3T Industry4.0

Report IO1 for France

25 March 2020

INDEX

1. SCOPE AND ANALYSIS

IO1 SCOPE

•To be done: study the content of existing trainings, the assessment of deficiency, the lack of skills

•Objective: Identify the most relevant technologies

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 (I4.0) contents
- The second about I4.0 training in companies

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

Tools and resources / **IO1 TASKS :**

• Search in bibliographic databases

• Analysis of technical documentation

• Examination of contents of official titles / qualifications of courses / trainings

• Interviews with stakeholders

• Creation of a database containing data from the situation of education and training to be used by all stakeholders in the field of Industry 4.0.

To verify relevance and data collection, a working group was established in each country's partners, so In France. The group is formed by a representative of the consortium, a representative of the industrial sector and a representative of an educational institution. The two external members of the working group participate in the focus group section, and moderator is the third member of that working group.

The MSForms 3Ti4.0 COUNTRY WORKING GROUP were used to fill the relevant information for data collection. See Annex 1 for questionnaire design.

Caar and *Mecanic Vallée* coordinate, transcript and sumarise the research carried out by Aitiip and CMQ. TUBS worked on German data. The data collected for the realisation of the study are uploaded on the project platform and into the database.

MsForms were used to fill other data collected. See ANNEX 9 to find links to each form.

2. OBJECTIVES OF THE STUDY AND FINAL RESULT

The study should allow the evaluation of training needs in Industry 4.0, detect gaps, and recommend skills and content to develop the teacher's training modules in the following phases.

To do this, we carry out the following activities:

A) DOCUMENTATION

    a) Study of publications
    b) Offer of existing trainings
    c) Interview questionnaires for companies / in-company training
    d) Interview questionnaires for vocational trainers in technologies that apply : freelance trainers and / or solutions providers
    e) Interview questionnaire for trainers / in-company.

B) REPORT PREPARATION

    a) Focus group
    b) IO1 Deliverables
    c) Closing of reports: VET & in-company training
    d) Data collection.

3. ACTIVITIES

3.1 Resources: publications study

The most relevant publications recorded on the form was reviewed. A minimum number of twelve publication must be recorded. The following issues was analysed for each publication:
-        Scope
-        Emerging competencies detected in the study
-        Training gaps detected
-        Recommendations.

The MSForms 3Ti4.0 RESOURCES was used to fill the relevant information for data collection. See Annex 2 for questionnaire design.

The aim was to detail all relevant information about the analysed documents, but especially the final information (those are mandatory fields in the questionnaire).

We searched information in French & English about French or European issues in :
- Relevant local, regional or national authority, training and education public departments
- Foundations, associations and consortia working on training in digital issues
- Engineering schools, vocational training centres
- sector associations, Clusters,
- Large suppliers of TIC I4.0 solutions
- Technical web sites.

For France, among more than 30 documents, the most twelve important ones were chosen. Most of them are in French, so, their titles was let in this language.

They are listed in the sheet :

Évolutions attendues, enjeux et analyse des besoins en compétences	CONFERENCE (PAPERS)	FOREM, Service wallon de veille, analyse et prospective du marché de l'emploi
TECHNOLOGIES CLÉS Préparer l'industrie du futur 2020	ORGANISATION REPORTS	DGE, Direction générale des entreprises au Ministère Français de l'économie
CATALOGUE DE FORMATIONS des Centres Techniques Industriels de France	ORGANISATION REPORTS	réseau des CTI, Centres Techniques Industriels de France
Industrie du futur : du système technique 4.0 au système social	ORGANISATION REPORTS	ALAIN CADIX, Président de l'Académie des technologies de France
Réalisation d'une analyse – synthèse des études sur l'évolution des métiers et des compétences de l'usine du futur	ORGANISATION REPORTS	AFPA, French Agency for Professional Apprentices
REPORT ON FRENCH INDUSTRY OF FUTURE	ORGANISATION REPORTS	INSTITUT MONTAIGNE
Etude prospective compétences - UIMM - Rapport final 04 11 2019	ORGANISATION REPORTS	Pyramis Consulting
Compétences, Mutations, Métiers et Transitions des Emplois de la métallurgie en Nouvelle Aquitaine	ORGANISATION REPORTS	KATAKYSE
Les technologies numériques de l'Industrie du futur : tendances et illustrations	ORGANISATION REPORTS	CETIM
Innovation et formation: un partenariat pour le changement	ORGANISATION REPORTS	Centre européen pour le développement de la formation professionnelle (Cedefop), 2015
VOCATIONAL EDUCATION AND TRAINING IN EUROPE : FRANCE 2018	ORGANISATION REPORTS	CEDEFOP

3.2 Training offer

A study was carried out for each of the following training areas:
- VET- minimum 6 items
- University education-mininum 6 items
- Private training offer- minimum 6 items.

