FACTORY 4.0

FOSTERING ADAPTABILITY AND ENHANCING COMPETENCES TOWARDS A DIGITAL INDUSTRY

F.A.C.T.O.R.Y.

MAPPING OF COMPETENCES: Units of learning outcomes

The industry - the sector and its associated business - in the economy of the European Union accounts for more than 50 % of private sector employment, 75 % of exports and 80 % of private research and development. The manufacturing sector employed 29.9 million people in 2014 and around 1 in 10 of all enterprises in the EU-28 non-financial business economy were classified to manufacturing, a total of 2.1 million enterprises which means a high potential for possible growth and employment.

Meanwhile, a new industrial revolution, driven by new generations of digital technologies such as big data, artificial intelligence is taking place. Modernizing of production is speeding up: it leads to a new definition of the nature of work itself and to competence evolution; new job profiles are requested. Indeed, the emergence of new technologies contributes to the automation and digitalization of manufacturing processes: boundaries between maintenance, manufacturing, operation, management, quality are heavily bewildered. Thus, new technicians are needed with a high level of adaptability and a strong multi technological training.

More, if we consider European policies, in March 2010, the Europe 2020 strategy to enhance the competitiveness of the EU and to create more growth and jobs was adopted. The latest version of the "Integrated economic and employment guidelines" includes a guideline to improve the business and consumer environment and modernize Europe's industrial base. In October 2012, so as to build on and update the integrated Industrial policy, the European Commission adopted a Communication entitled "a stronger European industry for Growth and Economic Recovery" which put forward policies to lay the foundations for Europe's industry of the future, which underlines the strategic role of this sector in the EU economy. Among other topics, this communication focuses on the role of human capital and skills, in particular, developing skills in the labour force for industrial transformation – it is mentioned that accompanying measures to increase investment in human skills are key to the success of industrial policy. Tools to anticipate skills needs are necessary to equip the labour force for industrial changes.

Up to now, none initial nor ongoing education is liable to propose contents relevant for these changes which are taking place: existing curricula are partially up to date and thus not able to prepare students and workers for the transformation occurring. On top of that, Europe faces serious challenges to supply of skills with mismatches and in some member states, even skill shortages; it means that if we want our industry to be a key driver for growth, employment and innovation, there is a urgent need for the education/training system to provide the right skills set for use in industry. **Investment in training is also investment in innovation, since much technical change results from incremental innovations by skilled workers on the factory floor. Training provides the ability to analyse and innovate. Anticipation of skills needs is recognized as vital to the success of every company.**

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INTRODUCTION

FACTORY is an Erasmus + project gathering partners from 5 countries: Finland, France, Greece, Poland and the United-Kingdom.

This project aims at:

- adapting the training offer to new needs and to a new manufacturing environment taking into account the digital evolutions which have an impact on the organization of companies,
- offering a pathway which is more suitable to the demand of the labour market: shorter, customized, more reactive,
- enhancing the transversal competences required in order to contribute to employability and even setting-up of businesses,
- fostering the adaptability of workers and students,
- supporting companies so that they can anticipate skills needs and train their teams in order to keep their level of competitiveness.

The consortium goal is to contribute to the achievement of the Europe 2020 objectives of smart, sustainable and inclusive growth: training professionals and future professionals is a way to increase the overall employability of the labour force and thus facilitate their transition to new jobs.

The expected results of this common work are:

- a greater relevance of the training and education system to the needs and opportunities of the labour market,
- a strengthening of the links between training and education systems and the socio-economical environment,
- a more comprehensive and strategic use of ICT and Open Educational Resources in training and education as well as in businesses related to adults training,
- synergies with digital policies implemented in our regions
- a common approach and pathway to give a common and adaptable answer to small and medium sized businesses in our regions and countries.

Several digital tools will be developed in order to support SMEs towards digitalization.

- A diagnosis tool to assess their level of maturity regarding 4IR
- A mobile app with training contents,
- An e-assessment tool so that employees can evaluate their training needs considering their job evolutions,
- An immersive reality tool to support and train the staff
- All of these built upon a mapping of competences and some units of learning outcomes defined by partners.

SKILLS AND COMPETENCES TO DEVELOP RELATED TO INDUSTRY 4.0

The project targets EQF levels 4 and 5 IVET and CVET learners attending education/training in the fields related to manufacturing industry.

With the mapping of competences, we wish to identify the skills, competences and knowledge needed by any operator working in an industrial environment facing the challenges of digitalization in order to adapt to changes occurring. **The project focuses on transversal competences, useful in any type of manufacture, in connection with production and maintenance, from supply to delivery.** It means that these competences and knowledge are common to workers at different stages of the manufacturing process: product design and process, piloting and controlling (piloting and control, traceability, flow management), manufacturing processes (precision and agility), services (maintenance) and work organization.

Digital transformation with a nearly total networking of the stages of production require new ways of thinking, of working, of cooperating and of training people. It implies changes in the different flows in the business either physical or linked to information.

Workers need to be able to face and solve impairment of production or product quality for instance and to have a global insight of the manufacturing process in order to gain in efficiency.

The new competences will refer to Lean management (with regards to approaches to solve problems, quality management, traceability, maintenance, the organization of production lines, communication …), the understanding of the all production unit and the ways the different flows occur.

