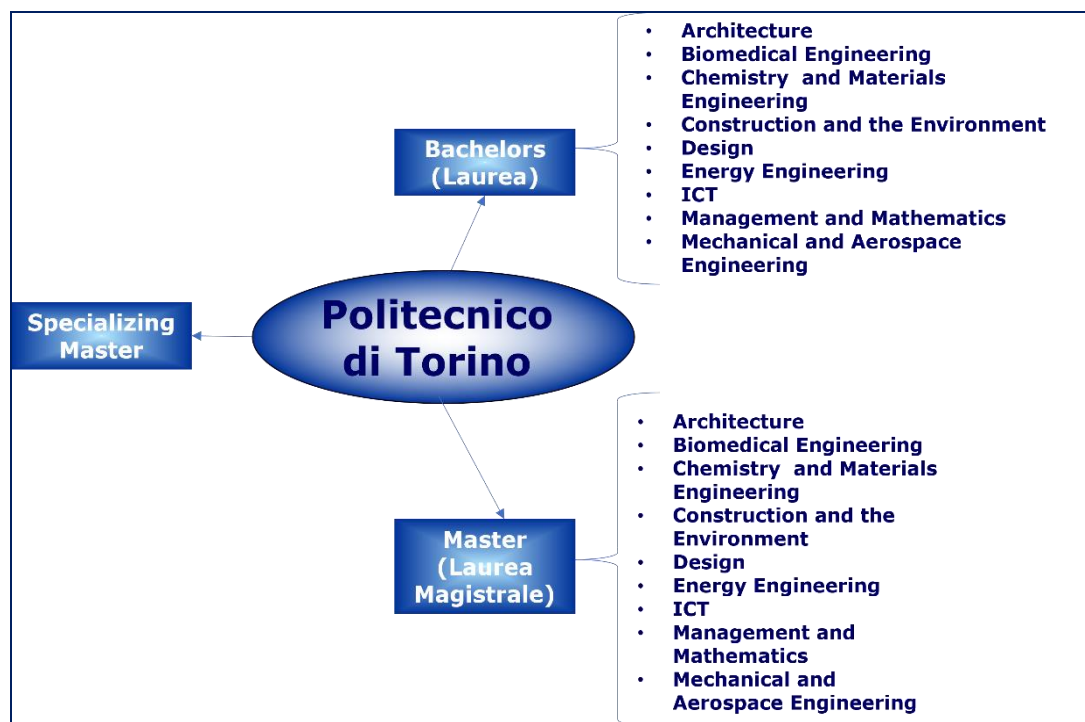That these two specialties of the POLITO are the closest and the most suitable for master NPR.

Figure 12. Identification of existing courses in Plitecnico di Torino (Energy Engineering) related to NPR.

Then according to the studies made we can see that already for the Tunisian partner there are universities which already have the almost adequate platform to prepare for the NPR master and only require some changes at the level of the study plan and

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there are others Universities which have to reformulate and even redesign their training strategies.

for the Italian partner we have noted that the two universities already present close and adequate training for the NPR master even if in well-defined axes but we can improve especially the study plans to scan the 3 axes of NPR to guarantee a good student success for the NPR master project

List of existing courses

Table 1presents existing courses in some Tunisian and European universities according to the Master in NPR.

- Applications for Product Transformation (POLITO)
- Advanced Production Systems (POLIMI)
- Additive Manufacturing (POLIMI)
- Artificial Intelligence (ISGI, ENIT, FSJEG)
- Artificial Intelligence and Advanced Simulation For the Safety, Reliability and Maintenance of Energy Systems (POLIMI)
- Automatisation et Robotisation de la production (ISGI)
- Automatisme & IoT (ENIT)
- Branding and Communication (POLIMI)
- Blockchain management (ISGI, FSJEG))
- Big Data (ISGI)
- Business Intelligence (ISGI, FSJEG)
- Computer Aided Design (ENIGA, ISGI,ENIT)
- Computer Aided Manufacturing (ENIT)
- Complex networks and systems (POLITO)
- Design technology (ENIGA)
- Design Strategy and Economics of Innovation (POLIMI)
- Digital Transformation (POLITO)
- Digital and Connected World (POLITO)
- Digital Business Innovation (POLIMI)
- Digital Marketing (ISGI, FSJEG)
- Design Management Lab (POLIMI)
- Deep learning (ENIT)
- Economics of Network Industries (POLIMI)
- Energy economics (POLIMI)
- Energy economics and markets (POLIMI)
- Energy law (POLIMI)
- Energy Management Lab (POLIMI)