An excel sheet was used. See [Annex 3](#) for questionnaire design.

In France, thirty two courses or trainings were detected, two diploma are officially dedicated to Industry 4.0. However, several universities or School for Engineers and Private training centres offer courses or short Trainings on subjects related on Industry 4.0.
Other ourses are mostly specialisations in engineering courses or specialized master degrees.
Some of them are free to attend, but several ones are proposed with high expenses rates.

- 6 of them are about VET ; Five are dedicated to I4.0 : Digital transformation in industry by IRUP, Introduction to Industry 4.0 by Centrale/Supelec, INP Toulouse, Dauphine University, and AFPA, French National centre for Apprentices;
- 9 of them are University education : just one is dedicated to I4.0 : Factory 4.0 Management by ENSAM;
- 18 of them are Private training offers ; most of them are specific trainings on specific areas, three of them are more general : Tools for I4.0 by COGIS Formations, and I4.0 Digital transformation of Factory by CEGOS.

Courses related to industry 4.0

🟨	= Private offer
🟦	= university courses
🟩	= VET offer

Outils de l'industrie 4.0	Certificate of Training	Cogis formations	training center	private	To determine
Industrie 4.0, la transformation numérique de l'usine	Certificate of Training	CEGOS	training center	private	7 h 1 day
Responsable des transformations numériques dans l'industrie	Licence Bachelor de Technologie	IRUP Institut régionnal universitaire polytechnique / Institut Mines-Télécom (IMT)	school engineers	public	3 years
Introduction au concept Industrie 4.0	Certificate of Training	INP Toulouse	school engineers	public	1 day
Master class industrie 4.0	Executive certificate	Centrale supélec	school engineers	public	10 days 37,5 h
Certificat Industrie 4.0	Certificate of Training	Dauphine PLS, Université Paris-Dauphine	University	public	10 days
Pépinière de l'industrie du futur	Certificate of Training	AFPA	training center	public	2-3 months / 350 h
Management de l'usine du futur	Master	ENSAM	school engineers	public	1 year

Courses related to industry 4.0 technologies

Some engineering schools, Universities or Private Training centers propose training or specialisations for their students, related to industry 4.0 fields. The table with all the identified training offers can be found below. In annexe, all details are presented : prices,…

🟨	= Private offer
🟦	= university courses
🟩	= VET offer

DEGREE NAME	KIND OF DEGREE	ORGANISATION	ORGANISATION PROFILE	duration	MODALITY
COMPRENDRE LES ENJEUX LIÉS À L'ÉCO-CONCEPTION	Certificate of Training	CETIM	Technical center	4h	e learning
Industrie 4.0 : robotisation, big data… Quels enjeux pour les entreprises industrielles ?	Certificate of Training	ECHOS FORMATION	training center	7 h	Meeting
Big Data : Architecture et technologies	Certificate of Training	Global Knowledge	training center	2 days	Meeting
FABRICATION ADDITIVE MÉTAL : MATÉRIAU / PROCÉDÉ FUSION	Certificate of Training	CETIM	Technical center	2 DAYS	meeting
ADDITIVE MANUFACTURING	Certificate of Training	I3d concept	Technical center	2 DAYS	meeting
AMÉLIORER LES PERFORMANCES D'ATELIER	Certificate of Training	CTIF	Technical center	2 DAYS	Meeting
Énergie : mesures et audits énergétiques	Certificate of Training	CETIM + CETIAT	Technical center	2 DAYS	Meeting
PRODUCTION AUTO-ADAPTATIVE USITRONIC-MÉTHODE COPILOT	Certificate of Training	CETIM-CTDEC	Technical center	2 DAYS	meeting
Maintenance prédictive	Certificate of Training	BOSCH & AFNOR	Technical center	2 DAYS	meeting
Maintenance prédictive	Certificate of Training	CETIM	Technical center	2 DAYS	meeting
FORMATION à L'ECO-CONCEPTION	Certificate of Training	ECO – CONCEPTION	training center	3 DAYS	meeting
MÉTHODES INNOVANTES EN CND	Certificate of Training	INSTITUT DE SOUDURE	training center	3 DAYS	meeting
LA FABRICATION ADDITIVE MÉTALLIQUE PAR FUSION LASER	Certificate of Training	CTIF + CETIM	training center	3 DAYS	meeting
Management 4.0	Yellow to Black Belt Licence Master	TOPTECH	Private Experts	5h to 5 days	meeting
Intelligence artificielle	Certificat d'Etudes Spécialisées «IA»	Télécom Evolution	training center	175 h 25 days	Meeting
De la robotique à la cobotique	Certificate of Training	ENSAM	school engineers	7 h	Meeting
Réalité virtuelle et réalité augmentée	Certificate of Training	ENSAM	school engineers	7 h	Meeting
Intelligence artificielle et reconnaissance des formes (IARF)	Master	Université Paul Sabatier UT3	University	1 year	in School

