LCAMP

Learner Centric Advanced Manufacturing Platform

OBSERVATORY METHODOLOGY

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LCAMP partners:
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Project name	Learner Centric Advanced Manufacturing Platform for CoVEs
Acronym	LCAMP
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Partners	P1: TKNIKA and MIGUEL ALTUNA, DEPARTMENT OF EDUCATION, BASQUE GOVERNMENT P3: AFM P4: DHBW P5: FORCAM P6: CMQ P7: MECANIC VALLEE P8: DA VINCI COLLEGE P9: KIC P10: MADE P11: AFIL P12: EARLALL P13: KPDoNE P15: GEBKIM OIZ P16: CNG P17: SIMUMATIK P18: TSCMB P19: SKUPNOST VSŠ P20: CAMOSUN COLLEGE
Project summary	The fifth industrial revolution is built upon the technologies of the fourth, with an increased emphasis on a human-centric, sustainable and resilient industrial base, emphasising the digital and green transitions. A key pillar of this economic transformation is the role played by Advanced Manufacturing systems such as Robotics, 3D & 4D printing, artificial intelligence and high-performance computing. I5.0, requires VET to develop 'learning centric approaches' that focus on the holistic competences of humans that plan, manage, oversee or operate technologies. LCAMP will tackle this by incorporating a permanent European Platform of Vocational Excellence for Advanced Manufacturing, seeded from a consortium of 20 partners and over 50 associate organisations including leading VET/HVET centres, companies, regional government, R&D centres, associations of companies and clusters. By collaborating across borders, LCAMP's goal is to support and empower regional AM CoVEs to become more resilient, innovative, and better equipped to train, upskill, and reskill young and adult students to

	successfully face the digital and green transitions. We will help regions grow and be more competitive through their VET systems. The Alliance is service-oriented, planning to establish permanent structures for: • Teaching & Learning: establishing AM skills frameworks and curricula; launching or revising AM programmes (including micro-credentials); creating or capacity building learning factories (special AM labs, jointly run by VET and industry) • Cooperation and Partnerships: launching a skills & jobs observatory for advanced manufacturing; accelerating industry/VET/region cooperation ideas via an open innovation community and providing consultancy to SMEs on integrating SME/VET connections. • Governance & Funding: creating a one-stop-shop portal for all our services; ensuring a business case for continuing services to stakeholders in the long-term, while enhancing participation
Work Packages	WP01: Project management and coordination. WP02: Learner Centric Advanced Manufacturing CoVEs Alliance. WP03: Observatory. WP04: Open Innovation Community. WP05: Human-Centric Learning for Advanced Manufacturing. WP06: Industry 4.0 technology absorption through the Collaborative Learning Factory. WP07: SME-VET connection. WP08: Advanced Manufacturing Excellence Discovery Platform. WP09: Dissemination. WP10: Roadmap for Continued Development Learner Centric Advanced Manufacturing CoVEs Alliance.

Glossary and acronyms

Acronyms

AI - Artificial Intelligence
AM - Advanced Manufacturing
Cedefop - European Centre for the Development of Vocational Training
CoVE - Centres of Vocational Excellence
EAfA European Alliance for Apprenticeships
EC European Commission
ECVET European Credit System for Vocational Education and Training
EntreComp The Entrepreneurship Competence Framework
EQAVET European Quality Assurance in Vocational Education and Training
EQF European Qualifications Framework
ESCO European Skills, Competences and Occupations
ETF European Training Foundation
EU European Union
HE Higher Education
HVET Higher Vocational Education and Training
I4.0 Industry 4.0
KET Key Enabling Technology
OECD Organisation for Economic Cooperation and Development
SME Small and Medium Enterprises
SWOT Strengths, Weaknesses, Opportunities, Threats
TVET Technical and Vocational Education and Training
VET Vocational Education and Training
WBL Work Based Learning

CONTENT TABLE

1 EXECUTIVE SUMMARY

Advanced Manufacturing (AM) and Higher Vocational Education and Training (HVET) need to update training, implement new technologies, and promote internationalisation.

The causes behind these needs are technological factors -Industry 4.0-, factors conditioned by education systems and education methodologies, social factors and environmental factors -the European Green Deal with its emphasis on greening industry-.

Under the CoVE initiative, the LCAMP project aims to support regional skill ecosystems and various stakeholders in the provision of new skills, the implementation of technologies in VET centres.

LCAMP will tackle this by incorporating a permanent European Platform of Vocational Excellence for Advanced Manufacturing,

By collaborating across borders, LCAMP's goal is to support and empower regional AM CoVEs to become more resilient, innovative, and better equipped to train, upskill, and reskill young and adult students to successfully face the digital and green transitions. We will help regions grow and be more competitive through their VET systems.

The Alliance is service-oriented, planning to establish permanent structures for:

- Teaching & Learning:
  - establishing AM skills frameworks and curricula;
  - launching or revising AM programmes (including micro-credentials);
  - creating or capacity building learning factories (special AM labs, jointly run by VET and industry)
- Cooperation and Partnerships:
  - **launching a skills & jobs observatory for advanced manufacturing**;
  - accelerating industry/VET/region cooperation ideas via an open innovation community
  - providing consultancy to SMEs on integrating SME/VET connections.
- Governance & Funding: creating a one-stop-shop portal for all our services; ensuring a business case for continuing services to stakeholders in the long-term, while enhancing participation

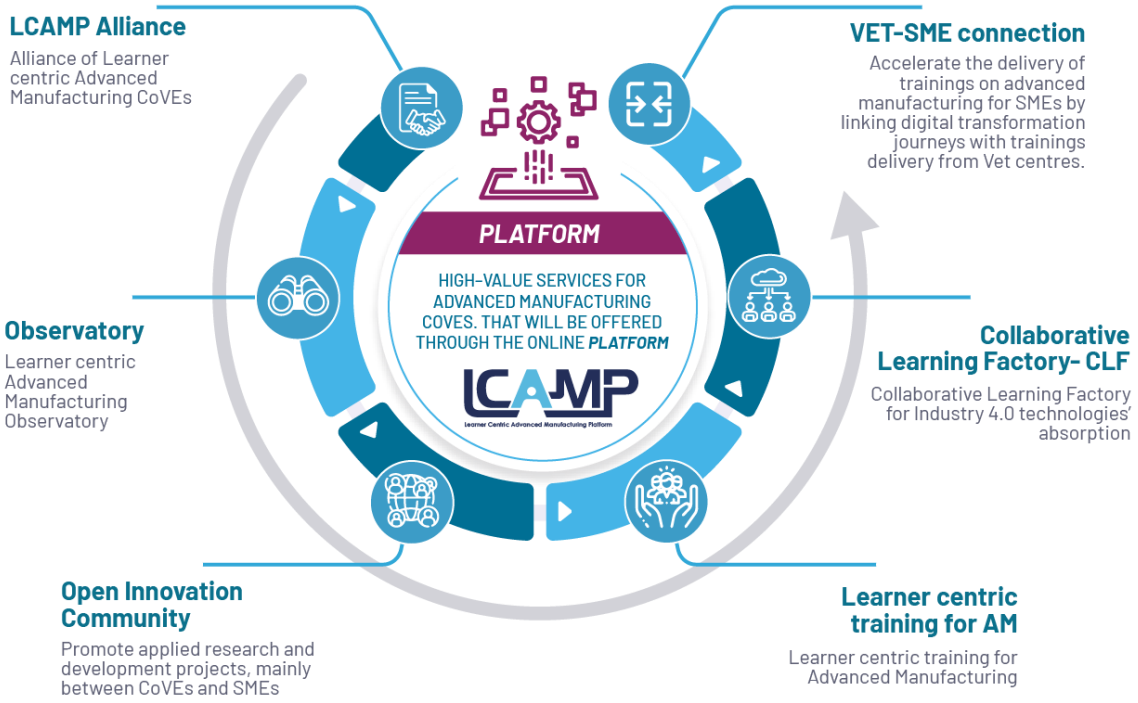

Figure 1 Outputs and services that will be delivered by the LCAMP platform

Therefore, the **LCAMP OBSERVATORY** is one of the services the LCAMP platform will put available to all the final users and target groups. The observatory is leaded by the French cluster *Mecanic Vallee* and the French VET centre CMQ.

This document details the **methodology that the LCAMP consortium will use** to set up and run the observatory. We have set up a process cycle for the observation consisting in 5 stages:

- ✓ Stage 1: Diagnosis and priority
- ✓ Stage 2: Search and information gathering
- ✓ Stage 3: Information Analysis
- ✓ Stage 4: Creating value. Elaboration of LCAMP reports
- ✓ Stage 5: Dissemination and communication.

2 INTRODUCTION

The **LCAMP Observatory** will be a reliable and easily accessible source of information and data for trainers, VET teachers, professionals, updated on Digital / Advanced Manufacturing / Smart Industry, delivered through a multimedia and interactive platform -LCAMP platform-, that can be customized according to individual interests.

This observatory will feed other Work packages (WP), as for instance, WP 5 on Learner Centric Training, Open innovation Community in the WP4.

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- ✓ Stage 5: Disseminate-communicate

Following this process cycle we will detail the main aspects of the observation methodology such as:

- Identify reliable sources that we can find in Europe about Advanced Manufacturing
- Classify and filter data gathered from different sources
- Present several ways to collect data and to analyse them
- Define the methods for the creation of reports
- Validation process for those reports
- launch a preliminary channel to disseminate the first results, before the building of the main LCAMP Platform

3 LCAMP OBSERVATORY

The LCAMP observatory is one of the services of the LCAMP platform.

The LCAMP Observatory will be a reliable and easily accessible source of information and data for trainers, VET teachers, professionals, updated on Digital / Advanced Manufacturing / Smart Innovations delivered through a multimedia and interactive platform that can be customized according to individual interests.

The observatory will publish periodical reports for VET and HVET target audience about technology trends, labour market changes, skills' needs, and occupations in Advanced Manufacturing. It expected that SMEs, industry clusters and other associations will also find valuable information in the observatory

The publication of a yearly report is planned.

- report 1 June 2023,
- report 2 June 2024,
- report 3 June 2025.

The mentioned main reports will be complemented with additional sub reports, regional and national reports that will be periodically distributed in our platform and by conventional dissemination channels.

3.1 Justification

At this moment, there is a lot of high-quality information about advance manufacturing, but it is not reaching VET/HVET centres.

- ✓ There are already existing observatories, some of them producing high quality data.
- ✓ There are also many data sources from official statistics: Cedefop, OECD and others.
- ✓ Each agent has a form of knowledge (Jensen, 2007) The information that each agent has, tends to be very “sticky” (Hippel, 2005) The transfer of information from one agent to the other is key for the EU AM sector to thrive.
- ✓ There are plenty of observatories, white papers, trends forecasts etc for AM but, from a VET perspective, the huge amount of info is very dispersed and difficult to gather and exploit.
- ✓ Human factor: the way the Industry 4.0 and Advanced Manufacturing are affecting workplaces and jobs, as well as its impact on people is of a strategic importance.
- ✓ VET practitioners are usually aware of their regional realities However, they lack the international perspectives
- ✓ There is no a cooperation network of VET/HVET centres of advanced manufacturing to monitor and share information.
- ✓ Students of all levels have difficulties to learn about the career opportunities they may have.

3.2 Objectives

The main goal for the Observatory is to offer high value reports to VET stakeholders by gather, filter and organize relevant information (also considering regional contexts) taking the best from existing Advanced Manufacturing platforms and observatories (business and education).

The operational goals are:

- ✓ To provide a one-stop-shop service for accessing all data and information generated by the observatory
- ✓ Collect the information needed to create all the LCAMP deliverable and services
- ✓ To create the structure and tools to assure the sustainability of the observatory
- ✓ to foster LCAMP Platform and Open Innovation community.
- ✓ to summarise the results of the observatory in easy-to-read yearly reports that will be shared with all stakeholders to promote an information-based decision making.
- ✓ To create 9 experts panel from the advance manufacturing sector in 9 countries to validate the findings and conclusions of the reports.

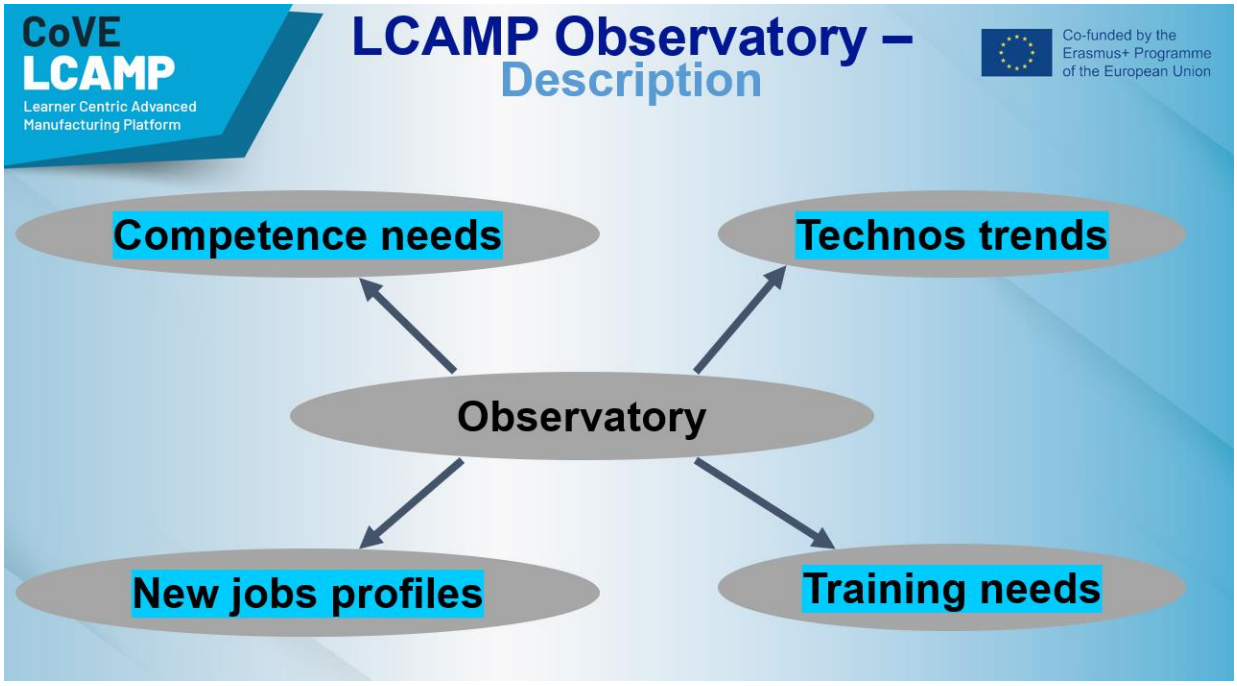

Figure 2 LCAMP observatory description

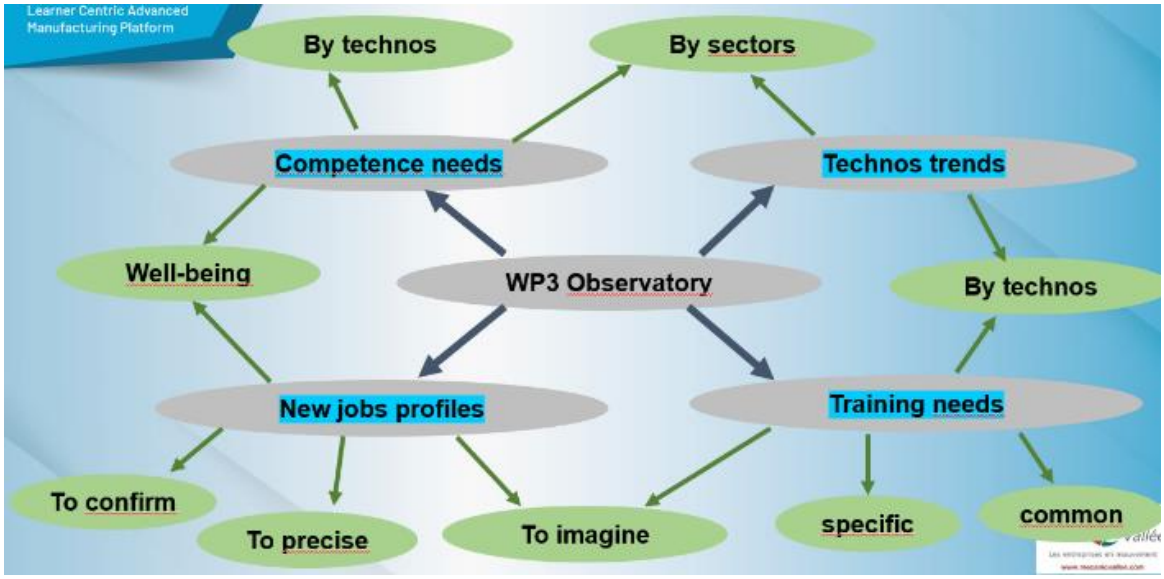

Figure 3 Links among observatory items

3.3 Outcomes

Waited Services in platform are to:

- Detect technology trends in Advanced Manufacturing (Closely screen and gather the topics «close» to Advanced Manufacturing in Industry 4.0, that impact the manufacturing world (sustainability, servitization, Industrial Smart Working, Resilient Supply Chain, Virtualization). It will help to understand how Smart / Advanced Manufacturing / digital Technologies are able to support its evolution
- Screen and gather the evolutions of digital & smart innovations on operations processes, at national and international level in terms of technologies, application environments, and national regulations;
- Screen and gather the spread of Industry 4.0 for AM in Europe, in terms of knowledge and applications;
- Screen and gather companies' best practices in regard to the areas of in-depth listed studies
- Detect skill needs in Advanced Manufacturing
- Detect new job profiles in Advanced Manufacturing
- Detect education trends in Advanced Manufacturing
- Connect existing networks, platforms, clusters, etc.: screen and gather the application and technology Industrial framework in Europe,
- Examine more closely the most representative success cases;
- Screen and gather interconnections and cooperation abilities among resources (physical assets, people, and information both within the factory as well as distributed across the value chain), which will dramatically change their efficiency and competitiveness
- Preparation of employees, job seekers and teachers for the digitalisation of companies in mains aspect of Industry 4.0 for Advanced Manufacturing:
- Check standard training courses: discovery of digitalisation, social and psychological consideration of the evolution, techniques that facilitate daily operations, environments, the interest of digitalisation and IOT tools, etc. soft skills adapted to this digitalisation,
- An inventory will be made of school courses, university courses, apprenticeships and continuing education
- Survey what others are doing, connect them
- Generate and spread knowledge on AM in Industry 4.0, about opportunities and the impact of digital & smart technologies.

