Intellectual Output No 2

ADVANCED MANUFACTURING CURRICULUM

vetriangle
acting together

Promotion of WBL via Vocational Education Training Triangle (VET)

VETriangle

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ADVANCED MANUFACTURING CURRICULUM

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Coordinator:

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1. INTRODUCTION

This intellectual output will focus on the description of a methodology to design and define new curriculums to cover skill gaps detected in the labor markets.

The dizzying speed at which technology is evolving at all levels is well known. The requirements needed to access to many jobs are also changing very fast. Consequently, the same speed is needed to generate new curriculums to ensure the adequate training for those jobs.

This document describes a "universal" methodology to detect competencies and skills that are not included in the current training programs and to generate new curriculas that respond to those needs. The term "universal" has been used due to the adaptability of the methodology to any specialty, country, region, productive sector and level. When designing new curriculums, the methodology developed prioritizes DUAL training.

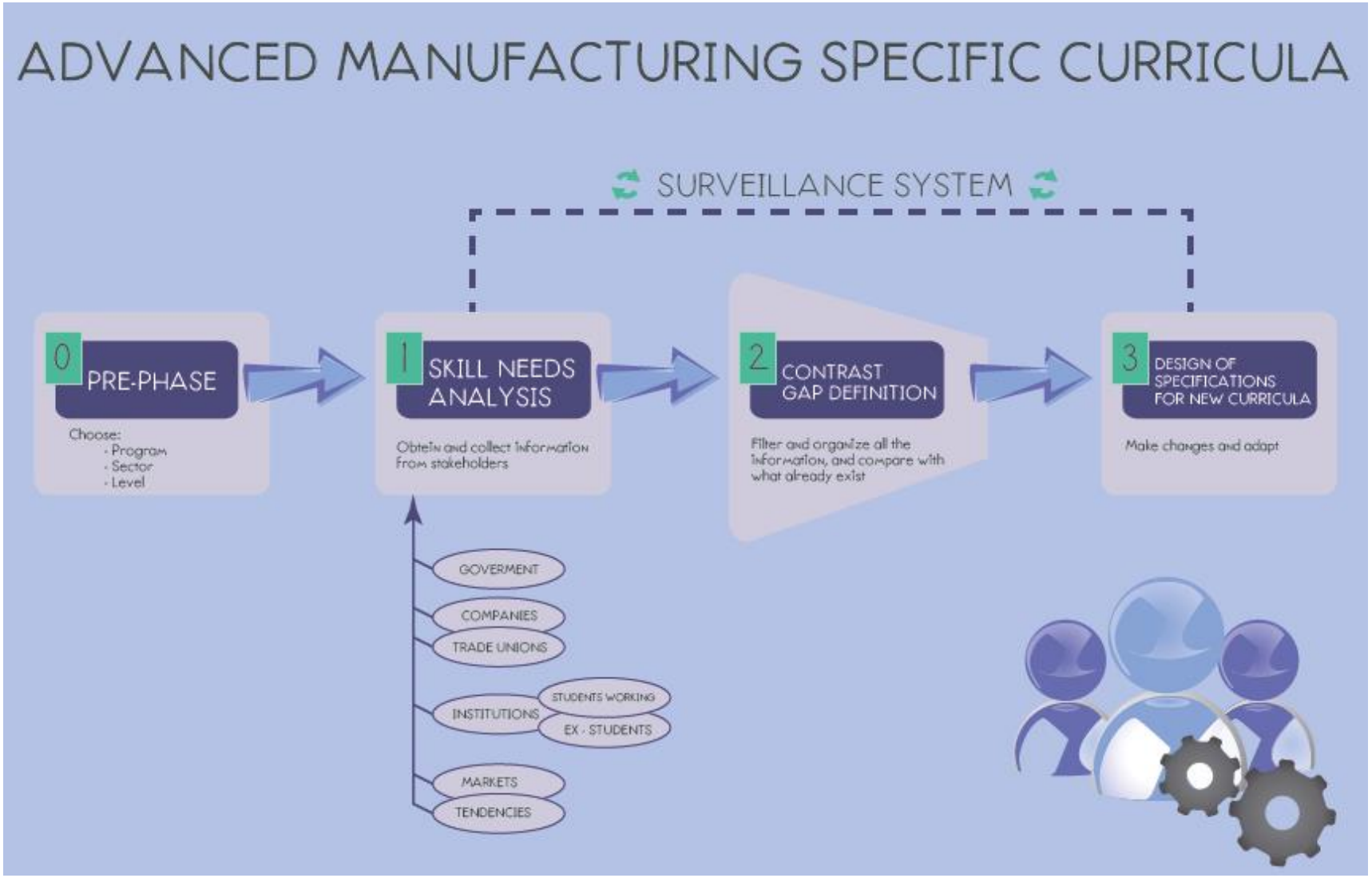
Multiple sources have been used to feed this Intellectual Output. On the one hand, the Intellectual Output 01 "Capacity Building for Developing VETriangle" where the roll of different organisms from VETRIANGLE consortium's partners countries involved in the DUAL training have been described. On the other hand, many researches and reports carried out by numerous organizations at European level describing methodologies for the detection and definition of new skills hve been referred, especially the Cedefop reports.

Finally, as an illustrative example of the designed methodology the steps followed in Miguel ALTUNA LHII (Spain) to create the curriculum "advance manufacturing" are described. In turn, the other partners have carried out an exercise in applying the method for defining different curricula in each country.

The methodology to create a specific curriculum consists of 4 phases or stages:

0) Pre-phase: Contextualization
1) Skill needs analysis
2) Contrast & Gap Definition
3) Design of Specifications for new curricula

It is important to underline that the process should be carried out over and over again, every time that new skills are demanded. In this context, the methodology must include a surveillance system in order to be updated concerning the labor market demands and needs, even to foreseen those demands. The surveillance systems will lead the organization to enter in the described loop every time that the need of new curriculums are detected.


ADVANCED MANUFACTURING SPECIFIC CURRICULA
SURVEILLANCE SYSTEM
0 PRE-PHASE
Choose:
- Program
- Sector
- Level
1 SKILL NEEDS ANALYSIS
Obtain and collect information from stakeholders
2 CONTRAST GAP DEFINITION
Filter and organize all the information, and compare with what already exist
3 DESIGN OF SPECIFICATIONS FOR NEW CURRICULA
Make changes and adapt
GOVERMENT
COMPANIES
TRADE UNIONS
INSTITUTIONS
STUDENTS WORKING
EX - STUDENTS
MARKETS
TENDENCIES

2. STAGE 0.- PRE-PHASE: Contextualization

Before starting to develop this methodology (strategy), it is very important, first, to contextualize the program or studies that we are looking for. To do this, it will be necessary to specify some crucial aspects, such as:

- PROGRAM (understood as study field or specialty)
- SECTOR
- LEVEL

For those programs where previous studies are needed in order to assure the acquisition of the competences, it will also be necessary to establish, for each case, what are the requirements to access such program, i.e. the access conditions that a person must fulfil to attend the program.

Concerning the levels, EQF levels will be used. However, being the showed example based on the Spanish education system (advanced manufacturing curriculum) the equivalence between EQF and CNCF are shown.

Table 1 equivalence between EQF and Spanish CNCF

European Qualification framework EQF	Spanish CNCF Catálogo Nacional de Cualificaciones Profesionales	Accreditation	Qualification Levels
Level 1	Level 1	Operator	Competence in a reduced group of relatively simple working activities related to normalized processes, in which the theoretical knowledge and practical capacities involved are limited.
Level 2			Competence in a group of well-determined professional activities with the capacity to use particular instruments and techniques concerning, mainly, an execution activity, which can be autonomous within the limits of the above-mentioned techniques. It requires knowledge on the technical and scientific fundamentals of the activity concerned and capacity for the comprehension and the application of the process.
Level 3	Level 2	Technician	Competence in a group of professional activities which require the command of different techniques and can be executed in an autonomous way. It involves responsibility

Level 4			on the coordination and supervision of technical and specialized work. It demands the understanding of the technical and scientific fundamentals of the activities concerned as well as the assessment of the factors in the process and the assessment of the economic repercussions. Competence in a wide group of complex professional activities performed in a great variety of contexts which require combining technical, scientific, economic or organizational variables to plan actions, or to define or develop projects, processes, products or services.
Level 5	Level 3	Advanced Technician	Competence in a wide group of professional activities of great complexity performed in different contexts, often unpredictable, which imply to plan actions or to conceive products, processes or services. Great personal autonomy. Frequent responsibility on the assignment of resources and on the analysis, diagnosis, design, planning, execution and assessment.
Level 6	Level 4	Grade	Competence in a reduced group of relatively simple working activities related to normalized processes, in which the theoretical knowledge and practical capacities involved are limited.
Level 7	Level 5	Master	Competence in a group of well-determined professional activities with the capacity to use particular instruments and techniques concerning, mainly, an execution activity, which can be autonomous within the limits of the above-mentioned techniques. It requires knowledge on the technical and scientific fundamentals of the activity concerned and capacity for the comprehension and the application of the process.
Level 8	Not defined	Doctor	Competence in a group of professional activities which require the command of different techniques and can be executed in an autonomous way. It involves responsibility on the coordination and supervision of technical and specialized work. It demands

			the understanding of the technical and scientific fundamentals of the activities concerned as well as the assessment of the factors in the process and the assessment of the economic repercussions.

2.1. Examples of contextualization from partners

In order to illustrate this pre-phase, different examples from different countries and specific curriculums are described. In the following sections, the methodology used will be illustrated using these same examples.

2.1.1. Contextualization SPAIN- BASQUE COUNTRY– MIGUEL ALTUNA LHII

- PROGRAM: Advanced Manufacturing
  - Manufacturing Processes
  - Mechatronics
  - Automatization & Robotics
- SECTOR: Industrial Sector: Automotive industry, aerospace, machine building
- LEVEL: **Level 4**
- ACCESS REQUIREMENTS: Bachelor or intermediate level training modules in mechanics/mechatronics **(level 3)** In Spain: Ciclo Formativo de medio grado de mecanizado/mecatronica.

2.1.2. GERMANY

- PROGRAM: Mechatronics Fitter

  Combination of mechanical and electrical contents

  Data processing

  Assembly & maintenance

- SECTOR: Mechatronics
- LEVEL:EQF 4
- ACCES REQUERIMENTS: The only formal requirement is a contract between the apprentice and the company. The company decides which level of school education is necessary and if there are other obligations. Youths younger than 18 have to provide a medical certificate about a first examination. Most companies choose apprentices who at last completed secondary school. Additionally the apprentice has to be 16 years old to start the apprenticeship.

2.1.3. Contextualization. POLAND

- PROGRAM: mechatronics technician

A graduation of a vocational school of mechatronics technician should be prepared in order to perform the following professional tasks:

1) assembly of mechatronic devices and systems;
2) exploitation of mechatronic devices and systems;
3) design of mechatronic devices and systems;
4) programming of mechatronic devices and systems

- SECTOR:

It occurs in many industries, including manufacturing Industrial in general, but especially in the automotive industry, aerospace and aerospace industry, armaments industry and industry processing materials.

- LEVEL: **Level 4 (EQE)**
- ACCES REQUERIMENTS:

Students have two options: Technical school (level 4) is choosen directly after graduating primary school (level 2) or after vocational school (level 3).

There is a significant number of professions directly and indirectly associated with the field of mechatronic technology in the Polish system of vocational education and training. According to the applicable classification of professions and specialties [1], professions related to the mechatronics sector are in the following groups: Specialists, Technicians and other medium staff, Opticians and Fitters of machines and equipment. The full and unequivocal identification of professions related to the mechatronics sector hampers the differences between the classification of professions and specializations (KZiS) developed for the needs of the labor market and the classification of professions in the education and occupational training system (KZSZ). Table 2 identifies professions in the system of vocational education and training, which due to the required qualifications are related to the mechatronics sector [2].

Table 2 professions in the system of vocational education and training.

Name of the profession	Level EQE
Mechanical engineer - industrial machinery and equipment	Level 6-7
Mechanical engineer - precision mechanics	
Engineer mechanic aviation	
Automatics and robotics engineer	

Engineer avionics	
Biocybernetics engineer and biomedical engineering	
Electrical Engineer	
Electrical-Automation Engineer	
Electronics technician	Level 4
Electrical technician	
Mechanical technician	
Mechatronics technician	
Car technician	
Technician aviation mechanic	
Avionics technician	
Electronics technician	
Electrical technician	
Mechanical technician	
Mechatronics technician	
Avionics technician	
Mechanic-fitter machines and equipment	Level 3
Car mechanic	
Electrician	
Electromechanics of motor vehicles	
Elektromechanik	
Monter electronics	
Avionics technician	
Monter mechatronics	
Mechanic of industrial automation and precision equipment.	

The level and scope of the detailed qualification requirements for the professions indicated in Table 3 is adapted to the area of engineering and the specificity of the profession. A list of the most important qualification requirements for professions has been developed using the existing curricula of the curriculum. In the case of specialist engineers, there are no standards for professional qualifications. There is also no description of the occupation for part of the occupations in this area. The table does not provide technical and directional requirements for the profession as a general requirement, which is one of the key conditions for attaining the professional skills indicated.

