

I01 REPORTS

- A. VET TRAINING REPORT
- B. COMPANIES REPORT

V 1.0_02/20

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1 REPORTS STARTING POINT

IO1 RESULTS:

Two different reports in English per country will be written, detailing both training needs and available trainings

- The first, about vocational training Industry 4.0 (I40) contents
- The second about I40 training in companies

The reports will identify key technologies for training modules development in next IO's

REPORTS SCRIPT PROPOSED:

1.- TRAINING OFFER

An executive summary will be made with the main conclusions of the previous studies. Two or more advanced examples of each area of the offer will be presented:

- Regulated vocational training
- University education
- Unregulated private training

2.- MATRIX NEEDS / OFFER:

The Excel sheet **<< FINAL MATRIX >>** that crosses NEED-OFFER will be completed to establish the GAPS between both concepts. See Excel Workbook **3Ti4.0 MATRIX** in project cloud IO1 folder to fill the matrix results.

Each relevant GAP / EMERGING SKILLS must be commented.

3.- CONCLUSIONS / RECOMMENDATIONS: SKILL SELECTED FOR NEXT IO

This part we believe that we should all work as a team to agree on the content through a conference, once we have the rest of the documentation. At the end of this phase we will obtain **two reports and a database with the relevant information**.

2 VET TRAINING REPORT

2.1 TRAINING OFFER

2.1.1 VET REGULATED TRAINING OFFER

EUROPE				S	5PAIN			
FOF	NQF	SQF		NQF SQF			EDUCATION SYSTEM	
EQF	MECU	MECES	CNCP	UNIVERSITY	VET OFFICIAL EDUCATION	LONGLIFE LEARNING		
1	1		1		FP BASICA			
2	2							
3	3		2		FP GRADO MIEDIO	CERTIFICADOS DE		
4	4		2			PROFESIONALIDAD		
5	5	1	3	FORMER DIPLOMADO	PP GRADU SUPERIOR			
6	6	2	4	GRADO				
7	7	3	5	MASTER	NO OFFER FOR CIVEP 4	& 5 LEVELS TODAT		
8	8	4		DOCTOR				

EQM European Qualifications Framework

NQF National Qualifications Framework. In Spain: "Modelo Español de Cualificaciones.MECU"

SQF Specialized Qualifications frameworks. In Spain "Marco Español de cualificaciones de la educacion superior, MECES" for Universitary education y "Catálogo Nacional de Cualificaciones Profesionales, CNCP", for

Image 1 shows a comparative table for the Spanish education system. It brings together the two specialised (SQF) regulated systems in Spain:

1.- MECES: The Spanish qualification framework for higher education. This framework regulates higher education in Spain and is compatible with the EQF and the higher education model derived from the Bologna process.

2.- CNCP: National catalogue of professional qualifications. This framework regulates vocational training (VET) in Spain. This training is divided into two main sub-systems here:

a) one derived from the education system, through the Vocational Training offered by public and private centres and regulated by the Ministry of Education, and the education councillors in the regional governments to whom all authority has been ceded. Regulation is attained through vocational training educational cycles: basic, intermediate and advanced levels. These correspond to levels 1-3 in the CNCP, which in turn correspond to levels 1-5 in the MECU and EQF scales.

b) one derived from ongoing and occupational training (lifelong learning) offered by various public and private centres, regulated either by particular public bodies (state ministers – those concerned with work, economy and technical matters; councillors for work and/or economy in the regional governments; independent institutes, official corporate bodies, etc.) through professionalism certificates or by speciality. These correspond to levels 1-3 in the CNCP, which in turn correspond to levels 1-5 in the MECU and EQF scales.

2.1.1.1 OFFICIAL DEGREES OFFERED WITH CARDEMY TECHS AND EQF LEVELS

In terms of the professional families and qualifications on offer in Aragon which are analysed in this work, the following table links the codes for the intermediate and advanced degrees on offer under the Spanish system. For the professional family and its content, see ANNEX 3.