Adaptability to a new industrial environment has, as prerequisite, the ability to learn and thus the need for workers to get to know how to learn and in order to be ready to be upskilled when needed. Operators also need a minimum of digital knowledge and competences.

APPROACH SELECTED BY PARTNERS TO DEFINE THE RELEVANT COMPETENCES REQUIRED IN ORDER TO FOSTER THE ADAPTATION OF THE WORK FORCE TO NEW TECHNOLOGIES

The partnership has decided to select an informational approach instead of the most commonly used organizational one.It has been decided to **focus on the informational and digital continuity within the production unit** and more precisely the **M.E.S. – Manufacturing Execution System** - which is a tool, central to the digital transformation of industry towards Industry 4.0 and thus becomes the guiding principle of our approach.

Regarding the digital transformation of production units, **the digital flow enables the process data to be used** in order to improve its control, to go further towards the predictive piloting. The main goal is to become more efficient with regards to the manufacturing of products which are every day more complex with higher and higher level of quality requirements.

MES is a lever for industry 4.0 operational excellency. It is a logical extension of ERP system.

In order to ensure a continuous digital flow, the MES has to work vertically from the sensor to the ERP system.

When we are talking about a continuous digital flow, the MES is the key cornerstone of the information system, which puts the execution at the centre of the structure and ensure the link between the manufacturing process and the business management.
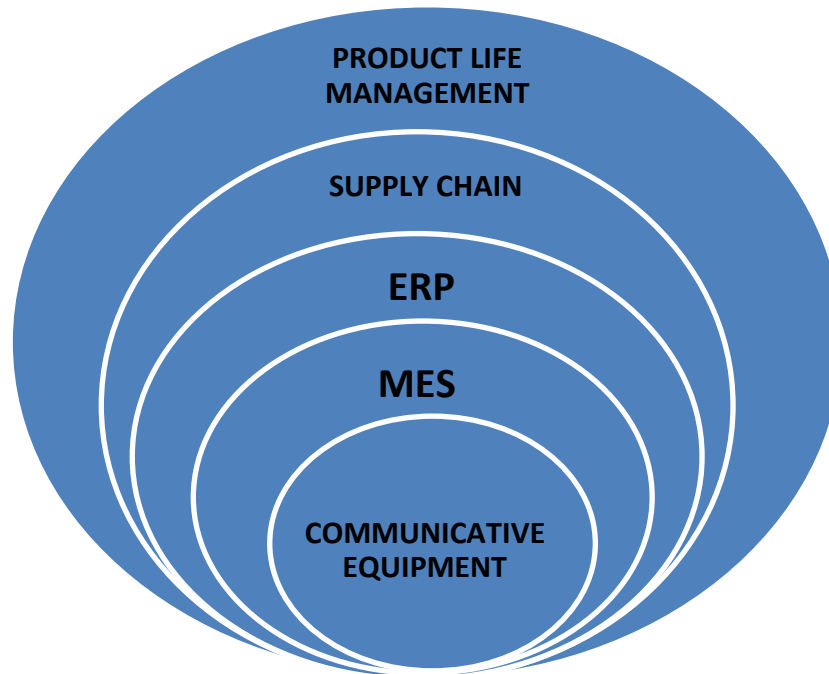
The M.E.S. comprises and covers 11 functions which are the following:

- Data collection
- Sequencing of operations
- Staff management
- Resources management
- Products flow
- Traceability
- Quality control
- Processes management
- Performance analysis
- Documents management
- Maintenance management

And that will be the basis of our mapping of competences.

DOMAINS AND THEMES

Here is the chart with the different domains and themes selected by the partners in order to design a set of learning outcomes. This mapping of competences will enable trainers to propose a complementary training to the existing curricula and consequently will update the training.