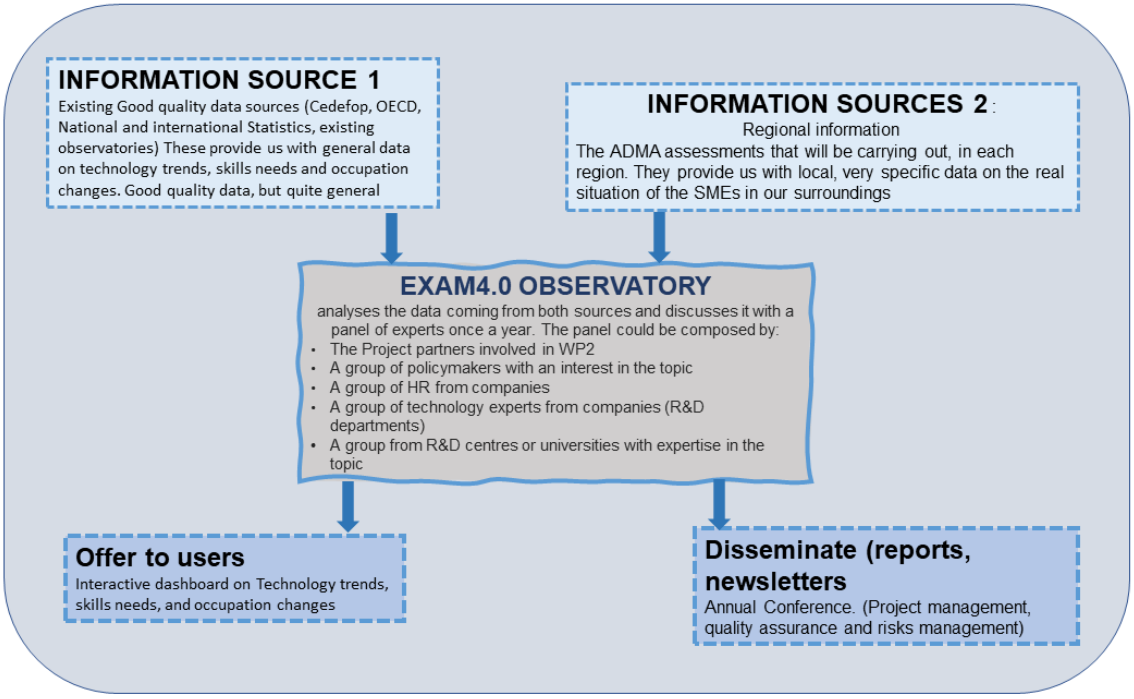

Figure 4 Draft observatory developed in EXAM4.0

The observatory is conected with other LCAMP services. Figure 4

- Learner Centric AM CoVEs ALLIANCE (WP 2)
- Open innovation Community (WP4)
- Learner Centric Training for AM (WP5)
- Collaborative Learning Factory for i4.0 technologies absorption (WP6)
- SME-VET connection (WP7)
- Platform (WP8) and Impact Assessment
- Roadmap Continuous Development LCAMP Alliance (WP10)

3.4 Scope

The scope of LCAMP observatory covers the interests of the target users of it. We have defined 4 boundaries to delimit the scope.

Firstly, LCAMP observatory is about Advanced Manufacturing from a VET/HVET perspective. Therefor the **educational scope** is considered. (3.4.3)

Secondly the geographical scope covered (3.4.1)

Thirdly we have identified the main industrial sectors that we will cover (3.4.2)

Finally, we have delimitated the target audience that we are addressing. (3.4.4)

The scopes defined in this document are open to revisions. The impact of the first report (June 2023) will open a revision phase for the observatory scope.

3.4.1 Geographical scope

The observatory will focus mainly on European countries. We will bring insights also from worldwide sources when research fields require them.

Concerning national and regional data, our main national sources are from the countries represented within the LCAMP consortium which are:

Belgium, France, Germany, Italy, Netherlands, Slovenia, Spain, Sweden, Turkey.

The observatory will build national reports for these countries, and possibly for additional ones.

Concerning regions, in each country we have very industrialized regions represented, Basque Country (Spain), Baden -Wurttemberg (Germany) Lombardi (Italy) Kocaeli (Turkey) Västra Götaland (Sweden) Occitan (France). Thus, the regional reports will be mostly focus on these regions although other representative regions might also be included in these reports.

3.4.2 Industry sectors

LCAMP is focused on advanced manufacturing and by extension, industry 4.0.

The technological fields expected to be observed are detailed in section 4.1.1

Sectors:

The aim of the Observatory is to cover a wide range of sectors and occupations. The areas of observation will probably be cut down by specializing in those of greatest interest to LCAMP.

- Machine tools (Mechanical Engineering),
- Automotive,
- Aerospace,
- Electric and electronic Industries,
- Transport,
- Maritime

Sectors defined by the EU Commision https://single-market-economy.ec.europa.eu/sectors_en (EU commission, 2022)

3.4.3 Education levels

LCAMP is focused on advanced manufacturing for the European VET and HVET Education systems. According to the European Qualifications Framework (EQF) (Europass, 2017) we will cover education levels from **EQF3 to EQF6**, covering VET and Higher VET Education systems.

The comparison between National Qualifications Frameworks' and EQF's levels is available on the Europass website. (Europass, 2017)

The EQF is compatible with the Qualifications Framework for the European Higher Education Area and its cycle descriptors. The framework was agreed by education ministers of the intergovernmental Bologna Process in 2005. (Europass, 2017)

In the EQF, knowledge is described as theoretical and/or factual, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments). Responsibility and autonomy are inscribed as the ability of the learner to apply knowledge and skills autonomously and with responsibility. (Europass, 2017)

Characteristics of learning outputs for the different EQF levels: (Europass, 2017)

EQF levels	Knowledge:	Skills:	Responsibility and autonomy:
Level 3	Knowledge of facts, principles, processes and general concepts, in a field of work or study	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information	Take responsibility for completion of tasks in work or study; adapt own behaviour to circumstances in solving problems
Level 4	Factual and theoretical knowledge in broad contexts within a field of work or study	Exercise self-management within the guidelines of work or study contexts that are usually predictable, but are subject to change; supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities	Exercise self-management within the guidelines of work or study contexts that are usually predictable, but are subject to change; supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities
Level 5	Comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge	A comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems	Exercise management and supervision in the context of work or study activities in which there are unpredictable changes; review and develop performance of self and others.

Level 6	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study	:Manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts; take responsibility for managing professional development of individuals and groups

Table 1 Characteristics of learning outputs for the different EQF levels:

Although LCAMP project is mainly devoted to VET and HVET target groups we will adopt a wider approach in the observatory. In Industry 4.0 and 5.0 the boundaries among educational levels are easy to extrapolate to specific technological skill levels. Therefore, in certain cases the observatory will also gather information from Higher Education organizations (EQF7-8). Furthermore, there will probably be certain learning pathways that goes in different direction that those marked by EQF levels.

Non formal education in upskilling and reskilling

The observatory is also expected to take into account non formal educations sources, training providers from outside education system. Currently there are plenty of technology suppliers' firms that also provide training to their customers.

That provision of training is also interesting for the LCAMP consortium and for its target audience.

3.4.4 Target audience

The target audience of LCAMP Observatory are teachers and professors, learners (young students and lifelong learners), VET centres -and involved organizations, SMEs, and other stakeholders.

Therefore, we have a large panel of targets, quite different about their needs, interests, ways of approach, and levels. The observatory will adapt the delivered products – reports or answers to queries in the platform – to the specific profiles of each target group.

As example of that heterogeneity, Mecanic Vallee asked their cluster-SME members what they would consider a lucrative Observatory on Advanced manufacturing. Replies could be summarised as the following comment:

"We are working in Machine tools for composites materials. So, I will enter the Observatory, to ask my question which is: "How Advanced Manufacturing can help me to develop new functions for my future machines, to reduce costs and to better perform them..."

Mainly, SMEs will reach out for pragmatic answers to precise questions.

4 METHODOLOGY OF THE OBSERVATORY, PROCESS CYCLE

The LCAMP observatory methodology is created based on Technology Surveillance (TS) and Competitive Intelligence (CI) systems.

The observatory will follow the classical steps of such systems that are:

- ✓ Stage 1: Diagnosis and priority
  - Set up priorities and fields to observe
  - Identify data sources
  - Classification of sources
- ✓ Stage 2: Search and information gathering
- ✓ Stage 3: Information Analysis
- ✓ Stage 4: Create value. Elaboration of LCAMP reports
- ✓ Stage 5: Disseminate-communicate

In this section we explain the structure of the LCAMP observatory. That structure follows the process cycle as shown in Figure 5

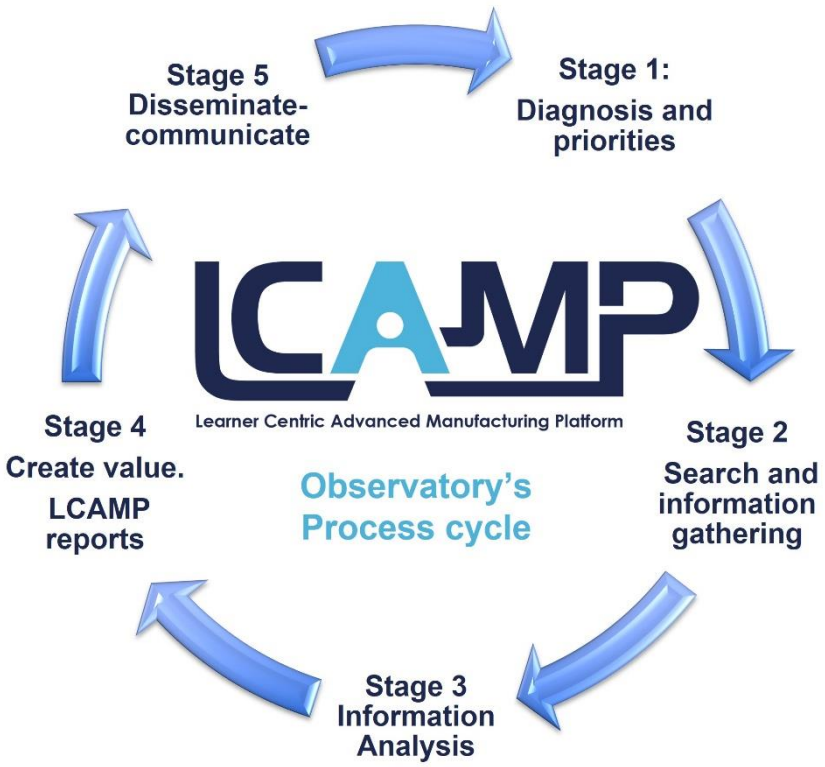

Figure 5: Process cycle for the observatory

4.1 Stage 01 Diagnosis and priority

Before targeting the sources relevant to the LCAMP observatory, the main goals, purposes and role of LCAMP needs to be clearly defined. These key questions need to be answered: What we want to get from the observatory? What are the outcomes of the Observatory? What for will do we use those outcomes?

The **diagnosis stage** starts answering the above questions (and similar ones) to always keep in mind the purpose, deliverables (products and services), tasks and mechanisms to produce the deliverables in the different Work Packages of LCAMP.

After such reflexion and once we have identified the answers to these questions, we have to first target the **fields or areas of surveillance** and **the sources that are relevant** for the observatory. In this stage we carry out the classification of the sources.

4.1.1 Fields. Areas of observation

The areas of surveillance that we have identified are specified and detailed in this section.

We have defined 4 main areas of observation for the LCAMP observatory, which is devoted to advanced manufacturing and industry 4.0 related topics (Figure 6)?

1. Trends for advanced manufacturing and Industry 4.0
2. Impact of industry 4.0 in jobs
3. Existing qualifications and educational offer
4. Future skills, Employability, most demanded jobs and skills.

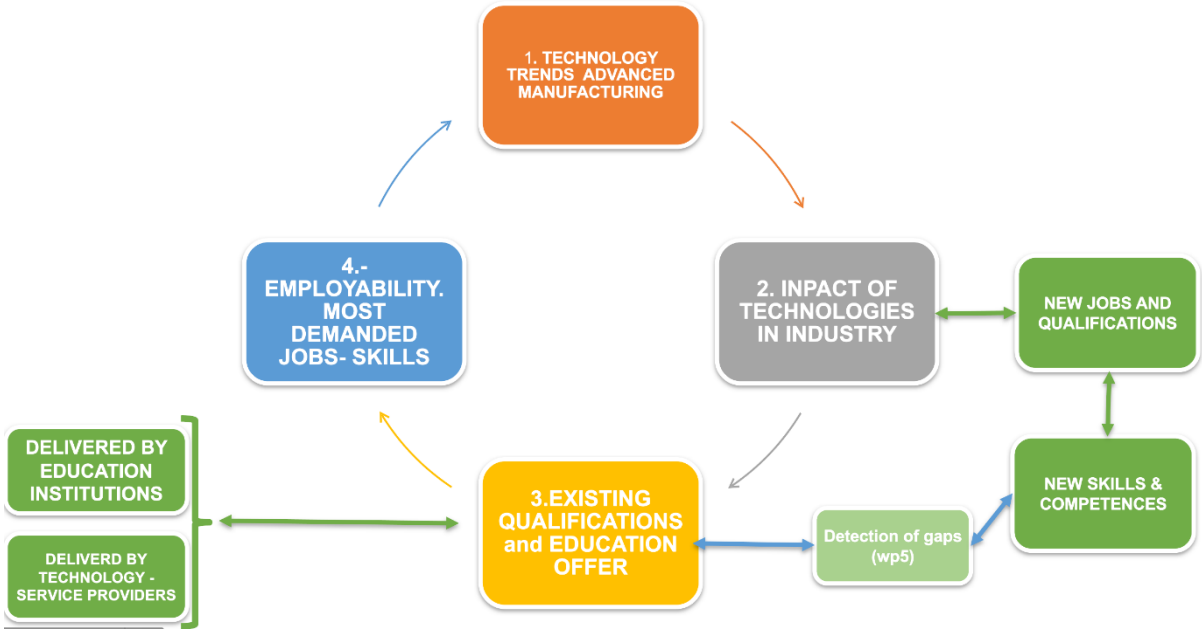

Figure 6 Areas of observation

4.1.1.1 Trends for advanced manufacturing and Industry 4.0

Currently there is a vast number of reports about the trends in industry 4.0. In order to narrow the scope for gathering and analysing trends, we will set up two levels for the trends:

A) Mega trends: The first level of observation will be a cross sectorial analysis of reports produced by big consultancy firms such as Capgemini, Price Waterhouse, Garner, + Siemens, Robert Bosch, Ericsson, Mc Kinsey, Accenture, and similar. This analysis will aim to refine the later study.

Research on their latest reports on technological trends in industry and their impact on jobs, skills and workforce.

B) Trends by regions, sectors and industries.

a) The research on regional and national trends will be carried out by countries/regions based on the concrete Research and Innovation Smart Specialisation Strategies (RIS3) and main industries and sectors.

For those sectors the research will focus on identifying which are the most impacting trends for those sectors. The trends are expected to be concrete technologies and/or derived from their practical applications, such as digital workplaces, a higher degree of automatization of manufacturing processes, the impact of the integration of robots, AVGs etc.

b) Trends are expected to be similar between several regions. There will be room for comparative analysis.

C) Trends by technologies

The range of technologies involved in digital and green transformations is wide. Moreover, the technologies are at different development stages and are developing rapidly. The in-depth monitoring of all of them requires an effort beyond the scope of the observatory.

The approach of the observatory is to select and prioritize the technologies to follow and observe in LCAMP while always relying on other existing observatories. From the classic cluster of I4.0 key enabling technologies shown in Figure 7 we have extracted a more concrete list of technologies that we consider will add more value to the observatory.

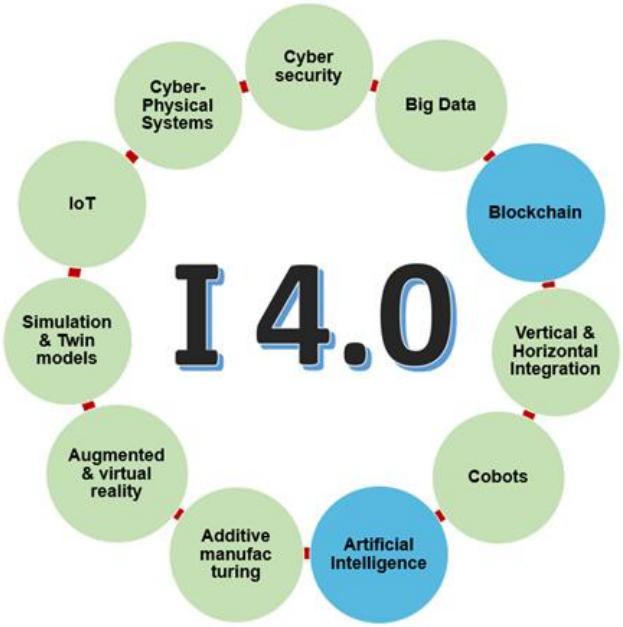

Figure 7 Key enabling technologies of Industry 4.0

The prioritization criteria basically follow the interests of the LCAMP partners and may change over time. The prioritization will also be conditioned by the findings in the other fields.

The selected technologies are clustered as follows:

Trends in manufacturing processes

- Machining: Turning, Milling, High Speed Machining, Grinding)
- Metalforming (Stamping, Forging, Bending, etc.)
- Welding, Casting, Powder metallurgy

Digitization of manufacturing processes

- Sensoring of manufacturing processes
- Data collection, analysis of data
- Multitask and hybrid machines, flexible systems
- Automation of processes
- Traceability
- Metrology

Robotics

- Industrial robotics
- Collaborative robotics
- Mobile robotics

Additive Manufacturing

- Generative design
- Topology optimization
- 3Dmetallic printing
- Hybrid machines
- 3D scanning

Digital Factory

  - Flexible and intelligent machines and systems
  - Digital workplaces, ergonomics
- Energy Efficiency
- Carbo Footprint
- Life Cycle/ Ecodesign
- Simulation of manufacturing processes,
- VR/AR/MR
- Artificial vision
- Cyber security
- Digital twin.

D) ADMA TRANSFORMERS' 7 dimensions for digital transformations

The EU-funded initiative ADMA Transformers (IMR, 2021)) has defined 7 dimensions to determinate the digital transformation of Small and Medium Enterprises (SME).

ADMA Transformers with its 35 partners covers all EU member countries and they aim to achieve 1000 SMEs in their project lifespan.

Based on a Memorandum of Understanding signed by LCAMP and ADMA Transformers' coordinators, both projects will collaborate in certain aspects, among other things, getting insight from those SMEs and their needs.

For that reason, we have included in our observation methodology the 7 dimensions defined in ADMA Transformers' framework. We will create cross links between the inputs coming from ADMA and the observation fields defined for LCAMP observatory.