Interaction homme machine (IHM)	Master	Université Paul Sabatier UT3	University	1 year	in School
Robotique & Cobotique	License Pro	Université Paul Sabatier UT3	University	1 year	In School
3DeTech	Master	Télecom Lille	school engineers	1 year	in School
Sécurité des systèmes et des réseaux	Master	Télécom SudParis	school engineers	1 year	in School
Expertise cloud computing	Master	ISEP	school engineers	1 year	in School
S2IP	Master	Université de Lyon	school engineers	1 year	in School

		Université Paul Sabatier UT3		
Robotique & Cobotique	License Pro	Université Paul Sabatier UT3		

3.3. Questionnaire / interview for trainers: VET

Interviews was conducted with **twenty three teachers** or professors of Vocational Training of the technologies that apply to us.

The MS Form called 3Ti4.0 QUESTIONNAIRE FOR VET TEACHERS & TRAINERS a French version of it and Sheet Excel were used to fill data. See Annex 5 for questionnaire design.

The objective is:
- To determine what technologies they are teaching, and how is the process of incorporating the I4.0 skills in their studies
- What equipment they have and how they are incorporated to the classroom
- If they have received "*training the trainer's courses*" in this area
- What competencies do they consider emerging or strategic and that are not found in current programs?

In France, we got 23 answers from nine different public organisations, average 48,2 year old (from 25 to 58), with diploma levels from licence to professors, namely : 4 engineers doctors/professors, 7 doctors, 1 engineer, 8 masters, 2 DESS and 1 licence.

Those professors and teachers work on various subjects : Digital tools, digital science, Engineering science, Predictive Maintenance, Prognostics & Health Management, Energy, renewable energies, biomass, thermochemical conversion, Tooling CN/ learning games, Process Engineering, Industrial Engineering, Electronics, physics, Mecanic Engineering, additive manufacturing, Mecanic Conception, numerical control, production planning, logistics supply, Electronics.

About the technologies they use to teach or include in their classes about Industry 4.0, they answered : 14 one just one technology, 4 answered two technologies, and 5 : 3 technologies.

5	Cloud
2	Cybersecurity
14	3D
4	augmented reality
7	Big Data
4	IoT
3	drones
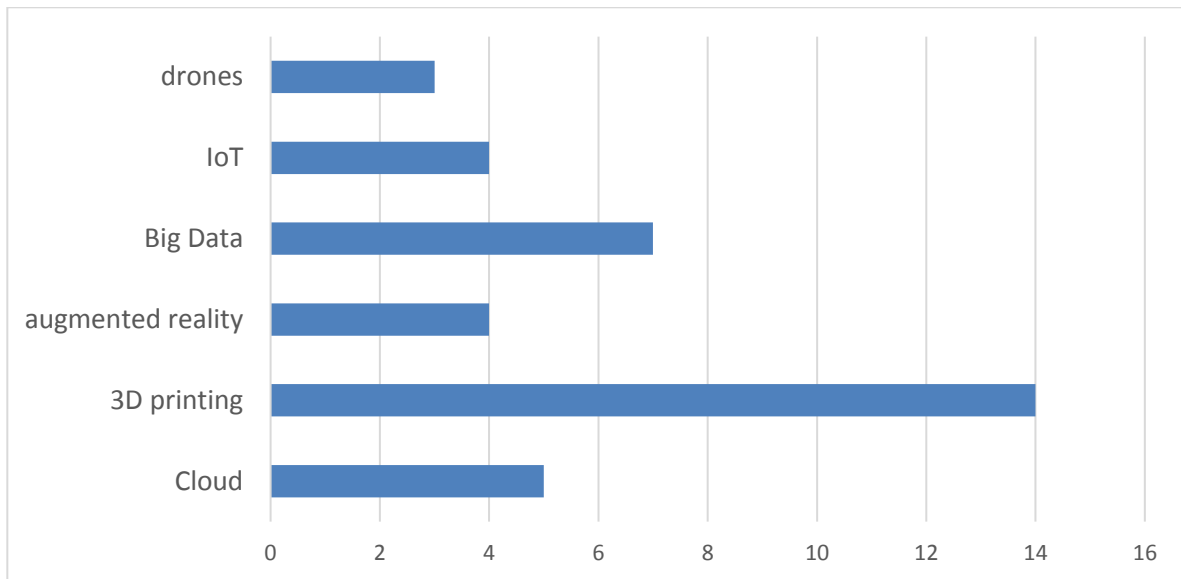
About identification in addition to the previous technologies, they consider emerging and key to the technological transition of companies :