There are two types of topics. The first group of topics will support learners towards adaptability and should be taken prior to the second one based on MES functions.
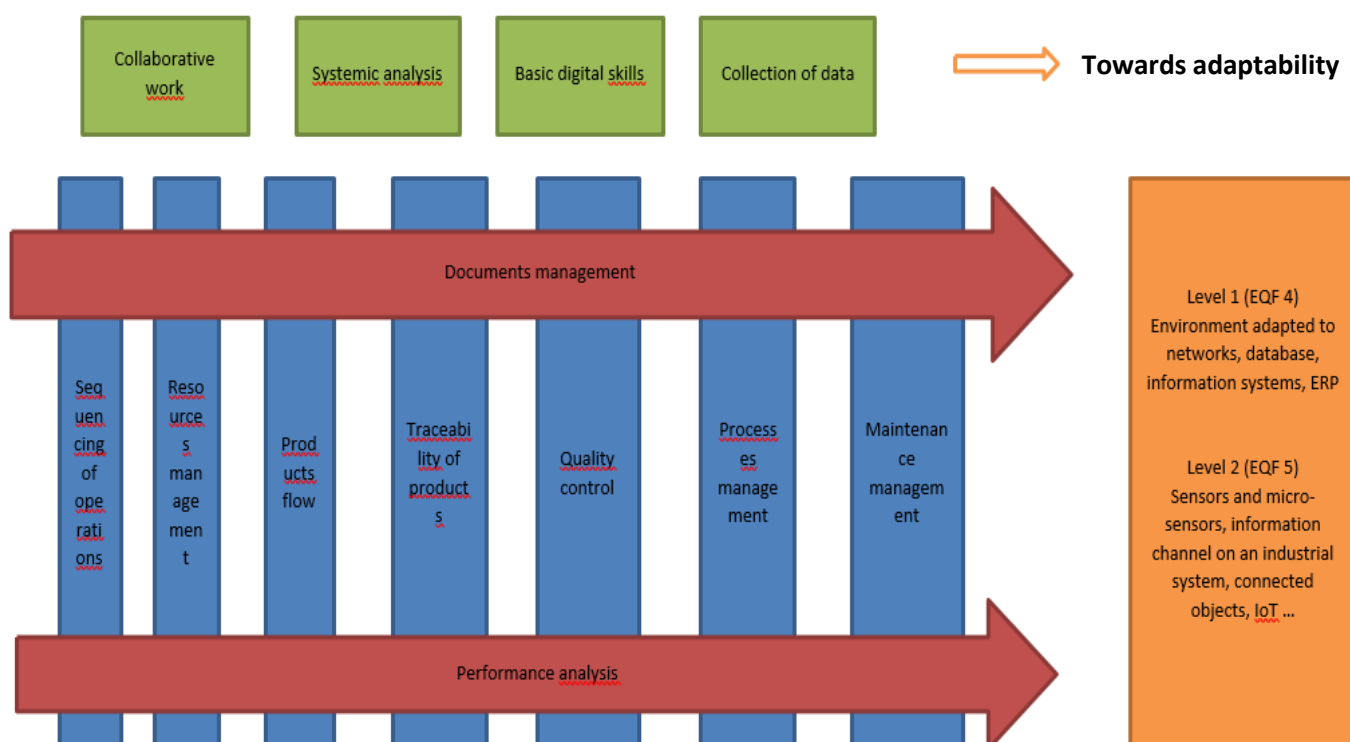
The following chart is to define **learning outcomes** in relation with EQF. A learning outcome is defined as a statement of what a learner knows, understands and is able to do on completion of a learning process.

Considering what each function and topic covers, it has been necessary to revamp the set of learning outcomes in order to obtain a comprehensive set taking into account the complementarity, the transversal skills and the possible overlaps.

THE LEARNING ACHIEVEMENTS:

Learning outcomes are broken down into: knowledge, skills and competences, and it seems important to provide a definition of what this word refer to.

Competence

Competence includes:

i) cognitive competence involving the use of theory and concepts, as well as informal tacit knowledge gained experientially

ii) functional competence (skills or knowhow), those things that a person should be able to do when they are functioning in a given area of work, learning or social activity

iii) personal competence involving knowing how to conduct oneself in a specific situation

iv) ethical competence involving the possession of certain personal and professional values

Knowledge

In the context of EQF, knowledge should be considered theoretical and/or factual and is specifically defined according to each of the EQF levels

Skill

In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments). The skills are specifically described according to each of the EQF levels.

Assessment criteria

The quality and precision of learning outcomes descriptions is an important basis for assessment. It is up to each VET institution to develop its own method of assessment according to the training pathways and overall curriculum they undertake. This guidebook and toolkit provide the necessary learning material including the description of learning outcomes and a wide range of exercise sets provided by study cases and the serious game. It is highly advisable to undertake assessment as an outcome of learning processes gained through training in the VET centre and through work-based learning during work-experience.

ECVET MEETS EQF (EUROPEAN QUALIFICATION FRAMEWORK)

(FROM HTTP://WWW.ECVET-TOOLKIT.EU)

The EQF encompasses all levels and all types of learning and centres on eight reference levels (*see table below*), known as EQF levels, that describe what a learner knows, understands and is able to do (learning outcomes descriptors). The EQF does not describe specific qualifications, however, relying instead on the levelling of qualifications and awards against existing National Qualifications Systems and Frameworks (NQFs).

The EQF shares common transparency goals with ECVET, with each of these instruments making use of learning outcomes. In ECVET, learning outcomes are used as a basis for credit transfer and accumulation. ECVET does not, however, provide a template or taxonomy for the development of learning outcomes, relying instead on models already in use at national, regional or systems level (for example, as a part of existing NQFs).

What is essential for ECVET is ensuring that learning outcomes are clearly identified and described to enable the mutual understanding of qualifications and judgments on:

- whether the qualifications covered in the framework of a partnership for geographical mobility lead to the same or similar occupation.
- whether learning outcomes, as described in one setting or context, are comparable with those able to be achieved in another setting or context.

Therefore, it should be possible to transfer units of learning outcomes which have been achieved and assessed in one learning environment to another learning environment. They should be comparable and transferable between countries, and capable of being "translated" into existing national training systems.

Improved mobility means that, following a placement abroad, learners come back with a certificate which is recognised in their own training system or learning context.

