IN4WOOD

Industry 4.0 for Wood and Furniture Manufacturers

Deliverable 2.2.: Common Curriculum Proposal Version 1

Lead Beneficiary:	CETEM
Approved by:	All Consortium
Dissemination Level:	Public

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Table of Track Changes

Version	Date	Changes
1	31st January 2018	First version of the document

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Annex 1: In4Wood Common Curriculum Proposal.

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1. Executive summary

Background

Many observers believe that Europe is at the beginning of a new industrial revolution, considered to be the fourth such leap forward and hence labelled Industry 4.0. The ubiquitous use of sensors, the expansion of wireless communication and networks, the deployment of increasingly intelligent robots and machines (as well as increased computing power at lower cost and the development of 'big data' analytics) has the potential to transform the way goods are manufactured in Europe.

This new, digital industrial revolution holds the promise of increased flexibility in manufacturing, mass customization, increased speed, better quality and improved productivity. However, to capture these benefits, enterprises will need to invest in equipment, information and communication technologies (ICTs) and data analysis as well as the integration of data flows throughout the global value chain.

The EU supports industrial change through its industrial policy and through research and infrastructure funding. Member States are also sponsoring national initiatives such as *Industrie 4.0* in Germany, "*Industria conectada 4.0*" in Spain, the *Factory of the Future* in France and Italy, and Catapult centres in the UK. However, **challenges like training** workers and future professionals **remain**.

One quarter of the world´s furniture is produced in the EU. In 2012, more than 900.000 EU workers were employed in approximately 126.000 firms, and production amounted to more than €84 Billion[1]. However, these figures are 13% lower than in 2007, while the Asian market has increased its production a 230% during the same period[2]. In this context, the implementation and transference of the state of the art technologies in the production chain is a crucial point for the European Furniture and Woodworking industries to remain competitive, coupled with the fact that Staff qualifications, along with the ageing workforce and the inability to attract young workers[3] remain one of the crucial points in these industries. To boost the recruitment of highly prepared staff requires initiatives addressing training to make the sector attractive and to transform both the academic knowledge and high-level basic and transversal competences to be useful and applicable.

The furniture and wood sector has identified that it has a shortage of professionals with high qualification in ICTs and other emerging technologies. Some of the specific skills and competencies that stand out as critical for managers in the furniture sector are ICTs skills that are crucial to operate in a modern business environment.[4]

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[1] (Eurostat SBS Eurostat, (sbs_na_ind_r2).

[2] CSIL processing data from official sources: Eurostat, UN, National Statistical Offices, National Furniture manufacturers associations.

[3] EFIC (2012) Enhancing the competitiveness of the European Furniture Industry.

[4] Investing in the Future of Jobs and Skills. Scenarios, implications and options in anticipation of future skills and knowledge needs. Sector Report. Furniture. European Commission, DG Employment, Social Affairs and Equal Opportunities.

The present document compiles the suggestions from the VET providers, sector experts and educational authorities from the In4Wood alliance for the design and delivery of a joint curriculum for "Manufacturers of Furniture Smart Factories" on Industry 4.0 expertise in the wood and furniture manufacturing sector.

2. Methodology

For the design of the common curriculum, it was followed the learning Outcomes Approach according to the principles of ECVET so as to support lifelong learning, the flexibility of learning pathways and the assessment, recognition and accumulation of the learning outcomes of each individual.

According to the Recommendation on the European Qualifications Framework - EQF[5], learning outcomes are statements of what a learner knows, understands and is able to do on completion of a learning process. The qualification frameworks usually detail the overall level of learning outcomes. For ECVET purposes, the EQF is used as a reference for levels. Learning outcomes may be acquired through a variety of learning pathways, modes of delivery (school-based, in-company, etc.), in different learning contexts (formal, non-formal and informal) or settings (i.e. country, education and training system …).

Based on the main findings of the Skills Analysis developed in WP1, content developers defined the different learning outcomes with the suggestions of the sector experts and VET authorities using the terms of Knowledge, Skills and Competences according to the Council Recommendation on the European Qualification Framework for lifelong learning[6].

Knowledge means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. In the context of the EQF, knowledge is described as theoretical and/or factual.

Skills means the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments.

Competences mean the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development.

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[5] Recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning.

[6] Council Recommendation of 22 May 2017 on the European Qualifications Framework for lifelong learning and repealing the recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning.

Such learning competences were grouped in units and sub units. Being a Unit a component of a qualification, consisting of a coherent set of knowledge, skills and competences that can be assessed and validated. For this, a Unit Description Template was prepared, that includes the basic information for the description of units using ECVET principles[7]:

-The generic title of the unit.
-The generic title of the qualification.
-The reference of the qualification according to the EQF and NQF levels.
-The learning outcomes contained in the units, in terms of knowledge, skills and competences.
-The procedures and criteria for assessment of such learning outcomes.
-The ECVET points associated.

Content developers completed four templates, one per each of the units that the In4Wood qualification comprises.

The In4Wood training curriculum has been designed to further implement those quality indicators that may be applicable to In4Wood, and proposed by the European Parliament and the Council for establishing a European Quality Assurance Reference Framework for Vocational Education and Training[8]. Which will be used to support the quality assurance and improvement cycle, implemented within the European Quality Assurance Reference Framework.