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- Energy Management (POLITO)
- Enterpreneurship Economics and Policy (POLIMI)
- Enabling Technologies (POLITO)
- E-Logistics (ISGI)
- Energy Saving and Renewables Energy in Building (POLIMI)
- Electric Conversion of Renewables Energy Sources (POLIMI)
- Engineering tools for industry 4.0 (POLITO)
- Entrepreneurship and innovation (POLITO, FSJEG)
- Fundamentals of Energy Systems and Technologies (POLIMI)
- Financial Risk Management (POLIMI)
- Fuels From Fossil and Renewables Sources (POLIMI)
- Finance participative (FSJEG)
- Induction (POLITO)
- International Distribution (POLIMI)
- Industry 4.0 Enabling Technologies (POLITO)
- Industrial Automation, Communication and Data Management (POLIMI)
- Industrial Eco-Efficiency (POLIMI)
- Industrial Project Management B (POLIMI)
- Industrial Technologies (POLIMI)
- Introduction au Big data et Cloud (ISGI)
- Introduction to Renewable Energy (ENIT)
- Industrial Informarics (ENIGA)
- Initiation à la CAO VLSI(ENIT)
- Introduction to Big Data(ENIT)
- IoT (ISGI, ENIT, FSJEG)
- Leadership and Innovation (POLIMI)
- Lean Management (ISGI, ENIT)
- Logistics Management (POLIMI)
- Management of Energy and Sustainability (POLIMI)
- Matematical methods for energy system analysis (POLIMI)
- Methods for the analysis of innovative energy systems (POLIMI)
- Management of Design and Innovation Projects (POLIMI)
- Methods for energy and environmental planning (POLIMI)
- Manufacturing systems engineering (POLIMI)
- Management of Design and Innovation Projects (POLIMI)
- Machining on CNC machines (ENIGA)
- Machine learning (ENIT)
- Marketing of innovation (FSJEG)
- Operations Risk Management and Resilience (POLIMI)
- Operations Management (POLIMI)

- Programming Language (ENIGA)
- Product Lifecycle Management (POLIMI)
- Power Production from Renewable Energy (POLIMI)
- PV technologies: design and modelling (POLIMI)
- Quality Data Analysis (POLIMI)
- Re-manufacturing (POLIMI)
- Robotics (ISGI, ENIT)
- 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)
- Software Project Management (ISGI)
- Supply Chain Management (ISGI, FSJEG)
- Sureté et sécurité des transports (ISGI)
- Social Innovation (POLIMI)
- Safety Engineering and Management (POLIMI)
- Strategy & Marketing (POLIMI)
- Smart Manufacturing Lab (POLIMI)
- Smart Grid and Regulation or Renewables Energy Sources (POLIMI)
- Smart electricity systems (POLITO)
- Smart and flexible energy management (POLITO)
- Socialresponsibility and business ethics (FSJEG)
- Technologies for IoT (POLITO)

Table 1. List of existing courses in Tunisian and European universities.

Conclusion

In this deliverable, we first presented a list of existing research and professional master's curricula and courses Linked to the NPR issued by each university.

Secondly, we presented taxonomy of the existing courses of the engineering cycle training.

We have noticed that there is a link between these programs and the NPR project but with different degrees.

Despite the lack of digital data about existing curricula and courses, the lack of multi-level support within universities (This is due to the confidential nature of some documents to certain universities) and the challenges posed by the COVID-19. Our work in WP1 investigate available curricula and courses in the field of Next Production Revolution, in both Tunisian and European Universities, which will allow

ENIT to identify gaps in key focal areas related to NPR and defining the content of the master program in WP3.

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