SPANISH	ENGLISH	INTERMEDIATE LEVEL (EQF 3/CNCP 2)	ADVANCED LEVEL (EQF 5/CNCP 3)
mecanizado cnc	cnc machining	FME202	
instalación y mantenimiento electromecánico	electromechanical installation and maintenance	MSP201 MSP203 IMA202 IMA203 IMA201	MSP302 IMA301
mecatrónica	mechatronics		IMA302
automatización y robotica	automation and robotics		ELE302 ELE303
programación de la producción en fabricación mecánica	production planning in mechanical manufacturing	FME203	FME304
programación de producción en moldeo de metales y polímeros	production planning in metal and polymer moulding	<i>FME205</i> (This degree is currently being trialled in a DUAL format, with the participation of CAAR companies)	FME305

2.1.1.2 DEGREES CONTENT ANALISYS UNDER I4.0 TOPICS

REGULATION OVERVIEW

The above linked degrees are regulated by administrative orders dating back some 4 to 7 years. Therefore, generally speaking, the I4.0 concept is largely absent. Cornerstones of I4.0, like IoT, smart devices, drones, cloud computing, cybersecurity, collaborative robotics, VR, etc. simply do not appear. Additionally, the constant reforming of legislation due to the politicisation of education, along with the complex autonomous system, make this regulatory system slow to include new ideas. The autonomous regions may modify some features of the content, but cannot significantly alter the texts or indexes. This makes it difficult for the regulation to include such advanced concepts.

However, it is easy to find content that, while not strictly I4.0, is structurally related to digital features and can, consequently, adapt to the new needs.

2.1.1.3 IMPROVING I4.0 CONTENT IN OFFICIAL VET DEGREES. 2017 ERASMUS+ CARDEMY APROACH

In 2017, in the Cardemy project context, we interviewed the staff and manager of a Vocational Training School in Zaragoza, which is characterised by its high content in industrial education.

Then, the conclusions reached from this was:

- The teachers include I4.0 content in their curricula as far as they can by means of tools which they are able to purchase either thanks to the budget at this school or through research projects.
- The head of the centre and the heads of studies ascertain which projects or technologies are emerging.
- The amount of digitalisation varies greatly from one degree to another. It is more evident in fields such as mechatronics and mechanical manufacturing.
- The centre is currently working on projects related to:
 - o Drones
 - o Augmented reality
 - o Smart devices
 - Sensor technology
- However, based on the conversation, it can be deduced that there is no overarching 4.0 strategy.

2.1.1.4 VET TRANING PARADIGMS : (2 of 6)

2.1.1.4.1 EQF 6-CNCP 4 EXPERIMENTAL CAAR PROGRAM : I40 CONTENT

Caar has developed in 2019, in collaboration with the regional administration of the Government of Aragon, an experimental course EQF6-CNCP4 (training that does not currently exist in the offer of the Spanish educational system) whose objective is to train cross-graduates or newly graduates little experience in degrees of VET training of the technologies that are of interest to Caar companies. : machining, robotics, injection-molding, mechatronics and design in mechanical manufacturing.

It is a DUAL training project: the student works four days in an automotive company, and attends a training program on Fridays, from September 2020 to June 2021, at CIFPA, the Innovation Center for Professional Training in Aragon, in Plaza. In addition, a final case study project is carried out.

The program includes industrial training for technicians:

 THE AUTOMOTIVE SECTOR: CHARACTERISTICS AND VALUE CHAIN
 MANUFACTURING PROCESSES IN THE AUTOMOTIVE SECTOR
 ADVANCED MEDIA MANAGEMENT AND ORGANIZATION SYSTEMS
 ADVANCED MAINTENANCE IN THE AUTOMOBILE INDUSTRY
 ADVANCED MANUFACTURING SYSTEMS IN INDUSTRY 4.0
 TEAM LEADERSHIP, AND SOFT SKILLS (TRAIN THE TRAINER, COMUNICATION, CONFLICT MANAGEMENT)
 FINAL CASE STUDY CASE

Point 5 develops, for the first time, and for a program offered in the education system from the administration, a specific content on industry 4.0

The specific content of this module is as follows:

1. The connected factory. SCADA systems. Sensorization.

2. Data storage, treatment and analysis.

3. Additive manufacturing processes and 3D printing

4. Smart devices. Application in the control and management of the connected factory of mobile devices tablets.

5. Smart and collaborative robots. Bin picking

6. Autonomus ground vehicles

7. Digital twin

8. Use of ICTs and Cybersecurity risks.

9. Action plan against digital emergencies.

2.1.1.4.2 SEAS 14.0 VET 14.0 MASTER

Seas is the online training brand of the San Valero group, a major Aragonese educational institution that develops VET training, university and training for companies.