The 7 dimensions included in ADMA are explained in Table 2

Transformation 1: Advanced Manufacturing Technologies	
Vision	Within a Factory of the Future there is a clear vision on how technology is to be used for gaining competitive advantage. The vision is translated into a roadmap of strategic plan.
Strategy	A clear investment policy that matches the strategic vision is put into practice.
Awareness	Technology is evolving rapidly making it necessary to gather information and build up knowledge in order to support investment decisions.
Level of capabilities	A Factory of the Future has the capability to introduce and operationalise advanced manufacturing technologies.
Transformation 2: Digital Factory	
Enabling infrastructure	The company has a flexible and secure ICT infrastructure, enabling the digital transformation.
Digital capabilities	Aside from having digital capabilities to optimise production with process data, the company also translated a clear vision on digitalisation into a roadmap or strategic plan.
Transformation 3: ECO Factory	
Resource management	The company systematically reduces its dependency on non-renewable energy sources, raw and auxiliary materials as well as water.
Compliance & Innovation	A resilient and robust organisation successfully withstands the impact of climate change and resource depletion.
Transformation 4: End-to-End Customer Focussed Engineering	

Customer focus & value proposition	The company maximises customer value creation whilst carefully managing related costs and risks.
Robust engineering processes	In order to speed up time to market, the company uses design, manufacturing and disposal processes that are robust, standardized and of highest quality.
Transformation 5: Human-Centred Organisation	
Individual employee	The company invests in challenging jobs, thereby focusing on individual growth and self-realisation, in terms of skills, knowledge and competences.
Team	The organisation empowers teams to ensure efficient production. Teams work with authority and responsibility.
Leadership	A clear vision and strategy is well deployed and new leadership roles have been developed.
Organization	The organisation stimulates life-long learning and individual growth paths using an open communication philosophy between all hierarchical levels.
Transformation 6: Smart Manufacturing	
Human-machine interaction	The company designs its shop floor processes such that they are able to exploit the full potential offered by user-friendly, automated, intelligent and flexible human–machine interaction, ranging from digital connected machines to using real-time connected info carriers, cobots, robots, etc.
Manufacturing Planning & Control Processes	The company uses self-managed manufacturing and quality control systems in order to "organize for complexity", i.e. being able to adapt quickly to changing orders and customer requests without always having to go in rush order status. Smart manufacturing KPI's are used as an essential monitoring and improvement tool for the shop floor to support high levels of productivity and flexibility.
Transformation 7: Value Chain Oriented Open Factory	
Cooperation and Partnerships	The organisation is structured to be agile and open towards various cooperation and partnership initiatives in order to enable co-creation, create demand-driven value chains and increase the factory's innovative capabilities.
External Expertise and Knowledge Management	To offer individualized and state-of-the-art products, the needs, demands and knowledge beyond the company's borders must be tapped into.

Table 2 Seven dimensions of ADMA TRANSFORMERS framework

4.1.1.2 Impact of i4.0 on jobs

The second field of observation defined within the LCAMP observatory is the impact that the industry 4.0 is having on jobs.

The aim of this field is to investigate and be aware of how factories are changing due to the twin transition: The implementation of industry 4.0 related technologies is changing not only the manufacturing processes but also the organizations themselves. These changes involve the transformation of jobs and work procedures, as well as changes in skills and competencies related to those jobs. These socio-economic changes will necessarily and directly impact people.

The nature, level and disruptiveness of these changes will vary from sector to sector, they may also vary depending on manufacturing processes and even among companies.

The observatory will identify emerging jobs clustered by sectors, manufacturing processes, and to some extent technologies. Here are the main aspects that will be considered about emerging jobs:

- Identification of the main changes in workplaces, in existing jobs. Quantitative analysis (number of affected jobs)
- Qualitative analysis: Identification of the key factors that enable those changes: concrete technology implementations, concrete digitalization processes, changes on
- The link between new jobs and changed jobs and skills & competences

4.1.1.3 Existing qualifications and educational offer

There already is a considerable amount of relevant educational offers in the targeted field of observation available, offered both by private and institutional stakeholders within Europe. As mentioned above, these educational offers are not always meeting nowadays working market needs due to unforeseen natural and socio-economic disruptive changes, affecting both existing qualifications and education offers on a global and regional level. As a consequence, there is a call for the adaption of qualification offers on all educational levels especially in sectors that are dealing with constantly changing I4.0 technologies. Exposed to smart technologies, learners will need to adapt their former abilities and habits to keep up with interacting and managing new intelligent technologies. That is why human-centred learning approaches and lifelong learning opportunities need to be continuously investigated, didactically checked and, if needed, tailored by the LCAMP's Open Innovation Community (OIC), by integrating and adapting new LLL opportunities and learning pathways (OER) with a focus on sector-specific upcoming future skills.
To improve the current educational situation in the fields of observation (4.1.1.1) by compensating skill gaps in the targeted fields in the long run, it is mandatory to investigate first the status quo on existing qualifications and educational offers among partners and affiliated entities of the LCAMP consortium. The benchmarking approach on new and existing qualifications will constantly be extended and adjusted in further stages of observation within Europe. The observatory's forecasting methodology will thus help to provide information on the most recent and relevant educational offers (OER) available, as well as performing the crucial analysis on up- and reskilling needs in the targeted fields of observation described above. (CEDEFOP, 2020)

To translate these tasks into reality, the LCAMP consortium will follow the benchmarking approach on existing qualifications and training offers relevant training offers which is planned as the following:

- Conduct a Desk-Research among partners in the LCAMP consortium and among affiliated industry stakeholders and technology-service providers gathering data on:
    - Existing qualifications EQF 3-6 (i.e. CEDEFOB database) on advanced manufacturing
    - Existing Job Profiles EQF 3-6 (i.e. ESCO, database) on advanced manufacturing
    - Delivered and relevant education and training offers (courses, tranings) per institution and country aligned to EQF framework
- Organize workshops within the consortium on how to adjust the observatory's benchmarking approaches in the long run.

4.1.1.4 Future Skills

Investigation on the most demanded jobs in the short and long run for VET level's (EQF3-6) positions in Advanced Manufacturing companies will let us to determinate the future skills linked to those jobs.

In this section we will also include the employability factor: Besides the needed future skills for the emerging new jobs and position, we consider relevant to observe which are the most popular occupations for VET students in general. It may happen that mature occupations with lower degrees of digitalization are still highly demanded.

The analysis in this field will be carried out combining statistical sources, existing other sources and desk research.

4.1.2 General classification of sources

To assess the current and future situation with the fields described in 4.2, we need to combine information from several data sources. Furthermore, we will analyse different data sources on the same fields to compare results.

The members of the observatory will **identify and classify the data sources** for each field of the observatory and classify them by the following criteria.

- Type of data that we will gather from that source
- Description of the source
- Fields addressed: It defines the field that the source is mainly feeding (trends, impacts on jobs, skills and qualifications, future skills)
- Scope
    - Geographical Scope: EU-wide, national (country-wide) and regional sources.
    - Sectorial scope: What industry sectors and/or activities the source refers to.
    - Educational scope: Education systems that the source covers or impacts. This scope identifies, classifies, and links the information gathered to education levels, specialities, skills, et
    - Social scope: Employers, employees, job seekers, policy makers, unions.
- Source analysis:
    - Justification on the relevance of the data source, why this data is useful. We will use a rating system
    - Usability of the data: what for we will use this data.

A common template to record and share data will be available for partners

4.1.3 Identified general data sources

We list here relevant sources that we have identified so far. This list includes mainly EU wide sources, centres and organizations dependants of the EU commission, EU funded projects connected to LACMP objectives and European databases. We also list some examples of other generic sources like relevant papers and insights from industry leaders.

This is not an exhaustive list, on the contrary the list will raise and change with time.

- **Published reports and surveys**. ILO, ESCO, CEDEFOP, OECD, EU commission, EIT manufacturing, European Forum for Manufacturing, World Manufacturing Forum
    - ILO Skills and employability (ILO, 2022)
        - Strengthening work-based learning in VET institutions (ILO, 2022)
        - The digital transformation of apprenticeships: Emerging opportunities and barriers (ILO, 2022)
        - Skills Development for a Just Transition (ILO, 2022)
    - Cedefop skills forecast (CEDEFOP, 2022) quantitative projections of the future trends in employment by sector of economic activity and occupational group.
    - Cedefop Skills Ovate database (CEDEFOP, 2022) jobs and skills employers demand based on online job advertisements (OJAs) in 28 European countries.
    - https://oecd.ai/en/ai-principles
- Reposts elaborated by consultancy firms: McKinsey, Garner, Capgemini, PWC,
- Statistical inference on EU-wide cross-country datasets
- Eurostat data on digital technologies and on the labour market
- National education reports
- National sectorial reports
- H2020,
    - Adma Trans4mers, ADMA TranS4MErs builds on the efforts of the European ADvanced MAnufacturing Support Centre (ADMA), an EU project launched in 2018 with the main goal of anchoring a future-proof and sustainable Manufacturing industry in Europe. Over its three-years lifetime, ADMA helped more than 100 SMEs in 12 European countries adapt advanced manufacturing solutions and social innovation strategies and become next-generation factories with more competitive, modern, and sustainable production. (IMR, 2021)
    - Bridge5.0,
    - Beyon4.0, aims to help deliver an inclusive European future by examining the impact of the new technologies on the future of jobs, business models and welfare. (TNO, 2020)
    - Untangled aims to examine the interconnected trends of globalisation, demographic change and technological transformation, and their effects on labour markets in the European Union and beyond. By engaging a broad range of stakeholders, including companies and civil society organisations, we will develop practical policy proposals to help governments cushion the negative impacts of these trends and ensure their benefits are enjoyed fairly across regions and sector (HIVA, 2020)
    - European Skills Strategy and Alliances: ESSA,
    - FIT4FOF aims at addressing workers' needs, analysing technology trends across 6 industrial areas of robotics, additive manufacturing, mechatronics/machine automation, data analytics, cybersecurity and human machine interaction, to define new job profiles, which will inform education and training requirements. (CTI, 2019)
    - BOOST40 Boost 4.0, starting 1st January 2018 and with a duration of 3 years, is the biggest European initiative in Big Data for Industry 4.0. (Innovalia, 2018)
    - FACTS4WORKERS Worker-Centric Workplaces for Smart Factories - (Virtual Vehicle Research Center - VIF, 2016)
    - HUMAN MANUFACTURING aims to define and demonstrate workplaces where automation and human workers operate in harmony to improve the productivity, quality, performance of the factory as well as the worker satisfaction and safety. (Sintef, 2018)

- An Advanced Circular and Agile Manufacturing Ecosystem based on rapid reconfigurable manufacturing process and individualized consumer preferences KYKLOS 4.0 will demonstrate, in a realistic, measurable, and replicable way the transformative effects that CPS, PLM, LCA, AR and AI technologies and methodologies will have to the Circular Manufacturing (CM)Framework. (Kyklos, 2020)
- FAREDGE Factory Automation Edge Computing Operating System Reference Implementation
- MAKERS RISE study issues related to the drivers and dynamics of sustaining the competitiveness of EU manufacturing sectors. The project's innovative research, training and mobility activities will address key concerns related to the historic opportunity for the EU to lead a manufacturing renaissance that not only upgrades existing manufacturing competences but, more importantly, develops new technological capabilities across EU regions to support regional industrial resilience for more distributed and sustainable socio-economic growth and prosperity. The MAKERS will create a multi-stakeholder platform to discuss the current understanding of issues related to the emergence of Industry 4.0 in Europe. (Birmingham Business School,, 2018)
- QU4LITY Digital Reality in Zero Defect Manufacturing, utonomous Qu4lity (AQ) and Zero Defect Manufacturing (ZDM) in the Industry 4.0. (Atos, 2020)
- ICP4LIFEICP4LIFE An Integrated Collaborative Platform for Managing the Product-Service Engineering Lifecycle (PATRAS University, 2018)

- ERASMUS + (Advanced manufacturing & I4.0 related)
  - Blueprints
  - CoVEs
  - Sector Skills Alliances
  - FLP
  - Selected KA2 projects: as www.3tindustry4.0.eu and www.iet40.eu
- European approach for Microcredentials,
- Micro credentials for lifelong learning and employability
- Microcredentials.eu

Sources EU Wide datasets:

European Manufacturing Survey
EU survey: Manufacturing our Future_(EU Commission, 2021)

- European company survey (Eurofund)
- European working condition survey
- European Skills and jobs survey (cedefop)
- Skills requirements (ilo)

EU commission's initiatives:

- Pact for skills
- European Skills agenda
- European Industrial and SME Strategy
- European Digital Strategy
  - The Impact of Artificial Intelligence on the Future of Workforces in the EU and the US

- European Skills, Competences, Occupations and Qualifications ESCO (Directorate General Employment, Social Affairs and Inclusion (DG EMPL), 2022)
- JOINT RESEARCH CENTRE JRC Publications repository (JRC, 2022)

Selected papers:

- Reshaping workplaces: workplace innovation as designed by scientists and practitioners (Dhondt, 2015)
- Creating spaces for innovations in education and lifelong learning (Antonius Schröder, 2017)
- Understanding technological change and skill needs Technology and skills foresight (CEDEFOP, 2021)
- Sector Skills Insights: Advanced Manufacturing, 2012 (Davis, 2012)
- Global Lighthouse Network: Reimagining Operations for Growth (Francisco Betti, 2021)
- Man and Machine in Industry 4.0 (Lorenz Markus, 2015)

Insights from industry and technology leaders (large companies, SMEs, regional ecosystems), there are also Technology generic sources. Useful examples of this sources are:

- 100 RADICAL INNOVATION BREAKTHROUGHS RIBRIS FOR THE FUTURE https://ribri.isi-project.eu/
- Siemens https://www.siemens-advanta.com/
- Kuka, Future of manufacturing https://www.kuka.com/en-de/future-production
- VTT https://www.vttresearch.com/en/industries/manufacturing
- Manufacturing Digital magazine: https://manufacturingdigital.com/
- Manufacturing x Digital (US) https://www.mxdusa.org/2022/03/17/22-for-22-the-most-in-demand-digital-manufacturing-jobs-right-now/
- Advancetech https://www.advancedtech.com/blog/manufacturing-trends/
- Machine tool world https://www.mtwmag.com/machine-tools-industry-future/
- Modern Machine Shop https://www.mmsonline.com/
- The manufacturer https://www.themanufacturer.com/etc

4.1.4 Contrast of observatory's ideas with students

The design of the observatory fields and the identification of general sources hs been carried out by the steering committee of the observatory.

In order to contrast and make a preliminary validation of the approach and ideas of the observatory we have the opportunity to supported by IMT EMAC, a French technology engineering University member of Mecanic Vallee cluster.

The point of view of these students from IMT EMAC, a French engineering university, is of great interest to support our work: they provide an outside advice to the Project, to support our work. The ideas and suggestion submitted will be considered to improve the observatory approach.

So, we have to consider this point of view which is engaging them, not LCAMP Project, nor LCAMP partners.

The student's contrast process is described in the following paragraphs.

The Student's team works in stages. They ask certain questions to professors and students involved in Industry 4.0. After discovering the subject, they use their own methodology consisting in discovery, analysis, surveys, proposals, in line with their professors. Taking their results into account, they can point this matrix from Porter:

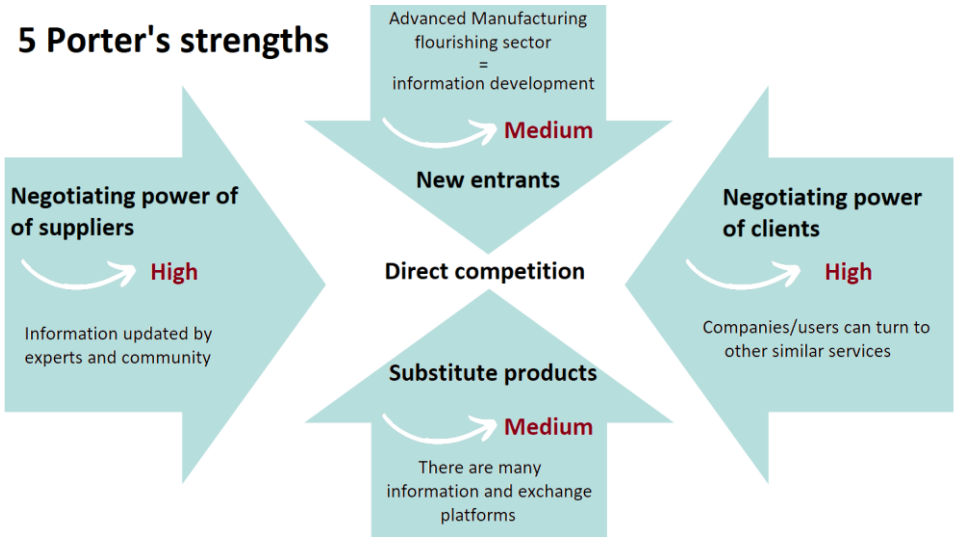

Figure 8 Porter's strengths used by IMT EMAC students

Then after, to present their results, they decide to create some virtual profiles to simulate observatory users and to explain different points of view.

Profils:

Sylvie: Human resources manager in an industry 4.0 SME for 15 years:

"I'm looking to quickly get all the Industry 4.0 info for training, job seekers, data etc."

Expectations

Complete and regularly updated information & Centralization of all information (training, recruitment, etc.)

Leverage

No budget constraints

Brake

Confidential information of the company

Simon: Student in engineering school who would like to pursue a thesis:

"I would like to easily know what skills I need and what training courses I need to take to reach my 21-year-old dream job."

Expectations

To have a place where all the information that interest him on the Industry 4.0 is centralized & to be able to easily reach recruiting companies and partners for research projects

Leverage

His school can ask him to only use this platform for his research work

Brake

Creating a link with companies and partners is complicated because he does not know how to approach them or by what means

Eva: Student:

"I like learning new things, especially when it comes to artificial intelligence."

Expectations

To have a place where all the information on the field of artificial intelligence is gathered & to no longer have to sort or double check the information she finds on a subject

Leverage

She does not need this platform in her professional life

Brake

Since she has no theoretical knowledge on the subject, she is not able to sort out the information she finds

Damien: Technician in the aeronautics industry for 10 years:

"I would like to have easy access to information regarding training and new technologies in my industry."

Expectations

Quick and easy to find information & News

Leverage

He may have privileged access due to his status as an employee in the company

Brake

Find the training courses and training centers dedicated to the sector of activity of the last years

4.1.5 Template to classify data sources

This sheet is an Example of the template to identify data sources. The template and the information are on LCAMP's shared cloud and accessible for consortium members.

Source				**Fields addressed**	**Scope**				**Analysis**	
Identification [1]	Type [2]	Responsible [3]	Description [4]	F1 to F4 [5]	Geographical scope [6]	Sectorial scope [7]	Education scope [8]	Social scope, [9]	Usability of the data [10]	Relevance rate 1 to 5 [11]

[1] Name of the source. Link can be added here
[2] Type source i.e. newspaper, website, database, report, statistics, etc
[3] Main responsible for gathering info from this source
[4] Description of the source
[5] Fields addressed: F1Trends F2 Impacts on jobs F3 skills and qualifications F4 future skills
[6] Indicate which region/country the data covers. EU, National, regional, indicate state and regions names
[7] Sectors. Industry sectors that are covered
[8] Education fields that are covered. i. e. VET, Higher Education, adult education. EQF levels can be used.
[9] Social aspects: adult education, Life Long Learning (LLL), unemployment data, inclusion, socio- technical aspects (i5.0)
[10] Usability of data: what for we could potentially use these data (in LCAMP). Connection with WPs and deliverables
[11] Relevance of the source.