IF WE CONSIDER THE PROJECT FACTORY, LEVELS TARGETED ARE LEVELS 4 AND 5 DESCRIBED BELOW

	Knowledge	Skills	Responsibility and autonomy or competence
Level 4 The learning outcomes relevant to Level 4 are	Factual and theoretical knowledge in broad contexts within a field of work or study	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Exercise self-management within the guidelines of work or study contexts that are usually predictable, but are subject to change; supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities
Level 5[The learning outcomes relevant to Level 5 are	Comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge	A comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems	Exercise management and supervision in contexts of work or study activities where there is unpredictable change; review and develop performance of self and others

Considering the objectives of the project, the partnership has defined that for each unit of learning outcome, there should be two levels considered. Each unit refers to EQF level 4 and EQF level 5. Knowledge, competences and skills referring to EQF level 5 are marked with an asterisk.

UNIT 1 : BASIC DIGITAL SKILLS

Unit: 1	Title: Basic digital skills	ECVET credit points
EQF level	4	

Key outcome(s):
Using ICT devices
Using digital services and applications
Using different digital environments and applications in their work tasks

Learning outcomes

Knowledge	Skills	Competence
The learner knows and understands: • digital services • social media and digital identity • principles of data storage • critical data analyses • copyright rules • information security • confidentiality, identification, authentication • data search in data banks • legislation on data protection • digital communication	The learner can: • use most common ICT devices, programs, applications and operating systems. • use internet, e-mail programs, digital communication, Skype, messengers, chat applications, Microsoft teams. • use electronic services and forms (filing e-forms, using e-keys, manage passwords) • implementing basic copyright rules • use text programs, calculating sheets and presentation programs (eg. Word, Excel) • digital image and video editing • use augmented reality and virtual reality devices • use cloud services • search and analyze data in a databank • share and protect information and documents on cloud services	The learner is able to: • choose appropriate devices according to different purposes of use • use the most common digital devices • use digital services and applications in own work tasks • systematically follow instructions related to data security and data protection • produce and share digital material in networks related to their vocational field • apply and comply to copyright rules • answer customers calls/messages • write reports, letters in a workbook/report • follow and understand software updates.

Performance criteria for assessment: according to national rules and practices

The learner is able to:	expected results*:	

- choose appropriate devices according to the purpose of use - use the most common ICT devices at the level of a citizen's digital competence - obtain information on appropriate digital services and applications - use digital services and applications in their work tasks - use and share digital content in compliance with copyrights - comply with instructions related to data security and data protection - understand the principles of creating their digital identity and protecting it - operate in digital environments and networks - share material and comply with instructions on copyrights	The learner is able to use the most common ICT devices, programs, applications, electronic services and operating systems in respective work field. The learner is able to search and analyze data, share information and documents according to copyright.

Hours of total learning unit: 36 hours	

Assessment methods:
self-evaluation, evaluation by teacher, national standardized tests. Several individual tasks during learning and work-based learning activities supported by on-line tools like self-evaluation questionnaires

UNIT 2: COLLABORATIVE WORK

Unit 2	Title: Collaborative Work	ECVET credit points
EQF level	4 -5	
Key outcome(s): Introducing style of management needed for handling collective work. Learners will be equipped with knowledge, skills and competencies necessary to coordinate roles and tasks of different teams for the benefit of common projects' goals on one-hand and individuals/ organisations on the other.		
Learning outcomes:		
Knowledge	**Skills**	**Competences**

The learner knows and understands:
 	
- CWE (Collaborative Work Environment) principles and CWE tools :
    - classical and corporate communication tools
    - product life cycle management tools (from design to manufacturing)
    - manufacturing process management tools
    - corporate project management tools
    - quality management tools
    - financial and costing management tools
 	
- Team building techniques
- Empowerment and confidence building solutions
- Motivational methods
- Conflict/ change management procedures
- Problem solving tools
- Key elements of HRM
	The learner can:
	
	- Implement techniques, methods, solutions, tools, procedures enabling effective management of individuals and teams within collaborative manufacturing working environment*
	- Define the capacity of all team members versus requirements*
	- suggest training for his/her team members.*
		The learner is able to:
		
		- Anticipate and plan collaboration flow between all work units and team members*
		- Encourage the full potential of all individuals basing on collaborative work with others*
		- explain in which collaborative system information can be found.*

Performance criteria for assessment	
The learner is able to:	Expected results*:
-know the different collaborative corporate systems used and who can have access, for which tasks -know the different links between the communication systems. -Help select compatible partners to carry out projects,* - Invest the necessary time and energy in collaborative tasks, - Provide the training to acquire collaboration skills, - Determine the best ways to engage employees/ co-workers* - Provide collaboration-related incentives, rewards, and benefits, - Emphasize a work-life balance for all team members, - Develop a culture of trust between cooperating parties involved,* - Identify the obstacles to success, - Interview clients to determine their needs and preferences,* - Modify staff roles and processes to enhance efficiency and satisfaction among partners,* -Updating collaborators on a project's developments.* - Be open to new ideas about how to proceed based on your team's' findings.	- Learners can demonstrate their capacity to understand, handle and explain the different collaboration systems and tools in a synthetic way. - Learners can demonstrate their capacity to become a team leader/ team facilitator enhancing collaboration by: - Listening actively to the concerns of team members, - Agreeing on the roles that capitalize on the team members' individual strengths,* - Analysing problems without assigning blame, - Defining mutually acceptable roles within the team, - Delegating tasks with open discussion, - Arriving at a consensus regarding goals and processes, - Eliciting the views of reluctant group members, - Facilitating group discussion, - Listening to the concerns of team members, - Making sure of hearing the perspectives of the quieter collaborators,* - Recognising and resolving conflicts with collaborators.*
Hours of total learning unit: 40 hours	
Assessment methods:	
Assessment Centre Method (several individual and group-based tests and practical simulations) supported by on-line tools like self-evaluation questionnaires	

UNIT 3: INDUSTRIAL INFORMATION CHAIN FOR AUTOMATION

Unit 3	Title: Industrial information chain for automation		ECVET credit points
EQF Level	*4 – 5**		

Key outcome (s):
Identifying and defining the characteristics of an industrial system's information chain.
Getting a functional and structural approach of a connected industrial system.