Figure 1: The Quality Assurance and Improvement Cycle. Source: the European Quality Assurance in Vocational Education and Training.

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[7] The European Credit System for Vocational Education and Training: Get to know ECVET better Questions and Answers.
[8] Recommendation of the European Parliament and of the Council of 18 June 2009 on the establishment of a European Quality Assurance Reference Framework for Vocational Education and Training.

Indicator	Type of Indicator	Purpose of the Policy
Overarching Indicators for Quality Assurance		
No 1 Relevance of quality assurance systems for VET providers: (a) share of VET providers applying internal quality assurance systems defined by law/at own initiative. (b) share of accredited VET providers	Context/Input	Promote a quality improvement culture at VET-provider level Increase the transparency of quality of training Improve mutual trust on training provision
No 2 Investment in training of teachers and trainers: (a) Share of teachers and trainers participating in further training (b) Amount of funds invested	Input/Process	Promote ownership of teachers and trainers in the process of quality development in VET Improve the responsiveness of VET to changing demands of labour market Increase individual learning capacity building Improve learners' achievement
Indicators supporting quality objectives for VET policies		
No 3 Participation rate in VET programmes: Number of participants in VET programmes [1], according to the type of programme and the individual criteria [2]	Input/Process/Output	Obtain basic information at VET-system and VET-provider levels on the attractiveness of VET Target support to increase access to VET, including for disadvantaged groups
No 4 Completion rate in VET programmes: Number of persons having successfully completed/abandoned VET programmes, according to the type of programme and the individual criteria	Process/Output /Outcome	Obtain basic information on educational achievements and the quality of training processes Calculate drop-out rates compared to participation rate Support successful completion as one of the main objectives for quality in VET Support adapted training provision, including for disadvantaged groups
No 5 Placement rate in VET programmes: (a) destination of VET learners at a designated point in time after completion of training, according to	Outcome	Support employability Improve responsiveness of VET to the changing demands in the labour market Support adapted training provision, including for disadvantaged groups

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Indicator	Type of Indicator	Purpose of the Policy
the type of programme and the individual criteria (^{3}) (b) share of employed learners at a designated point in time after completion of training, according to the type of programme and the individual criteria		
No 6 Utilisation of acquired skills at the workplace: (a) information on occupation obtained by individuals after completion of training, according to type of training and individual criteria. (b) satisfaction rate of individuals and employers with acquired skills/competences	Outcome (mix of qualitative and quantitative data)	Increase employability Improve responsiveness of VET to changing demands in the labour market Support adapted training provision, including for disadvantaged groups

Context information

Indicator	Type of Indicator	Purpose of the Policy
No 7 Unemployment rate(*) according to individual criteria	Context	Background information for policy decision-making at VET-system level
No 8 Prevalence of vulnerable groups: (a) percentage of participants in VET classified as disadvantaged groups (in a defined region or catchment area) according to age and gender. (b) success rate of disadvantaged groups according to age and gender	Context	Background information for policy decision-making at VET-system level Support access to VET for disadvantaged groups Support adapted training provision for disadvantaged groups
No 9 Mechanisms to identify training needs in the labour market: (a) information on mechanisms set up to identify changing demands at different levels (b) evidence of their effectiveness	Context/Input (qualitative information)	Improve responsiveness of VET to changing demands in the labour market Support employability
No 10 Schemes used to promote better access to VET:	Process	Promote access to VET, including for disadvantaged groups

Indicator	Type of Indicator	Purpose of the Policy
(a) information on existing schemes at different levels (b) evidence of their effectiveness	(qualitative information)	Support adapted training provision

(1) *For IVT: a period of 6 weeks of training is needed before a learner is counted as a participant. For lifelong learning: percentage of population admitted to formal VET programmes.*

(2) Besides basic information on gender and age, other social criteria might be applied, e.g. early school leavers, highest educational achievement, migrants, persons with disabilities, length of unemployment.

(3) For IVT: including information on the destination of learners who have dropped out.

(4) Definition according to ILO and OECD: individuals aged 15-74 without work, actively seeking employment and ready to start work

Table 1: A Reference Set of Selected Quality Indicators for Assessing Quality in VET.