Table 3 Level and scope of the detailed qualification requirements for the professions

Name of the profession	**Description of basic vocational qualifications**
Engeneers (level 6-7)	
Engineers indicated on the basis of the analysis of the curricula of the national university's technical curricula with respect to mechatronic engineering:	formulation and resolution of mechatronic design tasks; design and construction of mechatronic devices and systems; programming and use of mechatronic devices and systems; assembly and dismantling of mechatronic devices and systems; diagnosis of technical condition of mechatronic devices and systems; programming and management of equipment repairs and mechatronic systems.
Technican (level 4)	
Electronics technician	installation and maintenance of electronic equipment; use of electronic devices; repair of electronic devices;
Electrical technician	assembly and commissioning of electronic machines and appliances; execution and commissioning of electrical installations; assessing the technical condition, locating and removing damage to machines, devices and electrical installations
Mechanic technician	manufacture of machinery and equipment; assembly of machines and equipment; installation and commissioning of machines and equipment
Mechatronic technician	design and construction of mechatronic devices and systems; assembly and dismantling of mechatronic devices and systems; programming and use of mechatronic devices and systems; Diagnosis and repair of equipment and mechatronic systems;
Automotive technician	diagnosis of technical condition of self-propelled vehicles; maintenance and repair of vehicles; organizing and supervising the operation of motor vehicles;
Technician fly mechanic Avionics technician	performance of aircraft technical assessments; operating aircraft; repairing of airborne assemblies and equipment;
Fitters and mechanics (level 3)	
Mechanic - fitter of machines and devices	assembly, installation and commissioning of machines and devices; operating and maintaining machines and equipment;
Mechanic of motor vehicles	diagnosis of motor vehicles; repairing motor vehicles;

Electrician	assembly and commissioning of electronic machines and appliances; execution and commissioning of electrical installations; assessment of technical condition of machines, equipment and electrical installations after assembly on the basis of measurements
Electromechanical vehicles	Assessment of technical condition and repair of electrical and electronic systems of motor vehicles
Electromechanical	assembly and commissioning of electronic machines and devices based on technical documentation; assessing the technical condition of electrical machines and equipment after assembly on the basis of measurements; installation of control, adjustment and protection systems for electrical machinery and equipment on the basis of technical documentation
Monter electronics	assembly of components, components and electronic circuits; installation and maintenance of electronic equipment;
Monter mechatronics	assembly and disassembly of components, subassemblies and mechanical devices in mechatronic devices and systems; commissioning of mechatronic equipment and making the necessary adjustments; repair and maintenance of mechatronic devices and systems
Mechanic of industrial automation and precision devices	assembly and commissioning and operation of industrial automation systems and pre-tuning devices;

[1]. Regulation of the Minister of Labor and Social Policy of 27 April 2010 on the classification of occupations and specialties for the needs of the labor market and the scope of its application (Journal of Laws No. 82, May 17, 2010, item 537).

[2] Regulation of the Minister of National Education of 23 December 2011 on the classification of professions in vocational education (OJ of 03 January 2012, item 7).

2.1.4. TURKEY

- PROGRAM: Machine Technology
  - Machine Maintenance
- SECTOR: Manufacturing and Service Industry
- LEVEL: Level 4
- ACCES

REQUERIMENTS:

To be completed compulsary primary education (8 years), to carry out the entrance conditions determined by the Ministry of National Education according to school types and field / branch. On the other hand, the health status of the students should be suitable for doing the jobs required by the occupations under the Machine Technology field.

2.1.5. LITHUANIA

- PROGRAM: Automatic systems mechatronics.
- SECTOR: Automation, mechatronics, agriculture, energy industries.
- LEVEL: Level 4 (EQF).
- ACCES REQUERIMENTS: acquired basic education and training in the secondary education program or completed secondary education program.
- PROGRAM: Metal industry equipment mechatronics.
- SECTOR: Metal, mechatronics, construction industries.
- LEVEL: Level 4 (EQF).
- ACCES REQUERIMENTS: acquired basic education and training in the secondary education program or completed secondary education program.

3. STAGE 1: SKILL NEEDS ANALYSIS

3.1. Gathering of information

The Skill Need Analysis is one of the most important and therefore complex phases of the process.. In this first stage, the objective is to obtain and collect information from different sources in order to detect new demands coming from industry. These information will be related to the sector and programs selected in the pre-phase.

Therefore, the appropriate stakeholders will named and classified to carry out the gathering process.

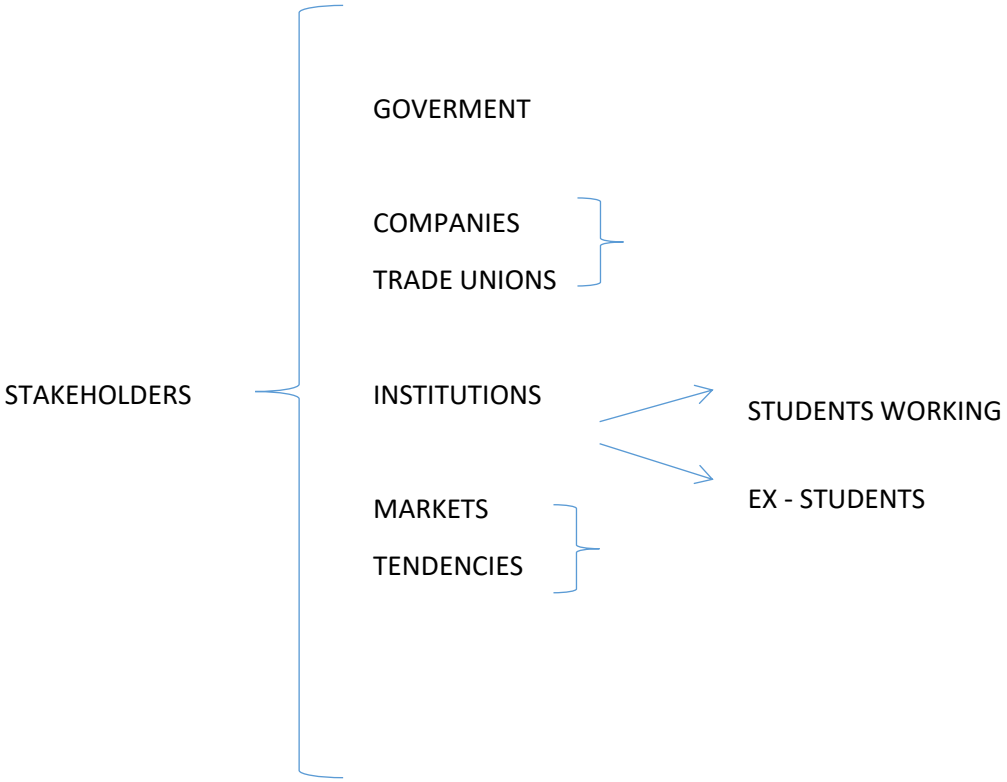


Figure 1 : SCHEME OF THE MAIN STAKEHOLDERS

In the Intellectual Output 01 “Capacity Building for Developing VETriangle” the role of intermediaries in the different partner countries has been described.

It will then be shown in each of these countries how this first phase of the methodology will be carried out, and which stakeholders are involved in it.

3.2. Useful information and links

There are many research works carried out explaining different methodologies to analyze the skill needs. In the following section some of these reports and some useful links will be referred.

Table 4 USEFUL DOCUMENTS

Name of the document	Topic	link
Skills Panorama	The Skills Panorama turns labour market data into useful, accurate and timely intelligence that helps policy-makers in making their decisions on skills and job in Europe.	http://skillspanorama.cedefop.europa.eu/en
Skills for employmnt	The Global Public-Private Knowledge Sharing Platform on Skills for Employment (Global KSP) aims to help strengthen the links between education and training to productive and decent work by sharing approaches, knowledge and experiences that governments, employers, workers and international organizations have found effective in addressing these issues of common concern across the world.	http://www.skillsforemployment.org

Table 5 ILO TOOLS FOR SKILLS NEEDS ANALYSIS AND ANTICIPATION

Skills for trade and economic diversification: A practical guide. ILO, 2012	Addresses anticipation of skills needs in promoting trade strategies and in exporting industries.
Anticipating skill needs for green jobs: A practical guide. ILO, 2015a	Addresses approaches to analysing and anticipating skills needs for the green economy and sustainable development.
Guidelines for inclusion of skills aspects into employment-related analyses and policy formulation ILO, 2015b.	Addresses the analysis of skills barriers to employability and skills needs for employment, and how to integrate the analysis in the process of national employment policy formulation.
Guide to anticipating and matching skills and jobs. Cedefop, ETF, ILO, 2015:	A compendium of tools for guidance and assistance in designing methods, instruments and institutional solutions to meet the challenge of matching current and future skills and jobs:
Volume 1: Using labour market information	Provides guidance on the principal types of data, data sources and indicators that can answer key policy questions related to overcoming or preventing skills mismatch.
Volume 2: Developing skills foresights, scenarios and forecasts	Addresses quantitative and qualitative methods of anticipation and forecasting of future skills needs at a macroeconomic level.

Volume 3: Working at sector level	Addresses methods, processes and institutional mechanisms of skills identification and anticipation at sectoral level.
Volume 4: The role of employment service providers	Addresses the role of public employment services and private employment agencies in skills anticipation and matching, including the collection and use of relevant labour market information.
Volume 5: Developing and running an establishment skills survey	Provides guidance on the implementation of surveys among employers (establishments) on skills shortages and gaps, recruitment difficulties and training measures.
Volume 6: Carrying out tracer studies ttp://www.etf.europa.eu/web.nsf/pages/Vol._6_Tracer_studies	Assists training providers and analysts in designing and implementing surveys among their graduates on their employability, how their skills are used, and how those skills relate to gaps on the labour market.
links	http://www.ilo.org/employment/Whatwedo/Projects/WCMS_534345/lang--en/index.htm

Source: "Anticipating and matching skills and jobs" ILO International Labor Office

There are many research works carried out explaining different methodologies to analyze the skill needs. In the following section some of these reports and some useful links will be referred.

Table 6 Useful documents from Polish educational system

Name of the document	Topic	link
Central Examination Board (Centralna Komisja Egzaminacyjna)	examination	www.cke.edu.pl
• Institute of the Knowledge Society (Instytut Społeczeństwa Wiedzy – ISW)	Knowledge Society	https://www.frp.org.pl/en/
• Ministry of National Education (Ministerstwo Edukacji Narodowej)	Education system in Poland	www.men.gov.pl/en/
• Ministry of Science and Higher Education (Ministerstwo Nauki i Szkolnictwa Wyższego)	Higher Education System in Poland	http://www.nauka.gov.pl/en/
• Ministry of Labour and Social Policy (Ministerstwo Pracy i Polityki Społecznej)	Organization provides services to adolescents aged over 15 years in the field of prevention of marginalization	http://www.mpips.gov.pl/en/

	and social exclusion and employment.	
• Educational Research Institute (Instytut Badań Edukacyjnych)	Educational research.	http://www.ibe.edu.pl/en/
• Centre for Education Development (Ośrodek Rozwoju Edukacji)	Development education	https://www.ore.edu.pl/centre-for-education-development
• National Centre for Supporting Vocational and Continuing Education (Krajowy Ośrodek Wspierania Edukacji Zawodowej i Ustawicznej – KOWEZiU)	Vocational education in Poland.	http://www.koweziu.edu.pl/index.php/english
School Education Information System (System Informacji Oświatowej – SIO)	Information about education system in Poland	www.cie.men.gov.pl
The evaluation of education system	Skills and needs in curriculum program	http://www.npseo.pl/action/requirements/wymaganie3_uczniowie_nabywaja_wiadomosci_i_umiejetnosci_okreslone_w_podstawie_programowej

Table 7 Useful documents from Turkish educational system

Name of the document	**Topic**	**Link**
Republic of Turkey Ministry of National Education Directorate General for Vocational and Technical Education	IVET provision and coordination	http://mtegmen.meb.gov.tr/index.asp
Directorate General for Vocational and Technical Education	Vocational and Technical Education Strategy Paper and Action Plan 2014-2018	http://mtegmen.meb.gov.tr/documents.asp
Directorate General for Vocational and	Monitoring transition from VET to Labour market	https://emezun.meb.gov.tr/

Technical Education		
TURKSTAT	Educational Statistics	http://www.turkstat.gov.tr/PreTablo.do?alt_id=1018
ISKUR (Turkish Employment Agency)	Data on Labour Market Analysis	http://www.iskur.gov.tr/en-us/homepage.aspx

TABLE 8 USEFUL DOCUMENTS FROM LITHUANIAN EDUCATIONAL SYSTEM

Name of the document	Topic	link
Ministry of Education and Science	Education system in Lithuania	https://www.smm.lt
Qualifications and Vocational Education and Training Development Centre	Vocational education and training in Lithuania	http://www.kpmpc.lt
Law on Education	Republic of Lithuania Law on Education	https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/07c2ecf0168711e6aa14e8b63147ee94?jfwid=rivwzvpvg
AIKOS	Vocational information, counselling, and guidance system	https://www.aikos.smm.lt
Education Exchanges Support Foundation	National agency for Erasmus+ and other initiatives in the field of education and vocational training	http://smpf.lt/
Agency of International Youth Cooperation	Development of international youth cooperation	http://jtba.lt/
AIESEC	Internships, job training	http://aiesec.lt
Job Opportunity Barometer	Possibilities for employment in Lithuania	http://www.ldb.lt/Informacija/DarboRinka/Puslapiai/isidarbinimo_galimybiu_barometras.aspx
Occupation map	Possibilities for employment in Lithuania	https://www.ldb.lt/INFORMACIJA/DARBORINKA/Puslapiai/Profesiju_zemelapis.aspx

Table 9 Useful documents from the German educational system

Name of the document	Topic	link
Federal Institute for Vocational Education and Training	Information on VET, programmes, research	https://www.bibb.de/en/index.php
Federal Institute for Vocational Education and Training	English framework curricula and information on German apprenticeship system	https://www.bibb.de/govet/en/54899.php
Bundesagentur für Arbeit	Information on VET and the German labour market	https://www.arbeitsagentur.de/en
Deutscher Industrie- und Handelskammertag	Information about the German chambers	https://www.dihk.de/en
Federal Ministry of Education and Research	Information on the German education system	https://www.bmbf.de/en/index.html

In Annex 1, As example of the available documents, some questionnaire to be carried out for the detention of needs are shown, extracted from CEDEFOP, “Guide to anticipating and matching skills and jobs, VOLUMEN 6: Carrying out Tracer Studies”.