Learning outcome:

Knowledge	Skills	Competences
The learner knows and understands how to: ● Recognise the different types of goods (lines, automated systems, sub-systems, functional plants, Information systems); ● Recognise the different types of process functions ● Decode a technical file and manufacturer's manual on paper, digital & augmented reality ● Read and decode the different tools used for description and presentation.	The learner can: ● Identify the different types of goods/items/products ● Identify the different functions of the system ● Identify the communicating systems ● Analyse the functional organisation ● Understand an automated & information system's architecture	The learner is able to: ● Explain the connected systems' functional architecture

Aspect and technical choices

The learner knows and understands:	The learner can:	The learner is able to:

● System specific functions:
  o To acquire information;
  o To process information;
  o To control power.
● Functions linked to the environment:
  o Dialogue (system/operator);
  o Communication (between systems).
	● Identify the functions of the information chain
	● Identify other safety, monitoring, maintenance functions
	● Justify the role and characteristics of the components which execute the function
	● Choose a component (*);
	● Identify the components' conditions of use, assembly, control setting;
	● Define the maintenance operations and associated procedures.
		● Explain an automated system's chain of information and its different functions
		● Explain the role of the components which execute the function
		● Justify the choice of component (*)

● The general structure of **an information acquisition chain and associated functions:**
  o Detection, transduction, adaptation, transmission;
  o Industrial detectors for automation;
  o Analog, digital, smart sensors & actuators.
	● Analyse, improve or adapt the acquisition of information function.
	● Identify the acquired data or information, its coding format (*)
		● Suggest an insightful approach towards improvement(*)

The learner knows and understands:	The learner can:	The learner is able to:
● The general structure of **an information acquisition chain and associated functions:** IOT 　o Main technologies 　o Architecture of a connected objects' system 　o Architecture of wireless objects, 　o Architecture of connection networks, ZigBee, BLE, NFC, 3G,4G (5G provision), Sigfox or LORA, …. 　o Protocols and norms	● Identify the communication protocol ● Analyse, improve or adapt the acquisition of information function from smart and connected sensors(*)	
● Information processing: logic, digital, analog; 　o Industrial programmable logic controller: 　o Working principle; 　o Notion of cycle duration; 　o Modular inputs/outputs; 　o Specific boards; 　o Setting up & being able to analyse a program on a programmable logic controller	● Analyse, improve or adapt the information processing function. ● Identify the tools used for information transmission	
● The man/machine dialogue for the management, settings and maintenance. 　o Types of HMI (Human Machine Interface). 　o Associated technical means: programmable operations panel, integrated PLC site. 　o Systems' communication basics; 　o Information transmission method; 　o Communication networks in/outside of the company. 　o Collaborative robotics	● Analyse, improve or adapt the system/operator dialogue function for maintenance operations ● Analyse, improve or adapt the communication function between machines for operations through maintenance ● Identify the parameters/settings screens of the communicating systems in the HMI	

The learner knows and understands:	The learner can:	The learner is able to:
● Surveillance or local diagnostic techniques via the use of smart pre-actuators and sensors; ● Centralised monitoring (communication function): concept of local network (Ethernet…); ● Error mode of the communication function; Monitoring assistance software packages;	● Analyse, improve or adapt the connected monitoring function of a system to improve availability.	
● Virtual Reality contribution ● Augmented Reality contribution ● THE FLOW FROM CAD DESIGN TO MACHINE PROGRAMMATION VIA MANUFACTURING ENGINEERING SPECIFIC CAD TOOLS	● Explain the contribution of this technology to ▪ line driving ▪ production and manufacturing ▪ maintenance Turning & milling examples or sheet metal cutting and bending machines Simple examples showing cad files, manufacturing work, post processing, machine code generation, transfert between users using a company information flow & data collection system (bill of materials, drawing)	

Performance criteria for the assessment:

The learner is able to:	Expected outcomes*:
● Decipher a technical file and manufacturer's manual ● Read and decipher the different tools used to describe and present. ● Clearly identify the functions of the information chain. ● Correctly identify the components of the information chain ● Justify the role, characteristics and layout of the components. * ● Correctly justify the setting parameters' values.* ● Identify pros and cons of technical solutions.* ● Suggest ways an approach towards improvement.*	● The diagnostics are aptly completed ● Judicious choice of replacement components * ● Insightful improvement suggestions with the aim of: ● Improving the system's availability* ● Improving the maintenance cost* ● Timely beginning regular and preventative interventions*

Hours of total learning unit: 100 hours

Assessment method:
Evidence for the Knowledge and/or Skills items in this Outcome to be provided on a sample basis. The evidence should be presented in response to specific questions. Each candidate will need to demonstrate that she/he can answer questions based on a sample of the items shown above.