3. Groups of interests of the In4Wood common curriculum.

The main beneficiaries of this common curriculum are the target groups that the In4Wood defined and in which the six designed learning pathways have been based:
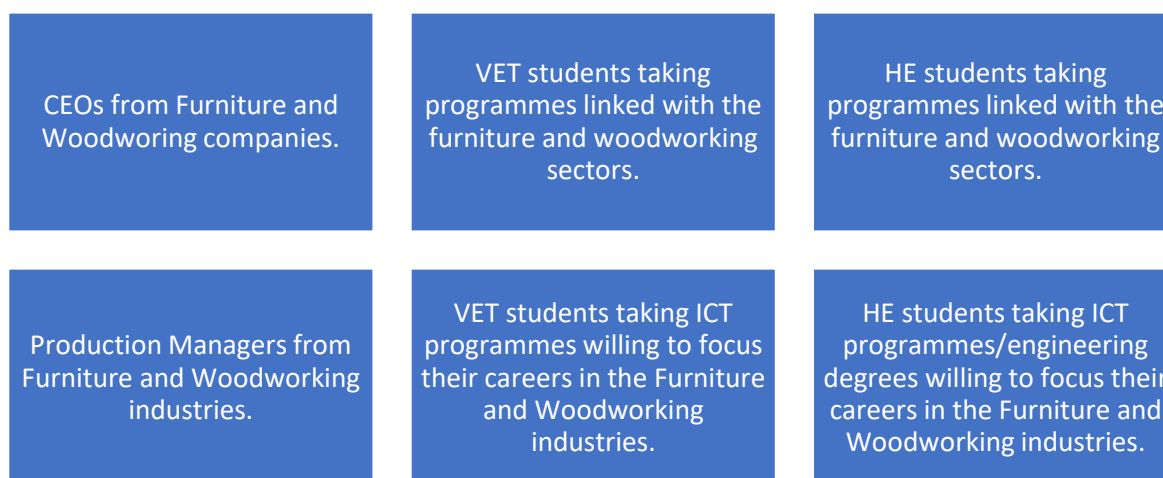
CEOs from Furniture and Woodworing companies.	VET students taking programmes linked with the furniture and woodworking sectors.	HE students taking programmes linked with the furniture and woodworking sectors.
Production Managers from Furniture and Woodworking industries.	VET students taking ICT programmes willing to focus their careers in the Furniture and Woodworking industries.	HE students taking ICT programmes/engineering degrees willing to focus their careers in the Furniture and Woodworking industries.

Figure 2: In4Wood´s target users.

The harmonised Joint Curriculum of European Smart Wood Furniture **manufacturers** will recognise the I4.0 skills and competences of **CEOS** and **production managers** from furniture and woodworking industries, **VET and HE students**. IN4WOOD will equip them with the required skills for deploying the different I4.0 technologies in the wood industry leading to convert them in a " smart factory of the future".

Moreover, the In4Wood common curriculum will also have the following beneficiaries:

Educational Institutions from the furniture and woodworking industries, Higher Education and Vocational Education and Training, including both those participating in the proposal and those European VET and HE institutions that will be reached during and after the project´s lifetime, will be able to include the IN4WOOD training course expanding their training offer according to the labour market needs.

Educational authorities and policy makers, specially those from regions highly impacted by such sectors, will have the chance of including the new JCV in their offer. The regional development agencies under the umbrella of EURADA will be able to offer and disseminate the results among local industries that will raise awareness of and the capacity of deployment of I4.0 technologies among their enterprises. This will finally impact.

Furniture and Woodworking industries of the sector by Increasing and facilitating the integration of ICT tools and techniques at the early stage of their business activity.

4. Conclusions and next steps.

This common curriculum proposal includes the suggestions of the In4Wood Alliance according to the key findings obtained from the experts of the furniture, woodworking and ICT sectors and the Educational community. The following steps will be focused on:

-The development of the didactic materials that will address the defined learning outcomes, this will allow to define the associated ECVET points of each learning unit.

-The implementation of the common curriculum during the pilot test experience (WP5) and further activities at national and EU level under the frame of Dissemination and Exploitation (WP6).

-The assessment and review of the common curricula according to the feedback from pilot testers, In4Wood partners and external stakeholders through different tools to be implemented under Quality Assurance (WP7) and Monitoring and Evaluation (WP8).

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Qualification	Manufacturers of Smart Furniture and wood factories.			
Unit	Digital and physic world hybridising			
EQF Level	NQF levels			
	Spain	UK	Italy	Germany
5	3	5	5	5
Associated ECVET points	To be defined			
Learning Outcomes				

Sub-unit	Knowledge	Skills	Competences
3D Printing and Additive Manufacturing for furniture manufacturing.	The learner… - Knows the steps to follow since you get the 3D model up to the printed piece.	The learner is able to… - Obtain and print a 3D object. - Identify what is printable or not. - Know what types of software are needed for each step of the 3D printing process.	The learner is able to… - Make decisions within the printing process. - Analyze the part before printing.
	The learner… - Knows the Influence of additive manufacturing on the design and prototyping of a product. - Knows the application of the additive manufacturing for the production of pre-mold or molds for short series.	The learner is able to… - Recognize what types of pieces of furniture can be printed in 3D. - Increase the added value of the product through this technology. - Know when and how to use rapid tooling.	The learner is able to… - Adapt the prototype to the specifications of the customer. - Analyze the production and improve costs and times in the production process. - Work with hybrid technology (Pieces of wood assembled with 3D printing parts).

	- Acquires knowledge about competitiveness of the additive manufacturing in the production sector.		
	The learner… - Knows how 3D printing is being used in the furniture market.	The learner is able to… - Identify the different uses of 3D printing in the furniture market.	The learner is able to… - Analyze and optimize the design for 3D printing, adapting it to market trends.
Augmented Reality and intelligent tools may be used during the design and fabrication of the product.	The learner… - Understands the functioning of augmented reality and its differences with virtual reality.	The learner is able to… - Define and determine what Augmented Reality is and how it works. - Identify the elements needed to create Augmented Reality.	The learner is able to… - Identify programs used in Augmented Reality. - Recognize the different types of Augmented Reality.
	The learner… - Knows the influence of Augmented Reality on the design and prototyping of a product. - Knows the uses of Augmented Reality throughout the production chain of furniture, from the design to the final piece.	The learner is able to… - Recognize the different uses of augmented reality in the production chain. - Start working with this technology within a company. - Know how AR can reducing costs and times in the production process of a furniture.	The learner is able to… - Adapt the prototype to the specifications of the customer through the use of AR. - Analyze the production and Improve costs and times in the production process. - Understand the new way of work with AR.
	The learner…	The learner is able to…	The learner is able to…