3.3. Examples of skills need analysis from partner's countries.

In this section, different agents who participate in the skill needs analysis in the partner countries are described. The objective is to detect Skills for new jobs, new skills for existing jobs, new industrial demands for the workforce, definitely information about how to update the current education programs.

Note that some of the roles of the stakeholders are already described in the IO01. References can be used.

3.3.1. SPAIN - BASQUE COUNTRY – Miguel Altuna LHII

3.3.1.1. STAKEHOLDERS:

- **GOVERNMENT:**

INCUAL (National Institute of Qualifications)

The Organic Act 5/2002 of 19 June 2002 on Qualifications and Vocational Education and Training confers on the INCUAL the responsibility for defining, creating and updating the National Catalogue of Professional Qualifications and the corresponding Modular Catalogue of Vocational Education and Training.

The governing body of the INCUAL is the General Council of Vocational Education and Training though the INCUAL is placed under the control of the Secretary General of Education (Ministry of Education, Culture and Sport), as laid down in Royal Decree 1553/2004 of 20 June 2004.

INCUAL is divided into four areas (Professional Observatory, Methodological Research and Organization of the National System for Professional Qualifications, Qualifications Design, Information and Resource Management) governed by a director.

https://www.educacion.gob.es/educa/incual/ice_CualCatalogo_ing.html

Within this, each community has its own body that adds 45% of the contents. In the case of the Basque Country is IVAC, regional dependent agencies that adapt to the context of the region.

IVAC

https://ivac-eei.eus/es/

In accordance with the Legislative Decree 169/2015, 8th of September (B.O.P.V. - Official Journal of the Basque Country nº 183, 25th of September) the establishment of the Basque Institute for Knowledge Development in Vocational Education and Training is announced, as a technical body tasked with defining strategies, programmers and procedures which through vocational training

consolidate lifelong learning and the development of knowledge and expertise in vocational training itself.

The nature and purpose of the Institute is to provide a service of research and of support to vocational training staff, it is an attached agency of the Vice Ministry of Vocational Training of the Department of Education, Linguistic Policy and Culture, and is reliant upon it organically and functionally.

Key objectives of the IVAC

- Respond to the requirements of the Basque Country economic -productive sector through the design of vocational training curriculum and a framework of socio-professional profiles, benchmarks and models with high quality and social value levels.
- Advance and develop knowledge levels by encouraging and promoting training programmers which have been contextualized and adapted to the needs and requirements which are demanded by society alongside the incorporation of values which, as a whole, improve both employability and social and economic progress.
- Collaborate in the assessment and accreditation procedure of the professional skills which people have acquired through either work experience or non-formal training routes.

Functions to be developed by the IVAC

- Support the Vice Ministry of Vocational Training in the creation of a Basque standard framework of qualifications, certificates and specializations in accordance with the current regulations, this standard framework will respond to the needs of the evolution and development of job professions in the Basque Autonomous Community.
- Analyze in accordance with the established qualifications and skills the needs and requirements of regularized job professions or those which require specific accreditation for the discharge of their working duties, in order to provide proposals agreed with the corresponding Basque Government Department regarding professional procedures, benchmarks and models for their approval.
- Draw up the curricular designs of the various training programmers which will be drafted based upon the qualification system, where applicable, of professional benchmarks and models. This will be achieved by analyzing and investigating all possible curricular solutions to facilitate an enriching diversification of learning – teaching methodologies.
- Promote and consolidate values and attitudes required by the business sector, and also foster cross sector instrumental, interpersonal and systematic skills and competences in the learning activities of the student. This is to ensure they discharge their duties in the workplace in a professional manner. This will be achieved through researching and developing the methods used to provide the qualifications and other training activities; all learning – teaching methodologies used will include a high level of student participation.

- Draw up a structured procedure for skills assessment and accreditation through the development of tools and recording processes / information management processes to guarantee the traceability of users. The training necessary to ensure that staff will be capable of using these tools and procedures will also be provided.
- Support the Vice Ministry of Vocational Training in the harmonization / standardization, or if it arises, educational validation of the certificates and qualifications of foreign born citizens with those of the Basque Autonomous Community, in accordance with the established regulatory guidelines.

- **COMPANIES:**

The skill needs detected in companies are driven either through industrial associations or directly to education organisms like IVAC or INCUAL. Lately, being the need of those new skills so urgent, companies tend to set up inner training programs by themselves. Of course, this is only possible with large companies and it is more difficult with SMEs. It also rather usual for those SMEs to collaborate with VET centers to respond to those needs.

DUAL system is becoming another way to update their new worker's skills. In the Spanish DUAL system, trainees are in a half part job. They have a contract and the companies pay their salary. Furthermore, trainers from companies are also paid by them. That means that companies are already financing the dual system.

The reason for companies to assume these costs is their real need of high skilled and specialized workforce. If they do not take part in the financing and in the particular training of their own workers it will be very difficult to hire the workforce according to their need in the market.

- **TRADE UNIONS:**

Trade Unions in Spain do not take part in the skill need analysis.

- **INSTITUTIONS (Students Working / Ex – Students):**

The institutions conduct surveys (questionnaires) either to the students who are at the same time working, as the students who have already finished.

In Annex 1, there are attached questionnaires models to be carried out for the detention of needs extracted from CEDEFOP, "Guide to anticipating and matching skills and jobs, VOLUMEN 6: Carrying out Tracer Studies".

http://www.etf.europa.eu/web.nsf/pages/Vol._6_Tracer_studies

- **MARKETS / TENDENCIES:**

There are associations that are dedicated to the employment observatory. In the case of the Basque Country and Spain:

- ADEGI (http://www.adegi.es/adegi/)
- FVEM (http://www.fvem.es/es/)
- CEOE (http://www.ceoe.es/es)
- The observatory itself within the INCUAL (https://www.educacion.gob.es/educa/incual/ice_CualCatalogo.html)
- LANBIDE (http://www.lanbide.euskadi.eus/general/-/informacion/futurelan/)

It is the Basque Employment Service that puts the Basque Government at your disposal to accompany and guide you in the job search process.

Lanbide is characterized by offering a comprehensive and personalized plan to every job seeker.

Integral because we accompany each person throughout the job search process advising him, guiding him, assisting him, with different training actions and supporting him for the creation of his own company, and customized because individual plans are designed appropriate to each professional profile.

From Lanbide we want to contribute to achieve full employment, stable and quality.

Who are they addressing?

To people who...

- looking for your first job
- Those who are unemployed
- Those who wish to rejoin
- Those who are working and want to change jobs

And for companies that ...

- want to fill jobs
- need advice and support for job creation

What kind of attention is it?

They offer personalized, direct and quality care to improve your chances of getting a job.

We speak personally to define the objectives, goals and professional profile and analyze the works that best suit their characteristics.

We create a personal Plan of job search facilitating tools such as training, job search techniques, practices in companies, personalized advice and mediation in the labor market with access to job offers more appropriate to the demand for employment.

Futurelan (http://www.lanbide.euskadi.eus/general/-/informacion/futurelan/)

FutureLan is a tool of Lanbide, Basque Employment Service, which has projections of employment in economic sectors and occupational groups of the CAE until 2030.

FutureLan is a key instrument for obtaining early information on the demand for workers from Basque companies and potential future imbalances with respect to qualified personnel in the labor market of the Basque Country with a focus on occupations and economic sectors.

It contains information of two types:

- Quantitative information with projections of the employment demand in the companies by economic sectors and professional groups.
- Qualitative information on trends and changes in occupational skills.

With regard to employment projections, the information covers two periods: from 2005 to 2015, with data from the Labor Market Census on the real evolution of employment in the different economic sectors and occupations and from 2016 to 2030 with data Expected changes in employment in these sectors and occupations. You can access this information of a quantitative nature through the links “sectors” and “occupations”, which will show:

- Evolution data: actual and forecast.
- The distribution of employment by occupation of the selected sector and the distribution of employment by sector of the selected occupation.
- The expected evolution of contracts in the sector / occupation selected.
- Qualitative information, trends that will affect occupations and their potential impact on future competencies changes, is shown on the “occupations” page in the “tab” tab. By selecting the occupation of interest it is possible to access information on the following aspects:
- The prospects for the future planned in Europe for this occupation.
- The sectors that will be most affected by this development.
- Trends and changes in competencies, distributed in organizational trends, technological trends and economic trends.

3.3.2. GERMANY

3.3.2.1. STAKEHOLDERS:

Government:

Besides the federal and state governments another important protagonist for skills demand analysis is the BIBB. The BIBB does research on its own to find new skill demands and to look for modernization needs in professions and curricula. On the other side also corporations, employer organisations and the members of the main board can hand in their demands and needs for changes, new professions and skills at the BIBB. There are no specific criteria or indicators which trigger a change but the BIBB evaluates every communicated need and demand.[1]

Companies:

As long as companies do use the standardized curricula for the occupation they need they can influence the practical contents according to their specific working processes and tasks. In small scale they can implement the skills they need directly.

Companies can communicate their needs and demands to the chambers, employer associations and especially the BIBB. Vocational training and apprenticeship in Germany is clearly focused on the need of the industry. The individual needs of the participants and apprentices have not the highest priority according to the conceptualization of curricula and training programmes. Their needs are addressed in the conduction of training.

The modernization according to the needs and demands of industry is a task of the BIBB and its main board. There is no clear criteria which needs and demands are addressed by the board and when it develops or adapts apprenticeships and training programmes.

Chambers: The chambers may take part in this process as a representative of the employers additionally to the employer associations but they are not directly involved in the main board.

Trade Unions:

As part of the main board in the BIBB the trade unions can influence the modernization and modification of dual VET and apprenticeships. Additionally the trade unions have direct links to the apprentices and get feedback from employee side. So in a way they include the needs and the other side of the skill needs analysis.

Institutions (Students Working / Ex – Students):

[1] For more details see IO1 p. 11 ff.

In the case of graduated apprentices they of course can influence the skill demands in their role as employees in the corporations. But there is no direct link to the BIBB for them to communicate skill needs.

Markets / Tendencies:

Employment observatory and research according to skills needs is done by the following organisations and protagonists:

BIBB

Jobcenters

Federal statistical office

In specific areas there can also be research activities by universities or other protagonists.

3.3.3. POLAND

3.3.3.1. STAKEHOLDERS:

- Government:

  The education system in Poland is centrally managed by two institutions – theMinistry of National Education (general and vocational education) and the Ministry of Scienceand Higher Education (higher education). It is only the national educational policy that is developed and carried out centrally, while the administration of education and the running of schools are decentralized.

  The Minister of Economy and Labor resposible for schools/organization which provides services to adolescents aged over 15 years in the field of prevention of marginalization and social exclusion and employment.

  In 2010, the Prime Minister established the Inter-ministerial Taskforce for Lifelong Learning, including the National Qualifications Framework to coordinate activities for the implementation of policy objectives in Poland for lifelong learning.62 The Taskforce will function for the preparatory period leading to implementation of the qualifications framework. Chaired by the Minister of National Education, the Taskforce includes the Minister of Science and Higher Education, Minister of Economy, Minister of Labour and Social Policy, Minister of Regional Development, Minister of Foreign Affairs and Head of the Chancellery of the Prime Minister [4,5].

  http://en.men.gov.pl/

  http://eurydice.org.pl/wp-content/uploads/2014/10/THE-SYSTEM_2014_www.pdf

- Companies /Chambers

  As a national social partner, the Polish Craft Association takes part in the Tripartite Commission's meetings. The Commission is formed by the Polish government, the biggest employers' organisations and trade unions. Thus the ZRP has an opportunity to influence bills on economic and social policies: taxes, national budget, labour market, EU structural funds and salaries. Being a member of the European Union of Craft, Small and Medium Enterprises (UEAPME), the ZRP is also involved in the social dialogue at the European level.

  The Polish craft is very active in the vocational education. ZRP members offer wide range of training opportunities: from the modern to unique (especially handicraft and artistic) professions. Over 92 000 apprentices of 100 professions are being currently trained by employers-craftsmen.

  http://www.zrp.pl

- Institutions (Students Working / Ex – Students):

NATIONAL CENTRE FOR SUPPORTING VOCATIONAL AND CONTINUING EDUCATION is a central, public, national-level institution providing professional development services for teachers subject to the Ministry of National Education.

The mission of the Centre is to:

- inspire, prepare and coordinate activities related to professional development of teachers from vocational schools and schools for adults.
- prepare and execute educational ventures related to the stages of educational transformation in Poland.

The Centre cooperates with other central government and educational institutions as well as non-government organizations from Poland and abroad. The Centre collects, processes and disseminates pedagogical information related to vocational and continuing education.