Rate 1 to 5 where:
1) low relevance, poor data quality, difficulties to interpretate
2) difficulties to interpretate data
3) acceptable data
4) very relevant
5) top quality. High quality data, easy to understand and to use.

4.1.6 Identified data sources BASQUE COUNTRY- SPAIN

Source				Fields	Scope				Analysis	
Identification [1]	Type [2]	Responsible [3]	Description [4]	F1 to F4 [5]	Geographical scope [6]	Sectorial scope [7]	Education scope [8]	Social scope [9]	Usability of the data [10]	Relevance rate 1 to 5 [11]
Innobasque	Innovation reports, Innovation policies and technology trends	TKN	Basque Innovation agency. An agent of the Basque Science, Technology and Innovation Network, created at the initiative of the Basque Government in 2007 to assist it in the design, implementation and promotion of new innovation policies.	F1, F2	Regional, Basque Country	Multisector, Advanced manufacturing, automotive, machine tool, etc.		Networking	Needs to elaborate and filter	3
SPRI	Reports, Specific trainings for industry, fundings		The Basque Business Development Agency. The entity of the Economic Development, Sustainability and Environment Department of the Basque Government for promoting the Basque industry.	F1, F2	Regional, Basque Country	Multisector		Networking	A lot of information about multiple topics. Filtering is needed	4
CEOE	Reports on industry	TKN	Spanish Employers association	F1,F2	National Spain	Multisector			Need to interpret and adequate	2
CONFEBASC (also ADEGI)	Reports on industry	TKN	Basque Employers Association	F1, F2	Regional, Basque Country	Multisector		Networking	Needs to elaborate and filter Wp4, wp7, w	3
AFM	Reports on industry, counselling, contacts to human	AFM	Cluster of Machine tool man	F1	National-Spain	Machine tool industry		Multidisciplinar team building	Being LCAMP's partners they can tailor some of their data to our needs	4

	cooperation teams									
ACICAE	Reports on automotive industry, Specific trainings for industry,	AFM	Automotive business association with the mission of improving the competitiveness of the automotive sector	F1-F4	Regional, Basque Country	Automotive industry		Multidisciplinar team building	Variable information about automotive sector. high supply of related training. Upskiling needs.	4
HEGAN	Cooperation with reputable companies	AFM	Cluster of aeronautics	F2	Regional, Basque Country	Automation industry				2
MCC	Reports on industry, counselling, contacts to human cooperation teams	TKN	Large corporation of companies	F1-F3	Regional, Basque Country	Multisector	Yes	Yes	Forecasting of global & societal megatrends, Future Skills	3
GEDSTAMP	Reports on automotive industry, reposts on skills needs	TKN	Large company	F1-F3	Regional, Basque Country	Automotive industry			Automotive Market Skills demand	3
CIE automotive	Reports on automotive industry, reposts on skills needs	TKN	Large company	F1-F3	Regional, Basque Country	Automotive industry			Automotive Market Skills demand	3
IVAC KEI	Qualifications, reposts on skills needs	TKN	Basque Institute for Qualifications	F3-4	Regional, Basque Country	Multisector	Yes	yes	Future skills demand	3
INCUAL	Qualifications, reposts on skills needs	TKN	National Institute for Qualifications	F3-4	National-Spain	Multisector	Yes	yes	Future skills demand	2

EHU-MU-DEUSTO	innovation reports, specific research articles/ reports	TKN	Universities	F1-4	Regional, Basque Country	Multisector	Yes	Yes	Future skills demand. Upskiling needs, A lot of information about multiple topics. Filtering is needed	3
ORKESTRA	innovation reports, Innovation policies and technology trend	TKN	Basque Institute of Competitiveness		Regional, Basque Country, also national	Multisector		Yes	rends forecasting, upskilling needs,	4

[1] Name of the source. Link can be added here
[2] Type source i.e. newspaper, website, database, report, statistics,
[3] Main responsible for gathering info from this source
[4] Description of the source
[5] Fields addressed: F1Trends, F2 Impacts on jobs, F3 skills and qualifications, F4 future skills
[6] Indicate which region/country the data covers. EU, National, regional, indicate state and regions names
[7] Sectors. Industry sectors that are covered
[8] Education fields that are covered. i.e. VET, Higher Education, adult education. EQF levels can be used.
[9] Social aspects: adult education, Life Long Learning (LLL), unemployment data, inclusion, socio- technical aspects (i5.0)
[10] Usability of data: what for we could potentially use these data (in LCAMP). Connection with WPs and deliverables
[11] Relevance of the source. Rate 1 to 5 where (1) low relevance, poor data quality, difficulties to interpretate (2) difficulties to interpretate data (3) acceptable data (4) very relevant (5) top quality. High quality data, easy to understand and to use

4.1.7 Identified data sources FRANCE

Sources are numerous: There are many data sources from official statistics: Cedefop, cecimos, EIT manuf, OECD and others that can be interesting for our project.

In what languages? English and French.

Examples of sources for Observatory:

Source				**Fields addressed**	**Scope**				Analysis	
Identification [1]	**Type [2]**	**Responsible [3]**	**Description [4]**	**F1 to F4 [5]**	**Geographical scope. [6]**	**Sectorial scope [7]**	**Education scope [8]**	Social scope, [9]	Usability of the data [10]	Relevance rate 1 to 5 [11]
Aerospace Valley	website	MV	European competitiveness cluster	All	EU & Regional France	Aerospace			Needs to elaborate and filter	5
CETIM	website	MV	French national agency for all mechanics subjects & Ind 4.0	All		Multisector			Needs to elaborate and filter	5
Groupe AFNOR	website	MV	French national agency for standardization	All	International	Multisector			Needs to elaborate and filter	3
CEDEFOP	website	CMQ			Europe					5
ADEME	website	MV	French national agency for Energy savings		France	Multisector				3
OECD	website	MV			World	Multisector				3
Usine Nouvelle	website &	MV	French national Newspaper for Industry		France	Multisector				4

	Newspaper									
Industries & technologies	website & Newspaper	MV	French national Newspaper for Technologies		France	Multisector				5
AiF Alliance Industrie du Futur	News letter	MV	French National private association for Ind 4.0		France	Industry 4.0				5
BPi	website & News letter	MV or CMQ	French National Public Bank for development		France	Industry and I 4.0				4
OPCO 2i	website & News letter	MV or CMQ	French National Training funder for Industry		France	Industry and I 4.0				5
AFPA	website & News letter	MV? CMQ	French National Center for technical learning and apprentices		France	Industry and I 4.0				5
UIMM	website	MV & CMQ	French National association of mechanic/metal industries		France	Industry and I 4.0				5

[1] Name of the source. Link can be added here
[2] Type source i.e. newspaper, website, database, report, statistics, study, research paper
[3] Main responsible for gathering info from this source
[4] Description of the source
[5] Fields addressed: F1Trends, F2 Impacts on jobs, F3 skills and qualifications, F4 future skills
[6] Indicate which region /country the data covers. EU, National, regional, indicate state and regions names
[7] Sectors. Industry sectors that are covered
[8] Education fields that are covered. a. e. VET, Higher Education, adult education. EQF levels can be used.
[9] Social aspects: adult education, Life Long Learning (LLL), unemployment data, inclusion, socio- technical aspects (i5.0)
[10] Usability of data: what for we could potentially use these data (in LCAMP). Connection with WPs and deliverables
[11] Relevance of the source. Rate 1 to 5 where (1) low relevance, poor data quality, difficulties to interpretate (2) difficulties to interpretate data (3) acceptable data (4) very relevant (5) top quality. High quality data, easy to understand and to use

Main links:

- https://www.cedefop.europa.eu/en/databases
- https://www.cedefop.europa.eu/en/tools/resources-guidance
- https://www.ademe.fr/en/our-missions/support-and-mobilise/
- https://www.cecimo.eu/policy/sustainability/
- https://www.oecd.org/science/
- http://www.industrie-dufutur.org/
- https://www.cetim.fr/formation/formation/Industrie-du-Futur
- https://www.bpifrance-universite.fr/formation/e-parcours-industrie-du-futur/
- https://www.opco2i.fr/branches-et-metiers-de-lindustrie/la-formation-pilier-de-lindustrie-du-futur/
- https://cmqindustriedufutur.com/nos-formations/
- https://www.afpa.fr/formation/nos-formations-parcours-diplomant/formez-vous-pour-travailler-dans-l-industrie-du-futur-
- https://uimm.lafabriquedelavenir.fr/industrie/
- https://dtamproject.eu/results/: European project in DT AM.

4.1.8 Identified data sources GERMANY

Source				Fields addressed	Scope				Analysis	
Identification [1]	Type [2]	Responsible [3]	Description [4]	F1 to F4 [5]	Geographical scope [6]	Sectorial scope [7]	Education scope [8]	Social scope, [9]	Usability of the data [10]	Relevance rate 1 to 5 [11]
SUEDWESTME-TALL https://www.suedwestmetall.de/bildung/weiterbildung	Employers' Association	DHBW	As a partner in education policy, SWM is committed to an efficient and high-quality education system, bringing teachers and training managers together, and helping to keep its finger on the pulse of teaching. Investing also in lifelong learning opportunities.	F1, F2, F3, F4	regional Baden-Wuert-temberg(GER)	Metal-working-electrical industry I 4.0	(H-)VET HEI EQF 3-5	Lifelong Learning (LLL) socio-technical aspects (i5.0)	(Mega-)trends forecasting, upskilling needs, design learning-pathways courses WP 3,4,5,8	5
AGENTURQ https://www.agenturq.de	Institution founded by two national Employer's Associations	DHBW	AgenturQ is a joint institution of the two collective bargaining parties. They aim to raise awareness among companies and work councils of the need for continuous professional development in a changing world of work to utilize the qualification potential of employees. Their main tasks include informing, advising and supporting companies in the metal and electrical industry in Baden-Württemberg in all matters relating to the collective agreement on qualification as well as developing models, and concepts within the framework of continuing vocational training.	F1, F2, F3, F4	regional Baden-Wuert-temberg (GER)	Metal-working-electrical industryI 4.0	VET EQF 3-5	Lifelong Learning (LLL) socio-technical aspects (i5.0)	design of learning-pathways courses, trainings (MC)	5
DIGI-MONITOR https://digimonitor.de/	free online-benchmarking and forecasting – tool	DHBW	Free Online benchmarking and forecasting – Tool, assessing the status quo of digitization within companies. Focusing on: strategic and implementation goals, VET-upskilling,	F1, F2, F3, F4	national (GER)	I 4.0	(H-) VET EQF 3-5	(Lifelong Learning) socio-technical	gap-analysis: assessment of Future Skills (Model for implementation on LCAMP platform)	3

			continuing education and Training (LLL)					aspects (i5.0)		
BIBB German Federal Institute for VET https://www.bibb.de/de/index.php	ADMA specific research articles/ reports (08/2022)" Smart Working & Learning"	D HB W	The Federal Institute for Vocational Education and Training (BIBB) is a federal institution for the research and further development of initial and continuing vocational education and training. The objectives of BIBB's research, development, and advisory work are to identify future tasks of vocational education and training, to promote innovations in national and international vocational education and training and to develop new practice-oriented proposals for solutions for initial and continuing vocational education and training.	F1, F2, F3, F4	national (GER)	cross-sectoral specific I5.0	H- VET EQF 3-5	LLL socio-technical aspects (i5.0)	advisory on Future Skills learning pathways, Micro-Credentials LCAMP:WP:3,4,5,8,10	5
Stifter-verband(SV) https://www.future-skills.net	non-profit registered association empirical research & reports	D HB W	The SV is a non-profit registered association. Its fields of activity are education, science and innovation. As an organization, the Stifterverband analyzes, advises, promotes and networks science and industry. Improving the performance of the science system The improvement of national and international cooperation in the field of science, the analysis and optimization of innovation processes, the improvement of cooperation between science, politics, business and society	F1, F2, F3, F4	national (GER)	cross-sectoral	HEI VET EQF 3-8	LLL socio-technical aspects (i5.0)	analysis and advisory on Future Skills, driving strategic innovation processes LCAMP:WP: 3,4,5	5

Zukunfts-institut (Future Institute) https://www.zukunftsinstitut.de/unser-angebot	Private R&D Centre empirical Research & Develop-ment	D HB W	The Future Institute is a renowned partner for people and organizations who want to recognize, understand and shape the future. It observes, classifies, inspires, and supports in actively shaping the future. As a reliable partner, the Zukunftsinstitut translates exclusive trends and research findings into concrete measures, concepts and decisions. Based on these findings, it advises on forward-looking strategic and operational issues. In combination with its broad network of experts, it also provides outlooks for industries, markets, individual organizations and complex future issues. Zukunftsinstitut's mission is to observe and describe the patterns of societal and economic change and to use them as a basis for individual and organizational decision-making.	F1, F2, F3, F4	national (GER)	cross-sectoral	VET HEI LLL	socio-technical aspects (i5.0)	Forecasting of global & societal megatrends, Future Skills LCAMP: WP: 3,4,5,8,10	3
BiBB https://www.bibb.de/dienst/veroeffentlichungen/de/publication	empirical research reports	D HB W	The Federal Institute for Vocational Education and Training (BIBB) is a federal institution for the research and further development of initial and continuing vocational education and training.	F1, F2, F3, F4	national (GER)	cross-sectoral	VET (3-4)	socio-technical aspects (i5.0)	Advisory on Future Skills, learning-pathways, MC LCAMP:WP: 3,4,5,8,10	5
BMBF Federal Ministery of Education and Research https://www.bmbf.de/bmbf/en/research/hightech-and-innovation/foresight-process/bmbf-foresight.html	federal Institute for H-VET empirical reports	D HB W	BMBF Foresight is tasked with recognizing relevant early developments, interpreting them, and anticipatorily passing the findings on to be used in current research policy. Knowledge of where to go from here will be provided in order to prepare politics, industry, academia, and society for the future of important technologies and technology needs.	F1, F2, F3, F4	national (GER)	cross-sectoral	H-VET (3-8)	socio-technical aspects (i5.0) LLL	Forecasting Instrument on Working Market Needs, Skills, Job Profiles, LCAMP: WP:3,4,5,10	5

Inno-VET https://www.inno-vet.de/innovet/de/die-projekte/digitalen-wandel-gestalten/digitalen-wandel-gestalten.html	VET-Think-Tank of BMWF empirical reports	D HB W	InnoVET is the Innovation Hub of the Federal Ministry of Education and Research (BMBF) for excellent vocational training. Carrying out numerous projects to enhance education and research in the field of VET.	F1, F2, F3, F4	national (GER)	ADMA I	VET EQF3-4	socio-technical aspects (i5.0)	Digital Transformation in VET I.5.0 Future Education Skills	5
Bertelsman Stiftung https://www.bertelsmann-stiftung.de/de/publikationen/publikation/did/auf-den-punkt-reform-der-beruflichen-weiterbildung-in-deutschland	Think-tank of a Private Foundation, publishing empirical reports	D HB W	It's main Interests in societal research projects are: Citizen Participation, Commitment & Civil Society, Digitalization and the Common Good Migration, Integration and Social Cohesion Vocational and further training https://link.springer.com/content/pdf/10.1007/978-3-658-32849-8.pdf?pdf=button	F1, F2,F3, F4	national (GER)	cross-sectoral I.4.0	H-VET EQF3-8	socio-technical aspects (i5.0)	upskilling/reskilling needs in VET LCAMP: WP:3,4,5,10	5
Industrie 4.0 Forschungs-beirat www.acatech.de/projekt/forschungsbeirat-industrie-4-0/	National Academy of Science and Engineering Federal Advisory Body	D HB W	As a strategic and independent body, the Research Advisory Board of the Industrie 4.0 Platform advises the I4.0 Platform, its working groups and the participating Federal Ministries. As a sensor of development trends, the Research Advisory Board observes and evaluates the development of the performance profile of Industry 4.0. and sees itself as a source of inspiration for future research topics and as a companion and advisor for the implementation of Industrie 4.0. focusing on: a) Industrial value creation in the green and digital transformation era; b) Perspectives of technological developments c) Engineering of Industry 4.0 solutions d) Work, business and society	F1, F2, F3, F4	national (GER)	I.4.0	LLL	socio-technical aspects (i5.0)	Advisory and expertise knowledge on I4.0 and digital and green transition LCAMP: all WPs	5

Rosa Luxemburg Foundation www.rosalux.de	Private Foundation empirical reports	DHBW	The foundation promotes a critical analysis of society and fosters networks of emancipatory political, social and cultural initiatives around Germany. Internationally, it participates in cooperative development projects and advocates for a dialogue between the Global North and South conducted on equal footing.	F1, F2, F3, F4	national (GER)	cross-sectoral		socio-technical aspects	Advisory and expertise on I4.0 LCAMP: all WPs	4
IHK		DHBW		F1, F2, F3, F4	national (GER)			socio-technical aspects (i5.0)	further need to elaborate and filter	4
HRK		DHBW		F1, F2, F3, F4	national (GER)			socio-technical aspects (i5.0)	further need to elaborate and filter	3
Forschungsinstitut für gesellschaftliche Weiterentwicklung https://www.ssoar.info/ssoar/handle/document/68006	Private Reasearch Institute private Organisation	DHBW		F1, F2, F3, F4	national (GER)	I4.0	LLL	socio-technical aspects (i5.0)	Innovation and Digitization	4

[1] Name of the source. Link can be added here
[2] Type source i.e. newspaper, website, database, report, statistics, study, research paper

[3] Main responsible for gathering info from this source
[4] Description of the source
[5] Fields addressed: F1Trends, F2 Impacts on jobs, F3 skills and qualifications, F4 future skills
[6] Indicate which region /country the data covers. EU, National, regional, indicate state and regions names
[7] Sectors. Industry sectors that are covered
[8] Education fields that are covered. i. e. VET, Higher Education, adult education. EQF levels can be used.
[9] Social aspects: adult education, Life Long Learning (LLL), unemployment data, inclusion, socio- technical aspects (i5.0)
[10] Usability of data: what for we could potentially use these data (in LCAMP). Connection with WPs and deliverables
[11] Relevance of the source. Rate 1 to 5 where (1) low relevance, poor data quality, difficulties to interpretate (2) difficulties to interpretate data (3) acceptable data (4) very relevant (5) top quality. High quality data, easy to understand and to use