➤ Typology,
➤ Data analysis and survey,
➤ Metrology 4.0,
➤ Data Monitoring, data analysis,
➤ fail detection,
➤ signature of phenomenons in machining,
➤ autonomous machines and learning machines,
➤ and innovation in pedagogy / training.
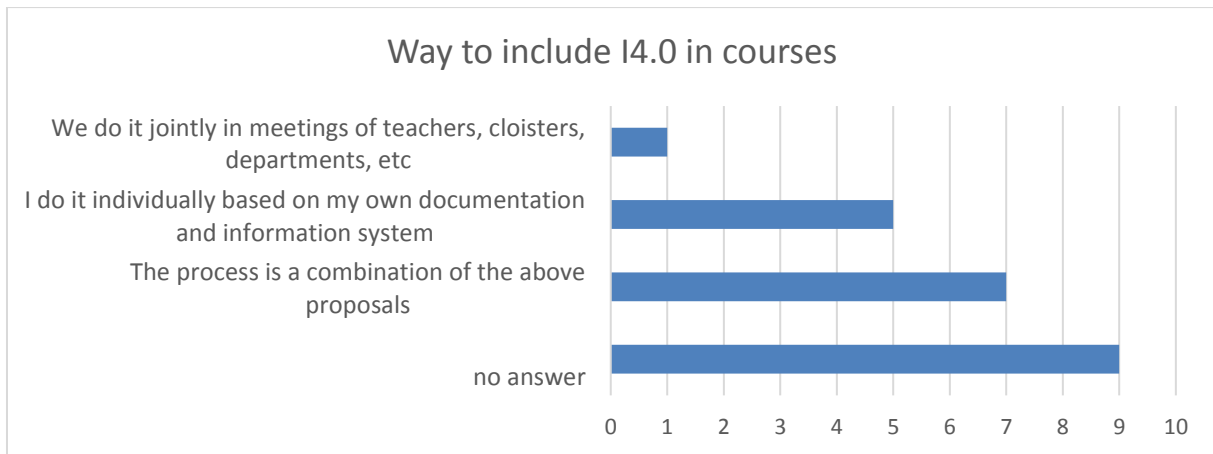

I4.0 contents in courses
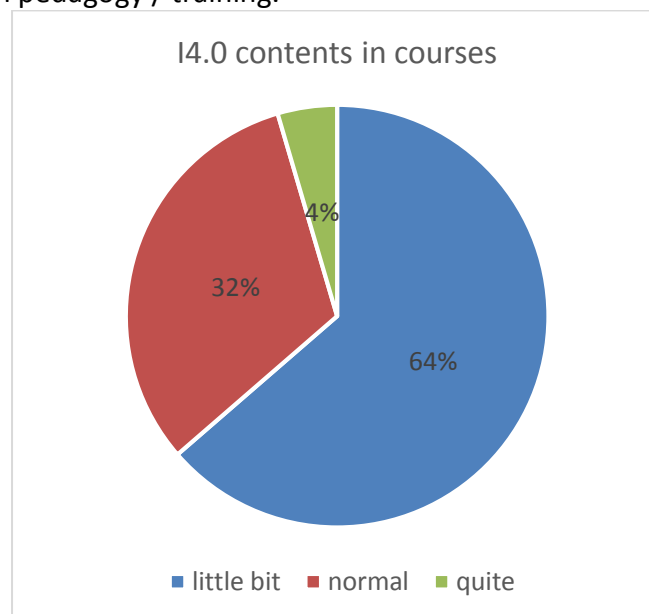
Do you consider that the training curricula taught in vocational training centers include digital content aligned with the concepts of industry 4.0 ?

➤ 14 little bit

- ➢ 7 normal
- ➢ 1 quite

Have you received training of trainers on the subjects related to Industry 4.0 : 18 no, 4 yes

Do you incorporate contents in matters of industry 4.0 in your classes : 9 no 14 yes

Way to include I4.0 in courses

We do it jointly in meetings of teachers, cloisters, departments, etc

I do it individually based on my own documentation and information system

The process is a combination of the above proposals

no answer

0 1 2 3 4 5 6 7 8 9 10

**If yes, how do you determine the content to include in your classes?**

- ➢ 5 answered : "I do it individually based on my own documentation and information system",
- ➢ one said "We do it jointly in meetings of teachers, cloisters, departments, etc",
- ➢ and 7 said : "The process is a combination of the above proposals