The information published in the magazine concerns vocational and continuing education and new initiatives taken on by the Ministry of Education.

The National Centre for Supporting Vocational and Continuing Education is also the publisher of the e-magazine.

http://www.bip.ore.edu.pl/archiwum/index-2.html

http://www.edukator.ore.edu.pl/projekt-efektywne-doradztwo-edukacyjno-zawodowe-dla-dzieci-mlodziezy-doroslych-efekty-osiagniete-roku-2016/

- Markets / Tendencies:

The most popular forms of cooperation employer with schools are indicated:

-practical training;

- apprenticeships;

- sponsorship of schools;

Vocational training covering theoretical and practical classes, including specialization (Other than practical and occupational classes such as laboratories).

To provide training for students in cooperation with the school or CKP, enriching the school base with didactic materials and:

- Partnership contracts with a vocational school;

- Provision of workshop equipment;

- Providing materials or raw materials for practical apprenticeship;

- Patronage classes.

[4] Banach, C. (1995). Polska szkoła i system edukacji. Przemiany i perspektywy [The Polish school and educational system. Changes and perspectives]. Toruń.

[5] Zahorska, M. (2007). Zmiany w polskiej edukacji i ich społeczne konsekwencje [Changes in Polish education and its social consequences]. In: M. Marody (ed.). Wymiary życia społecznego. Polska na przełomie XX i XXI wieku [Dimensions of social life. Poland at the turn of the XXI Century]. Warszawa.

3.3.4. TURKEY

3.3.4.1. STAKEHOLDERS:

- **Government:**

In Turkey, there are three different protagonists that are currently collect and analyse data related to education and labour market:

http://www.etf.europa.eu/web.nsf/pages/TRP_2016-17_Turkey

MoNE (Ministry of National Education) determines the needs of labour market and the supply from the VET schools through *The Provincial Employment and Vocational Education Boards established* in all 81 provinces in Turkey. The contemporary practices indicate that the chances for success are higher if the solutions for employment and education are developed locally by taking into account the provincial conditions in the framework of national policies. These Boards are important mechanisms having the potential to produce "local solutions for local problems" by means of social dialogue method. Provincial employment and vocational education boards have been created to mobilize local facilities and resources in the fight against unemployment by providing collaboration and peer between different institutions and organizations. They consist of the representatives of other public authorities, as well as workers, employers and trade organizations, industry chambers and other local organizations representatives. Boards are expected to determine and monitor the needs of the local labour market status needs and problems by the related people corncerned, provide vocational courses in the areas of labour force demand and prevent employment loss. Board decisions are final. The Committee prepares the action plans of the decisions taken, determines the responsible institutions, practices and results. The Board meets quarterly. Secretariat is carried out jointly by the Provincial Employment Agency and the Provincial Educational Directorate with the fields of own to stay limited. Follow-up on the decisions taken and the other researches towards labour market and different activities are performed by the Executive Board.

ISKUR (Turkish Employment Agency) has tools to determine the trends of short term labour force demand in local level, detect job vacancy rates and the qualifications of demanded labour force on the basis of province, country, sector and occupation groups, collect data for planning Active Labour Market Policies to meet the necessities, reach a main report which contains labour market supply and demand data in local level

Turkish Labour Market Demand Research for 1st Term of 2014 is done in the workplaces which have 10+ employers, totally 100.852 workplaces are visited. In 74 provinces complete inventory and in 7 provinces sampling methods are used.

Labor Market Needs Analysis is done by **ISKUR** twice a year. 2105 Analysis show that one of three workplaces visited has a vacant job. 75 of every 100 employers need qualified employees. 60% of employers indicating that they have difficulty in recruiting employees and explain the lack of vocational qualifications and skills as a reason of this. In other words, employers have difficulty in finding qualified employees. Research results reveal «the problem of not having an occupation» and «lack of qualifications» in Turkey country concretely.

Analyses help policy makers to take consistent decisions about vaocational training by taking into account the long-term priorities and goals from strategic perspective. Besides, these surveys are considered to provide major contribution to strengthening the connection between vocational training and employment in addition to educating human resources fit for the needs of the labor market.

http://www.iskur.gov.tr/en-us/homepage.aspx

Turkish Statistical Institute (TURKSTAT) collects the data on the work based learning programs in the enterprises through the survey conducted every five year on the sample companies.

Within the framework of the Official Statistical Program (RIP) , statistics produced by all governmental institutions, have started to be accepted as Official Statistics. In this sense, for the WBL programs on the enterprises which also cover VET education, TURKSTAT will work in close cooperation with MoNE. Besides, foundations, companies, universities and other similar organizations also collect data about their specific activities related to WBL. Yet, these are comparatively small and will not be considered to give a real picture of this activity as well as a reliable statistics. In addition to that, there isn't a general database that compiles all these data. Reportedly, the major problem is that the data collected by these three pioneer governmental institutions are compatible with each other. The reason behind that the definitions of the statistics produced may differ for each institution. For instance, the definition of unemployment differs for İŞKUR and TURKSTAT. This, in turn, leads to the failure to understand the magnitude of education and labour force activities throughout Turkey. In fact, the implementation of the Official Statistics Program (RIP) provides an enabling environment for such collaboration. For the WBL statistics, TURKSTAT may produce statistics out of the official records. MoNE has different databases that may be combined under one platform which may be used to produce statistics. With the specific modules inserted to e-school, e-graduate, e-nonformal, the data on traineeship can be collected. Besides, the data produced by İŞKUR can be integrated to the system. This, in turn, will help to produce more up to date, accurate and reliable data for WBL in Turkey.

http://www.turkstat.gov.tr/Start.do

Turkey has its own resources in order to undertake this activity. IPA II Funds can also certainly be used for this purpose. Although statistics is not an area of intervention under IPA II, the necessity to produce the statistics compatible with national and international standards is an important benchmark to measure the improvement made. Therefore, a component on the improvement of data collection may also be included in the comprehensive, sectoral approach project.

Education data are collected through various systems and means. For example, the Information System for Determining Educational Needs on Vocational and Technical Education (2005-13), E-school, a computerised web-based data management system, tracks students on an individual basis and the E-graduate project monitors the transition from VET to work. E-graduate report presents data on: a. school types of graduates; b. year of graduation; c. ratio of graduates going to HE; d. sectors in which graduates work; e. legal status of enterprises where graduates work; f. connection/relation between graduation and work field; g. social insurance status of graduates; h. rate of use of educational background in current job; i. graduate remuneration. MoNE Situation Assessment Studies, which track student achievement at / in various grades and subjects, are used to compare regions, schools and programmes, to inform policy development. International surveys, e.g., PISA and PIAAC, are carried out. Data on the ET2020 benchmarks are collected. EQAVET indicators have been piloted in selected sectors in advance of being used at system level.

http://www.oecd.org/edu/EDUCATION%20POLICY%20OUTLOOK%20TURKEY_EN.pdf

- **Companies:**

Although they are comparatively small and will not be considered to give a real picture, foundations, companies, universities and other similar organizations also collect data about their specific activities related to WBL.

- **Trade Unions:**

The government sees social dialogue in VET as very important. NGOs and social partners are involved in decision-making. The most active are the Union of Chambers and Commodity Exchanges of Turkey (TOBB), business confederations and associations, and other trade and employers' unions and associations. They are involved in many functions of governance, through public bodies like VEC (Vocational

Education Council) or public-private partnerships for skills development or capacity building. At regional and local level, the provincial and district national education directorates, the Provincial Employment and Vocational Education Board and the Provincial Employment Agency are in charge of both implementing VET policy and developing public-private partnerships at provincial, district and municipal levels.

https://www.etf.europa.eu/webatt.nsf/0/7D64D12092C6C886C1258131004777AF/$file/Turkey.pdf

https://www.tobb.org.tr/Sayfalar/Eng/Arsiv.php?s5=70&lst=Haberler&kategori=

- **Institutions (Students Working / Ex – Students):**

The **E-graduate** project monitors the transition from VET to work. E-graduate report presents data on: a. school types of graduates; b. year of graduation; c. ratio of graduates going to HE; d. sectors in which graduates work; e. legal status of enterprises where graduates work; f. connection/relation between graduation and work field; g. social insurance status of graduates; h. rate of use of educational background in current job; i. graduate remuneration.

https://abdigm.meb.gov.tr/meb_iys_dosyalar/2013_11/15024437_educationpolicyoutlookturkey.pdf

- **Markets / Tendencies:**

Education data are collected through various systems and means. For example, the Information System for Determining Educational Needs on Vocational and Technical Education, E-school, a computerised web-based data management system, tracks students on an individual basis and the **E-graduate** project monitors the transition from VET to work. E-graduate report presents data on: a. school types of graduates; b. year of graduation; c. ratio of graduates going to HE; d. sectors in which graduates work; e. legal status of enterprises where graduates work; f. connection/relation between graduation and work field; g. social insurance status of graduates; h. rate of use of educational background in current job; i. graduate remuneration. MoNE Situation Assessment Studies, which track student achievement at / in various grades and subjects, are used to compare regions, schools and programmes, to inform policy development. International surveys, e.g., PISA and PIAAC, are carried out. Data on the ET2020 benchmarks are collected. EQAVET indicators have been piloted in selected sectors in advance of being used at system level.

http://www.eqavet.eu/Libraries/Website_Update_2016_Reports/2_TR_final_Template_for_updating_info_on_the_EQAVET_website.sflb.ashx

3.3.5. LITHUANIA

3.3.5.1. STAKEHOLDERS:

- **Government:**

In Lithuania, the Ministry of Education and Science is an institution of the Lithuanian executive power that formulates and implements the national policy on education and research. At present, the Ministry of Education and Science has five departments:

- Department of General Education and Vocational Training is involved in the formation and implementation of the State policy for provision of education. It develops and implements the State policy for provision of vocational education and training, design of the national qualifications framework and vocational guidance.
- Education Quality and Regional Policy Department participates in the development of the national education policy and the strategies for its implementation.
- Department of Higher Education, Science and Technology is involved in the formulation and implementation of the State policy in the fields of higher education studies and academic mobility.
- Department of the European Union Assistance Coordination formulates and implements the policy regarding the use of the EU structural support for education and research and is involved in shaping the policy of implementing the EU structural assistance programmes in Lithuania.
- Finance Department develops the funding system of education and higher education and research.

Educational institutions that are subordinate to the Ministry of Education and Science include the following:

- Education Development Centre designs and produces the national curriculum of general and continuing adult education in compliance with the needs of the public, initiates, develops and implements innovations in general and continuing adult education, also initiates and carries out work relating to quality assurance in general and continuing adult education.
- National Examination Centre organises and conducts evaluation of learning achievements in education.

- Qualifications and Vocational Training Development Centre manages the Lithuanian Qualifications Framework, improves the quality of vocational education and training, enhances the attractiveness of vocational education and strengthens cooperation among the participants of vocational training provision.

A special role in developing human resources has been given to the Ministry of Economy. It participates in creating and implementing human resources development policy, VET policy, and organises research on future skill needs and disseminates its results for career counselling purposes. Other ministries can also participate in developing and implementing education and training policy by submitting proposals for legal acts on education and training, and participating in working groups that draft legal acts. Some ministries (such as the Ministry of Finance, Ministry of Social Security and Labour, Ministry of Health, Ministry of Internal Affairs, and Ministry of Agriculture) contribute to developing and implementing initial as well as continuing education and training programmes.

- **Companies, trade unions:**

Employer representatives, trade unions, and education providers are involved in skills anticipation, mainly through their roles in ensuring that qualification and training programmes meet certain standards and relate to demands in the economy. In 2014-15, the Ministry of Education and Science signed collaboration agreements with associations representing employers from the hotels, restaurants, catering, aviation, IT, apparel and textiles, and engineering sectors. The agreements fostered a closer working arrangement to solve issues linked to the legal framework for VET, VET provision, career guidance, and work-based learning (including apprenticeships).

Employer representatives help to design VET programmes according to labour market needs by participating in the management of VET institutions as members of their boards.

Chambers of Commerce are involved in assessing skills needs, and the social partners are actively involved in assessing competences acquired through formal, non-formal, work-based, or informal learning.

Central Professional Committee coordinates strategic issues relating to the qualifications system and consists of a committee of representatives of state and municipal government, VET providers, and the social partners, such as workers' and employers' representatives. Its main responsibilities are to establish priority sectors, make suggestions regarding the qualifications structure and advise the Qualifications and VET Development Centre on qualifications and labour market needs.

- **Markets / Tendencies:**

Short-term forecasting is undertaken by the Lithuanian Labour Exchange (Lietuvos darbo birža prie Socialin s apsaugos ir darbo ministerijos). This provides a forecast of skills demand one year ahead. This feeds into the Skills Barometer that gives a regular update on the skills most in demand. The national forecast, job opportunity barometer and the occupation map are all based on an employer survey on current and expected employment demand. The survey of employers is conducted by the Territorial Labour Exchanges (part of the Lithuanian Labour Exchange) in September and October every year using a standardised questionnaire. The questionnaire includes questions on existing and projected demand for the company's products/services, its current and future occupational needs, expected recruitment and redundancies by occupation, the training of employees, investment expectations, and other company specific details and information.

4. STAGE 2: CONTRAST and GAP DEFINITION

After collecting information from different stakeholders, the second phase consists on organize and filter all the gathered information to define the more detailed as possible the objective skills and to contrast them with the current curricula. From this comparison those needed skills that are not covered in any curriculum will be discovered.