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	- Knows how Augmented Reality is being used in the furniture market.	- Identify the different uses of Augmented Reality in the furniture market.	- Analyze and optimize the design, adapting it to market trends.
Examples of performance activities developed in BLM department for the dissemination.	The learner… - Learns through practical examples.	The learner is able to… - Know how to apply Augmented Reality and 3D Printing.	The learner is able to… - Get an object using 3D printing or to show this 3D object with AR.
Sensors and Wearables	The learner… - Understands what sensors and wearables are and how they work. Knows about the context of sensors and wearables in the industry and their main characteristics	The learner is able to… - Define what sensors and wearables are. - Enumerate the main characteristics of sensors and wearables Enumerate the operation modes of sensors and wearables and their uses in different industrial sectors.	The learner is able to… - Understand the use of sensors and wearables in different industrial scenarios. Recognize main characteristics of sensors and wearables
	The learner… Acquires knowledge about different types of those sensors and wearables widely used in the industry	The leaner is able to… Distinguish among different types of sensors and wearables, according their characteristics, operation mode or use	The learner is able to… Analyze and take decisions about the better sensor or wearable to use for a specific purpose, facility, operation mode, etc.
	The learner… - Knows about different use cases of sensors and wearables, mainly focused on industrial scenarios	The learner is able to… - Recognize use cases of sensors and wearables.	The learner is able to… - Analyze an industrial scenario in order to identify if the use of sensors and/or wearables could

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	- Knows about real business success stories, how sensors and wearables have improved an industrial facility or industrial process. - Knows the future of sensors and wearables in industry.	- Propose uses of sensors and wearables in different industrial sectors. Identify differences between current and future sensors and wearables	improve the performance of the industrial activity. - Get a sensor or wearable and suggest use cases of it - Take decisions about the most suitable sensor/wearable for a specific industrial need. Analyze the future of sensors and wearables and their use cases
RFID&NFC	The learner… - Understands what RFID and NFC Technologies are. Knows about the context of RFID and NFC in the industry	The learner is able to… - Define what RFID technology is - Define what NFC technology is	The learner is able to… - Understand the use of RFID and NFC in different industrial scenarios. - Recognize main characteristics of RFID and NFC
	The learner… - Knows the main characteristics of RFID and NFC - Knows the different operation modes of RFID and NFC Acquire knowledge about the standards behind NFC and RFID	The learner is able to - Enumerate the main characteristics of RFID and NFC - Enumerate the operation modes of RFID and NFC - Identify the standards of RFID and NFC	The learner is able to… Analyze and take decisions about the type of RFID and NFC technologies and features fit with an specific use, operation mode or standard
	The learner…	The learner is able to…	The learner is able to…

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	- Acquire knowledge about different use cases of RFID and NFC focused on factories, traceability, logistic, etc. - Knows about real business success stories, about the use of RFID and NFC in industrial facilities and industrial process. Knows the future of RFID and NFC in industry	- Enumerate use cases of RFID and NFC in different industrial sectors. - Identify the advantages of RFID and NFC in an industrial scenario To provide an analysis about the future of RFID and NFC	- Analyze an industrial scenario in order to identify if the use of RFID and NFC for improving the performance of the industrial activity. - Given a type of RFID or NFC device, to enumerate features of it and suggest use cases in industrial scenarios - Take decisions about the most suitable RFID or NFC technology for a specific industrial need. Analyze the future of RFID and NFC as well as their use cases

Robotics applied to furniture production at the different production stages	The learner…
	- knows how to use a robotics mobile platform for **logistics and transportation tasks** in the furniture market
		The learner is able to…
		- program using the programming language such as:
		   o C/C++
		   o Python
		   o Java
		   o Basic/pascal
		   o LISP
		- use robotics middleware such as:
		   o ROS (Robot Operating System)
		   o YARP (Yet Another Robot Platform)
			The learner is able to…
			- define **mapping algorithms** in order to a robot understands the environment where it works
			- define **localization algorithms** in order to a robot knows where it is to successfully carry out tasks
			- implement robotics **motion planning algorithms** for mobile platforms that have to navigate in industrial environments from a start to a goal position among a

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		o Orocos (Open Robot Control Software) o Player o Marie (Mobile and Autonomous Robotics Integration Environment) o OPRoS (Open Platform for Robotic Services) o MIRA (Middleware for Robotic Applications) - Mechanical knowledge such as: o analytical mechanics issue o applied mechanics issue	collection of static and dynamic obstacles - improve the efficiency of logistcs process because robotics can sort through incoming and outgoing packages faster, place on shipping containers which would avoid unnecessary returns or delays in the order fulfillment process. - Improve costs and times in the logistics process.
	The learner... - knows how to use a robot for **palletizing and de-palletizing tasks** in the furniture market		The learner is able to... - implement **manipulation algorithms** to **grasp**, **hold** and **handle** furniture pieces