Way to include I4.0 in courses

We do it jointly in meetings of departments 4%

I do it individually with my own documentation 23%

no answer 41%

The process is a combination of the above proposals 32%
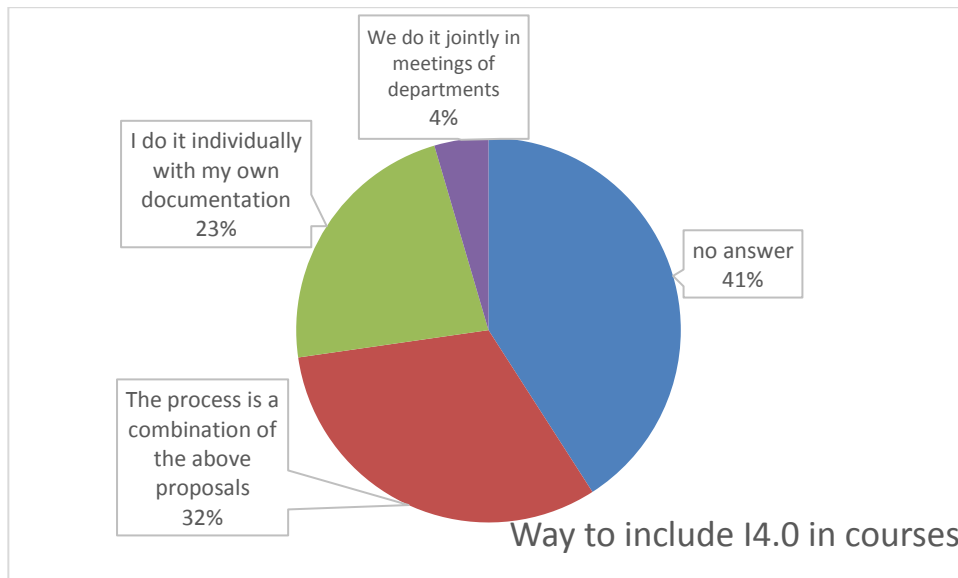
Do you consider the equipment of the center sufficient to deliver the indicated materials?

- ➢ 12 little bit
- ➢ 4 not at all

➢ 6 quite
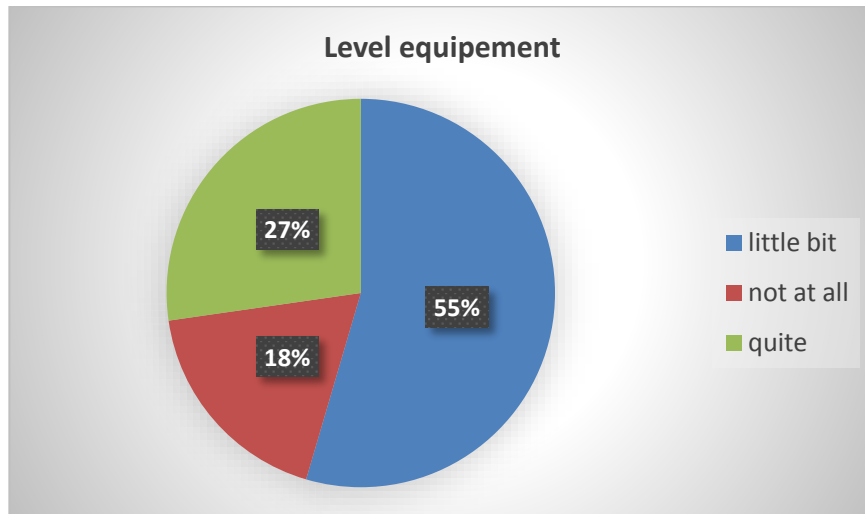
Do you receive train the trainers courses or workshops from I4.0 equipment providers
➢ 9 sometimes
➢ 14 never.

3.4. Questionnaire / interview for trainers in-company

There are nine surveys-interviews in France between trainers in matters of industry 4.0, whose origin could be in companies providing digital solutions. The target trainers are:
• In company trainers
• Unemployed trainers
• Private institution trainers like R+D organisations, clusters, sectorial or tech associations, etc.
• Public institution trainers from non-educational institutions, like Economic Development Agencies, R+D agencies, etc.
• Other trainers from non-educational institutions.

The MS Form called 3Ti4.0 QUESTIONNAIRE FOR IN-COMPANY TRAINERS was used in a French version to fill data. See Annex 6 for questionnaire design.

The objective of this activity is:
• Evaluate the volume and content of the formations that the trainers and suppliers' companies are carrying out with their clients
• Evaluate what content they consider emerging and necessary for digital transformation and that they are not being demanded by companies.

In France, we got 9 answers, average 37,2 year old (from 23 to 53), with diploma levels from licence to engineers, namely : 7 engineers, 1 DESS and 1 licence.

Those trainers work on various subjects : industry 4.0, digital transformation, Engineering science, Predictive Maintenance, Tooling CN, Process Engineering, Industrial Engineering, Mecanic Engineering, Mecanic Conception.