Different methods can be used to carry out the contrast step. In this section a simple and easy using method is proposed. A matrix comparing the current skills covered by different curriculums versus the new needed skills gathered in phase 2 is used.

TABLE 10 : MATRIX EXAMPLE

Competences covered with current programs ⇨	Program Name [1]			Program Name [2]								Degree of compliance
	CU 1: XXXX L5P	CU 2: XXXX L5P	CU 3: XXXX L5P									
Needed skills ⇩	L 5	L 5	L5									
Skill 1	100%											100%
Skill 2		80%										80%
Skill 3												0%

In the example TABLE 10, the competences covered by current programs will be placed horizontally, at the top of the matrix. These *competences [see* Table 11 *for definitions]* will be classified by different competency units (CU). In the matrix different competence units from different programs are listed in order to let the user compere *learning outcomes* from different programs at the same time.

The needed skills, instead, are located vertically, on the left side of the matrix, as reflected in the table 04 the needed skills will be those obtained in stage 1, information obtained through different stakeholders.

When comparing the Competence Units covered by current programs with the needed skills, there is the possibility of only a percentage of the needed skills are covered by any of the existing

Competence Units. In those cases, those percentages must be noted on the matrix. It is possible to assets a minimum percentage, as example 75% in order to consider that the needed skills are covered enough by the UCs. If this percentage is not reached, it would mean that extra learning outcomes (and the related contents) are needed in the new curricula that will be developed.

On the other hand, if a 75% of the needed skills are covered it would be considered that those skills are covered enough by the current programs.

Once the matrix is completely fulfilled, the user will have useful information about:

- Which of the current UCs are useful for the new curriculum
- Which skill must be included in the new UCs

In the Table 11 , a glossary of terms is included in order to avoid confusions concerning the terms being used in this section.

Table 11 : GLOSSARY OF TERMS

Competence unit	*The competence unit is the minimum set of professional competences which can be partially recognized and accredited*
Competence	The ability to apply learning outcomes adequately in a defined context (education, work, personal or professional development). ***Comment***: competence is not limited to cognitive elements (involving the use of theory, concepts or tacit knowledge); it also encompasses functional aspects (involving technical skills) as well as interpersonal attributes (e.g. social or organisational skills) and ethical values.
Learning outcomes / learning attainments	The set of knowledge, skills and/or competences an individual has acquired and/or is able to demonstrate after completion of a learning process, either formal, non-formal or informal
Skill	The ability to perform tasks and solve problems
Qualification	The term qualification covers different aspects: (a) formal qualification: the formal outcome (certificate, diploma or title) of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards and/or possesses the necessary competence to do a job in a specific area of work. A qualification confers official recognition of the value of learning outcomes in the labour market and in education and training. A qualification can be a legal entitlement to practice a trade (OECD); (b) job requirements: the knowledge, aptitudes and skills required to perform the specific tasks attached to a particular work position (ILO).

Sources: “Terminology of European education and training policy A selection of 100 key terms” Cedefop ww.cedefop.europa.eu/files/4117_en.pdf
INCUAL glossary https://www.educacion.gob.es/educa/incual/ice_glosario.html

4.1. SPAIN - BASQUE COUNTRY – Miguel Altuna LHII

The following table shows an example of application of the contrast matrix”

Table 12 Contrast of current competences and detected needed skill for SPAIN

		CURRENT COMPETENCEs																			
		MECHATRONICS					INDUSTRIAL AUTOMATION AND ROBOTICS						MECHANICAL MANUFACTURING								
NEEDED SKILLS	Criticity (1 low criticity-5 High criticity)	UC1284_3: Supervise and perform the maintenance of machinery, industrial equipment and automated lines	UC0106_3: Automate mechanical manufacturing products	UC1282_3: Plan and supervise the installation in machinery plant, industrial equipment and automated lines	UC1283_3: Plan the maintenance of machinery installations, industrial equipment and automated lines	UC1285_3: To control the tests and to realize the start-up of installations of machinery, industrial equipment and automated lines	UC1568_3: Develop projects of control systems for sequential processes in industrial automation systems	UC1569_3: Develop projects of measurement and regulation systems in industrial automation systems	UC1575_3: Manage and supervise the assembly processes of industrial automation systems	UC1576_3: Manage and supervise the processes of maintenance of industrial automation systems	UC1577_3: Supervise and carry out the implementation of industrial automation systems	UC1570_3: Develop projects of communication networks in industrial automation systems	UC0107_3: Elaborate the technical documentation of the products of mechanical manufacture	UC0110_3: Elaborate the technical documentation of the tool	UC0113_3: Elaborate the technical documentation of the mold or model	UC0105_3: Design mechanical manufacturing products	UC0108_3: Designing tools for sheet&bulk metal processing	UC0111_3: Design molds and models for the foundry or forging process	UC0780_3: Participate in the design, verification and optimization of molds and tools for the transformation of polymers	UC0109_3: Automate the operating processes of sheet metal processing tools	UC0112_3: Automate mold operating processes	Degree of Compliance
Automate production processes for composites.	2		30																	30		30
Design for manufacturing for composites.	3															60				30		60
Manufacture parts by additive manufacturing technologies. (metal and plastics)	4					20																20
Set up of forming presses for bulk metal forming	4																50					50
Interpretation of FEM simulation in manufacturing	2															20						20
High speed machining of exotic materials	4												40	20								40

Artificial vision applied to automatized systems	5							50	50													50
Metrology, error compensation, auto calibration,	5												40	10	10	10	10	10	10			40
Inverse engineering. Scanning system in production lines for rapid components verifications.	5		15										10			10						15
Incorporation of Advanced Robotics. Collaborative Robots, Flexible robots	5		10					60	20													60
Data adquisition systems to monitorize production data in real time	5		10					10	10													10
Data management-secure storage, treatment, analysis and modelling.	4																					0
Sensorization and communication between components-equipment-environment.	5						10					20									10	20
Virtual reality technologies and augmented reality as an aid to planning, simulation and training processes.	5																					0
Virtual systems for process simulation, monitoring and real-time data exploration.	3								20													20
Intelligent metrology, enriched with traceability management systems.	5												40	10	10	10	10	10	10			40
Servo presses for metal sheet and bulk metal forming	5															10	20					20
Advanced maintenance, intelligent, related to the requirements and requirements of the digitization of the company.	4																					20

4.2. GERMANY

NEEDED SKILLS	Criticity (1 low criticity-5 High criticity)	PROGRAM-Germany													
		1 Analyse functional correlations in mechatronics systems	2 Produce mechanical sub-systems	3 Install electrical equipment according due consideration to technical safety aspects	4 Investigate the energy and information flows in electrical, pneumatic and hydraulic sub-assemblies	5 Communicate with the assictance of data processing systems	6 Plan and organise work processes	7 Realise simple mechatronics components	8 Design and develop mechatronics systems	9 Investigate the information flow in complex mechatronics systems	10 Plan assembly and disassembly	11 Commissioning, trouble shooting and repair	12 Preventive maintenance	13 Hand over mechatronics systems to customers	
Automate production processes for composites.	2														
Design for manufacturing for composites.	3														
Study of the mechanical characteristics of manufactured parts by additive manufacturing technologies. (metal and plastics)	4		20		30										30
Set up of forming presses for the production of aluminium alloy parts in bulk metal forming	4														
Set up and Interpretation of results of FEM simulation analysis in manufacturing processes	2														

High speed machining of exotic materials (titanium, inconels, harden materials, hard metals etc.)	4														
Artificial vision applied to automatized systems	5														
Monitoring of equipment and processes, metrology, error compensation, auto calibration, time reduction.	5						20		40				30		40
Inverse engineering. Scanning system in production lines for rapid components verifications.	5														
Incorporation of Advanced Robotics. Collaborative Robots, Flexible robots	5														
Data adquisition systems to monitorize production data in real time	5														
Data management-secure storage, treatment, analysis and modelling.	4					20			10			30	40		40
Sensorization and communication between components-equipment-environment.	5														
Virtual reality technologies and augmented reality as an aid to planning, simulation and training processes.	5								30			20			30
Virtual systems for process simulation, monitoring and real-time data exploration.	3								50			30			50
Intelligent metrology, enriched with traceability management systems.	5											20			20
Servo presses for metal sheet and bulk metal forming	5														
Advanced maintenance, intelligent, related to the requirements and requirements of the digitization of the company.	4													30	30

4.3. POLAND

Table 13 Contrast of current competences and detected needed skill for POLAND

Current skills ⇨ / ⇩ Needed skills	EE.02. Installation, commissioning and maintenance of mechatronic equipment and systems					EE.21. Operation and programming of mechatronic devices and systems			Degree of Compliance
	Assembly of components and mechanical assemblies	Assembly of components, subassemblies and pneumatic and hydraulic assemblies Assembly of components, subassemblies and pneumatic and hydraulic assemblies	Assembly of electrical and electronic components and components	Commissioning of equipment and mechatronic systems	Maintenance of mechatronic devices and systems	Operation of mechatronic devices and systems	Creation of technical documentation of equipment and mechatronic systems	Fundamentals of programming devices and mechatronic systems	
Automate production processes for composites.	10%								10
Design for manufacturing for composites.								20%	20
Manufacture parts by additive manufacturing technologies. (metal and plastics)									
Set up of forming presses for the production of component parts by bulk metal forming							10%	20%	20
Set up and Interpretation of results of FEM simulation analysis in manufacturing processes									
High speed machining of exotic materials (titanium, inconels, harden materials, hard metals etc.)						5%			5
Artificial vision applied to automatized systems									
Metrology, error compensation, auto calibration, time reduction.	25%								25

Inverse engineering. Scanning system in production lines for rapid components verifications.									
Incorporation of Advanced Robotics. Collaborative Robots, Flexible robots									

Data adquisition systems to monitorize production data in real time							10%	5%	5
Data management-secure storage, treatment, analysis and modelling.							40%	20%	20
Sensorization and communication between components-equipment-environment.									
Virtual reality technologies and augmented reality as an aid to planning, simulation and training processes.									
Virtual systems for process simulation, monitoring and real-time data exploration.									
Intelligent metrology, enriched with traceability management systems.								30%	30
Servo presses for metal sheet and bulk metal forming									
Advanced maintenance, intelligent, related to the requirements and requirements of the digitization of the company.	10%								10

4.4. TURKEY

Table 9 Contrast of current competences and detected needed skill for TURKEY

	Machine Maintenance									
CURRENT COMPETENCES NEEDED SKILLS	Criticity (1 low criticity-5 High criticity)	**Periodic maintenance of the machines**	**Periodic maintenance of the machines**	**Periodic control of the systems**	**Using lifting and handling tools**	**Diagnose faults**	**Repairing the faulty machine**	**Electric Arc welding to make welding of small diameter pipes and profiles horizontally**	**Making a blunt attachment with oxy-gas**	Degree of Compliance
Rotating equipment maintenance and repair	4		10	20						20
Maintenance and repair of hydraulic equipment	5			25	15					25
Layn setting	3			20						20
Oils and lubrication	5		35	100						100
Maintenance and repair of	4			35						35

closed containers										
Heat exchanger / cooler maintenance and repair	3			30						30
Project reading and application	5		10							10
Welding Technologies	3							35	40	40
Valve maintenance and repair	3			25						25

4.5. LITHUANIA

CURRENT COMPETENCES

		Automatic systems mechatronics								Metal industry equipment mechatronics									
NEEDED SKILLS	**Criticity (1 low criticity-5 High criticity)**	Mechanical equipment (construction materials, tools and safety, drawings and diagrams, installation and adjustment)	Electrical equipment (mechatronics electrotechnical equipment, assembling and coordinating electrical equipment)	Electric motors (application of electric motors in automated systems; types, structure, use of electric motors and their control devices; choosing, safely installing control units, connecting different types of engines)	Electronic components and devices (selecting and connecting electronics components and devices, carry out assembly and construction work safely)	Sensors (selecting and installing sensors, principles of sensor application in automated systems, sensor technology and performance)	Pneumatic and electro-pneumatic equipment (installing pneumatic and electro-pneumatic equipment, operating of pneumatic and electro-pneumatic equipment and systems)	Hydraulic and electro-hydraulic equipment (installing and operating hydraulics and electrohydraulic equipment and systems)	Logic controllers (managing controllers in automated systems, creating management schemes and programs, programing controllers)	Automated production systems (selecting, installing and operating automated production control systems)	Servo gear (types, structure and use of step and gear actuators and their control devices; selecting, installing the controls, connecting the steps and servo drives)	Robotics (mobile and fixed robotic control devices, installing control units, operating mobile and fixed robots)	Technological processes (selecting, installing and operating technological process control devices, operation of process control equipment and system)	General professional activities (work safety, using tools and technical information sources)	Mechatronic system equipment (operating management systems, installing, operating and maintenance of hydraulic, pneumatic, electric and electronic systems)	Mechanical processing of structural materials (reading and drawing detailed and assembly drawings, selecting structural, operational and electrotechnical materials, preparing technical documentation, producing items for universal machine tools)	Metal processing machines (management and adjustement of metal processing machines, producing parts for SPV metal machining)	**Degree of Compliance**
Automate production processes for composites.		10		40					15	50			60					60
Design for manufacturing for composites.									20	40			15					40
Study of the mechanical characteristics of manufactured parts by additive manufacturing technologies. (metal and plastics)		20														55	60	60
Set up of forming presses for the production of aluminium alloy parts in bulk metal forming															15		50	50
Set up and Interpretation of results of FEM simulation analysis in manufacturing processes													15					15

High speed machining of exotic materials (titanium, inconels, harden materials, hard metals etc.)		5											10	20	5	40		40
Artificial vision applied to automatized systems						15			50	10		25						50
Monitoring of equipment and processes, metrology, error compensation, auto calibration, time reduction.		25	10	20	10	60			50			25	50		40	40	10	60
Inverse engineering. Scanning system in production lines for rapid components verifications.										20						10		20
Incorporation of Advanced Robotics. Collaborative Robots, Flexible robots						50			60			55	15		10			60
Data adquisition systems to monitorize production data in real time										10					5			10
Data management-secure storage, treatment, analysis and modelling.															20			20
Sensorization and communication between components-equipment-environment.					40	55				10								55
Virtual reality technologies and augmented reality as an aid to planning, simulation and training processes.															30			30
Virtual systems for process simulation, monitoring and real-time data exploration.										10				20	50			50
Intelligent metrology, enriched with traceability management systems.															40	40		40
Servo presses for metal sheet and bulk metal forming											45					10	20	20
Advanced maintenance, intelligent, related to the requirements and requirements of the digitization of the company.		10												20	25			25

5. STAGE 3: DEFINITION OF SPECIFIC CURRICULUMS

In this stage the specifications of a new curriculum that covers the detected gaps will be described.