	The learner...
	- knows how to use a robot for:
	  o **Cutting** tasks
	  o **Polishing**, **Sanding** & **Finishing** tasks
	  o **Painting** and **Coating** tasks
	  o **Material removal** tasks
			The learner is able to...
			- implement **manipulation algorithms** to **grasp**, **hold** and **handle** furniture pieces
			- implement **perception ability** of the robot, extracting information from sensors and interpreting these data. In particular :
			  o implement **recognition algorithms** to detect the workpiece

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| | | | o implement **sensing fusion algorithms** to merge force control and vision to successfully carry out tasks
- guarantee higher levels of output, enhanced process and product quality, greater efficiency and flexibility |
| | The learner...
- knows how to use a robot for **assembly tasks** | | The learner is able to...
- implement **manipulation algorithms** to **grasp**, **hold** and **handle** furniture pieces
- implement **perception ability** of the robot, extracting information from sensors and interpreting these data. In particular :
  o implement **recognition algorithms** to detect the workpiece
  o implement **sensing fusion algorithms** to merge force control and vision to successfully carry out tasks
  o implement **planning** and **execution** of sequences |

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			strategy involving multiple objects
Simulation, modelling and virtualization in the design, virtual catalogues, 3D scanning.	The learner… • Realizes modelings in order to complete the rendering through the application of materials and finishes • Realizes 3D modeling techniques in order to correctly represent the contents of the project	The learner is able to… • Transfer the design contents expressed by designers into 3D drawings • Realize 3d models • Realize photorealistic images • Define presentation rendering of the project to be proposed to the company or the market	The learner is able to… • Build the transition from CAD tools to CAM tools to ensure correct industrialization of the product • Develop virtual modeling of projects presented by designers to communicate content of the same (shapes, dimensions, materials, colors) to the managers of the company and / or the market (representatives, retailers, consumers-sample) • Manage virtual product archives
Delivery Methods	3D Printing and Additive Manufacturing for furniture manufacturing.	-26 Video pills. -1 pdf document. -Additional material.	

	Augmented Reality and intelligent tools may be used during the design and fabrication of the product.	-19 Video Pills. -1 PDF document.
	Examples of performance activities developed in BLM department for the dissemination.	-2 PDF documents
	Sensors and Wearables	-8 video pills. -2 PDF documents. -Additional documents with use cases and business success stories.
	RFID&NFC	-12 video pills. -2 pdf documents. -Additional documents with use cases and business success stories.
	Robotics applied to furniture production at the different production stages	-33 video pills -1 PDF document.
	Simulation, modelling and virtualization in the design, virtual catalogues, 3D scanning.	-33 video pills -6 ppt-pdf additional documents
Assessment Criteria	3D Printing and Additive Manufacturing for furniture manufacturing.	- Practice work: students have to analyse the advantages and disadvantages of using 3D printing in the furniture sector and describe how additive manufacturing can improve business competitiveness. They will put in practice the knowledge gained in this unit. - Multiple choice questionnaire.
	Augmented Reality and intelligent tools may be used during the design and fabrication of the product.	-Practice work: students have to do a little research on how augmented reality can be used in the first transformation

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		processes of wood. As for example, geolocalize by augmented reality the trees that are ready to be cut in a plantation. - Multiple choice questionnaire.
	Sensors and Wearables	-Practice work: students have to analyse an industrial scenario where a sensor network can be implemented. They will have to evaluate the type of sensors to use, the communication protocols (learnt in other training unit), and interaction with the cloud (learnt in other training unit), or with other systems (RFID/NFC, learnt in other training unit). -Multiple choice questionnaire.
	RFID&NFC	-Practice work: students have to analyse an industrial scenario where RFID and NFC technologies could be used to improve the manufacturing processes. The students will have to decide the type of RFID and NFC technology to use, making use of the contents learnt in the training unit. -Multiple choice questionnaire.
	Robotics applied to furniture production at the different production stages	-Multiple choice questionnaire.
	Simulation, modelling and virtualization in the design, virtual catalogues, 3D scanning.	-Practice work: students will be asked to use simulation, modelling and virtualization techniques in order to realize 3D models, photorealistic images and virtual modelling of a specific selected project and show them in a presentation rendering as it was to be proposed to a company or the market. -Multiple choice questionnaire to evaluate knowledge acquired.

![IN4WOOD - Industry 4.0 for Wood and Furniture Manufacturers]

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Qualification	Manufacturers of Smart Furniture and wood factories.			
Unit	Telecommunications and Data			
EQF Level	NQF levels			
	Spain	UK	Italy	Germany
5	3	5	5	5
Associated ECVET points	To Be Defined			
Learning Outcomes				

Sub-units	Knowledge	Skills	Competences
Internet of Things	The learner… - Describe Internet of Things and its uses. - Understand the features of IoT.	The learner is able to… - Understand the advantages and disadvantages of Internet of Thing. - Describe possible uncertainties of IoT and how to mitigate them.	The learner is able to… - Make decisions related to the development of IoT projects.
	The learner… - Is familiar with both IoT technologies and IoT-related technologies.	The learner is able to… - Can understand the pros and cons of technologies to be used in an IoT environment.	The learner is able to… - Can start working in an IoT environemnt.
	The learner… - Is knowledgeable about the SOFIA2 IoT platform.	The learner is able to… - Can generate a SOFIA2 client and connect it. - Can generate basic rules in SOFIA2.	The learner is able to… - Can start working in a SOFIA2 environment.
	The learner…	The learner is able to…	The learner is able to…