The technologies they use to teach or include in your training about Industry 4.0 are :

6	Big Data
2	Cybersecurity
5	IoT
3	3D
5	Cobots
4	Cloud
25	total

3 answered just one technology, 2 said 2 technologies, 2 others said 3 technologies and 1 said 4 ones.
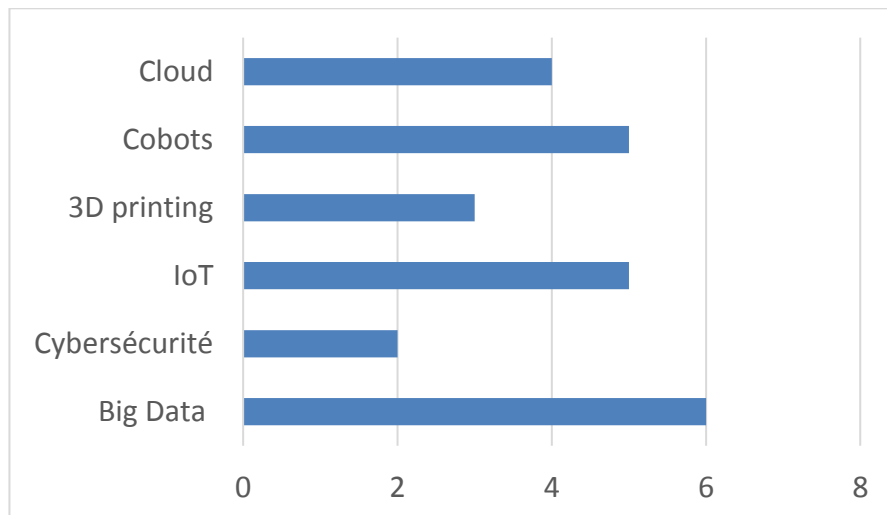
Do you identify in addition to the previous technologies, any other that you consider emerging and key to the technological transition of companies?
One answered : Artificial Intelligence.

What subjects do you consider essential to receive training the trainers courses related to the mentioned technologies
➢ 3D printing,
➢ Cobots,
➢ Augmented reality.

Have you received training of trainers on the subjects related to Industry 4.0 ?
5 answered No and 4 yes.

3.5. Focus Group

The organisation of the focus-group is planned with four-six profiles :
- HR/Training manager from a Big TIER1
- Plant manager from a SME TIER1
- Chief technology officer (CTO)
- In company trainer
- VET trainer
- Expert ICT I4.0 provider I4.0.

The approach is to carry out this work at the end of this stage, in order to deepen the conclusions that may have been detected in the previous interviews, and validate / clarify / change these conclusions, in order to define precisely the emerging digital skills and gaps.

On the initiative of *Mecanic Vallée*, a French Focus Group has been created, gathering industry professionals and training experts. This aims to have a better vision of future needs in Industry 4.0 field, to be advised by training experts and to start a Think Tank about the project orientation.

The Focus Group first meets partly on 05th of February and all the 28th of February. The Focus group participants are shown in the table below :

Aurélie	MONTEILLET	Manager	CFI de Cambes	training center
Isabelle	SOULIE	HR department	ROBERT BOSCH	large Company
Marianne	PRADALIER	Manager	VPM Automation	SME
Davy	LAGRANGE	Executive Manager	CMQ d'excellence Industrie du Futur	public Education & VET
Hervé	DANTON	General Manager	*Mecanic Vallée*	cluster
Cathy	PONS LELARDEUX	Doctor engineer	Université CHAMPOLLION	University

Focus group have detected in the analysis of publications that the following competencies can be considered:

1. Digital competencies
2. Technological expertises (**Common base on Industry 4.0**, programming, project management,…)
3. English language
4. Transversal Competencies
5. Among them : competences in Training / Teaching
6. Survey on new technologies
7. Needs analysis competences.

Focus Group think these skills must applies in their field :

➢ To be trained for new tools : online, virtual ones, MOOC, learning tools, PFOAD,…
➢ Self training.

Focus Group have detected that companies consider, however, that the emerging competencies are:

➢ Common basis on Industry 4.0 with focus on Cybersecurity
➢ Digital competencies for industry : among them, Data analysis
➢ Artificial Intelligence & business intelligence
➢ Human in the core of Industry 4.0

Focus Group thinks to improve collaboration between companies, trainers and training authorities :

➢ In creating Work group as *Mecanic Vallée* RHMV group gathering most of the RH managers from MV members companies and Training organisations**.**
➢ By integration of much companies inside Training courses
➢ In using more private contractors inside public education organisations
➢ Through CMQE, Campus for works and Qualifications
➢ To do common projects.

Focus Group consider methodologies most effective in training in digital skills :

➢ Serious Games
➢ E-learnings
➢ New ways for teaching as multi-skills interdisciplinary works, and collaborative trainings
➢ MOOC.

Focus Group thinks the role that trainers, companies, solution providers should play are :

To work together through best practices to be determined

➢ To grow up links between companies and Public Education system

➢ To support initiative as CMQE

➢ To develop multi-skills interdisciplinary works and collaborative trainings with companies participation.

Focus Group effectively detect emerging competencies :

➢ See other parts of the report.