Two main pillars are taken into account:

- Program outputs (as result of the stage 02)
- Curriculum definition: Modules, contents, credit hours

For the development of a curriculum, then, we show the structure that should be carried out and how each section should be written. It is very important to carry out the guidelines of the template that we raise very conscientiously.

The document called "02 Procedure_to_Design_Specializations_Programs_and_Curriculums" describes briefly the characteristics of the different sections that form a curriculum. Althought the sections of the doceument may vary from one country to another, the different elements that are described should appear somewhere in all the curriculums. Being aware that the *curriculums* are official documents linked with national policies, we use "**Specialization programs**" to appoint new programs that may not be included in official curriculums.

5.1. Specific Curriculum in Advance Manufacturing

Following the indications gathered in the above mentioned document *02 Procedure_to_Design_Specializations_Programs_and_Curriculums*.pdf an example of a new *curriculum* or *Specialization program* has been developed. It is called "**Specialization Program in Advanced manufacturing".**

IDENTIFICATION DATA

Denomination: TECHNITIAN in ADVANCED MANUFACTURING

DURATION: 800 hours

INDUSTRIAL SECTOR: Mechanical Manufacturing Processes [2]

PREREQUISITES: Secondary education degree

[2] Based on Spanish VET programs

PROFESSIONAL PROFILE

GENERAL COMPETENCE:

The technicians in advanced manufacturing will perform manufacturing processes, programing machines, setting up production machines and lines, controlling automatized lines and verifying produced components.

PROFESSIONAL FIELD, OCCUPATIONS AND MOST RELEVANT JOBS:

- Technician in producing components using advance manufacturing technologies
- Technician in maintenance organization of industrial automation systems.
- Installation technician for industrial automation systems
- Technician in automated systems in advance manufacturing.

TECHNICAL, PERSONAL AND SOCIAL COMPETENCES:

- Determine machining processes based on technical information.
- Prepare machines and systems.
- Program numerical control (CNC) machine tools, robots and manipulators.
- Operate chip-forming, forming and special-purpose machine tools to obtain mechanical elements, according to the specifications defined in the manufacturing drawings.
- Check machined products.
- Perform top-level maintenance on machines and machining equipment.
- Configure automatic systems and systems according to specifications and regulations.
- Select the equipment and wiring and interconnection elements required in the automatic installation, according to the specifications and statutory requirements.
- Develop control programs according to the specifications and functional characteristics of the installation.
- Assemble the mechanical, hydraulic, pneumatic and other auxiliary elements associated with electromechanical installations. •
- Set up electrical and control systems associated with electromechanical installations, under conditions of quality and safety.
- Perform the tests and verifications, both functional and regulatory, of the facilities to check and adjust their operation.
- Diagnose the malfunctions of the equipment and elements of the facilities, using the appropriate means and applying established procedures with the required security.
- Repair, maintain and replace equipment and elements in facilities to ensure or re-establish operating conditions.
- Configure automatic systems and systems according to specifications and regulations.

- •Select the equipment and wiring and interconnection elements required in the automatic installation, according to the specifications and statutory requirements.
- Configure the equipment by developing programs for management and control of communication networks using standard buses of industrial automation systems.
- Verify the development of the production process, ensuring that the specifications of the project and therefore the quality of the product are met, complying with the standards of prevention of occupational risks and environmental protection.
- Supervise and apply quality management procedures, universal accessibility and "design for all people", in the professional activities included in the processes of production or provision of services.
- Resolve situations, problems or contingencies with initiative and autonomy within the scope of their competence, with creativity, innovation and a spirit of improvement in personal work and that of team members.
- Organize and coordinate work teams with responsibility, supervising the development of the same, maintaining fluent relationships and assuming leadership, as well as providing solutions to group conflicts that arise.
- Communicate with their peers, superiors, clients and people under their responsibility, using effective communication channels, transmitting the appropriate information or knowledge and respecting the autonomy and competence of the people involved in the scope of their work.
- Generate safe environments in the development of their work and that of their team, supervising and applying procedures for the prevention of occupational and environmental risks, in accordance with established by the regulations and the objectives of the company.
- work together with other people within the scope of their occupational activity and communicate with these people including in English;
- use technical regulations and provisions when working with mechatronics systems;
- accord due consideration to technical and business management values in carrying out basic calculations; use tables and formulae for this purpose;
- take ergonomic, economic, ecological and societal aspects into account when planning and executing work;
- minimice the negative impact of the work process on the environment by using appropriate materials, acting in a responsible manner and according due consideration to environmental regulations;
- ensure the smooth operation of plants and systems by complying with maintenance regulations; have an awareness of quality which enables them to adhere to quality standards and demonstrate cost-effective solutions;
- develop well-founded approaches for the identification of errors and rectification of malfunctions;
- use error diagnoses to derive conclusions for error rectification;

- Understand descriptions, operating instructions and other information typical to the occupation in their mother tongue and English and can prepare such information for the customer in a comprehensible form.

TRAINING: LEARNING AREAS; LEARNING OUTCOMES and CONTENTS

Table 14: Learning areas and timing

LEARNING AREA	Timing (hours)
1. Technologies in Advance Manufacturing	120
2. Definition and verification of manufacturing processes	120
3. Electric, pneumatic and hydraulic automatized systems	220
4. High speed and high performance machining	180
5. Robotics & automatization	160

LEARNING AREA 1: TECHNOLOGIES IN ADVANCE MANUFACTURING

Learning Output01 Applies operational techniques used in the chip removal machining processes interpreting the characteristics and limitations of the same.

Evaluation criteria:

a) The different chip-removal processes have been described.
b) The different geometric shapes, dimensions and superficial qualities have been related with the machines that produce them, and the limitations they have.
c) The risks of the processes have been identified.
d) The applicable environmental protection standards have been identified.

Learning Output02 Applies operational techniques used in metal forming processes, interpreting the characteristics and limitations of the same.

Evaluation criteria:

a) The different metal forming processes have been described.
b) The different geometric shapes, dimensions and superficial qualities have been related with the machines that produce them, and the limitations they have.
c) The risks of the processes have been identified.
d) The applicable environmental protection standards have been identified

Learning Output03 Applies operational techniques for the use of sensors and artificial vision in different processes, interpreting the characteristics and limitations of the same.

Evaluation criteria:

a) The different uses of sensors and artificial vision have been described.
b) The different geometric shapes, dimensions and superficial qualities have been related with the used devices and the limitations they have.
c) The risks of the processes have been identified.
d) The applicable environmental protection standards have been identified

Learning Output04 Applies operational techniques used in additive manufacturing processes, interpreting the characteristics and limitations of the same

a) The different processes of additive manufacturing have been described
b) The different geometric forms, dimensions and superficial qualities have been related with the machines that produce them, and the limitations they have.
c) The risks of the processes have been identified.
d) The applicable environmental protection standards have been identified

CONTENTS LEARNING AREA 01

- Chip removal Processes
  - Machining by chip removal (drilling, turning, milling, broaching, sawing, electro-grinding).
  - Accessories and tools: mooring and positioning of parts, and tools for machining processes by chip removal.
  - Feeding accessories (loading and unloading) of chip starting tools.
  - Metrology: measurement and verification of operations performed by chip removal.
  - Machining costs.
  - Machine capacity.
  - Risks in machining by chip removal.
  - Environmental aspects of start-up machining
- Metal forming Processes
  - Cutting and forming: punching, bending, shearing, sheet metal processing, bending, deep drawing
  - Cold, warm and hot forging
  - Hot stamping
  - Hidroforming
  - Metrology: measurement and verification.
  - Machine capacity
- Artificial vision and sensors
  - Introduction to artificial vision.
  - Commissioning or use of basic artificial vision equipment
  - Measuring practices in the vision machine.
  - Industrial applications of artificial vision.

- Detection technologies. Switches of position. Inductive proximity switches. Photoelectric detectors. Ultrasonic detectors. Pressure Detectors, Encoders, Security Detectors
- Detector installation conditions
- Practical work with detectors
- Manipulation of equipment with the most common examples of application and installation in the industrial field.

- Additive manufacturing
  - Introduction to Additive Manufacturing processes - Non-metallic materials.
  - FDM (Fused Deposition Modeling) processes. Machine structures, materials, fields of application, execution process, obtaining 3D models, 3D modeling, 3D object preparation, parts manufacturing. 3D Printing Practices
  - Scanning of parts with digital scanners, obtaining point cloud, image processing, CAD processing, final 3D printing processing. Scanning practices.
  - Workshop of execution of practices, preparation of machines, loading of filament, maintenance of extruders, initial calibrations, execution of pieces.
  - Introduction to Additive Manufacturing processes - Metallic materials. Powder bed technologies and direct energy deposition technologies
  - Direct process by Electric Plasma Arc with contribution of Metallic Wire. Introduction to direct arc processes. General principles of plasma welding. Materials and fields of application. Characteristics and parameters of the process, type of geometries and practices generated, programming of the robot for the accomplishment of simple practices. Carrying out practical exercises.
  - Direct process by laser beam with metallic powder - LMD (Laser Metal Deposition). Introduction to LMD technology. General principles of laser technology with powder. Powder feed system and feed nozzles. Characteristics and applications of processed materials. Recommendations for the use of technology. Advantages and limitations. Demonstrative practice.
  - Powder bed process with selective powder melting - SLM (Selective Laser Melting).

LEARNING AREA 2: DEFINITION AND VERIFICATION OF MANUFACTURING PROCESSES

Learning Outcome 01 Analyze the technical information of the drawings to obtain the data that defines the components to be manufactured.

Evaluation Criteria:

a) The standardized technical symbols applicable to advanced manufacturing have been interpreted.
b) They have identified the materials of the component to be formed, the finishes to be obtained and the thermal treatments that must present.

c) The geometric shape of the final component has been defined.
d) Dimensional, geometric and surface tolerances of the component to be obtained have been identified.

Learning Outcome 02 Applies verification and control techniques, ensuring that the technical specifications are met.

Evaluation criteria:

a) The environmental and cleaning conditions have been established for the verification of the part.
b) The instruments and equipment of verification have been related with the elements and characteristics to be controlled.
c) The calibration of the verification tools and machines has been checked.
d) Tests have been carried out that reproduce the conditions of service that the product must support.
e) The AMFE applied to the manufacturing process has been explained
f) The data obtained have been recorded, and the corresponding reports have been made.
g) The standards of risk prevention and environmental risks have been followed.

Learning Outcome 03 Elaborates quality control guidelines on the final component obtained by advance manufacturing processes based on the technical documentation and observing the current regulations.

Evaluation criteria:

a) The specifications of thecomponent have been analyzed, to determine what characteristics are subjected to final quality control of the component.
b) Current legislation in relation to the component to be checked have analysed.
c) Procedures, devices and control instruments and periodicity have been determined.
d) The data collection guidelines and tabs to be used in the control of the final component have been defined.

Learning Outcome 04 Performs calibration and adjustment operations, and interprets calibration certificates for instruments and verification equipment.

Evaluation criteria:

a) The elements that make up a calibration plan have been described.
b) Calibration procedures have been described.
c) Calibration has been done by choosing the patterns appropriately.
d) Uncertainty has been calculated.
e) The acceptability or not of the instrument has been determined, depending on the criterion of acceptance and rejection.
f) The calibration report / certificate has been made.
g) Calibration certificates have been interpreted.

CONTENTS LEARNING AREA 2

- Analysis of technical information
  - Symbology for manufacturing.
  - Dimensional, geometric and surface tolerances.
  - Surfaces and reference elements.
  - Material identification codes.
  - Interpretation of drawings of complex parts.
  - Plan assembly and disassembly
  - Produce mechanical sub-systems
- Control Guidelines
  - Concept, structure, content and periodicity of the control guidelines.
  - Design control reports with the guidelines to follow in the control. Current legislation.
  - Prepare data sheet for data collection, once the part is finished.
  - Analyse functional correlations in mechatronics systems

- Verification and quality control
  - Conditioning of the parts for verification.
  - Verification and control instruments, equipment and machines.
  - Checking components
  - Control models.
  - Verification of components in coordinate measuring machine, point-to-point, 3D scanner and photogrammetry.
- Destructive and non-destructive tests .
  - Verification reports.
  - Compliance with labor and environmental risk prevention standards.