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	- Knows the concept of complex systems and related concepts. - Knows the mathematical foundations of complexity theory.	- Can identify the advantages and disadvantages of complex systems.	- Start working with complex systems with aprovechamiento. - Provide informed opinion on the changes and evolutions of an integrated system. - Mitigate undesirable loops and accelerate positive evolutions in a complex systems.
Integrated systems	The learner… - Understands the architecture in a complex system and several of its nuaces. - Understand pros and cons of different architectures and its implementation.	The learner is able to… - Identify several kinds of architectures for integrated systems.	The learner is able to… - Make decisions in the architecture stages of an integrated systems with an understanding of the implications.
	The learner… - Knows about features of middleware for distributed applications. - Knows about integration of distributed systems, pros and cons of each choice and its challenges.	The learner is able to… - Start working in the implementation of a distributed architecture. - Identify different network-based integration topologies. - Identify pros and cons of each integration alternative.	The learner is able to… - Start working with middleware software. - Contribute to the progress of a network-based middleware architecture. - Work in the implementation of a network-based architecture.
Big data and Analytics	The learner… - Learns the foundations of big data.	The learner is able to…	The learner is able to… - Define big data concepts.

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	- Knows the influence of big data in current businesses.	- Understand the concepts of big data, data mining and analytics, and their use. - Identify the concepts related with big data.	
	The learner… - Identifies technologies and platforms of big data. - Identifies the basic operations of big data. - Understand more complex operations of big data.	The learner is able to… - Start working with big data platforms in basic operations.	The learner is able to… - Work with big data platforms under controlled conditions.
	The learner… - Understand mathematical foundations of analytics. - Differentiate between different analytics technologies.	The learner is able to… - Identify patterns and relationships in data. - Perform basic machine learning and predictive modeling.	The learner is able to… - Perform basic data analytics on real sources.
Cloud Computing	The learner… - Acquires basic knowledge about Cloud Computing and its main features. - Knows the utility of Cloud Computing in the industrial context.	The learner is able to… - Give a definition about what Cloud Computing is - Enumerate the main characteristics of cloud computing. - Describe some industrial scenarios where Cloud Computing can be deployed.	The learner is able to… - Give a general view of cloud computing. - Provide uses of cloud computing in industrial scenarios.

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	The learner…	The learner is able to…	The learner is able to…
	- Acquire knowledge about the hierarchy of Cloud Computing.	- Describe the models of Cloud Computing.	- Decide what cloud computing model is the best for different business models.
	The learner… - Acquires knowledge about different configurations available to develop cloud services.	The learner is able to… - Enumerate and explain the different deployment models in Cloud Computing.	The learner is able to… - Analyze and take decisions about the better configuration to use for a specific purpose.
	The learner… - Knows the advantages and disadvantages of developing services in the cloud versus locally. - Knows business experiences where Cloud Computing has been used.	The learner is able to… - Enumerate the advantages and disadvantages of Cloud computing versus local servers. - Describe the current use and the future of cloud computing in the industry.	The learner is able to… - Analyze an industrial scenario in order to identify if the use of cloud computing could improve the performance of the industrial activity. - Take decisions about the most suitable deployment of cloud computing for a specific industrial need.
Communication Networks	The learner… - Acquires basic knowledge about communication networks and their specific uses in the industry.	The learner is able to… - Provide a definition about the different communications networks and their context in the industry.	The learner is able to… - Identify the need and usability of communication networks in different industrial scenarios.
	The learner…	The learner is able to… - Enumerate the main industrial communication networks,	The learner is able to… - Take decision about what kind of industrial communication network

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	- Gets an extensive knowledge about the different types of current communication networks.	distinguishing among Body, Personal, Local and Wide Area Networks.	fulfills the requirements of an industrial scenario.
	The learner… - Knows about some the standards behind the industrial communication networks.	The learner is able to… - Enumerate the main industrial communication standards, and what - is the most suitable to use in each context.	The learner is able to… - Identify the main communication network standards and how they work in order to use them in the industrial environment. -
	The learner… - Knows some business experiences (use cases) where the communication networks have been used. - Acquires a general view about the future of communication networks in the industrial sector.	The learner is able to… - Describe the impact of the communication networks in the industry. - Give some examples of business success stories related to communication networks.	The learner is able to… - Enumerate use cases where communication networks are used in an industrial scenario. - Enumerate the advantages and disadvantages of each communication technology in specific scenarios.
Cyber-Security	The learner… - Acquires basic knowledge about cybersecurity, its main features and its role in the industry.	The learner is able to… - Give a definition and enumerate the basic features of cybersecurity - Describe the need of cybersecurity in the industry.	The learner is able to… - Recognize and justify the need of applying cybersecurity in the industry
	- The learner… - Knows about some of the malwares that could reach a business network.	The learner is able to… - Give a description about different malwares.	The learner is able to… - Recognize among different malwares.