In its portfolio of products it has the Master in Industry 4.0. A 60 ECTS program whose objectives are:

- Know in depth fundamental areas in the company and the different technologies Industry 4.0.
- Master the different types of production and the techniques for standardizing processes and work methods, essential for improving the quality of production processes.
- Design industrial automation processes by analyzing and adapting the process from the raw material to the final customer.
- Laying the foundations to work with the data generated within the industrial field. From the storage of them to their exploitation through machine learning methods.
- Identify and develop business models based on service, products and applications for Industry 4.0

It is developed in an online format, and students obtain their own degree from the Universidad San Jorge, the university entity of the group

The program includes the following areas:

MANUFACTURING SYSTEMS ENGINEERING
 LEAN MANUFACTURING & SIX SIGMA
 MAINTENANCE 4.0
 ARTIFICIAL VISION
 PROGRAMMABLE AUTOMATES
 INDUSTRIAL AND COLLABORATIVE ROBOTICS
 ADDITIVE MANUFACTURE. 3D PRINT
 INTERNET OF THINGS (IOT)
 BIG DATA, VIRTUALIZATION AND MACHINE LEARNING
 CYBERSECURITY
 BUSINESS MODELS FOR INDUSTRY 4.0

2.2 2019 3TI40 VET TRAINERS SURVEY RESULTS

From the previous approach, it follows that the contents in industry 4.0 are incorporated autonomously by the trainers in their subjects independently of the official curricula, since these evolve very slowly, For this reason, in 2019 we have considered it more relevant to evaluate how the Teachers incorporate this knowledge and technology into their training. To do this, we have carried out a questionnaire among VET trainers to assess whether the situation has changed anything in these two years. These are the results :

Twelve trainers from public and private centers have answered the questionnaire with this distribution:





The Industry 4.0 enablers that the trainers include in their content are:

- Big Data analysis for predictive maintenance and other productive applications:
- Cloud computing for data production storage
- Cibersecurity in production area
- Internet of things:
- 3D printing for Prototyping
- 3D printing for Additive manufacturing
- Augmented realty and smart glasses
- Cobots: collaborative robots
- Drones
- Bin Picking
- Others



3TIndustry4.0 project/ 2019-1-FR01-KA202-062244: *IO1 Spain Final Report*

Trainers consider it a priority to receive training from trainers in these subjects (+ indicates intensity)

- IoT & smart devices: +++++
 Big data for preventive maintenance ++++
 Cobots +++
 Cloud +++
 Cybersecurity, ++
 Communication
 Industrial Control
- 8.3D prototyping

Crossing the data with the information, the enablers in whom they are interested in receiving training of trainers, and do not include, or in a very limited way, in their contents are:

- BIG DATA PREDICTIVE MAINTENANCE
- CYBERSECURITY
- CLOUD COMPUTING

The teachers consider that the official programs include little digital content:



- Only 30% have received training on matters related to Industry 4.0 in the last two years
- 83% incorporate I4.0 content in their training modules
- 60% do it individually based on their own documentation and information system.
- 40% combine this form with teachers' meetings, cloisters, department meetings, etc.
- 40% state that the equipment in the center is purchased with a budget from the center
- 40% state that the equipment is acquired by combining the center's budget and adhoc research projects
- 20% state that the equipment is acquired through research projects
- 90% state that they receive training from equipment suppliers never or scarcely.
- They demand more communication and training on I4.0 in tune with companies.

2.3 FOCUS GROUP

2.3.1 VET CONCLUSIONS



The focus group included in the project was held on February 27, 2020. The results of the surveys were previously sent to companies, VET trainers and executive trainers to be evaluated by the participants, as well as other relevant training on the subject.