- Only EQF 5

UNIT 4: SYSTEME ANALYSIS

Unit 4	Title: Systems analysis	ECVET credit points
EQF Level	4 - 5*	
Key outcome(s) : Being able to decipher all types of technical representations of systems from the industrial world by combining them with an observation of the item or product in its reality		
Knowledge	**Skills**	**Competences**
The learner knows and understands: o The different types of items or goods: ● Production or transformation lines of goods or energy ● Installation integrated to a building or structure ● Isolated system ● Sub-system ● the company o The internal structure of a system: ● The entities making up the system ● The links/flows between these entities: ▪ Flows of material, energy, information, decisions… ● The functions having an effect on flows: ▪ Transformation, transport, storage, exchange and treatment o Breakdown in sub-systems o The system's functions: ● Its global function ● Its specifications and technical requirements. o The time-related representation of the system's behaviour	The learner can: o Describe the system's functional organisation and the interactions between the items or products o Identify and justify the technical functions and associated material solutions o Identify the performances expected of the item/product. o Identify the control settings and their influence on the item/product's behaviour. o Analyse the system's production methods and operating mode. o Read and interpret the description of the system's temporal evolution.	The learner is able to: o Give an interpretation of a system's representation using appropriate tools (intelligible, and respecting the representation's standards) ● Mapping of flows ● Kinematic, fluidic, pneumatic and electric blueprints ● Networking structure ● Information and energy chain ● the organization chart of the company (hierachical, functional) o Fill in functional specifications o Approve that the functional specifications have been respected by observing/measuring the real system o Read and interpret the description tools of systems ● sequential ● time-based ● logical

Performance criteria for the assessment	
The learner is able to:	**Expected outcomes***
o Describe the functional organisation of the system and the interactions between the items/products.	o The functional organisation is described accurately.

o Identify and justify the technical functions and material solutions associated with them	o The components, their characteristics, their conditions of use are all correctly:
	     o identified
	     o and justified*

o Identify the item/product's expected specifications/performance	o The performances are correctly identified.
o Identify the control settings and their influence on the product's behaviour	o The control settings are identified and their influence is correctly described.
o Analyse the system's production methods and operating mode*	
o Read and interpret the description of the system's temporal evolution*	o The various operating functions (sequential, logical and time-based) are identified and the different operating states of the product are made explicit.
	o The different stages of operation are made explicit.
Hours of total learning unit: 45 hours (depending on the level to reach)	
Assessment methods	
A case study (explain the system)	

*only for EQF 5

UNIT 5: PRODUCTION PLANNING GENERAL OVERVIEW

Unit 5	Title : Production planning general overview	ECVET credit points
EQF level	4 "know" participate and understand 5 "Master" lead the basics	
Key outcome(s): Explaining the Principles of Production Planning and Control		
Learning outcomes:		
Knowledge	Skills	Competences
The learner knows and understands : • Reasons for applying production planning and control philosophies and techniques. • Different levels of planning. • Independent and dependent demand types and demand fluctuations. • Inventory management (including inventory types and classification). • Capacity planning (avoiding bottlenecks, loading, multi-cycling). • Bill of Material (BOM). • Concept of Just-in-time and Kanban • Forecasting techniques • Planning techniques • Capacity Planning techniques • Operations scheduling techniques	The learner can: • Explain and compare the principles of production planning and control. • Apply relevant elements of production planning and control philosophies and techniques • Improve production techniques and the efficient use of plant and traceability of items within a manufacturing facility	The learner is able to : • define production planning as an aid to the efficient use of available manufacturing resources to produce one or more items as opposed to not using a system where the results could be less efficient • describe consequences of not using it • describe the different approaches required for at least two levels of planning • explain the difference between dependent and independent demand types • describe a minimum of two types of inventory and state the disadvantages of holding inventory • describe the principles of capacity planning and its importance • describe the structure of a Bill of Material and the types of information it contains • state the principles and objectives of Just-in-Time approach to production management

Performance criteria for assessment	
The learner is able to :	expected results*:
Understand and apply the principles of planning and production control to improve production techniques and the efficient use of plant and traceability of items within a manufacturing facility.	On completion of the Unit the candidate should be able to: • deciding a planning approach • developing the plan • deciding a control approach • developing the sequence schedule • writing the documentation
Hours of total learning unit : 20 hours (level 4) + 20 hours (level 5)	
Assessment methods	
Evidence for the Knowledge and/or Skills items in this Outcome to be provided on a sample basis. The evidence should be presented in response to specific questions. Each candidate will need to demonstrate that she/he can answer questions based on a sample of the items shown above.	