Verification of design of tools

  - Check list for approval.
  - Analysis of the manufacturing process applying the process AMFE: defects and failures typical of advance manufacturing processing tools.
  - Verification of safety and environmental standards.
- Calibration of instruments and control equipment
  - Calibration plan.
  - Dissemination and traceability.
  - Measurement uncertainty.
  - Acceptability and rejection criteria.
  - Tolerance relationship, acceptance and rejection criteria (CAR) and uncertainty.
  - Calibration of verification instruments.
  - Calibration certificates.

LEARNING AREA 3.- ELECTRIC, PNEUMATIC AND HYDRAULIC AUTOMATIZED SYSTEMS

Learning Outcome 01. Identifies the elements that make up the pneumatic, electro-pneumatic, hydraulic and electro-hydraulic circuits, taking into account their physical and functional characteristics.

Evaluation criteria:

a) The different elements used in the realization of pneumatic and electro-pneumatic and hydraulic automatisms have been recognized by their function and typology.
b) The different areas of application of the pneumatic, electro-pneumatic and hydraulic automatisms have been identified.
c) It has been recognized the sequence of operation of a hydraulic pneumatic / electro pneumatic automatism
d) Information has been obtained from pneumatic, electro-pneumatic, and hydraulic diagrams.
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Learning Outcome 02. Assembles pneumatic / electro-pneumatic and hydraulic / electro-hydraulic automatisms, interpreting the technical documentation, applying wiring techniques, and performing tests and functional adjustments.

Evaluation criteria:

a) Sketches have been made to optimize the layout of the elements.
b) The elements have been distributed in the simulation panel according to their situation in the machine.
c) The physical interconnection of the elements has been made.
d) Mechanical fastening and / or correct electrical connection have been ensured.
e) The physical variables that must be regulated to perform the automation control have been identified.
f) The appropriate tools and tools have been selected to make adjustments and adjustments.
g) The physical variables that characterize the operation of the pneumatic and / or hydraulic automatism have been regulated.
h) The movements and races have been adjusted to the parameters established during the execution of the functional tests in vacuum and in load.
i) IAdjustments and / or modifications have been made for an adequate functionality of the pneumatic and / or hydraulic automatism.
j) The results have been collected in the corresponding document.

Learning outcome 3 Write simple programs for programmable controllers, identifying the variables to be controlled and responding to the operating specifications.

Evaluation criteria:

a) The variables to be controlled have been identified.
b) The sequence diagram of the automatic control of a sequential machine or process has been elaborated.
c) The number of inputs, outputs and program elements to be used has been determined.
d) Sequence diagrams (flow diagrams and GRAFCET, among others) have been made.
e) A control program meeting the prescribed operating specifications has been developed.

f) The program developed with the corresponding comments has been documented.

Learning outcome 3 Physically configures wired and / or programmed automatisms for automatic control, drawing sketches and diagrams for their construction.

Evaluation criteria:

a) Wired and / or programmed solutions that meet the specifications of the automation have been proposed.
b) The equipment and materials that meet the technical and economic specifications established have been selected from technical-commercial catalogs.
c) The minimum necessary calculations have been made for the configuration of the pneumatic / hydraulic automation of a small machine or sequential process.
d) The process to be followed in the assembly and testing of the pneumatic / hydraulic system of a small machine or sequential process has been documented.
e) The physical interconnection of the pneumatic / hydraulic elements has been carried out.

CONTENT LEARNING AREA 03

- Automation of mechanical manufacturing processes
  - Analysis of automatic systems used in advanced manufacturing processes.
  - Interpretation of pneumatic, hydraulic, electrical schemes and their combinations.
  - Identification of components of an automated system: linear and turning actuators (pneumatic, hydraulic and electric); Information collectors; Data entry (pushbuttons, switches, limit switches, detectors, etc.); Control elements and drives (relays, contactors, distributor valves.
  - Basics of manufacturing automation.
  - Pneumatic automation.
  - Hydraulic automation.
  - Electrical and electronic automation.
  - Automatic systems applications in F.M. (Gripping, sorting, sorting, sorting, insertion, positioning, clamping, transmission operations).
  - Integration of flexible systems: cells, lines and flexible manufacturing systems.
  - Computerized manufacturing (CIM).
  - PLC applications in manufacturing.
  - Transport and automatic assembly processes.
  - Automatic modular systems of tools and tools.
  - Forms of energy used in an automated, electrical, pneumatic and hydraulic system.
  - Install electrical equipment according due consideration to technical safety aspects
  - Investigate the energy and information flows in electrical, pneumatic and hydraulic sub-assemblies
  - Communicate with the assistance of data processing systems

- Realise simple mechatronics components
- Design and develop mechatronics systems
- Investigate the information flow in complex mechatronics systems
- Commissioning, trouble shooting and repair
- Preventative maintenance
- Hand over mechatronics systems to customers

- Programming of automatic systems
  - Programming PLCs.
  - Connection of sensors and actuators to a PLC.
  - Software simulation, transfer of the program to the PLC or robot.
  - Execution of the program of the PLC and Robot, optimization of movements, verification of trajectories or correction of program.
  - Preparation of the documentation corresponding to the programs carried out.

LEARNING AREA 4. HIGH SPEED AND HIGH PERFORMANCE MACHINING

Learning Output 01: Plan the phases of the high speed and high performance machining processes based on the component's drawings.

Evaluation criteria:

a) High speed and high performance machining processes and their phases have been explained.
b) Dimensional and geometric tolerances have been related according to the material of the workpiece, the machines and tools required.
c) The various machining strategies have been determined according to the material of the workpiece, the machines and tools required.
d) The architecture of the machine and the number of axes have been selected, depending on the operations to be performed and the required accuracy.
e) The machine-aided devices and instruments necessary for checking the specifications of the manufactured component have been identified.

Learning Output 02: Develop high-speed and high-performance machining processes based on the specifications gathered on the component's drawings.

Evaluation criteria:

a) The critical points of the machining process of the component to be obtained have been identified and described.
b) High speed and high performance machining strategies have been determined taking into account the cutting tools and working conditions.
c) The appropriate cutting tools have been selected for the material and the geometry of the component, based on the strategy to be performed.

d) The cutting parameters have been determined, taking into account all the variables that concur and the type of process.
e) The type of cooling and lubrication of the machining and its conditions of application have been stipulated, depending on the material to be machined and the cutting operation, taking into account the environmental protection regulations.

Learning Output 02: Produces CAM programs to obtain components by high speed and high performance machining based on the drawings of the component to be obtained and the computer file containing the solid part.

Evaluation criteria:

a) The CAM environment has been configured according to the machine to be used.
b) The geometry of the workpiece has been entered.
c) The geometry of the tools selected for modeling has been introduced.
d) The strategies of thinning, machining of debris and finishes have been established, depending on the geometry and surface qualities to be achieved.
e) The proper sequence of operations has been determined.
f) The inputs and outputs of the tool in the workpiece, positions of the tools and their cutting parameters have been entered in the CAM.
g) The trajectories of the cutting tools have been modified to facilitate high-speed machining (path from one path to another, changes of direction ...)
h) The CAM project has been debugged and optimized for its post-processing

Learning Output 02: Performs, with specific computer applications, the simulation of the CAM project to obtain componentss by high speed and high performance machining.

Evaluation criteria:

a) The geometry and kinematics of the high-speed or high-performance machine have been modeled.
b) The geometry and kinematics of the mooring tool have been modeled.
c) The geometry of the tool and the tool holder has been modeled.
d) The starting gross has been determined (prismatic piece or predetermined piece).
e) The project generated with the CAM was simulated.
f) Errors have been detected and corrected after the simulation, ensuring that the trajectories are free from interference.
g) The CNC file has been generated according to the language used in the numerical control of the machine.

CONTENTS Learning area 4

Determination of the phases of the machining process

- Machining processes and their phases.
- Dimensional and geometric tolerances to be obtained with each machine.
- Dimensional and geometric tolerances to be obtained with the tools.

- Dimensional and geometric tolerances to be obtained based on the machined material.
- Introduction to machining strategies.
- Machine concepts for machining in 3 axes, in 3 + 2 axes and 5 axes.
- Functions, shapes, geometries and materials of cutting tools.
- Mooring tools of the component
- Testing devices and instruments.

Development of the machining process

- Determination of critical machining points:
  - The surface integrity of the complex geometry.
  - The problem of machining thin walls.
  - The accessibility of the tool.
  - Proper cooling and lubrication of the cutting area.
  - Removal of chip from the cutting area.
  - Machining of magnesium.
  - Machining of surfaces with zero Vc.
- Selection of the roughing strategy in machining at high speed and high performance.
- Selection of high-speed and high-performance debris machining strategy.
- Selection of machining finishing strategies at high speed and high performance.
- Selection of machining strategies for high speed and high performance joints.
- Selection of the cutting tools required to machine the part:
  - Determination of cutting parameters:
  - Cutting speed, machining and penetration feed, axial and lateral feed depths.
  - Material of the piece, tool, surface quality, tolerances, among others.
  - Process type.
- Tool wear and life.
- Types and conditions of cooling / lubrication
- CAM software programming
  - Setting up the CAM environment based on the machine to be used.
  - Import of the geometry of the workpiece to be machined in the CAM program.
  - Modeling of tools in the CAM program.
  - Introduction of the cutting conditions in the CAM program.
  - Generation of trajectories of thinning strategies.
  - Generation of trajectories of finishing strategies.
  - Generation of trajectories of the strategies of machining remains.
  - Generation of trajectories of the finishing strategies of unions.
  - Sorting operations until correct sequencing.

- Determination of the inputs and outputs of the tool suitable for each part.
- Debugging and optimizing programs.
- Simulation of CAM programs
  - Machine modeling of high speed and high performance.
  - Modeling of the mooring tool for the part.
  - Geometric modeling of tools and tool holders.
  - Modeling of the prismatic starting material or the predetermined part.
  - Simulation of the projects of the pieces.
  - Correction of errors detected in the simulation.
  - Postprocessed.

LEARNING AREA 5.- ROBOTICS & AUTOMATIZATION

Learning outcomes 01. Recognizes different types of robots and / or motion control systems, identifying the components that form them and determining their applications in automated industrial environments.

Evaluation criteria LO01:

a) Industrial applications which justify the use of robots and motion control systems have been identified.
b) The typology and characteristics of robots and industrial manipulators have been determined.
c) The electrical elements that make up a robotic and motion control system, with their application, have been related.
d) The mechanical systems used in the joints of robots and industrial manipulators have been recognized.
e) Robots and industrial manipulators have been identified depending on the application required.

Learning outcomes 02: Configure motion control and robotics systems, selecting and connecting the elements that compose it.

Evaluation criteria LO02

a) The selection and actuation elements necessary to communicate the robots and / or industrial manipulators with their environment have been selected.
b) Schemes and schemes of robotic and motion control systems have been made using industrial communication buses.
c) The standardized symbology has been used for the representation of the devices.
d) The required security elements in the environment of a robot have been represented.
e) The components of the movement control system and / or robotics have been connected.
f) Security measures have been taken into account.

Learning outcomes 03: Program robots and / or motion control systems, using techniques of programming and data processing.

Evaluation criteria LO03:

a) The movement path of a robot has been planned.
b) The different types of signals to be processed have been identified.
c) The control sequence has been established by a sequential graph or flow chart.
d) Programming instructions have been identified.
e) The different types of data processed in the programming have been identified.
f) The robot or motion control system has been programmed.
g) G) Different programming languages have been used.
h) The system startup protocol has been developed.

Learning outcomes 04: Verify the operation of robots and / or motion control systems, adjust control devices and apply safety regulations.

Evaluation criteria LO04:

a) The connection between the elements that make up a movement control system and / or robotics has been verified.
b) The operation of the safety devices has been verified.
c) An action protocol for the implementation of a robot and / or a motion control system has been followed.
d) The sequence of operation has been verified.
e) The internal sensors have been calibrated for the positioning of a robot and / or an axis control system.
f) The response of motion control systems to abnormal situations has been checked.
g) The status of the external and internal signals and the value of the processed data have been monitored.
h) Safety standards have been taken into account.

CONTENTS Learning Area 5

- Recognition of different types of robots and motion control systems
    - Applications of robots and / or systems of control of movement (Motion Control). Palletizing, handling, welding, transporting, assembling, painting, measuring, among others.
    - Typology of robots: Cartesian, cylindrical, polar or spherical, angular, Scara, among others.
    - Analysis of security systems in robotized environments.
    - Morphological of a robot. Constitutive elements. Degrees of freedom.
    - Mechanical systems: mechanical elements. Transmission systems. Transformation of movement: circular-circular, linear-circular, circular-linear. Couplings: spherical, patella, planar, screw or screw, prismatic, rotational, cylindrical, among others.

- Tools and tools of the robot: tweezers, pneumatic or vacuum elements, electromagnets, among others.
- Robot control units. I / O interface, robot interface, connection, commissioning, security devices.
- Motion control systems.
- Programming units.
- Teleoperated systems for the control of manipulators and / or robots.
- Guidance and navigation systems in mobile applications.

- Robots programming and motion control systems
  - Planning the movement path of a robot.
  - Positioning of robots. Logical operations applied to robot programming.
  - Programming languages of robots.
  - Sequential programming and structured programming.
  - Programming of motion control systems.
- Robots operating verification and movement control systems
  - Simulation and verification techniques.
  - Concepts about program monitoring.
  - Measuring instruments
- Collaborative Robots

TITLES ASSOCIATED WITH THE PROGRAM. Prerequisites.