Session attendees:

Name	Profile	Organisation
Elsa Jimenez	Hr Manager	Kongsberg
Juan Abad	IT Director	Dana
Felix de Miguel	Executive trainer	Freelance
JuanFranciso Martinez Blas	VET Trainer	SanValero educational group
Joaquin Diaz	Tecnology integration expert	Asai

Focus group supporters		
Name	Organisation	
Eva Sanchis	Aitiip	
Victor de la Mata	Caar	
Jorge Mateo	Caar	

In the interesting and relaxed conversation that takes place during the foculs group celebration, the following conclusions about VET Training were reached:

A person with cross-cutting knowledge, with level training in digital systems and interaction with the production chain is increasingly needed.

It is necessary to delve into all the mechanisms that allow closer collaboration between companies and VET trainers:

- Promoting stays in companies
- Developing common innovation projects
- Solving joint challenges between teams of teachers and business experts.
- Funding companies' resources costs liberated for training projects.

2.3.2 NEW KEY CONTENTS FOR VET TRAINING



The experts highlight as new content of high interest, not usually included in the programs, and which detect that the VET trainers do not perceive as necessary:

• <u>Connected factory</u>: The previous step for digitization is to connect the factory so that it allows obtaining data from the processes in real time.

• <u>Digital twin and cyber / physical systems:</u> intimately linked with the previous one, but at a higher level, by requiring the premise of the connected factory, the need to develop content on digital twin and cyber / physical systems is pointed out

• <u>Data ethics</u>: the enormous amount of information that the company generates, in the interaction of man with the machine, and in the automated processes themselves, requires deep reflection on the ethical use of data, beyond cybersecurity

• <u>Industry 4.0 for SMEs</u>: It is necessary to simplify and land I4.0 content for SMEs, who do not feel the need to implement these projects due to ignorance of the possibilities of technology, and because it is beyond their daily lives.

• <u>Infotronics and maintenance</u>: convergence between computing and electronics with a clear focus on maintenance and programming of digital systems. The need for a mixed profile of an electronic technician and a high-level programmer to adapt the market systems to the needs of the company.

• <u>Artificial intelligence</u>: it is the great challenge for all agents who have expressed an opinion in this study. Beyond big data and cloud, connected factory, and predictive systems, AI gives the plant the ability to make decisions in much more secure environments and based on the analysis of the data that the company stores and manages.

2.4 KEY TECHNOLOGIES FOR TRAINING MODULES DEVELOPMENT

According to the conclusions and data derived from the previous work, we can identify the technologies that can be key for the development of I40 content for VET trainers in this table:

TECHNOLOGY	VET TRAINERS PRIORITY	VET TRAINERS CURRENTLY CONTENT	FOCUS GROUP
BIG DATA FOR PREDICTIVE MAINTENANCE	VERY HIGH	ZERO	
CIBERSECURITY	HIGH	ZERO	
CLOUD COMPUTING	MED	LOW	
IOT&SMARTDEVICES	VERY HIGH	HIGH	
3D PROTOTIPING	LOW	VERY HIGH	
COBOTS	HIGH	HIGH	
COMUNICATIONS	LOW	ZERO	
INDUSTRIAL CONTROL	LOW	ZERO	
CONECTED FACTORY			Х
DATA ETHICS			Х
I40 FOR PYMES			Х
INFOTRONIC: TICS, ELECTRONIC, MECHATRONIC			Х
IA			Х

3 COMPANIES AND EXECUTIVE TRAINING REPORT

3.1 TRAINING OFFER

We have analyzed 37 courses and training programs related to Industry 4.0.

The offering entities are:

Association	11%
Business School	14%
Employers'S Organisation	3%
Manufacturing Center	3%
Private Achademy Or School	17%
Public Foundation	3%
Technology Center	6%
Training Organisation Or Institution	14%
University	11%
Vet Institute Or School	17%

The duration of the programs is:

SHORT	12
LONG	25

Short duration: 50 hours or less

25% are free, funded by spanish training social security costs bonification system, or other public funds from employment promotion programas.