4.1.9 Identified data sources LOMBARDY / ITALY

Source				Fields addressed	Scope				Analysis	
Identification [1]	Type [2]	Responsible [3]	Description [4]	F1 to F4 [5]	Geographical scope [6]	Sectorial scope [7]	Education scope [8]	Social scope, [9]	Usability of the data [10]	Relevance rate 1 to 5 [11]
ISTAT (National Institute of Statistics) https://www.istat.it/en/	Website, statistics	AFIL	ISTAT is the national statistical institute of Italy and has published several reports on education in Italy, including data on enrolment and graduation rates in VET, higher education, and adult education programs	F1, F2, F3, F4	ITALY	Multisectoral scope	Vet, Higher Education, adult education	Unemployment data, employment data, school enrolment, etc …	(Mega-)trends forecasting, upskilling needs, design learning - pathways courses WP 3,4,5,8	4
MIUR (Italian Ministry of Education, University and Research) https://www.miur.gov.it/	Website, reports, statics	AFIL	MIUR is the national ministry responsible for education and research in Italy and has published data and information on VET, higher education, and adult education in Italy, including data on enrolment and graduation rates, funding, and initiatives to support these sectors	F3, F4	ITALY	Multisectoral scope	Vet, Higher Education, adult education	Education, Adult education, inclusion	(Mega-)trends forecasting, upskilling needs, design learning - pathways courses	4

									WP 3,4,5,8	
Ministry of Labour and Social Policies https://www.lavoro.gov.it/Pagine/default.aspx	Website, reports and studies, data and statistics	AFIL	The Italian Ministry of Labor and Social Policies provides information about labor and employment policies in Italy, including information about trends in the labor market, the impacts of technological and other changes on jobs, skills and qualifications, and the skills that may be needed in the future.	F1, F2, F3, F4	ITALY	Multisectoral scope	Education	Employment	(Mega-)trends forecasting, upskilling needs, design learning-pathways courses WP 3,4,5,8	4
FILO https://www.filo.unioncamere.it/	Website, reports and studies	AFIL	FILO is a platform operated by the Union of Italian Chambers of Commerce, Industry, Crafts and Agriculture (Unioncamere), which is a national organization that represents the interests of businesses in Italy. The website provides data and information on education and Industry 4.0 in Italy.	F1, F2, F3, F4	ITALY	Multisectoral scope	Vet, Higher Education, adult education	Socio-technical aspects	trends forecasting, upskilling needs, design learning-pathways courses WP 3,4,5,8	4
EXCELSIOR https://excelsior.unioncamere.net/	Website, reports and studies	AFIL	EXCELSIOR is a platform operated by the Union of Italian Chambers of Commerce, Industry, Crafts and Agriculture (Unioncamere), which is a national organization that represents the interests of	F1, F2, F3, F4	ITALY	Multisectoral scope	Vet, Higher Education, adult	Socio-technical aspects	trends forecasting, upskilling needs, design	4

			businesses in Italy. The website provides information and resources on qualifications and professional figures in relation to the Italian job market.				educati on		learning - pathway s courses WP 3,4,5,8	
Alternanza scuola-lavoro https://scuolalavoro.registroimprese.it/rasl/home	Website, database	AFIL	Alternanza scuola-lavoro is a database maintained by the Union of Italian Chambers of Commerce, Industry, Crafts and Agriculture (Unioncamere). It provides data and information about various training and employment initiatives in Italy, including: programs and courses offered by schools, universities, and other educational institutions; apprenticeships and internships; job fairs and employ; training and professional development opportunities; funding and support programs for businesses and individuals.	F1, F2, F3, F4	ITALY	Multisect oral scope	Vet, Higher Educati on, adult educati on	Socio-technical aspects	trends forecast ing, upskillin g needs, design learning - pathway s courses WP 3,4,5,8	4
Centro Studi Confindustria https://www.confindustria.it/home/centro-studi	Website, reports and studies, data and statistics	AFIL	Centro Studi Confindustria is a national research center based in Italy that studies and reports on economic, social, and technological trends and developments in Italy.	F1, F2	ITALY	economi c, social, and technolo gical trends and develop ments in ITALY	Educati on in general	Socio-technical aspects	Future trends WP3	4
Confindustria Lombardia	Website, reports	AFIL	Confindustria Lombardia is the association of Italian industrialists for the Lombardy region. Their internal research	F1, F2, F3, F4	Regional scope	Multisect oral scope	Vet, Higher Educati on,	the role of education in supporting	(Mega-)trends forecast ing,	4

https://confindustria.lombardia.it/lobby/politiche-territoriali/centro-studi	and studies		centre focuses on Industry 4.0 and 5.0 in Lombardy region.		LOMBARDY (IT)		adult education	the adoption and impact of Industry 4.0 and 5.0 technologies	upskilling needs, design learning - pathways courses WP 3,4,5,8	
Centro Studi Assolombarda https://www.assolombarda.it/centro-studi	Website, reports and studies, data and statistics	AFIL	Centro Studi Assolombarda is a research center based in Milan (Italy) that studies and reports on economic, social, and technological trends and developments in some provinces of Lombardy region.	F1, F2	Regional scope LOMBARDY (IT)	economic, social, and technological trends and developments in Lombardy	VET	Socio-technical aspects	Future trends WP3	4
Osservatori Digital Innovation - School of Management - Politecnico di Milano https://www.osservatori.net/	Website, reports and studies, data and statistics	AFIL	Osservatori Digital Innovation is a research center based in Milan (Italy) whose mission is to conduct studies and draft reports on the impact of digital technologies on society and the economy.	F1, F4	ITALY	Digital Innovation	Education	Socio-technical aspects	Future trends WP3	4
EU Digital Innovation Score Board 2022 (Focus on Italy) https://ec.europa.eu/assets/rtd/eis/2	Website, reports and studies, data and statistics	AFIL	EU Digital Innovation Score Board contains information about the research and innovation landscape in Italy, including information about funding opportunities, research and innovation infrastructure, and the	F1, F2	EU	economic, social, and technological trends and	Education and innovation	Socio-technical aspects	Opportunities for learners and CoVes	4

022/ec_rtd_eis-country-profile-it.pdf			main actors and stakeholders in the field. This document contains also statistics and data on the state of research and innovation in Italy, as well as information about the country's policies and strategies in these areas.			develop ments				

[1] Name of the source. Link can be added here
[2] Type source i.e. newspaper, website, database, report, statistics,
[3] Main responsible for gathering info from this source
[4] Description of the source
[5] Fields addressed: F1Trends, F2 Impacts on jobs, F3 skills and qualifications, F4 future skills
[6] Indicate which region /country the data covers. EU, National, regional, indicate state and regions names
[7] Sectors. Industry sectors that are covered
[8] Education fields that are covered. i. e. VET, Higher Education, adult education. EQF levels can be used.
[9] Social aspects: adult education, Life Long Learning (LLL), unemployment data, inclusion, socio- technical aspects (i5.0)
[10] Usability of data: what for we could potentially use these data (in LCAMP). Connection with WPs and deliverables
[11] Relevance of the source. Rate 1 to 5 where (1) low relevance, poor data quality, difficulties to interpretate (2) difficulties to interpretate data (3) acceptable data (4) very relevant (5) top quality. High quality data, easy to understand and to use

4.1.10 Identified data sources NETHERLANDS

Source				Fields addressed	Scope				Analysis	
Identification [1]	Type [2]	Responsible [3]	Description [4]	F1 to F4 [5]	Geographical scope [6]	Sectorial scope [7]	Education scope [8]	Social scope, [9]	Usability of the data [10]	Relevance rate 1 to 5 [11]

[1] Name of the source. Link can be added here
[2] Type source i.e. newspaper, website, database, report, statistics,
[3] Main responsible for gathering info from this source
[4] Description of the source
[5] Fields addressed: F1Trends, F2 Impacts on jobs, F3 skills and qualifications, F4 future skills
[6] Indicate which region /country the data covers. EU, National, regional, indicate state and regions names
[7] Sectors. Industry sectors that are covered
[8] Education fields that are covered. i. e. VET, Higher Education, adult education. EQF levels can be used.
[9] Social aspects: adult education, Life Long Learning (LLL), unemployment data, inclusion, socio- technical aspects (i5.0)
[10] Usability of data: what for we could potentially use these data (in LCAMP). Connection with WPs and deliverables
[11] Relevance of the source. Rate 1 to 5 where (1) low relevance, poor data quality, difficulties to interpretate (2) difficulties to interpretate data (3) acceptable data (4) very relevant (5) top quality. High quality data, easy to understand and to use

4.1.11 Identified data sources SLOVENIA

Source				Fields addressed	Scope				Analysis	
Identification [1]	Type [2]	Responsible [3]	Description [4]	F1 to F4 [5]	Geographical scope [6]	Sectorial scope [7]	Education scope [8]	Social scope, [9]	Usability of the data [10]	Relevance rate 1 to 5 [11]

[1] Name of the source. Link can be added here
[2] Type source i.e. newspaper, website, database, report, statistics,
[3] Main responsible for gathering info from this source
[4] Description of the source
[5] Fields addressed: F1Trends, F2 Impacts on jobs, F3 skills and qualifications, F4 future skills
[6] Indicate which region /country the data covers. EU, National, regional, indicate state and regions names
[7] Sectors. Industry sectors that are covered
[8] Education fields that are covered. i. e. VET, Higher Education, adult education. EQF levels can be used.
[9] Social aspects: adult education, Life Long Learning (LLL), unemployment data, inclusion, socio- technical aspects (i5.0)
[10] Usability of data: what for we could potentially use these data (in LCAMP). Connection with WPs and deliverables
[11] Relevance of the source. Rate 1 to 5 where (1) low relevance, poor data quality, difficulties to interpretate (2) difficulties to interpretate data (3) acceptable data (4) very relevant (5) top quality. High quality data, easy to understand and to use

4.1.12 Identified data sources SWEDEN

Source				Fields addressed	Scope				Analysis	
Identification [1]	Type [2]	Responsible [3]	Description [4]	F1 to F4 [5]	Geographical scope [6]	Sectorial scope [7]	Education scope [8]	Social scope, [9]	Usability of the data [10]	Relevance rate 1 to 5 [11]

[1] Name of the source. Link can be added here
[2] Type source i.e. newspaper, website, database, report, statistics,
[3] Main responsible for gathering info from this source
[4] Description of the source
[5] Fields addressed: F1Trends, F2 Impacts on jobs, F3 skills and qualifications, F4 future skills
[6] Indicate which region /country the data covers. EU, National, regional, indicate state and regions names
[7] Sectors. Industry sectors that are covered
[8] Education fields that are covered. i. e. VET, Higher Education, adult education. EQF levels can be used.
[9] Social aspects: adult education, Life Long Learning (LLL), unemployment data, inclusion, socio- technical aspects (i5.0)
[10] Usability of data: what for we could potentially use these data (in LCAMP). Connection with WPs and deliverables
[11] Relevance of the source. Rate 1 to 5 where (1) low relevance, poor data quality, difficulties to interpretate (2) difficulties to interpretate data (3) acceptable data (4) very relevant (5) top quality. High quality data, easy to understand and to use

4.1.13 Identified data sources TURKEY

Source				Fields addressed	Scope				Analysis	
Identification [1]	Type [2]	Responsible [3]	Description [4]	F1 to F4 [5]	Geographical scope [6]	Sectorial scope [7]	Education scope [8]	Social scope, [9]	Usability of the data [10]	Relevance rate 1 to 5 [11]

[1] Name of the source. Link can be added here
[2] Type source i.e. newspaper, website, database, report, statistics,
[3] Main responsible for gathering info from this source
[4] Description of the source
[5] Fields addressed: F1Trends, F2 Impacts on jobs, F3 skills and qualifications, F4 future skills
[6] Indicate which region /country the data covers. EU, National, regional, indicate state and regions names
[7] Sectors. Industry sectors that are covered
[8] Education fields that are covered. i. e. VET, Higher Education, adult education. EQF levels can be used.
[9] Social aspects: adult education, Life Long Learning (LLL), unemployment data, inclusion, socio- technical aspects (i5.0)
[10] Usability of data: what for we could potentially use these data (in LCAMP). Connection with WPs and deliverables
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4.2 Stage 02 Search and information gathering

4.2.1 Research methodologies and tools available

Within the consortium partners, we are using different methodologies for the so call Technology Surveillance and Competitive Intelligence. The information gathering strategy defined in the observatory takes the best of all those methods and combines their use depending on the observation targets.

In this section, we describe the methodologies and tools used by partners. There is also some software an IT applications that could be used in the project, if tailored to LCAMP needs.

- Different methodologies, how they are used
- Software or other tools used in each methodology (if any)
- When we will use each methodology or combination of those.

4.2.1.1 Desk research

During the first year of the project, and specifically its preparation phase, the observatory will base mainly in secondary research activities (Wikipedia, 2022) , having desk research activities, a predominant role in the observatory.

1. Web Scraping. “real time” information
2. Literature reviews
3. Publications review, scientific papers, non-scientific publications, sectorial magazines, clusters’ reports, etc.
4. EU project’s results review.

The areas of observations selected (section 4.1.1) and the sources identified so far (section 4.1.3) involve a huge amount of information to process, classify and filter.

The desk research activities will be carried out, on the one hand at a national level in LCAMP partner countries Belgium, France, Germany, Italy, Netherlands, Slovenia, Spain, Sweden, Turkey. We will produce national reports based on the regional and national desk-research activities. On the other hand, we will also carry out our desk research at the EU level through a subgroup of the observatory devoted to that latter task.

The main observatory reports included in the deliverables D3.2, D3.3 and D3.4 with gather all national and EU-wide reports.

4.2.1.2 Competitive Intelligence System of Tknika

Background

Since its foundation in 2005, and as a centre for research and applied innovation, Tknika has been interested in methodologies to optimally address the search for information, its analysis and exploitation.

During these years, different approaches have been tested and, as a result of this experience, its own methodology has been developed. Since 2013, the use of this methodology has been promoted among the VET centres in the Basque Country, as a system for monitoring the environment.

To this end, Tknika coordinates two programmes in which more than 80 centres are involved:

- Innovation Routines
- Competitive Intelligence.

Innovation Routines

The aim is to systematise the innovation-related activity of the organisations around 4 routines:

1. Awareness raising
2. Observation
3. Project portfolio
4. Exploitation.

These routines are oriented to feed a database of project ideas (the project portfolio), which will be prioritised, executed according to the available resources, managed and exploited to provide the highest possible return.

Competitive Intelligence

The aim is to acquire a broad knowledge of the environment to be able to exploit it to make better decisions both at the level of the organisation's strategy and at the level of departments and even at a personal level. The latter is interesting because it extends its usefulness to all teachers, trying to make them aware of the importance for their teaching activity of being well informed and having a broad knowledge of the evolution of their subjects.

Within these programmes, participating schools are offered a first year of support:

- To learn how to implement the proposed monitoring system
- To design a pilot implementation in each centre
- To draw conclusions and design the extension of the pilot.

In addition, different tools are made available to facilitate the implementation of the routines and the analysis of the information collected.

The image shows an example of the tools offered. In this case, it is a checklist to facilitate the implementation of the observation routine.

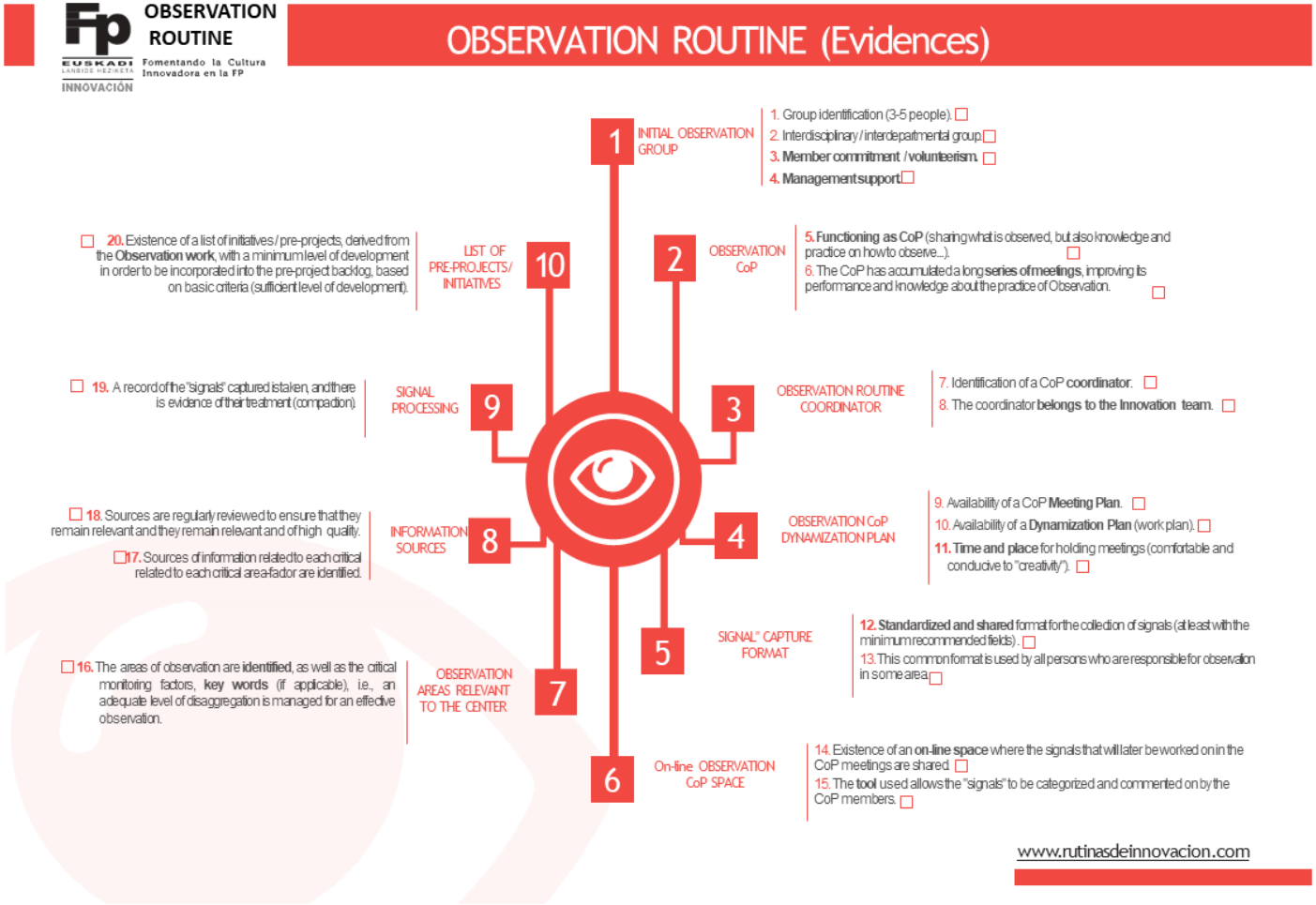


Figure 9 The checklist of the observation routine

This other image explains the signal compaction process. Here the captured information signals are analysed and converted into possible projects.