UNIT 6: PRODUCTION FLOWS MANAGEMENT

Unit 6	Title : Production flow management & Flexibility	ECVET credit points
EQF level	4 "know" participate 5 must "Master" lead the basics	
Key outcome(s): Scheduling, prioritising and managing individual works' orders to meet global planning requirements. Explaining the principles of production planning and control		
Learning outcomes:		
Knowledge	**Skills**	**Competences**
The learner knows and understands prior to this: ⬛ Material Requirements Planning (MRP) system ⬛ Kanban system ⬛ Work centre data	The learner can : Use the information from the Capacity Planning system and the work centre data to determine a load for work operations Compare the load on each work operation with the capacity available	The learner is able to : Plan the work order data from the Material Requirements Planning (MRP) system to determine the load for work operations Calculate a capacity profile for each work centre Explain how capacity can be adjusted to accommodate the word load

Performance criteria for assessment	
The learner is able to:	Expected results*:
Determine and manage the capacity of work operation based on manufacturing orders. Schedule, prioritise and manage individual works' orders to meet customer requirement. Knowledge and Skills gained include: Plan Material Requirements Planning (MRP2) system Kanban system Work centre data Line & cell production Work load, depth of process, tack time, bottlenecks Comparison of load and capacity Capacity profiles *(to be precised for accurate translation, look SAP shoptalk)* Adjust capacity to accommodate the load requirements Priority management approaches Prioritising and sequencing rules Load levelling Forward and backward scheduling Finite and infinite scheduling ⬜ Push/pull systems	Learners can demonstrate all aspects of their Knowledge and/or Skills in this Outcome by showing that they can: Explain how the organisation may decide on priority management Prioritise and sequence customer orders based on the organisation's policy Assess the loading to achieve a level load where possible Conduct both forward and backward scheduling activities Explain the concepts of finite and infinite scheduling Compare the use of a pull system with the more established push system of shop floor loading. Identify type of production, bottlenecks, production flows Calculate Depth of process, tack time, dependant needs and time offsets
Hours of total learning unit : from 20 hours to 30 hours	
Assessment methods:	
The assessment of this Outcome could take the form of a case study	

UNIT 7: PRODUCTION SHOPFLOOR ORGANIZATION TOOLS

Unit 7	Title : Shopfloor organization techniques	ECVET credit points
EQF level	4 "know" to participate 5 must "Master" lead the basics	
Key outcome(s)		
Explaining the principles of production flow		
Learning outcomes:		
Knowledge	**Skills**	**Competences**
The learner knows and understands : ● Lean leadership and management ● Visual management ● Workplace organisation (5S's) ● Key performance indicators small overview (TRS/TRG/Tackt time…) ● Just In Time (JIT) ● Total Productive Maintenance (TPM) ● Continuous improvement (Deming wheel) ● SMED ● Lines, C lines, isolated cells	The learner can : ● Understand & Explain lean manufacturing philosophy and associated concepts and practices Intelligence to situation	The learner is able to : ● Explain the philosophy behind production flow manufacturing in terms of the elimination of waste or improving the flow or smoothness of work ● Describe the concepts of value added and non-value added in lean methodology ● Explain what is meant by the term value stream in the context of production and lean manufacturing ● Describe the difference between 'pull' and 'push' manufacturing processes ● Explain the importance of visual management in production flow processes ● Explain the importance of good workplace organisation in improving the efficiency of a manufacturing process ● Define two of the following: Lead Time, Takt Time, Changeover Time, Overall Equipment Effectiveness or any other relevant KPI ● Explain the role of a Just in Time (JIT) strategy in manufacturing

| | | ● List the five main elements of Total Productive Maintenance (TPM) |
| | | ● Explain how continuous improvement is a part of the ~~development of a lean production flow~~ |

Performance criteria for assessment:

The learner is able to :	expected results*:
Understand and apply the principles of planning and production control to improve production flow techniques.	On completion of the Unit the candidate should be able to: ● Identify customer values (such as product quality and performance, delivery times and acceptable costs) ● Identify the membership of the production team (this can be in terms of work titles) ● Explain the ways in which production flow tools are used in the implementation of a system ● Identify the key KPIs used to measure improvements (e.g. Takt Time, Lead Time etc.)

Hours of total learning unit : 20 hours

Assessment methods

Evidence for the Knowledge and/or Skills items in this Outcome to be provided on a sample basis. The evidence should be presented in response to specific questions. Each candidate will need to demonstrate that he/she can answer correctly questions based on a sample of the items shown under the Knowledge and/or Skills items in the Outcome

UNIT 8: RESOURCE MANAGEMENT

Unit 8	Title : Resource Management	ECVET credit points
EQF level	4 + 5 (*)	
Key outcome(s): Explaining the principles of Resource management. Mastering the following production quality basics to participate in a Lean or Total quality production environment		
Learning outcomes:		
Knowledge	**Skills**	**Competences**
The learner knows and understands : ● Resource Objectives ● ● Customer values ● Implementation team ● Team requirements ● Resource tools ● KPI' ● Value stream maps ● Visual controls ● Supply chain (kits, packaging ● Partners companies (Electronic Data Exchange) ● Workforce planning ● Lead times ● Stocks control (real time on system) ● Outcomes from lean study (*)	The learner can : ● Plan the transition of a manufacturing process to production flow and lean operations (*) ● Participate to a part of a transition plan of a manufacturing process to production flow and lean operations ● Read and understand indicators	The learner is able to : ● Define clearly the objectives Resource Management ● Identify clearly the ultimate customer values (such as product quality and performance, delivery times and acceptable costs) ● Explain the ways in which resource tools are used in the study and in any implementation of the system thereafter (e.g. Plan, Do, Check, Act (PDCA)) (*) ● Identify the key KPIs used to measure resource improvements (*) ● Identify any visual controls that will help in communicating manufacturing system ● Explain the Outcomes of resource study showing any potential changes to the manufacturing process (*)