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	- Knows how to distinguish malwares. - Knows the main symptoms that a network could have if a malware is running on it.	- Describe the symptoms of a malware infection in a network system -	- Test a system in order to identify a malware infection. -
	The learner… - Acquires knowledge about some of the different cybersecurity methods and devices used to increase protection in a network. - Acquires knowledge about sanity checks in networks to mitigate malware effects.	The learner is able to… - Enumerate devices and methods to mitigate malware effects - Enumerate to prevent networks of malware infection.	The learner is able to… - Check an infected system to provide of devices and methods to mitigate the malware effect. - Prevent the malware installation. - Isolate an infected device.
	The learner… - Knows a guideline explaining, step by step, what are the best security practices to follow in the industry. - Acquires a general view about the future of the cybersecurity in the industry, focused on I4.0.	The learner is able to… - Enumerate, step by step, the best practices for protecting or mitigating cybersecurity attacks in the industry. - Describe the importance of cybersecurity in Industry 4.0.	The learner is able to… - Take decisions about the steps to follow in order to reduce the impact of a malware. - Identify the need of cybersecurity polices in an industrial deployment. -
Delivery Methods	Internet of Things		-30 video pills. -1 pdf document. -Additional documents with use cases,business success stories and guidelines.
	Integrated systems		-16 video pills.

		-No additional documents.
	Big data and Analytics	-13 video pills. -1 pdf document. -Additional documents with business success stories and guidelines.
	Cloud Computing	-8 video pills. -1 pdf document. -Additional documents with use cases and business success stories.
	Communication Networks	-8 video pills. -1 pdf document. -Additional documents with use cases and business success stories.
	Cyber-Security	-8 video pills. -1 pdf document. -Additional documents with use cases and business success stories.
Assessment Criteria	Internet of Things	-Optional practice work: Students try to build a test IoT environment with a microcontroller information producer and a web browser-based consumer, with a free-of-charge server framework. -Multiple choice questionnaire.
	Integrated systems	-Multiple choice questionnaire.

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	Big data and Analytics	-Optional practice work: Students can connect to a distributed big data service, free of charge, and put in practice the theory learned in the unit (to be discussed). -Multiple choice questionnaire.
	Cloud Computing	-Practice work: students have to analyse the advantages and disadvantages of using cloud computing in an industrial scenario. They will put in practice the knowledge gained in this unit. -Multiple choice questionnaire.
	Communication Networks	-Practice work: students have to analyse an industrial scenario where some of the communication network technologies studied in this unit are implemented. -Multiple choice questionnaire.
	Cyber-Security	-Practice work: students have to analyse a security use case in an industrial scenario, putting in practice the skills acquired in this unit. -Multiple choice questionnaire.

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Qualification	Manufacturers of Smart Furniture and wood factories.			
Unit	Management Systems			
EQF Level	NQF levels			
	Spain	UK	Italy	Germany
5	3	5	5	5
Associated ECVET points	To Be Defined			
Learning Outcomes				

Sub-units	Knowledge	Skills	Competences
Application of Logistics	The learner… -Knows the principles and basics of Warehouse Management. -Identifies the different kind of Plant Layouts. -Knows and recognizes the most relevant Warehouse Management System (WMS) tools.	The learner is able to… -Adapt WMS tools to a Furniture/Woodworking company. -Carry out industry plant layouts.	The learner is able to… -Manage the warehouses from furniture and woodworking industries.. -Carry out the most suitable plant layout at a furniture/wood products manufacturing plant.
	The learner… -Knows the principles and basics of Inventory Management. -Knows and recognizes the most relevant Inventory Management (WMS) tools.	The Learner is able to … -Adapt Inventory Management and Distribution Resource Planning tools to a Furniture/Woodworking company.	The learner is able to… -Manage the Inventory from Furniture and Woodworking industries. -Distribute and plan all resources from Furniture and Woodworking industries.
	The learner… -Gains knowledge and expertise on Key Performance Indicators (KPI) analysis and advanced techniques.	The learner is able to… -Create and define KPI that help any business unit. -Analyze and Infer KPI results.	The learner is able to… -Implement a manage monitoring and evaluation management system that helps the logistics of any

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			furniture/wood products manufacturing company.
Workflow Management Systems	The learner… -Correctly identifies and knows the different data capture system for logistics control. -Gets familiar with the different types of radio frequency data collection devices.	The learner is able to… -Identify the implementation of RFID technologies in any industrial process and the most suitable interaction means with any software/hardware system.	The learner is able to… -Analyse the use of RFID technologies in different processes from any furniture/woodworking company.
	The learner… -Gets familiar with the production management systems and their main tool.	The learner is able to… -Define Strategic and Production plans. -Create and execute workflow management systems.	The learner is able to… -Define and execute strategic and production planning in furniture/woodworking companies.
	The learner… -Knows the uses and functionality of the Enterprise Resource Planning (ERP).	The learner… -Acquires the basic skills for working with a ERP system.	
	The learner… -Know the basics of the most relevant Lean Manufacturing tools.	The learner -Is able to implement Lean tools in a production plan.	The learner is able to… -Identify and implement improvements in different manufacturing processes from furniture/woodworking companies.
Collaborative platforms	**B2B (business to business) –** The Learner … Knows the key requirements for communicating with with potential partners and suppliers	The Learner is able to identify… Mechanisms by which they can engage with other businesses and collaborate and potentially offer complimentary products	The Learner is able to … Identify potential partners see what other businesses in the market are looking for in terms of supply opportunities
	B2C (business to consumer),	The Learner is able to identify…	The Learner is able to…