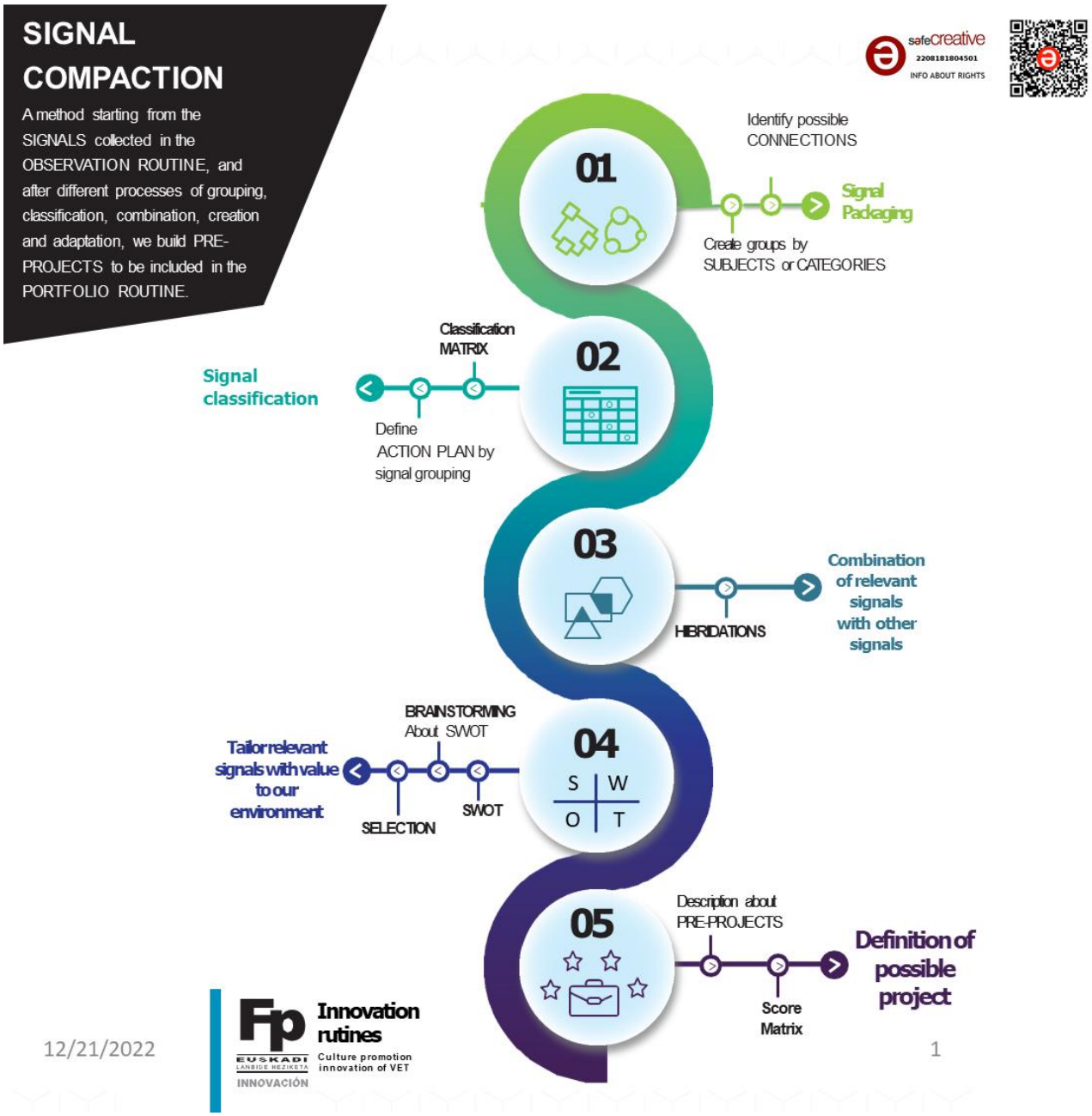


Figure 10 The proposed Signal Compaction Process

In the second and subsequent years:

- The centres organise themselves into communities of practice to share their experiences and to keep learning collaboratively.
- Gamification campaigns are organised to encourage schools to continue improving.
- Sessions are designed to share good practices, etc.

Because of the use of this methodology in recent years:

- The centres are acquiring greater knowledge of their environment.
- They are more mature in terms of innovation management.
- They are more proactive when it comes to proposing projects and seeking partnerships with third parties.

All this means that the proposed approach has proved to be effective for Basque Country's VET system.

In the area of Technological Innovation and Intelligent Systems in Tknika, the same methodology is also used as that proposed to the VET centres in the Basque Country.

DESCRIPTION OF THE METHODOLOGY

The following is a description of the methodology, taking as a reference the way of working in the area of Technological Innovation and Intelligent Systems at Tknika. In this area, the methodology mentioned in the previous section is used, except that now the objective, instead of being to know the environment and identify possible areas in which to develop projects, is to know the evolution of the technologies with which they work and draw conclusions to direct the evolution of their projects.

The designed method consists of 4 phases:

1. Organisation and direction.

2. Information gathering.

3. Analysis and conclusions.

4. Exploitation of results.

1. Organisation and direction.

There are several initial decisions that need to be made in order to get started. In relation to the general organisation, it is necessary to decide how much time will be devoted to monitoring in an "intentional" way. A weekly time should be set aside and made public to try to ensure that it will be respected and that there will be no interference.

The tool to be used to share the information should also be decided and configured.

In terms of management, it is essential to be clear about the objective to be pursued as a result of the monitoring process. In each of the projects in Tknika's Technological Innovation and Intelligent Systems area, the questions to be answered are identified in order to direct the monitoring towards the information that will provide knowledge to direct, in turn, the project.

At a general level, there are also specific needs that can be met by the projects. All this makes it possible to generate a series of questions to be answered that will serve as a guide to configure the search for information and the tool to be used to share it (definition of labels).

Next, it is necessary to determine the sources of information to be used and, if possible, to automate access to the information. The aim is for the information to arrive automatically in a space where the user can filter it.

Finally, it must be ensured that all staff involved have a general idea of the information needs in the different projects. This will facilitate the subsequent exchange of signals of interest.

2. Information gathering.

Once the sources have been identified, the data collection has been automated and the signal-sharing tools have been configured, the system starts to flow. This is the easiest part of the methodology because it is simple to achieve results and is satisfactory for the participants.

The task of each person involved is to filter the information received and share it, adequately labelled. When sharing a signal, it is important to add information about what and why. In other words, it is necessary to indicate what has been considered interesting in what is being shared and for what purpose it may be useful. This prevents the information-sharing tool from becoming a mere collection of links.

The repository of signals should allow interaction with the information received so that users can comment on the information shared by other colleagues.

3. Analysis and conclusions.

As mentioned above, information gathering is often a very satisfying activity, but it is at this stage that value is really extracted from the process. Here information is converted into knowledge and action.

A team dynamic is proposed here in which information signals are analysed and classified into four different categories: curiosities, direct, relevant or future.

- ✓ Curiosities: This first category is general information that does not provide more value than being aware of something that has happened. Once processed, these signals are discarded.
- ✓ Direct: These are signals that require an immediate decision to be made. Once a decision has been made, they are discarded.
- ✓ Future: This is information that seems interesting but not enough to make a decision. Further information needs to be gathered.
- ✓ Relevant: These are information signals that are considered critical and lead to direct action on the evolution of a project or the identification of a new line of research.

Once the classification exercise has been completed, a quick round is carried out to share the decisions taken and to look for relationships between the signals processed.

4. Exploitation of results.

As mentioned above, except for the signals classified as "Curiosities", all the others are actionable to a greater or lesser extent. The level of exploitation of the monitoring results depends on the effective implementation of these actions.

In addition, the information can be used to generate material to share with different stakeholders.

Everything done so far has to feed back into the monitoring process itself. The conclusions reached are supposed to be used to answer the questions identified in the first phase. The questions can then be redefined, the sources of information updated, and a new monitoring cycle started.

4.2.1.3 INNGUMA – AFM cluster's surveillance tool

AFM, the Spanish Association of Machine Tool Manufactures, is partner of LCAMP project and participate in the LCAMP observatory. AFM has its own tool for their member companies for technology surveillance. For the LCAMP consortium, AFM tool will be tailored

Services provided by INVEMA

INVEMA is the technological unit of AFM CLUSTER. INVEMA offers several technological services to the more than 700 member companies of the cluster. These services are classified in four main categories:

- Technology surveillance
- Machine safety
- Regulations & legislation
- R&D project promotion

Figure 11 Services offered by INVEMA to their associate companies

Technological surveillance

The Technological Surveillance service is open to all AFM CLUSTER companies. It requires the payment of an annual subscription fee for the interested ones. The purpose of this service is to provide information about the most important developments in the Machine Tool and Advanced Manufacturing sector. This is done through the following two activities:

- Trade show reports: these are reports with information about the last tendences in the advanced manufacturing sector gathered in the most important national and international trade shows attended by INVEMA research and development team.

Figure 12 Example of the trade show report

Figure 13 Example of the trade show report

- Monthly newsletters: these newsletters are personalized according to the subsector of segment of activity of each company. There are different bulletins for the following subsectors:
  - Turning
  - Grinding
  - Milling
  - EDM
  - Broaching

- Metal forming

These bulletins include information classified in the following sections:

- Latest news
- Patents
- Articles
- Leaders' news
- Outstanding reports
- Future events
- Government grants' guide

TRENDS NEWS

AFM CLUSTER FOR ADVANCED & DIGITAL MANUFACTURING

AFM TRENDS: DEFORMACIÓN Noviembre 2022

#ÚLTIMAS NOTICIAS

Trumpf convierte la fabricación de chapa en un proceso más sencillo, más productivo y más sostenible

Trumpf presentó en la feria EuroBLECH 2022 una serie de soluciones para hacer más sostenible la fabricación de chapa. La empresa de alta tecnología pretende aprovechar su posición como proveedor de soluciones para ayudar a los clientes a que sus fábricas sean más competitivas y ecológicas.

Schuler ofrece a sus clientes un nuevo portal de servicios

En la feria EuroBlech de Hannover, Schuler ha lanzado un portal de servicios al que se puede acceder en cualquier momento y lugar. Los clientes del servicio técnico saben que en Schuler pueden obtener todo de una sola mano: desde ayuda rápida las 24 horas del día hasta servicio de piezas de repuesto, servicios de reparación y mantenimiento, modernizaciones y prensas usadas, así como soluciones digitales. Todo esto está ahora también disponible en línea a través de dispositivos móviles o desde el PC de la oficina.

Los cobots para la fabricación de chapa metálica

Los robots colaborativos, o cobots, son utilizados por los fabricantes de estampación para aumentar la productividad, mejorar la calidad y aumentar la ergonomía. También es una de las soluciones posibles para abordar el déficit de cualidades en las prensas de estampación con el fin de automatizar las funciones y los turnos que son difíciles de cubrir. Este artículo comenta las principales consideraciones y medidas a tener en cuenta a la hora de seleccionar un sistema de automatización de estampación basado en un cobot.

Las prensas servomecánicas impulsan el aumento de la productividad de las piezas de automóvil

En Stratford, Ontario (Canadá), Omex Manufacturing ULC produce componentes para empresas de primer nivel del sector de la automoción y fabricantes de equipos originales de todo el mundo. Su producción incluye componentes de transmisión, asientos y carrocerías. Para mantener su elevada posición en el mundo del suministro de automóviles, la empresa, que se convirtió en una filial de Wico Metal Products, con sede en Michigan, en 2021, se ha centrado en la automatización, la experiencia en una variedad de procesos y la inversión en equipos de última generación.

Consejos y técnicas de diseño para la estampación de BIW

En este artículo se mencionan algunas de las mejores prácticas de diseño que ayudarán a conseguir el rendimiento esperado de las estructuras de la carrocería y a evitar posibles problemas.

#PATENTES

- Bending machine, in particular a press brake, with a safety system (BYSTRONIC)
- Speed reduction mechanism control system, speed reduction mechanism control program, and servo system (AMADA)
- Press machine an method of displaying operating state of press machine (AIDA)

#ARTÍCULOS

Figure 14 Example of the bulletin

INNGUMA tool

Most of the information included in the newsletters is obtained from the monitoring done through the INNGUMA tool. This is a software that allows you to program monitoring markers on the internet. This way, the information that could be interesting to analyse is filtered.

The tool monitors the internet taking into account the selected keywords. AFM CLUSTER's case, the search markers that are being used are mainly the following topics:

- Turning
- Grinding

- Milling
- EDM
- Broaching
- Metal forming

The software allows to periodically monitor information sources such as:

- Specific technical magazines (Modern Machine Shop, Mold News, Machine Utensili…)
- Specific scientific journals (science direct…)
- Specific web pages (mtdcnc.com, engineering.com…)
- Social media
- Web pages of the leading competitors in each segment

Searches are performed continuously. Every time the software detects a new document or entry related to one of these topics, it is filed in the corresponding folder.

An exhaustive monitoring of technical and scientific magazines, patents and the market leaders of the sector is carried out to know the news regarding key issues. As a result, the software provides different links to the articles and web pages detected. The program classifies all the information in the following categories:

- Technical magazines
- Patents
- Scientific articles
- Leading companies

Each one of these categories are divided in the selected topics (turning, grinding, milling, EDM, broaching and metal forming). The software includes in each folder the links to the new documents found in the searches.

Figure 15 Example of a folder

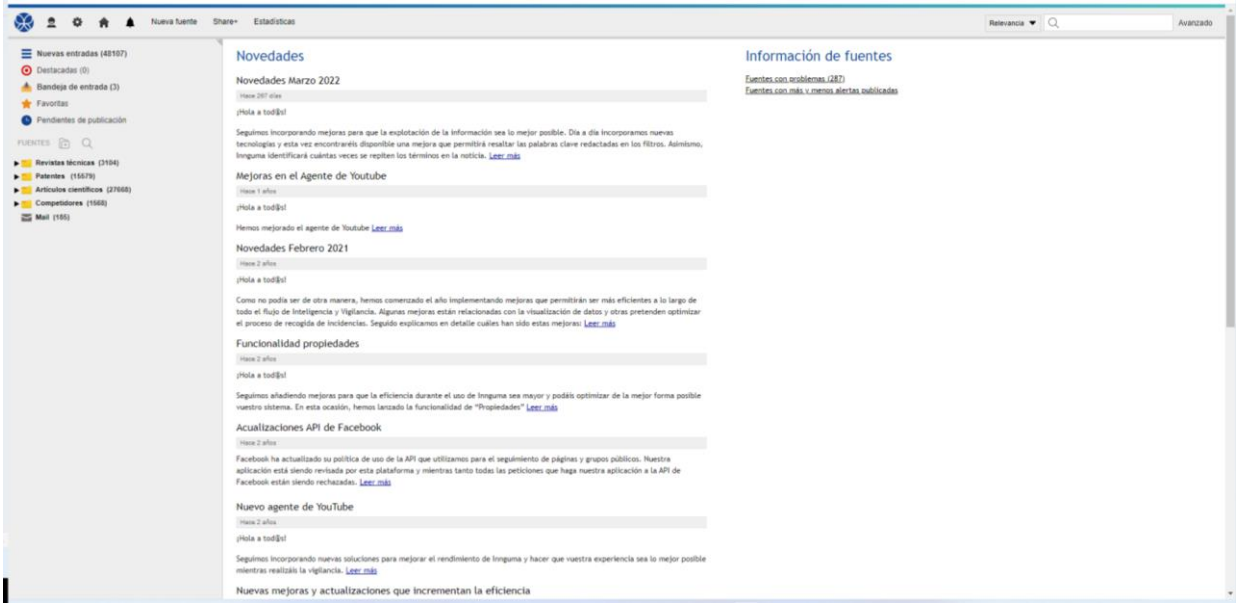


Figure 16 Example of the INNGUMA software platform

The information gathered through INNGUMA is a first phase of the monitoring system of INVEMA. In the second phase, the technical staff of INVEMA analyses all the information and selects the most interesting information. And in the third phase, the technology director reviews the information in order to select the most suitable information for the bulletins.

There are several types of software licenses, some of them allow to perform more actions than others. INVEMA's license is the basic one. There is another premium version with more alerts and keywords that allows the possibility to do more specific searches.

INVEMA could provide to the consortium information concerning the following topics and keywords that are already being searched by the software: turning, grinding, milling, EDM, broaching and metal forming.

In case the project consortium finds interesting to add some new searching options to feed the observatory with INNGUMA software, INVEMA could analyse the possibility of adding these new markers and keywords to its searching options.

In case that the searching options required by the consortium are different from the ones used by INVEMA, a new INNGUMA software license could be acquired by the project consortium, as the cost of the software is affordable.

4.2.1.4 MV's surveillance organisation

TEAMS:

Inside *Mecanic Vallée*, there is no formal groups or teams, about general surveys, except specific working groups on HR, 3D printing, predictive maintenance.

Surveys are mainly top down, and rarely bottom up.

So, team is MV managers.

METHODS:

The MV team is all the time collecting data on main interesting subjects:

- On technologies,
- On HR subjects in relationship with technos
- On Companies in relationship with our interests.

Sources are:

- Industrial newspapers
- Aerospace Valley daily surveys (by IA)
- Local newspapers
- Rarely, bottom-up data

Mecanic Vallée

Les entreprises en mouvement

Veille *Mecanic Vallée* du 24 08 22

Bonjour

Voici une nouvelle veille de 2022 destinée aux Adhérents *Mecanic Vallée*.

Notez bien les prochains RDV : le 26 août, réunion de bassin à Decazeville, et la 24e rencontre MV le mardi 4 octobre à Figeac.

Formation à l'industrie du Futur - 3T Industry40 :

Accédez aux ressources pédagogiques sur l'industrie 4.0 et aux 8 modules de formation en ligne (environ 5h chacun) en version anglaise sur :

- la Cybersécurité
- le Lean
- la Réalité virtuelle
- la Mix reality : virtuelle et augmentée
- l'Intelligence artificielle
- la Maintenance prévisionnelle (disponible en version française également)
- l'Impression 3D (disponible en version française également)
- les Smart Devices

Ces modules peuvent être utilisés par les enseignants de la formation professionnelle, les formateurs en entreprise et les entreprises qui souhaitent former leurs salariés.

--> Accès gratuit sur inscription : https://3tindustry40training.eu/

Il y a déjà une soixantaine d'inscrits qui se forment à distance. Pourquoi pas vous et vos collaborateurs ?

Pour toutes informations, contactez Camille Esquerré c.esquerre@mecanicvallee.com

Figure 17 MV surveillance methodology

MEDIA:

Information is sent twice a month, by a MV newsletter (around 10 pages) on main subjects.

Specific subjects are addressed to specific contacts: Ex: organisation of a workshop on Predictive maintenance to the PM MV group.

MV have collect a huge amount of data for 15 years, but no analysis. It seems the same for other French clusters as, for instance, the World-Wide innovation cluster Aerospace Valley which is using an Artificial intelligence tool for daily survey, for more than 5 years.

4.2.1.5 Surveys

LCAMP observatory will start its work using secondary research methods.

Primary research methods are not discarded but they are expected to be used in later stages. The reasons behind this decision are a) lot of available sources b) The main target audience to carry out surveys are companies. Currently, company representatives are rather fed up of fulfilling surveys.