Performance criteria for assessment	
The learner is able to :	expected results*:
Understand and apply the principles of resource management techniques within a quality policy.	On completion of the Unit the candidate should be able to: ● Prepare resource management maps of the following: — Current state resource ● Read and understand ann existing resource management map. ● Identify the training requirements of those involved in the lean team (*) ● Explain the ways in which production resource management tools are used in the implementation of a system ● Explain the Outcomes of the resource management process justifying any potential changes to the manufacturing sequence ● Identify and explain the quality indicators to the objectives (*) (customer needs and company profitability) ● Collect and process datas for indicators
Hours of total learning unit : 30 hours	
Assessment methods	
Evidence for the Knowledge and/or Skills items in this Outcome to be provided on a sample basis. The evidence should be presented in response to specific questions. Each candidate will need to demonstrate that he/she can answer correctly questions based on a sample of the items shown under the Knowledge and/or Skills items in the Outcome	

UNIT 9: ONGOING IMPROVEMENT

Unit 9	Title : Continuous improvement	ECVET credit points
EQF level	4 + 5(*)	
Key outcome(s) : Measuring, Reporting, Maintaining records on production (schedule, inventory, quality…) AND participating to their improvement. Explaining the principles of production planning and control.		
Learning outcomes:		
Knowledge	**Skills**	**Competences**
The learner knows and understands : The skills needed for you to monitor and report on production performance and the associated supply chain	The learner can : Check tools, equipment and resources are used efficiently and effectively in line with regulatory and organisational requirements. Ensure quality and compliance specifications are adhered to, records are maintained and reports relating to the progress and performance of the production line are communicated to relevant colleagues	The learner is able to : Assess performance, which includes the progress of the production line to meet production targets and additionally include the monitoring of the production line in relation to organisational or customer specification, quality and compliance requirements.

Performance criteria for assessment	
The learner is able to :	expected results*:
Report promptly on production issues affecting progress, quality, compliance or additional organisational requirement Source positive and negative feedback from customers and relay to colleagues Work within the limits of your authority to ensure feedback is acted upon Complete or check production and equipment records in systems and documentation accurately and promptly to organisational requirements Ensure that relevant people have access to current and accurate production information (*), via visual tools or System information Communicate performance and productivity to relevant colleagues on the production line file records or system in the appropriate place (*) Know PDCA Deming Wheel, Hoshin, Creativity methods, Ishikawa diagrams methods Solve problems using PDCA Deming Wheel, Hoshin, Creativity methods, Ishikawa diagrams methods as team leader & implement solutions (*)	The Learner can: Report and maintain records on production progress in accordance with workplace procedures and taking effective action in response to two operating problems Change or implement, proof, document new records, methods, procedure within the information system (*)
Hours of total learning unit : 20 hours	
Assessment methods: Evidence of performance may employ examples of the following assessment: observation; written and oral questioning; Evidence from company systems (Management System); reviewing the outcomes of work; checking any records of documents completed; checking accounts of work that the candidate or others have written.	

UNIT 10 : METROLOGY BASICS MEASUREMENTS AND DATA COLLECTION

Unit 10	Title : Metrology basics, measurements and data collection	ECVET credit points
EQF level	4 + 5 (*)	

Key outcome(s):
Mastering the following production quality basics to participate in a Lean or Total quality production environment
Explaining the principles of Resource management

Learning outcomes:		
Knowledge	**Skills**	**Competences**
The learner knows and understands : ● Understanding basics of metrology (conditions of measures, gauges, measuring tools, machine parameters, machine calibrations, deviations, expected precisions of a measure… ● Performance indicators in details (Global & Synthetic productivity ratio) ● SPC statistical process control basics (capability machine + Process) ● SPC statistical process control basics, (incoming controls and final production sampling) ● Maintenance policies (preventive, PPM, Corrective) ● Maintenance and reliability indicators (MTBF, MTTR) ● Data collection organization in the mainframe system	The learner can : ● Read and understand all related indicators and graphs (Visual management…) ● Read and use measuring equipment in the appropriate manner ● Use the measurement equipment in the right conditions, check the operating condition of metrology tools used ● Plan, organize the checks and repairs of metrology tools with appropriate organizations and known standards (*) ● Compare a measure to the drawing or known standard or requirements ● Calculate & explains those indicators (*)	The learner is able to : Implement a standardized known technique to collect datas for a given problem (*) Collect according to procedure and Address data to the appropriate database

Performance criteria for assessment	
The learner is able to :	expected results*:
Understand and apply the principles of resource management techniques within a quality policy.	On completion of the Unit the candidate should be able to:
Hours of total learning unit : 30 hours	
Assessment methods	
Evidence for the Knowledge and/or Skills items in this Outcome to be provided on a sample basis. The evidence should be presented in response to specific questions. Each candidate will need to demonstrate that he/she can answer correctly questions based on a sample of the items shown under the Knowledge and/or Skills items in the Outcome	