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The Learner… Understands what they believe the current customer requirements and needs are in th market	How to engage with the customer base in order to identify current and emerging customer wants and needs	Identify ways to engage with the customer base to determine current and future needs and how they can produce products which do or will meet their needs
C2C (consumer to consumer), The learner… Understands they need a fórum where they can discuss and highlight their wants and need from the industry	The Learner… Will gain the skills to be able to discuss these interactively with other consumers and provide an insight to be used by the industry	The Learner… Will understand the trends of other consumers and the trends in the market which may influence their choices and decision making
U2B (university to business) Understanding current trends in the Marketplace and wanted and needed products	The Learner…. Will gain an insight into what they can develop and what businesses in the marketplace actually need to satisfy their customers	The Learner… Will have a much clearer understanding of what the businesses need and what they should be focusing their students on and what innovations they can prototype for them.
U2S (University to Student) The Learner… Understands the current trends in the Marketplace that they need to train their students to deliver on	The Learner… Will understand the priority and upcoming areas of focus for the market.	The Learner… Will know how to focus their studies to add the best values to their skills and also be successful in a career in the market.

	S2S (Student to Student) The Learner… Knows what area of the market they would like to work in and the opportunities in it.		The Learner.. Will understand the trends in the market and where the best opportunities exist for career progression from their peers	The Learner… Will be able to make an informed decision on their areas of focus from their careers.
Delivery Methods	Application of Logistics		-28 Video pills -1 PDF document	
	Workflow Management Systems		-22 Video pills -1 PDF document	
	Collaborative Platforms		-20 Video Pills	
Assessment Criteria	Application of Logistics		-Multiple choice questionnaire.	
	Workflow Management Systems		-Multiple choice questionnaire.	
	Collaborative Platforms			

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Qualification	Manufacturers of Smart Furniture and wood factories.			
Unit	Standard Certifications and Legal Issues			
EQF Level	NQF levels			
	Spain	UK	Italy	Germany
5	3	5	5	5
Associated ECVET points	To Be Defined			
Learning Outcomes				

Sub-units	Knowledge	Skills	Competences
Introduction to Standardization	The learner… - Acquires knowledge about the context of standardization in Industry 4.0 paradigm and its importance. - Knows challenges of standardization in Industry 4.0 - Knows how to address standardization in Industry 4.0 through the Reference Architecture Model for Industry 4.0 (RAMI 4.0)	The learner is able to… - Identify the need of standardization in Industry 4.0 - Describe the challenges regarding standardization in Industry 4.0 - Extract from RAMI 4.0 a simple and manageable architecture model as reference for Wood and Furniture Sector	The learner is able to… - Analyze standardization issues in the use cases of companies/factories implementing technologies of Industry 4.0 - Evaluate the RAMI 4.0 architecture model in order to follow the right steps to implement Industry 4.0 in a company/factory
Consortium and Organizations	The learner… - Acquires knowledge about the consortiums and organizations bodies behind Industry 4.0 standardization: their roles and the	The learner is able to… - Identify the international organizations and entities behind Industry 4.0 standardization	The learner is able to… - Provide useful information about what standardization bodies are involved in what standards and vice versa.

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	kind of standards they propose, approve, review, or modify.	- Enumerate the roles of standardization bodies - Enumerate what standards (layers in the RAMI 4.0 architecture) are in charge of each entity.	
Working Group Committees	The learner… - Acquires deep knowledge about the working group committees focused on the standards behind the Key Enabling technologies - Knows about the most relevant standards, focused on the key enabling technologies	The learner is able to… - Describe the most important working groups involved in Industry 4.0 standardization - Link the working groups with the standards of Industry 4.0 under their approval or supervision. - Enumerate the standards focused on the most relevant key enabling technologies of Industry 4.0	The learner is able to… - Identify existing and future working groups and standards, distinguishing those that work on technologies of interest for the wood and furniture sector - Identify the subset of standards for rapid implementation of partial content for Industry 4.0
Standards in factories and legal issues	The learner… - Knows a guideline about how to apply standards in factories applying Industry 4.0, mainly for wood and furniture sector. - Acquire knowledge about the legal issues in Industry 4.0	The learner is able to… - Enumerate the steps to follow in the implementation of Industry 4.0 in companies/factories under the current and future standards. - Describe the legal issues concerning the Industry 4.0	The learner is able to… - Analyze the need of standardization and set the way to obey standards in an Industry 4.0 development. - Analyze the legal issues behind a implementation of an industrial process improved with a key enabling technology of Industry 4.0
	Introduction to Standardization	-11 video pills.	

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Delivery Methods	Consortium and Organizations	-1 PDF document. -Additional documents: public ISO/IEC norms and reference standards about I4.0 standardization.
	Working Group Committees	
	Standards in factories and legal issues	
Assessment Criteria	Introduction to Standardization	-Practice work: students have to analyse an industrial scenario where some of the technologies reviewed in other units will take place. They will have to identify the reference standards and norms to follow for the I4.0 adoption. -Multiple choice questionnaire.
	Consortium and Organizations	
	Working Group Committees	
	Standards in factories and legal issues	