The titles associated to the program as access prerequisite will vary from country to country. Each country will detail them taking into account that the considered level for the program is an EQL 4

ECONOMIC SECTOR AND APPLICANTS

Different types of companies can apply for the specialization program. Basically all kind of companies that integrate automatic production lines, assembly lines, machine production, machine building, precision machining, metalforming processes etc.

TEACHERS' AND INSTRUCTORS' REQUIREMENTS

The requirements for teachers and trainers to carry out the specialization program can vary from country to country. Therefor the German types of teachers are included in the program as generic reference.

For Germany the following types of trainers are active in VET:

Table 15 Types of teachers and trainers in the German VET system

Type of training	Type of Staff
Dual system of training	Trainers (instructors) or masters within companies (Certified educators/trainers in professional education, Certified educators/trainers in initial and continuing vocational education) including the responsible VET managers in large companies); VET teachers in vocational schools (two categories: 1. university trained teachers for job-related theory and general education subjects; 2. *Werklehrer* (master craftsmen or technicians with additional further training) imparting practical skills) Instructors and trainers within inter-company VET centres (*ÜBS*)
Special VET for disadvantaged leading to dual system diplomas	VET teachers/trainers within private institutions
Full-time vocational schools	VET teachers in vocational schools (see above)
Learning facilitators	Youth workers in training schemes for the disadvantaged, training counsellors in the chambers, vocational guidance counsellors employed by the Federal Employment Agencies etc. [3]

[3] Kristina Alice; Hippach-Schneider, Ute: Germany. VET in Europe - Country report 2014, 28.

5.2. Specific Curriculum in Technician in Machine Maintenance

Following the indications gathered in the document *02 Procedure_to_Design_Specializations_Programs_and_Curriculums*.pdf a second example of a new *curriculum* or *Specialization program* has been developed. This curriculum has been implemented in Turkey by the partner **Kocaeli Milli Eğitim Müdürlüğü PEK**, using the method described in this Intellectual Output.

This program is being implemented in Machine Maintenance branch of Körfez Mesleki ve Teknik Anadolu Lisesi (Korfez Technical And Vocational High School) thanks to the protocol signed between Directorate General for Vocational and Technical Education and Türkiye Petrol Rafinerileri Anonim Şirketi –TÜPRAŞ- (Turkish

Petroleum Refineries Corporation.

The leading organisation of the energy sector in Turkey and adopting the vision of a world-class refining company, TÜPRAŞ aims to produce low-cost quality products in accordance with the laws on environment and human health, pursuant to the norms of the European Union. The factor of qualified, experienced, trained employees, which require long years to train in petroleum refining sector, has a great importance in the operation of refineries which are critical facilities with regard to national economy, national security and community life, in a profitable, efficient and safe way.

In the framework of protocol, the curricula of Machine Maintenance branch for the 11th grades have been modified and updated according to the needs of refinery industry in the machine maintenance services. The students of the school also have the opportunity of having their practical training in that company.

The program is called "**Specialization Program in Technician in Machine Maintenance**"

IDENTIFICATION DATA

Denomination: Technician in Machine Maintenance

DURATION: 325 hours

INDUSTRIAL SECTOR: Manufacturing and Service Industry

PREREQUISITES: To be completed compulsory primary education (8 years), to carry out the entrance conditions determined by the Ministry of National Education according to school types and field / branch. On the other hand, the health status of the students should be suitable for doing the jobs required by the occupations under the Machine Technology

PROFESSIONAL PROFILE

GENERAL COMPETENCE:

Technician in Machine Maintenance performs maintenance and repair works by detecting the failures of all machines and construction elements, ensures the continuity of the use of machinery and equipment in the manufacturing and service sectors and the efficiency of production without causing disruptions and downtimes.

PROFESSIONAL FIELD, OCCUPATIONS AND MOST RELEVANT JOBS:

The employment area of the machinery manufacturing enterprises is very high. Employment occurs mostly in private establishments. It is highly possible to work in large industrial enterprises and SMEs (small and medium sized enterprises).

They can work in private business establishments as maintenance supervisor, quality control supervisor, workshop supervisor, department supervisor according to their experience.

TECHNICAL, PERSONAL AND SOCIAL COMPETENCES:

- Emergency information
- Analytical thinking skills
- Simple first aid information
- Ability to make simple cost calculations
- The ability to enter data into a computer
- Workspace editing skills
- Knowledge of operation and control procedures
- Knowledge of environmental protection practices
- Knowledge and skill of the use of hardware and tools
- Teamwork skills
- Hand skill
- Handling, handling and fixing equipment usage skills
- Ability to use milling benches
- Occupational health and safety information
- Transaction documentation and knowledge of various technical specifications

- Providing accurate information to supervisors
- Trial and application in fault detection
- To provide routine repair of defective equipment
- Deciding within the knowledge and experience
- Carefully check the condition of the work equipment and machines
- Adopting environmental, quality and OHS rules
- Being sensitive about natural resource use and recycling
- To be able to work together in the team

- Making careful selection of required cleaning materials
- Stopping the operation of the equipment in case of emergency and necessary
- Communicate correctly and relay information during business cycles
- Respect workplace hierarchy relationship
- Watching the safety of yourself and others
- Be careful when preparing materials
- To be able to determine adverse environmental effects
- Be willing to convey what you learn
- Being sensitive about risk factors
- To fulfill responsibilities
- Take care to process quality
- To comply with instructions and guidelines
- Informing concerned persons in danger situations
- To perceive and assess dangerous situations
- Care for cleaning, order and work place

TRAINING: LEARNING AREAS; LEARNING OUTCOMES and CONTENTS

LEARNING AREAS	Timing (hours)
1. PERIODICAL MAINTENANCE INSTRUCTION 1	36
2. PERIODIC MAINTENANCE INSTRUCTION 2	27
3. PERIODIC CONTROLS OF SYSTEMS 1	27
4. PERIODIC CONTROLS OF SYSTEMS 2	27
5. STEAM TURBINES AND COMPRESSORS	54
6. TROUBLE SHOOTING	18
7. FAILED MACHINERY MAINTENANCE 1	9
8. FAILED MACHINERY MAINTENANCE 2	19
9. ELECTRIC ARC WELDING	36
10. PIPING SYSTEMS, VALVES AND FITTINGS	18
11. PUMPS AND POWER TRANSMISSION ELEMENTS	54
TOTAL	325

LEARNING AREA 1: PERIODICAL MAINTENANCE INSTRUCTION 1

Learning Output01 The student will be able to create periodic maintenance calendars and instructions when the necessary environment is provided.

Evaluation criteria:

a) Create a maintenance schedule for a specified machine.

b) Explain the instructions of a specified machine by examining the maintenance catalog and operating manuals.

c) Provide maintenance instructions.

d) Prepare layout plan fort he macines in the workshop.

e) Completes the work in the desired time.
f) Be careful of cleanliness in work.
g) Pay attention to safety rules in their work.
h) Use protective clothing in work.

LEARNING AREA 2: PERIODICAL MAINTENANCE INSTRUCTION 2

Learning Output01 The student will be able to create periodic maintenance calendars and instructions when the necessary environment is provided.

Evaluation criteria:

a) Controls the sealing components.
b) Present a sample machine as a project by reading and interpreting the catalog pictures.
c) Reads catalog and choose components.
d) Completes the work in the desired time.
e) Be aware of cleanliness in work.
f) Pay attention to safety rules in their work.
g) Use protective clothing in work.

LEARNING AREA 3: PERIODIC CONTROLS OF SYSTEMS 1

Learning Output01 Control the transmission elements If provided with the needed environment.

Evaluation criteria:

a) Know the types of bearings.
b) Know the types of bearing house.
c) Assembly bearing and bearing house.
d) Mounting and inspection of transfer gears, bearings and bushings.
e) Controls the clutch and brake system
f) Adjusts the clutch.
g) Completes the work in the desired time.
h) Be careful of cleanliness in work.
i) Pay attention to the safety rules in their work.
j) Use protective clothing in work.

LEARNING AREA 4: PERIODIC CONTROLS OF SYSTEMS 2

Learning Output01 Be able to control periodic maintenance safety and lubrication systems If the required environment is provided;

Evaluation criteria:

a) Explains the tasks of the machine by examining the safety systems.
b) Checks the safety systems of the machine.
c) Checks the lubrication systems of the machines.
d) Select the oil according to catalog specifications.
e) Changes the machine oil.

f) Completes the work in the desired time.
g) Be careful of cleanliness in work.
h) Pay attention to the safety rules in their work.
i) Use protective clothing in work.

LEARNING AREA 5: STEAM TURBINES AND COMPRESSORS

Learning Output01 Be able to detect faults in steam turbines and compressors If the required environment is provided.

Evaluation criteria:

a) Recognize steam turbines.
b) Recognize the types of steam turbines.
c) Know the main parts of steam turbines.
d) Identify the sealing components.
e) Know bearing houses.
f) Know the properties of gases.
g) Know the laws concerning gases.
h) Know the working principles of compressors.
i) Know the types of compressors.
j) Know the working principle of centrifugal compressors.
k) Know how to make lubrication and cooling.

LEARNING AREA 6: TROUBLE SHOOTING

Learning Output01 Be able to detect the faults in the machine If the required environment is provided.

Evaluation criteria:

a) Review and report on the failure notification form and the history of the machine.
b) Identifies the defective part according to the given data.
c) Investigate the causes of failure.
d) Completes the work in the desired time.
e) Be aware of cleanliness in work.
f) Pay attention to safety rules in their work.
g) Use protective clothing in work.

LEARNING AREA 7: FAILED MACHINERY MAINTENANCE 1

Learning Output01 Be able clean and distmantle of defective If the required environment is provided.

Evaluation criteria:

a) Cleans the oiled and dusty parts of the defective machine by using cleaning methods and techniques.

b) Disassemble the defective part using suitable disassembly tools.
c) Sequence of parts removed according to assembly order.
d) Number the parts according to the assembly picture.
e) Completes the work in the desired time.
f) Be careful of cleanliness in work.
g) Pay attention to safety rules in their work.Çalışmalarında koruyucu kıyafet kullanır.

LEARNING AREA 8: FAILED MACHINERY MAINTENANCE 2

Learning Output01 Be able to replace and test the defective part If the required environment is provided.

Evaluation criteria:

a) Decides to repair or replace the defective part when necessary.
b) Installs the component using the appropriate assembly tools.
c) Performs lubrication and adjustment according to the instructions for use.
d) Tests the operation of the machine.
e) Completes the work in the desired time.
f) Be careful of cleanliness in work.
g) Pay attention to safety rules in their work.
h) Use protective clothing in work.

LEARNING AREA 9: ELECTRIC ARC WELDING

Learning Output01 Be able to make electrical arc welding and Oxy-Gas welding If the required environment is provided.

Evaluation criteria:

a) Prepares the welding machine, chassis and pliers for welding.
b) Operates the welding machine and adjusts the welding ampere by selecting the electrode diameter according to the pipe cross section.
c) Positions the pieces in the welding position, using angles or v houses if necessary.
d) Does the joint welding by adjusting the electrode angle, movement and feed rate.
e) Does the butt welding of the small diameter pipes.
f) Does the “T” welding of the small diameter pipes.
g) Does the butt welding of profiles.
h) Does the “T” welding of the profiles.
i) After the welding, breaks the welding cement and cleans the welding seam with a wire brush.
j) Checks the quality of the welding made.
k) Completes the work in the desired time.
l) Be careful of cleanliness in work.
m) Pay attention to safety rules in their work.
n) Use protective clothing in work.

LEARNING AREA 10: BORULAMA SİSTEMLERİ, VANALAR VE FITTINGSLER

Learning Output01 Carries out the maintenance of the piping systems, valves and fittings If the required environment is provided.

Evaluation criteria:

a) Defines the pipe.
b) Know the usage areas of pipes.
c) Have knowledge about the standards, specifications and measures of piping.
d) Know the piping elements and their measurements.
e) Carry out the thermal insulation of pipes.

LEARNING AREA 11: PIPING SYSTEMS, VALVES AND FITTINGS

Learning Output01 Carries out the maintenance of the pumps and power transmission elements.

Evaluation criteria:

a) Knows the purpose of using the pump.
b) Classifies the pumps.
c) Knows cavitation.
d) Have practical knowledge about pumps.
e) Knows the tools used in power transmission.
f) Explains the clutches.
g) Knows gear types.
h) Knows the operating system of the belt pulley assembly.

TITLES ASSOCIATED WITH THE PROGRAM. Prerequisites.

The titles associated to the program as access prerequisite will vary from country to country. Each country will detail them taking into account that the considered level for the program is an EQL 4

ECONOMIC SECTOR AND APPLICANTS

Although this program is prepared specially for the maintenance technician need of oil refinery companies different types of companies in manufacturing and service sector can apply for the specialization program.

TEACHERS' AND INSTRUCTORS' REQUIREMENTS

1. Teachers who have undergraduate education and have sector experience in their field,
2. Professionals who have mastery and mastership certificate working in the sector when necessary.

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acting together

PROJECT PARTNERS:

KIELCE TECHNOLOGY PARK

GLOBAL IDEAS PROJECTS

T.C. MİLLÎ EĞİTİM BAKANLIĞI

Bergara MIGUEL ALTUNA INSTITUTUA

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