The average price is 16 euros / hour

The most economical: 10 euros an hour

The most expensive: 40 euros an hour

37% allow to obtain an official title:

University degrees: 4	
-----------------------	--

- Postgraduate 2
- Vet Grades 5
- Vet Certificates (partial Vet Grades) 3

The frequency of the items that appear in the programs is as follows:

BIG DATA/CLOUD	
IOT/SENSORIZATION	
ADDITIVE MANUFACTURING	
ROBOTS, COBOTS, AUTOMATION	
DEEP LEARNING/MACHINE LEARNING	
DIGITAL STRATEGY	
CIBERSECURITY	
VR	
CONNECTED FAB	
AR	
AV/BIN PICKING	
DIGITAL TRANSFORMATION	
IA	
DIGITAL TWIN	
LEAN 4.0	
AGV	
BLOCKCHAIN	
DATA ETHICS	
MANUFACTURING INTELLIGENCE	
NANOTECHNOLOGY	

Some comments about it:

Training in industry 4.0 in companies is usually linked to services offered by the provider/integrator of the technology that is being implemented. This approach is lateral, it only affects personnel directly related to the implementation project, and it usually involves very practical and operational aspects.

This training is not offered openly by providers, although some of them have training promotion programs that allow obtaining certain training resources such as Siemens.

The solutions and tools used in each training are enormously varied and different. Only in terms of <u>**Big**</u> <u>**Data & Al**</u> this is the 2018 landscape:

	BIG DATA & AI LANDSCAPE 2018	
INFRASTRUCTURE	ANALYTICS	APPLICATIONS - ENTERPRISE
Courses and the second and the secon	and some recover the open to a some a starting to a some recover to the open to a some to a some to a some to a some to a some a some to a some to a some to a some to a some to a some to a some to a	ARE CONTRACTOR AND A CO
Comprise Groups Comprise	Frances	
CIL DEVENDENCE RECOVERED ON THE OFFICE OFFI	CONTROLLED ALL ALL ALL ALL ALL ALL ALL ALL ALL AL	APTICATIONS - DECISITY - DATA
	NOT TAY BALLON CRACLE THAT STATES (addes OPESCORE CALL AND	
	DATA SDURCES & APIs	DATA RESOURCES
ACCESS OF ALL AND ALL		

3.2 COMPANIES QUESTIONNAIRE

To find out the degree of implementation and training in Industry 4.0, a questionnaire was sent to Caar companies. The most relevant information has been extracted from said questionnaire.

16 responses were obtained, classified as follows:

TIER1: 7 TIER2:5 TIER3:4+++++ BIG COMPANIE: 7 PYME: 9

Technology :



Equipo técnico :

UNIVERSITARY DEGREE PEOPLE DIRECT PRODUCTION







3TIndustry4.0 project/ 2019-1-FR01-KA202-062244: /01 Spain Final Report

VET PEOPLE PER TECHNOLOGY



ABOUT TRAINING

I4.0 TRAINING DURING 2019



14.0 TRAINING AREAS

Más detalles		
 Calidad Produccion 	8 8	9
 Mantenimiento Riesgos laborales 	9	
 Habilidades directivas Gestión 	5	3
Otras	0	

I4.0 ENABLERS TRAINING in 2019



14.0 ENABLERS TRAINING PLANIFIED IN 2020



14.0 TECH USED TODAY



14.0 TECH USED TODAY



14.0 TECH RELEVANCE IN FUTURE



The companies consider the following technologies to be important in the short and medium term, in this order:

- lot and connected factory
- Big data
- Cloud
- 3d print
- Cybersecurity
- Cobots

These results are consistent both in said importance and in the training planned for this year.

Companies do not detect new enablers. This may be a consequence of the profile of the people in charge of the questionnaire:



3.3 FOCUS GROUP

In this sense, the results obtained in the focus group seem to be closer to the reality of what companies perceive, in which the heterogeneity of the chosen group allowed an interesting and enriching debate.

In reference to company training, and as conclusions added to the comments in the VET training section, it is worth saying:

- SMEs do not feel the need to train in these matters, so specific training for SMEs would be necessary.
- Training must be devoted to transmitting open source resources on the network for industrial digitization issues
- It is necessary to train transversally in digitization
- The management of digitization projects is also a special topic, since these technologies are usually developed under projects.