4. ANALYSIS & RECOMMENDATIONS

4.1. Resources

The most relevant publications recorded on the form was reviewed.

TITLE	AUTHOR'S LAST NAME	SCOPE
TECHNOLOGIES CLÉS Préparer l'industrie du futur 2020	DGE, Direction générale des entreprises au Ministère Français de l'économie	DESCRIPTION OF ALL KEY TECHNOLOGIES to Prepare industry of future 2020
Évolutions attendues, enjeux et analyse des besoins en compétences	FOREM, Service wallon de veille, analyse et prospective du marché de l'emploi	PANORAMA COMPLET DES BESOINS EN COMPETENCES DANS PLUSIEURS FILIERES ECONOMIQUES DONT AEROSPACE, GENIE MECA, INDUSTRIE NUMERIQUE
Réalisation d'une analyse – synthèse des études sur l'évolution des métiers et des compétences de l'usine du futur	AFPA, French Agency for Professional Apprentices	analyse – synthèse des études sur l'évolution des métiers et des compétences de l'usine du futur
Industrie du futur : du système technique 4.0 au système social	ALAIN CADIX, Président de l'Académie des technologies de France	THIS DOCUMENT ANALYSES DEEPLY ALL THE FRENCH INDUSTRY 4.0 SYSTEM AND PRESENTS WAYS AND SOLUTIONS TO FILL THE GAPS, TO GO FURTHER AND FASTER
REPORT ON FRENCH INDUSTRY OF FUTURE	INSTITUT MONTAIGNE	REPORT ON FRENCH INDUSTRY OF FUTURE / WHAT NEEDS FOR TRAINING ?
Etude prospective compétences Occitanie - UIMM - Rapport final 0411 2019	Florence LAPARRA, Consultante Pyramis Consulting	L'étude traite des besoins en compétences présents et à venir des industriels de la région Occitanie / France ;
Compétences, Mutations, Métiers et Transitions des Emplois de la métallurgie UIMM en Nouvelle Aquitaine	KATALYSE	Cerner les besoins en ressources humaines et en compétences à horizon de 3 et 8 ans. Etablir une cartographie de l'offre de formation Elaborer le bilan d'adéquation
Les technologies numériques de l'Industrie du futur : tendances et illustrations	CETIM Laurent COUVE	Présentation des technologies numériques liées à l'l'Industrie du futur : tendances et illustrations en industrie mécanique
CATALOGUE DE FORMATIONS des Centres Techniques Industriels de France	réseau des CTI , Centres Techniques Industriels de France	Catalogue des formations des Centres Techniques Industriels de France

Major emerging keys technologies among this studies are :

Cybersecurity   IA   3D   Predictive maintenance   IOT   Cloud   augmented reality   DRONES   COBOTS

Digital Twin   Blockchain   HUMAN IN THE HEART OF INDUSTRY 4.0   Data Analysis

Most relevant points are :

➢ In these studies, have been identified cross-functional skills to be developed, including Cybersecurity. English must be taught in France as active language and common tool . This learning on the basis of participatory methods should be accompanied by immersion courses.

➢ The ability to train continuously, especially for trainers so that they can adapt the training courses to the realities on the ground, whose developments are becoming faster and faster.

➢ We have to give time to the maturation of technologies, and fully integrate the transformation of society through digital Aim for an international business model taking into account the contribution of technology to value creation.

➢ We have to promote social ownership of technologies, building on innovation ecosystems, integrating the brakes in the deployment of technologies.

➢ Workers must be trained at all levels and throughout all life.

➢ Labor market innovation will redefine VET, which needs to become more dynamic and innovative, in order to increase the innovation capacity of individuals, and make them agents of economic and social change. In addition, VET must innovate to become a relevant and attractive learning solution and be seen by companies as an investment rather than a cost.

➢ Promoting workplace learning through enabling environments brings together learning and innovation policies, driven by new ideas and intergenerational learning.

4.2.   Training offer

As said, thirty two courses or trainings were detected in France, there is still not a lot of National diploma officially dedicated to Industry 4.0, except two. However, six universities or School for Engineers and Private training centres offer short courses or short Trainings on subjects related on Industry 4.0. Other Courses are specialisations in engineering courses or specialized master degrees in Industry 4.0.
Some of them are free to attend, but several ones are proposed with high expenses rates.

It is Noticeable that most of those trainings are proposed by large institutions in France : Universities in Toulouse, Paris or Lyon, and School of Engineers as ENSAM or Centrale/Supelec. Around fourteen of these institutions are holding most of Public courses. There are also some major National French Technical centres which are able to propose important courses: CETIM and AFPA About special I4.0 training, for professionals.
We have to note that seven courses are at the level Master, on thirty two trainings and courses.