Therefore, in the first period of LCAMP it is not planned to launch surveys to gather data. Instead, we will first analyse the vast amount of data available to create our reports.

However, for the 2nd and posterior LCAMP reports it is not discarded to launch surveys to a well targeted panel with very specific purposes.

Concerning the techniques of survey data collection, at this point it is not defined what methodology we will use to construct the surveys. It is planned that we will use, depending on the case, different survey methodologies: (Starlight Analytics,, 2020)

Exploratory Survey Research

To diving deeper into research subjects and finding out more about their context. The focus is to discover ideas and insights instead of gathering statistical data.

Predictive Survey Research

Also called “causal survey research”. It’s pre-planned, structured, and quantitative in nature. It’s often referred to as conclusive research as it tries to explain the cause-and-effect relationship between different variables. The objective is to understand which variables are causes and which are effects and the nature of the relationship between both variables.

Research Method

Quantitative Research to collect numeric data in a systematic way. Quantitative research methods include polls, systematic observations, and face-to-face interviews.

Qualitative Research to collect non-numeric data from research participants. Qualitative research methods include focus groups, one-on-one interviews, observations, and case studies.

In any case the Survey Process will cover:

- Survey Design
  - Sample Selection
  - Sample Size

    - Stratification and Clustering
    - Choice of Survey Media
- Survey Development
    - Survey Questions
- Survey Execution
- Data Analysis and Reporting Survey Results.

4.2.2 Data strategy, Data gathering process

We will stablish the strategy to locate and gather information in an organized manner. It also implies the strategies for data processing based on the selection and combination of complementary data sources.

4.2.2.1 Data classification methods. Tags, levels

The data classification will be executed analysing and organizing structured and unstructured data into categories by tagging data based on, file types, contents, context, and metadata. The tagging system will include

- Geographical classification,
- Chronological classification,
- Qualitative classification,
- Quantitative classification
- Classification by observation fields and subcategories within those
- Classification by potential target users, including internal users.

In any case, the classification will be made according to the technical specifications of the LCAMP platform and the services to be provided from it.

4.2.2.2 Frequency

The frequency of data gathering for the different sources is not determined yet. What it is stablish are the frequency of the official reports to be publishes that are:

- report 1, June 2023,
- report 2 June 2024,
- report 3 June 2025.

The deadlines of the reports and the type of information included in them will determine the frequency. The editorial board for each report will stablish the frequency.

4.3 Stage 03 Data analysis & processing

This section refers to the way we will assure the representativeness of data gathered from different sources. Some sources directly offer quality data others like web scraping data or survey-based data need a further elaboration to use it.

All this data will be used in different services delivered by the LCAMP platform and also directly in different WPs, therefore a process of processing the data will be implemented in this methodology.

We have determined information validation criteria, information-analytical techniques combined with specialized computer tools (WP8) to support the selection of the relevant information according to the search targets (4.2).

The criteria used to analyse and process the data are the following:

We foresee the use of the data on different levels and each of those levels may have specific filtering and clustering criteria. The foreseen data usage within the team are:

- **Data used by the "LCAMP Observatory team" to create public reports.** Those reports are included in the D3.2 and D3.3, and will also be published via LCAMP website and other dissemination channels.
- **Data used to feed the LCAMP platform services.** In WP8, LCAMP platform, it is foreseen to offer "forecasting services" for our target groups which are VET centres, students, job seekers, companies, policy makers. The format and specification of the correspondent data will be defined by the Platform's leaders. They will provide the correspondent templates and details to "prepare" and filter the data coming from different sources.
- **Data used in WP5 Human-Centric Learning for Advanced Manufacturing.** The specification of the data to be used in this WP will be provided by WP leaders and included in the correspondent templates. Those specifications and templates are included in the WP5 task's template.
- **Data used in WP4 Open Innovation Community (OIC).** The observatory will feed the needs of the OIC using certain data coming from the sources of the observatory. We will identify the needs of companies in applied research, technical services, consultancy, etc. Therefore, WP4 leaders will communicate the data they may need and the format of that data. Both leaders will agree on the data processing criteria.
- **Data used in WP7 VET-SME connection**. This level is bidirectional as WP7 is both, an observatory data user, and a data source. A combination of both requirements will be defined between WP3-WP7 leaders about the data format and processing. Indeed, WP7 is directly connected with the initiative ADMA Transformers from where the observatory may have access to valuable data of SME all over EU.(check data sources 5.1 section)
- **Data used by the WP6 Collaborative Learning Factory**. Although the data used in CLF about the development of training to address certain competences and skills will be based on finding of WP5, it is possible that Wp6 will use other data coming from WP3.

Note that there is a coordination and common work between different WP leaders to agree on the treatment to the common data. (WP8, WP5, WP6, WP4; WP7)

4.3.1 Working groups for data processing

The LCAMP observatory is composed by members of 12 organizations from 9 countries.

The observatory is organized by thematic working groups to cluster, filter and evaluate the gathered data.

The groups will correspond to the observatory fields determined in 4.1.1. The thematic working groups will be integrated by representatives of the partners countries.

- Thematic team 01 Trends for Advanced manufacturing and Industry 4.0
- Thematic team 02: Impact of industry 4.0 in jobs.
- Thematic team 03: Existing qualifications and educational offer
- Thematic team 04: Future skills, Employability, most demanded jobs and skills
- Thematic team 05: Eu wide policies, transversal data

Each Thematic team (TT) will have EU wide and regional covertures.

Work package leader and co-leader, Mechanic Vallee (MV) and Dual Hochschule Baden Württemberg (DHBW) respectively, they will be in charge of coordinating the observatory reports and therearfore, the work carried out by the respective Thematic Teams.

4.3.2 Tools for data analysis

It is foreseen that Business Intelligence tools (wikipedia (b), 2022) or Data Analytics tools will be used to process the data and create the observatory reports.

“Business intelligence (BI) comprises the strategies and technologies used by enterprises for the data analysis and management of business information. Common functions of business intelligence technologies include reporting, online analytical processing, analytics, dashboard development, data mining, process mining, complex event processing, business performance management, benchmarking, text mining, predictive analytics, and prescriptive analytics.” (Wikipedia, 2022)

It is expected that the LCAMP observatory, we will handle a big amount of unstructured and unstructured data. At this stage it is not decided which Business Intelligent (BI) tool (wikipedia (b), 2022) is going to be adopted in LCAMP consortium. This decision is very dependent on LCAMP platform developer’s team’s approaches (WP8), and it will be taken in early 2023.

4.4 Stage 4 Extract value. Report creation

This section explains the mechanism for the valuation of the relevant information processed. The validation process will take place normally at the final stage of the process, just before the publications of the reports.

The results of the observatory are a set of report in different formats where we will include valuable information for decision-making..

The observatory will publish specialized reports and newsletters. The way those reports will be present will be diverse:

- Technology monitoring and reports.
- Skills monitoring reports
- Prospective reports.
- Newsletters.
- etc

The main reports will be yearly reports gathering all the outputs of the observatory clustered by the criteria explained in section 4

- countries/regions
- technology sectors
- Education parameters
- Target groups.

The same working teams in charge of data gathering describe in 4.3.1 will create the reports.

- Thematic team 01 Trends for Advanced manufacturing and Industry 4.0
- Thematic team 02: Impact of industry 4.0 in jobs.
- Thematic team 03: Existing qualifications and educational offer
- Thematic team 04: Future skills, Employability, most demanded jobs and skills
- Thematic team 05: Eu wide policies, transversal data

Each Thematic team (TT) will have EU wide and regional covertures.

The observatory's leader and co-leader, Mechanic Vallee (MV) and Dual Hochschule Baden Württemberg (DHBW) respectively, they will be in charge of coordinating the observatory reports and therefore, the work carried out by the respective Thematic Teams.

4.4.1 Validation process

The validation process will assure the quality of the reports generated within the observatory.

The process of validation of the results of the analyses carried out by the observatory must be very exhaustive. The credibility of the results published is based on three pillars.

1) The contrasted quality of the sources used.
2) The transparency of the process of analysis of information.

3) The validation of the conclusions by authorities with expertise in the relevant fields.

Considering the high relevance of the validation process, it will be carried out in 3 levels:

- Internal validation at a thematic team level or/and at regional level.
- Validation at consortium level.
- External validation carried out by panels of experts.

4.4.2 Internal Validation

The Observatory's steering group will validate the reports. The final internal evaluation will be leaded by the observatory leader and co-leader, that are *Mecanic Vallee* (MV) and Dual Hochschule Baden Württemberg (DHBW) respectively, with the help of TKNiKA.

The internal validation will be a prerequisite to call the panel of experts and continue with the external validation steps.

4.4.3 Panel of experts

We will create an international panel of experts that will validate the conclusion and finding to be included in the reports elaborated in the LCAMP observatory.

Composition of the panels of experts

We will create 9 regional panels of experts. Each panel will be represented by:

- 3 industry representatives,
- 3 VET representatives
- 3 government representatives
- (at least) one LCAMP partner organisation.

The countries where we will create expert panels are: Belgium, France, Germany, Italy, Netherlands, Slovenia; Spain; Sweden, Turkey.

Therefore, we expect to build a group of the total numbers of 91 experts composed by 27 industry representatives, 27 VET representatives, 27 government representatives.

Duties of the panels of experts:

Validate the conclusion and finding of the reports elaborated in the LCAMP observatory.

Work methodology for validation of the experts' panels

Once the research teams of LCAMP observatory create the main conclusions and finding to be included in the reports of the observatory, and after the validation of those reports by the Observatory's steering group, the regional panel of experts will meet and validate those findings.

Each panel will decide the format of their meetings and the methodology

The LCAMP partner organization will report the finding and conclusion of the panel. This partner will create the definitive regional reports to be sent to the observatories' steering committee.

Frequency and timing.

The group of experts will meet at least once a year, just before the publication of the reports.

The publication date for the reports are :

- report 1, June 2023,
- report 2 june 2024,
- report 3 june 2025.

The experts panel should validate the information to be included in the reports one month before the publication date

Deadlines for the validation of the conclusions and contents of the reports:

- report 1 May 2023,
- report 2 May 2024,
- report 3 May 2025.

Once the validations are complete, the final reports will be edited and translated to the corresponding languages: English, Spanish, French, Italian, Turkish and Slovenian

In the table below the panel datas are shown.

	Reports finding ready to validation	**Experts' Validation deadline**	**Final English version deadline**	**Publishing deadline In 6 languages**
Observatory report #1	1 May 2023	15 May 2023	25 May 2023	15 June 2023
Observatory report #1	1 May 2024	15 May 2024	25 May 2024	15 June 2024
Observatory report #1	1 May 2025	15 May 2025	25 May 2025	15 June 2025

Table 3 Planned dates for external validation processes

4.5 Stage 05 Communication

The final stage of the observation methodology is the communication process to distribute internally and externally the different outputs of the observatory.

To this end, an effective internal communication strategy will be used The internal communication strategy covers the information needs of the consortium staff for the correct fulfilment of the programmed tasks. We will use the most widespread means of communication, covering both informal and formal ones.

Our objective is to define the best channels to disseminate all the results (reports and data) to the decision-making authorities in the consortium and outside it. The communication can also be in-process tasks, meaning making information and data available internally in the consortium to support the creation of deliverables.

Thus communication channels will have to be used:

- Internally among partners and associated partners
  Each WP teams has identified their topics of interests for their activity as well as the persons receiving the information from the observatory. We will use subscription mechanism to this end.
- Externally to everyone outside the consortium.
  - All the outputs of the observatory will be available in the LACMP platform. Furthermore, user wil have the opportunity to search for specific information and to filter the outputs following different criteria.
  - The output will be communicated and disseminated also using more conventional channels: social media, downloading from LCAMP website, in newsletters and also using partners' own dissemination channels.

Before the launch of the first version of the LCAMP Platform, we will use "preliminary communication database", in order to start to communicate and to disseminate results, in an early stage of the project. To this end, Observatory leaders will set up a simplified communication tool, that would be integrated later in the definitive LCAMP platform.

4.5.1 Preliminary communication channels (internal)

A framework of the Database was built using Open Office Base, a free and open-source tool used for database development and administration.

This framework is simply a base to gather data for the observatory to work on. It was built around these four core entities of LCAMP.

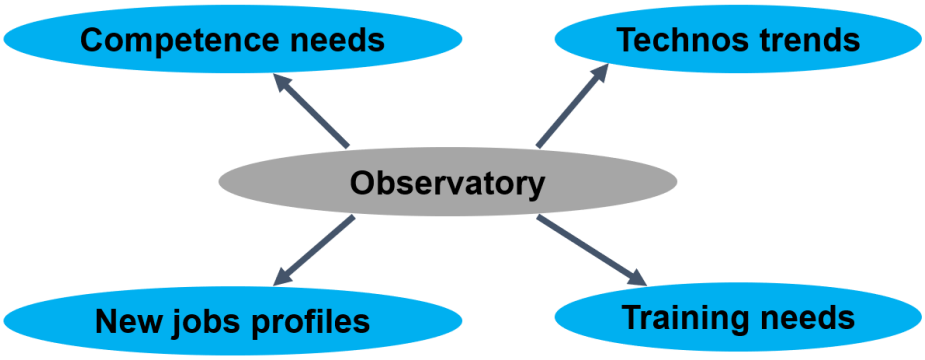


Figure Core entities of LCAMP

Figure 18 Schematic view of the preliminary database

Thus, we proposed a simple data base such as this one Figure 18

The structure is made up of:

- ✓ main tables, representing the core entities of the observatory as well as the data sources

  Job contains all jobs (1: Tech Sup CPRP, 9 : Data Scientist, 10 : Data Analyst, 11 …)

  ActArea includes all industries (1 : Aeronotics, 2 : Automobile, 3 ……)

- ✓ junction tables, which connect the data of the main tables (e.g. all jobs of a sector of activity, all the trainings proposed by a VET, all the technologies used by a job).

  Junction table: **JobArea** connects jobs and sectors of activity.

  Tech Sup CPRP is connected to 5 sectors including **Aeronautics**, **Automobile** etc.

  Aeronautics is connected to 2 jobs **Tech Sup CPRP** et **Data Scientist**.

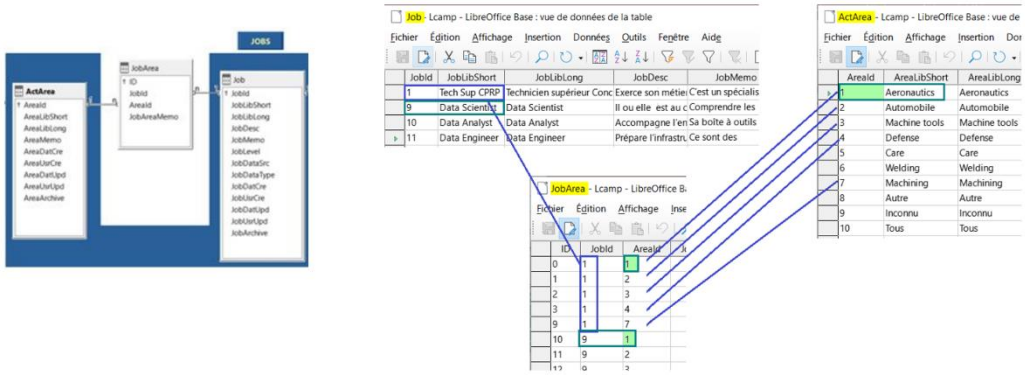
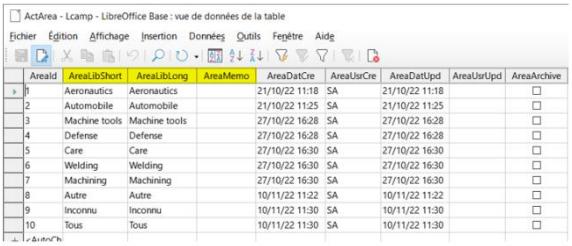


Figure 19 Main table and junction table

Of course, for each table, it will be necessary to determine the list of information that will be used by the different services of the platform, but it will also be important to think about the metadata fields.

- the data fields used to build the pages of LCAMP: These are all the information that we want to display on the training courses, the jobs, etc.
- and the **metadata** which is used for the control, the automatic update etc. of the data



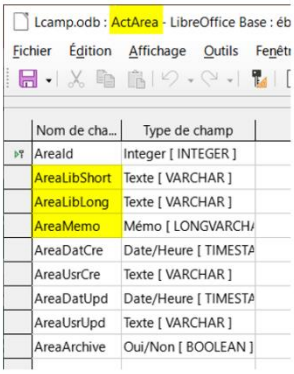


Figure 20 Data fields and metadata

Metadata will allow, for example, to know the date of creation and the update of a record, but it will also be useful in the control of the data.

For example, the **metadata** allows us,

- •to know the dates of creation and modification of the record.
- They facilitate the detection of "old" records who might need to be corrected.
- •to archive to keep a record but exclude it from the platform (logical deletion instead of a physical one).
  Example: it's possible to automatically delete all the archived records whose last update date is 1, 2, 3, etc. years earlier.
  Simple and efficient cleaning of the database

The constraints (uniqueness, mandatory or optional entry, etc.) to be set on specific fields of each table will guarantee the reliability of the data:

To fill in the job description

- some boxes are mandatory and others optional.
- For example, the fields in yellow are mandatory (e.g. Lib Long, Source and Type).
- The green fields are mandatory and must be unique to avoid duplication.