3.4 IN-COMPANY TRAINING SURVEY RESULTS

14 responses were obtained from executive trainers:

- 12 engineering specialties
- 1 physics
- 1 from Business Administration

Their areas of expertise were as follows:

- Cross professional profile
- Crm / erp
- Project management and continuous improvement ITIL 4.0 Statistical tools and Data mining Lean 6 sigma Core tools
- Cybersecurity, AI strategy
- 3D Design and 3D Printing
- Machine construction
- Lean Manufacturing
- Operations Management, SCM
- IT ERP systems SAP
- Mechanical manufacturing
- Business Intelligence
- Six Sigma Master Black Belt
- Industry 4.0 digital transformation strategy in the industry. Project manager

They therefore cover a wide variety of specializations.

The trainer's profile is:



They train this kind of students:







Currently they include in their syllabi or courses the following subject I4.0 :

- Big Data analysis for predictive maintenance and other productive applications:
- Cloud computing for data production storage
- Cibersecurity in production area
- Internet of things:
- 3D printing for Prototyping
- 3D printing for Additive manufacturing
- Augmented realty and smart glasses
- Cobots: collaborative robots
- Drones
- Bin Picking
- Others



They cite the following as emerging technologies:

- Artificial intelligence whether machine learning or deep learning
- Scada
- 3D scanning
- Data processing, Cloud,
- Process automation (flow)
- Data Mining and Data Analytics
- RFiD for material tracking
- Blockchain, Artificial Intelligence

They consider that they need to receive training from trainers on the following topics: (+ indicates intensity)

- Big data ++++
- IoT, Additive Manufacturing (different to 3D printing) ++
- Artificial Intelligence L +
- Human machine interaction in the same workspace, how to help and guide human sensations
- Bin Picking
- Cobots, Augmented reality, Internet of things
- Programming
- In general, know all the technologies they serve, where they are applied and what value they contribute to the management of manufacturing processes

4 TRAINING MATRIX

TECHNOLOGY	TRAINING OFER	TECH RELEVANCE IN THE FUTURE FOR COMPANIES	EXECUTIVE TRAINERS PRIORITY	VET TRAINERS PRIORITY	VET TRAINERS CURRENTLY CONTENT	FOCUS GROUP	COLUMNS
BIG DATA FOR PREDICTIVE MAINTENANCE	HIGH	HOH	HGH	VERY HIGH	ZERO		с
CIBERSECURITY	HIGH	HDIH		HIGH	ZERO	HIGH	3
CLOUD COMPUTING	HIGH	HIGH		MED	TOW		3
IOT&SMARTDEVICES	HIGH	HOIH	HGH	VERY HIGH	HIGH	HIGH	5
3D PROTOTIPING	HIGH	HDIH	HOH	NON	V ERY HIGH		3
COBOTS	HIGH	HDIH	MED	HIGH	нідн	HIGH	5
COMUNICATIONS	row			NOT	ZERO		1
INDUSTRIAL CONTROL	ZERO			ROW	ZERO		1
CONECTED FACTORY	MED					HIGH	1
DATA ETHICS	ROW					HIGH	2
140 FOR PYMES	ZERO					HIGH	2
INFOTRONIC: TICS, ELECTRONIC, MECHATRONIC	ZERO		MED			HIGH	2
IA	LOW		HIGH			HIGH	2
AR	MED	MED					1
BINPICKIN	MED	MED	MED				2
DRONES	HIGH	MOT					
HUMAN MACHINE INTERFACE	LOW		MED				2
VR	MED	MED					
DEEP LEARNING/MACHINE LEARNING	HIGH						1
DIGITAL STRATEGY/TRANSFORMATION	HIGH						
INDUSTRIAL PROGRAMMING	LOW		MED				2
DIGITAL TWIN	MED						
LEAN 4.0	ZERO						1
AGV	MED						
BLOCKCHAIN	MED						
MANUFACTURING INTELLIGENCE	ZERO						1
NANOTECHNOLOGY	LOW						1

5 CONCLUSIONS, RECOMMENDATIONS