Most important is to stand out that in France, most of these courses are addressing **Big Data, Artificial Intelligence, Cobots**, and in a second step, 3D subjects : prototyping and manufacturing.

The best practices defined for each of the areas are surely :

Pépinière de l'industrie du futur	Certificate of Training	AFPA	training center	For Apprentices / Professionals	2-3 months / 350 h
Responsable des transformations numériques dans l'industrie	Licence Bachelor de Technologie	IRUP Institut régionnal universitaire polytechnique / Institut Mines-Télécom (IMT)	school engineers	For Students Bac to Bac+3	3 years
Certificat Industrie 4.0	Certificate of Training	Dauphine PLS, Université Paris-Dauphine	University	For Master level and Professionals	10 days
Management de l'usine du futur	Master	ENSAM	school engineers	For Master level & Engineers-1	1 year

AFPA is dedicated on three modules :
Module 1. : Electronics & connected objects
Module 2. : Automation, robotics
Module 3. : Maintenance, additive manufacturing.
So, these long training on three months takes Apprentices and Professionals from traditional level to Industry 4.0 refurbishing.

IRUP is preparing Bac level students in three years to Licence level on : Digital technologies, electronics, automation, robotics, industrial IT, networks, CA03D, additive manufacturing, virtual reality, big data, cyber security, digital evolution and transformation. Just 25 students are accepted per year.

Dauphine University is proposing for Professionals a 10 days Training on: robotics & cobotics, data analytics, artificial intelligence, platforms, cloud, human-machine interface, Internet of Things (IoT), towards Production 4.0 (Smart Manufacturing), Logistics 4.0 (Smart logistics) and Value proposition 4.0. (5.500 € per candidate).

ENSAM School of Engineers will prepare young engineers to Digital, connected, adaptable, agile and collaborative factory, with Augmented reality, Robotisation and automation of workstations, Consideration of Man in the Factory, Environmental consideration in the product design and its production system, Data management & Big data, Design, control and piloting of reliable and safe processes.

4.3.   Training needs

Most of interviewed companies are currently using technologies related to industry 4.0. Several technologies, such as internet of things are widespread used. Others, as augmented reality are not used yet.

To help them in their transition to Industry 4.0, interviewed companies consider necessary following soft skills: capacity of leadership and solving problems, initiative and communication.

"Industry 4.0" concept has been judged as too general. The **Focus Group** thinks that the subject needs to be more explained and detailed. They agreed on the fact that people in the project target levels may not be well-informed on these technologies, or on the same basis, even on their future impacts on their (future) job. To remedy this situation, they propose the creation of a **document including general knowledge about industry 4.0**, in complement to more specific and more technical ones.

The training needs on this side are focused on more emerging technologies. One big factor is Cybersecurity, in links with all new technologies. Then after, technologies about 3D are primordial. Most of our companies ask also about Maintenance 4.0 & Predictive Maintenance. Then, they wonder about virtual Reality environments and the development of skills in general.

Several training needs have also been identified by the **Focus Group**, such as Virtual Reality, predictive Maintenance and cyber Security. Yet, some subjects proposed in the questionnaire seem to be less pertinent, such as training in cloud computing or drones.

4.4.   Matrix needs / offer

The Excel sheet **<< FINAL MATRIX >>** that crosses NEED-OFFER is 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 is commented.

GAP MATRIX		TRAINING NEEDS			focus group analysis
TRAINING OFFER		French companies	MV companies	further needs	
TRAINING OFFER REFERENCE	**KNOWLEDGE & competences**				
Big Data	6				medium
Predictive Maintenance	2		6	7,2	HIGH
Cloud computing	5	7	4	6,5	medium
Cibersecurity	4		10	9	HIGH
IoT Internet of things	4	3,5	6	6,5	HIGH
3D for prototyping	7	3,5	5	6,5	HIGH
3D for manufacturing	7	3,5	5	7	HIGH
Augmented reality	5	7		4,2	medium
Virtual reality	5	7		4,2	HIGH
Cobots	7	6,5	5	6	medium
Drones	4		2	4,5	
Bin Picking	4			3,5	
Management 4.0	3		6		HIGH
IA	6				medium

5. CONCLUSIONS

Today, there are serious gaps between educational training and industrial needs in industry 4.0 fields. For degrees corresponding to the project target (specialized operator), educational courses don't offer enough training in these technologies. Yet, companies are already using them, causing a lack of competence. Today, specialists and middle managers are already aware of Industry 4.0 new technologies, from their studies or training provided by their companies.

According to future and actual needs of competencies, most immediate needs in training seem to be focused on the following technologies:
- Predictive Maintenance & Internet of things
- Cyber security
- 3D printing for prototyping and manufacturing
- Virtual Reality.

A general course about Industry 4.0 technologies could also be relevant, to inform the target workforce of future changes in their jobs and give them general knowledge about this subject.