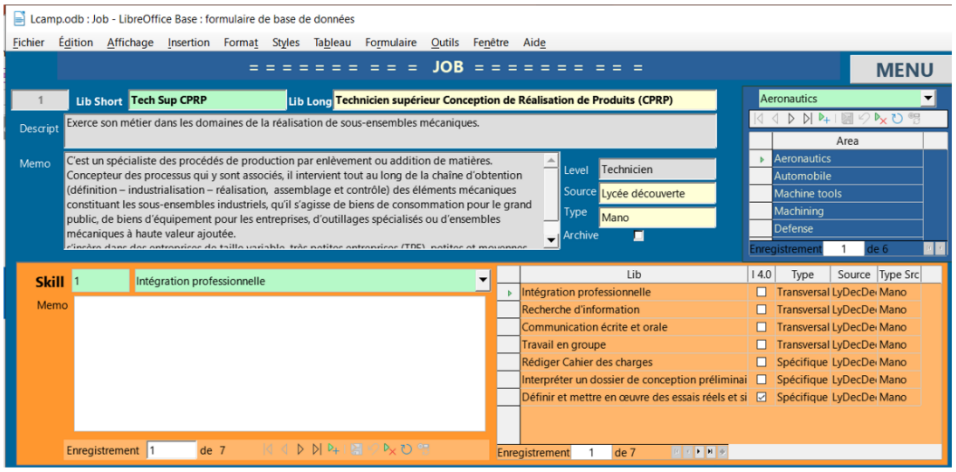


Figure 21 Defining the constraints

The general structure is as following:

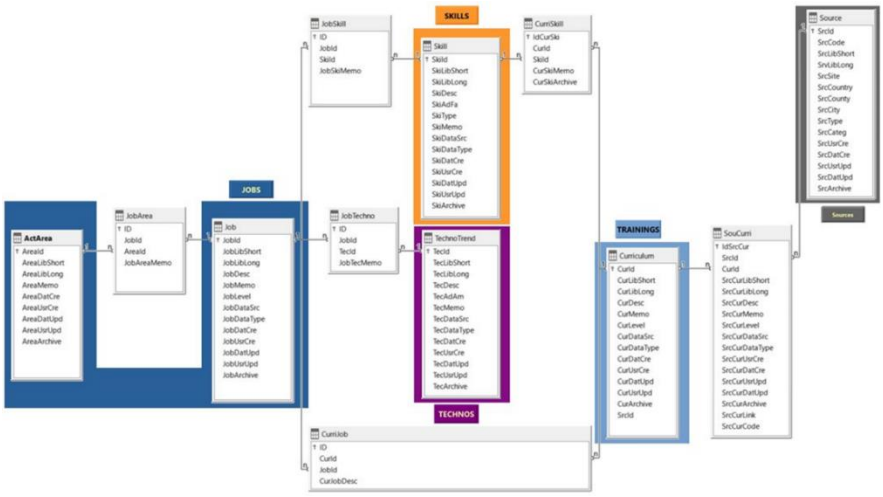


Figure 22 General structure

This Draft Database will face some limits as explained here:

This is a first approach based on the analysis of less than 5 French examples of training. It is likely that some links will need to be adapted (for example, it may be interesting to create a direct link between technologies and skills). The final structure will surely need to be adapted.

Other issues that have not yet been addressed: the parameter tables (e.g. list of countries, regions, etc.), the multilanguage management, etc.

The purpose of the LibreOffice tool was to facilitate data collection and to test the limits of the proposed structure.

The following slides show a main table (e.g. Job) and display all the links that the draft provides with the other main entities (e.g. Job, links with ActArea, Skill, TechnoTrend and Curriculum):

Jobs and Sectors of activity

Each table (AREA and JOB) contains its own data.

and the JobArea junction table allows to link as many records as necessary between these 2 tables

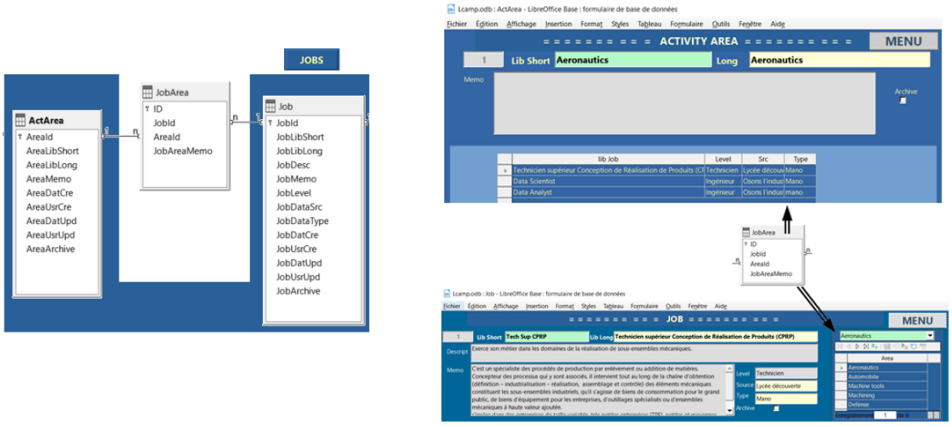


Figure 23 Jobs & Sectors of activity

Jobs and Skills, Technologies and Trainings

We plan on connecting the same way the records of Job with these 3 other entities.

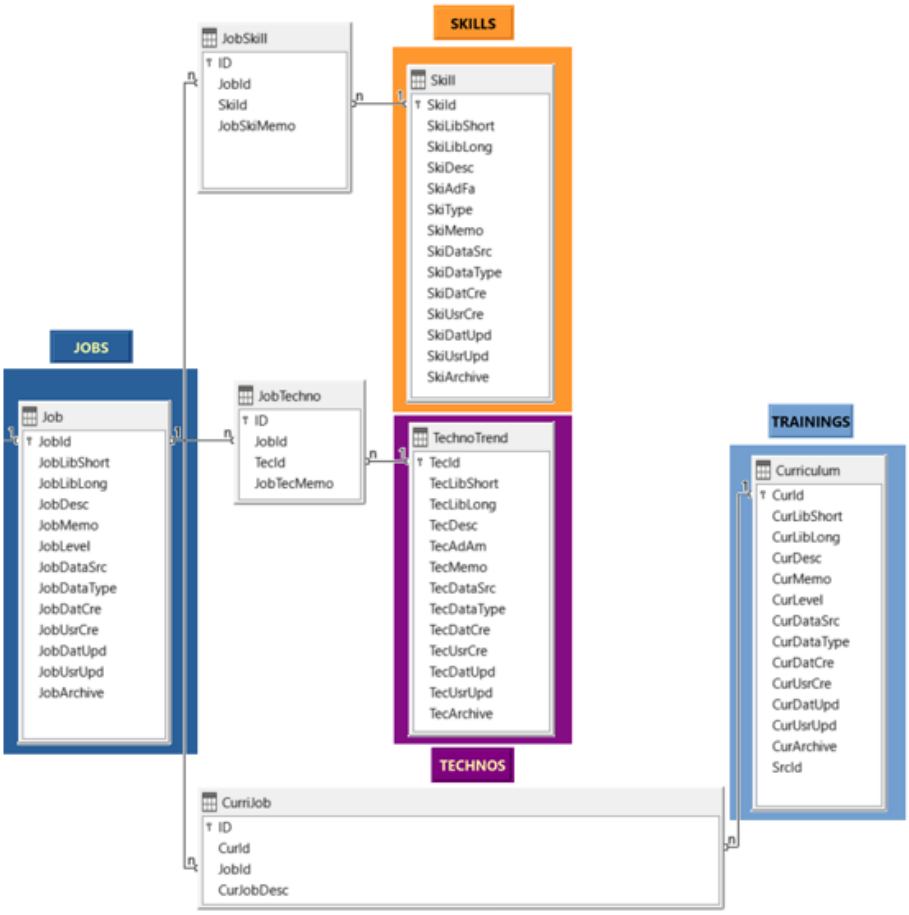


Figure 24 Other links of Jobs

Skills links

The proposed structure provides information on the links between skills and jobs and training

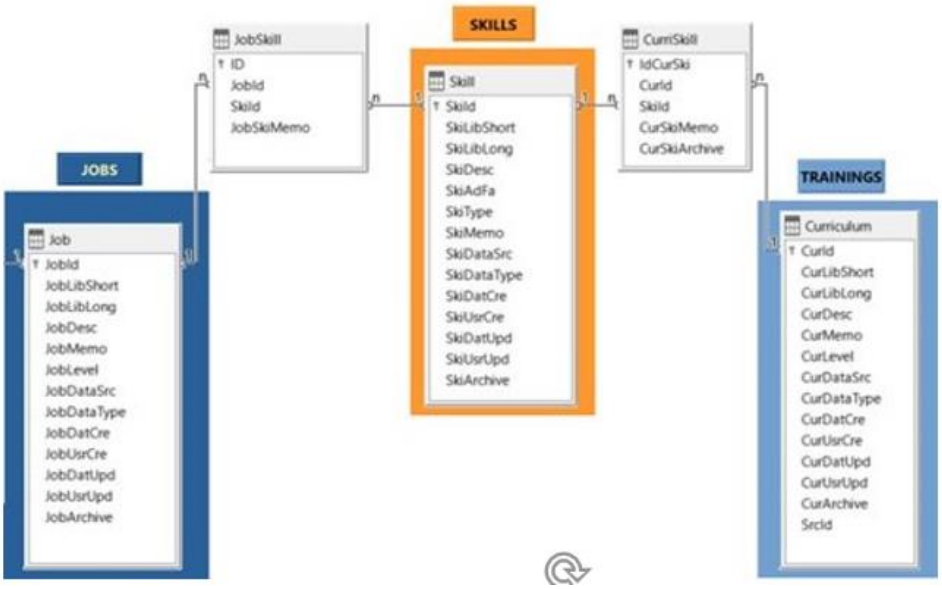


Figure 25 Skills links

Technologies link

Technologies are only connected to jobs.

As previously mentioned, it could be interesting to create a direct link between technologies and skills.

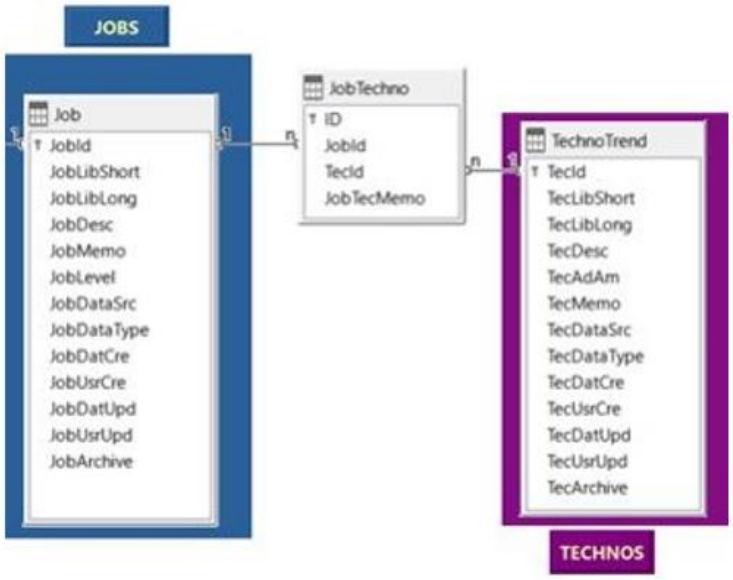


Figure 26 Technologies trends link

Trainings links

- The link to the Jobs is included.
- We also plan on listing all the skills related to each training.

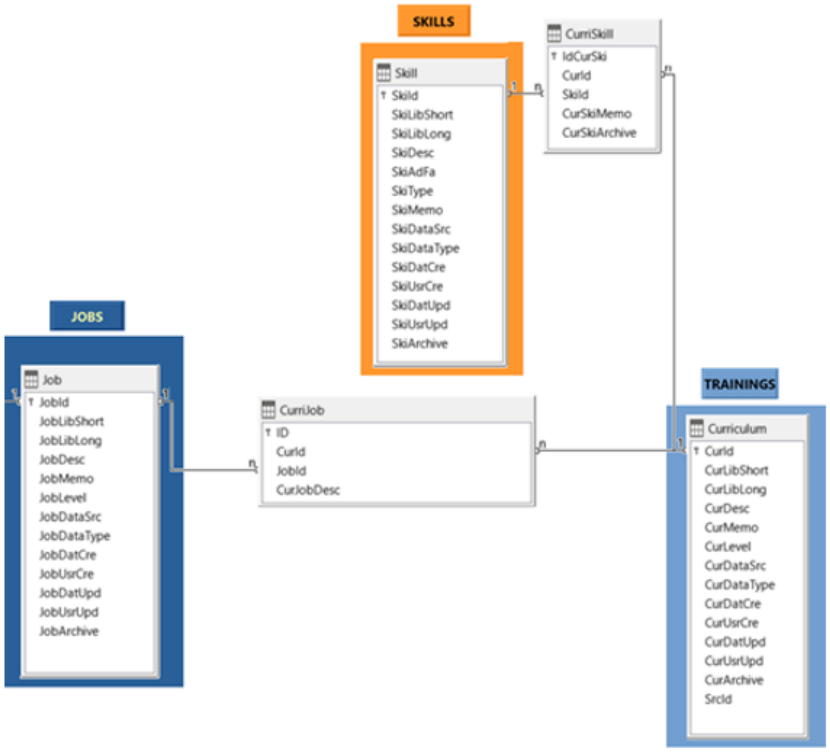


Figure 27 Curriculum links

Sources link

- The sources are all the organizations that offer the listed trainings.

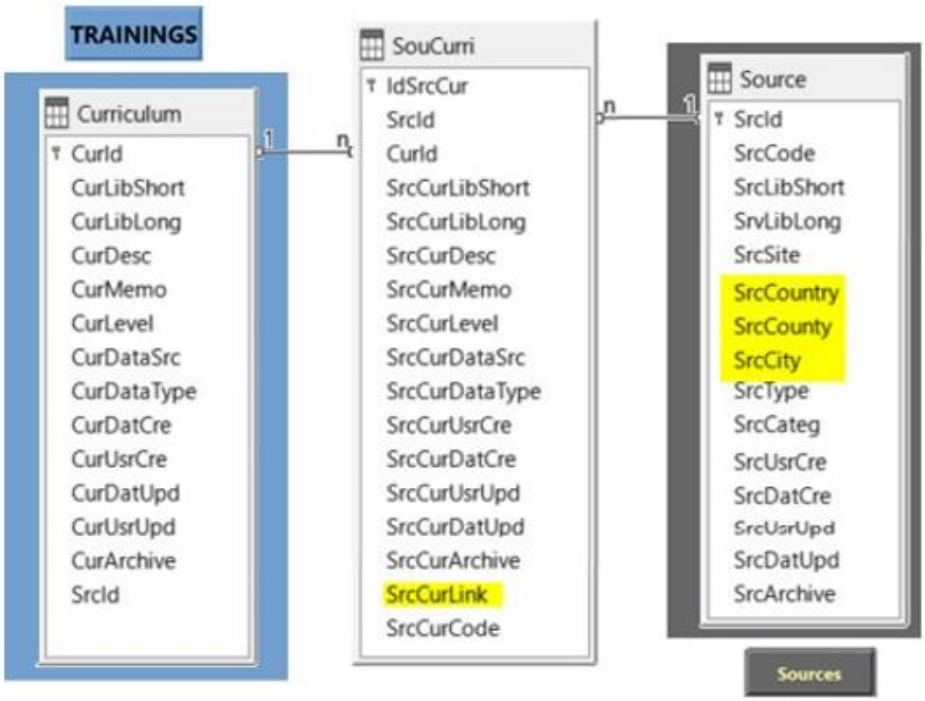


Figure 28 Sources link

SrcCurLink : link to the training sheet on the organization's website.

This link should be systematically checked as soon as it is concerned by a search.

We include in the source file the information of places as the country, the region and the city (ScrCountry, SrcCounty, SrcCity)

4.5.2 External communication channels

For the general dissemination of the results we will use two main ways:

Firstly, the LCAMP platform. The platform is one stop online tool where all the results of LCAMP are available including all the outputs of the observatory.

Information will be tailored for the different type of users identified so far.

Secondly, the results of the observatory will be disseminated using the channels defined in LCAMP dissemination strategy. LCAMP website, social media, partners own channel etc.

Results will also disseminated in conferences, workshops and events related to advanced manufacturing and VET.

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6 INDEX OF ILLUSTRATIONS

7 INDEX OF TABLES

8 ANNEXES

8.1 Legend of Figure 7 Key enabling technologies of Industry 4.0

- ✓ **Cybersecurity:**

  Secure data storage and transmission.

- **Big Data:**

  More varied data, arriving in increasing volumes and at a higher speed. Data analysis and AI allows the optimization of machine performance while improving quality.

- **Blockchain:**

  Secure data transmission. Guaranteed traceability of components or operations.

- **Vertical & Horizontal Integration:**

  Facilitated data sharing with customers or suppliers.

- **Cobots:**

  Robots equipped with safety sensors that eliminate certain tedious tasks while automating others. Process of imitating human intelligence that relies on the creation and application of algorithms run in a dynamic computer environment

- **Artificial Intelligence:**

  Its goal is to enable computers to think and act like human beings.

- **Additive manufacturing:**

  3D printing makes it possible to manufacture unique and personalized objects quickly and at low cost

- **Augmented & virtual reality:**

  Technology allowing the integration of virtual elements in a real environment in order to assist the operators.

- **Simulation – Twin models:**

  Model twin of a product with sensors on the main object in order to retrieve data on its position in space, its condition, its temperature, etc.

- **IoT:** Internet of Things

  Thanks to an electronic chip, a sensor or any other connector, objects can communicate, collect and exchange information. IoT allows to control and follow objects remotely.

- **Cyber-Physical Systems:**

A system capable of communicating that integrates electronics and software. It exchanges information autonomously, controls processes and triggers actions (e.g. predictive maintenance) according to the circumstances.

8.2 Members of Partner organizations that participate in the observatory:

List of LCAMP participants

Members of Partner organizations that participate in the observatory:

Organisation	Name	Surname
TKNIKA	Unai	Ziarsolo
TKNIKA	Iñigo	Araiztegui
TKNIKA	Juan Carlos	Molinero
TKNIKA	Iñigo	Tercero
AFM	Josu	RIEZU
INVEMA	Leire	SOLABERRIETA
DHBW	Raimund	Hudak
DHBW	Klaus-Dieter	Rupp
DHBW	Jan	Stenzel
DHBW	Lea	Schmitt
CMQ	Nathalie	Lavaurs
CMQ	Audrey	Le Bras
MV	Hervé	DANTON
KIC	Jasmina	Policnik
AFIL	Samuel Nazzareno	Monaco
AFIL	**Eda**	
EARLALL	Noelia	Cantero
EARLALL	Alicia	Gaban
KPDoNE	Firat	Arslan
KPDoNE	Hasan Burcin	Mentes
KPDoNE	Volkan Alparslan	Kilic
GEBKİM	Cem	Kilinc
SIMUMATIK	Mikel	Ayani
Skupnost VSS	Alicia Leonor	Sauli Miklavčič

Skupnost VSS	Miha	Zimšek

Other direct participants from outside the consortium (if they are identified):

Source			Scope		
Identification	Responsible	Description	Geographical scope	Sectorial scope	Education scope
Institut National Universitaire Jean-François Champollion	MV	Regional Institute for Qualifications	Regional (Occitanie) France	Multisector	Higher Education
IUT du Limousin	MV	Regional Technological Institute for Qualifications	Regional France	Multisector	Higher Education
Robert Bosch France	MV	Industrial	International	Multisector	
Ratier-Figeac - Groupe COLLINS	MV	Industrial	International	Aerospace	
IMT EMAC Mines Albi Carmaux	MV	School of Engineers	National	industries	Higher Education

Specifically, a group of students from IMT EMAC, an Engineering University Mines ALbi Carmaux (France) worked for the project: We solicited them within the timeframe of a 4-month mission (end of October 2022 to February 2 2023) in order to submit to them the LCAMP project and to see which directions they would favour.

- ✓ 2 Supervisors (teachers): Dominique VAN ZWYNSVOORDE, Louis ADAM
- ✓ 1 Tutor: Camille Fréquelin
- ✓ 6 Students: Emma Bouchez, Marie Bescond, Maigret Manin, Bredel Jimmy, Galzin Yann, Yassir Ramz.

LCAMP

Learner Centric Advanced Manufacturing Platform

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