



Learner Centric Advanced Manufacturing Platform



DIGITAL TWINS IN VOCATIONAL TRAINING EDUCATION

WPN° 3 Observatory



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GLOSSARY AND/OR 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



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EXECUTIVE SUMMARY

Advanced Manufacturing (AM) and Higher Vocational Education and Training (HVET) need to update training, implement new technologies, and get quick access to data.

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 the greening industry).

Under the CoVE initiative, the LCAMP project aims to support regional skill ecosystems and various stakeholders in providing new skills and implementing new or updated 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 Advanced Manufacturing 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 European regions and countries grow and be more competitive through their VET systems.

Therefore, the LCAMP OBSERVATORY is one of the services in the LCAMP platform. The observatory is led by the French cluster *Mecanic Vallée* and the French VET provider *Campus des Métiers et des Qualifications d'Excellence Industrie du Futur*.

This present document details the first results of the LCAMP Observatory, through the methodology that the LCAMP consortium used to set up and run the Observatory. We had set up a process cycle for the observation consisting of 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.

1. INTRODUCTION

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

The LCAMP Observatory must be a reliable and easily accessible source of information and data for trainers, VET teachers, and 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 (Work in progress in WP8).

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

In a first document about methodology, are 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: Create value. Elaboration of LCAMP reports
- Stage 5: Disseminate-communicate.

Following this process cycle, are detailed the main aspects of the observation methodology:

- 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 annual reports.
- Validate process for those reports.

The observatory will publish periodical reports for VET and HVET target audiences about technology trends, labour market changes, skill needs, and occupations in Advanced Manufacturing. It is 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.

This first annual report is gathering sub-reports written by around twenty different writers, from the main partners involved in the LCAMP project. 39 Topics were determined, and 22 TOPICS were analysed and worked on during this first period.



2. TOPICS: DIGITAL TWINS IN VOCATIONAL TRAINING

The purpose of this chapter is to present some of the development areas related to AM.

These are topics that concern all or some of the stakeholders

- CoVEs and VETs: teachers, trainers and heads of VET schools;
- Learners: students, active workers, job seekers;
- Companies;
- Policy makers and other stakeholders

2.1 INTRODUCTION

2.1.1 BACKGROUND AND CONTEXT

Digital twins, virtual replicas of physical assets, systems, or processes, have emerged as a powerful technology in various industries, including manufacturing, aerospace, and healthcare. These digital representations enable real-time monitoring, analysis, and optimization of their physical counterparts, leading to improved efficiency, reduced costs, and better decision-making. The rapid advancement of the Internet of Things (IoT), artificial intelligence (AI), and data analytics has further accelerated the development and adoption of digital twin technology.

2.1.2 PURPOSE OF THE REPORT

This report aims to explore the potential of digital twins in the context of Vocational Training Education (VET). It will provide a brief overview of digital twins and their key components, discuss their applications and use cases in vocational training, and analyse the benefits, challenges, and limitations associated with their implementation. Additionally, the report will touch upon future perspectives, highlighting emerging trends and technologies that may shape the role of digital twins in vocational training education.

2.2 DIGITAL TWINS: AN OVERVIEW

2.2.1 DEFINITION AND KEY COMPONENTS

Digital twins are virtual representations of real-world objects or processes, which enable real-time monitoring, analysis, and optimization. They consist of three primary components: a data model, a set of algorithms, and a communication network. The data model represents the physical asset or process, while the algorithms enable the analysis of the data collected from



the physical counterpart. The communication network facilitates the exchange of information between the digital twin and the real-world object or process.



Figure 1 : Exchange of information

2.2.2 CONNECTION TO IOT, AI, AND DATA ANALYTICS

The development and adoption of digital twins have been accelerated by advancements in IoT, AI, and data analytics. IoT devices and sensors collect data from the physical world, enabling digital twins to be updated with real-time information. AI and machine learning algorithms are used to analyse the data, identify patterns, and make predictions or recommendations. Data analytics tools help visualize and interpret the data, allowing for better decision-making and improved performance of the physical assets or processes.

2.3 DIGITAL TWINS IN VOCATIONAL TRAINING EDUCATION

2.3.1 APPLICATIONS AND USE CASES

Virtual labs and hands-on learning

Digital twins can be used to create virtual labs, providing students with hands-on learning experiences in a safe and controlled environment. These virtual labs allow students to interact with complex machinery, equipment, or processes without the risks and costs associated with physical labs.





Figure 2 : Some of the virtual labs created by instructors in Simumatik as part of the pilot project led by Tknika

Tknika, a leading center for innovation in vocational education and training in the Basque Country, is collaborating with Simumatik, a digital twin platform, to develop virtual labs as part of their pilot project. These virtual labs aim to improve the quality of vocational training by incorporating digital twins and Industry 4.0 technologies into the educational process. This collaboration allows students and instructors to work with realistic simulations of real-world machinery and processes, enhancing the learning experience and better preparing students for the future workplace.

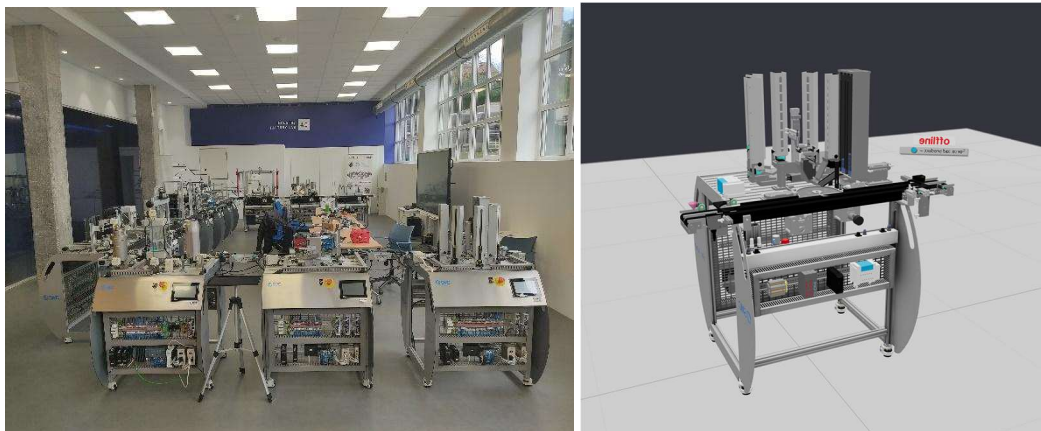


Figure 3 : Tknika, Industry 4.0 Factory Lab with the Digital Twin of one of the workstations

Remote collaboration and accessibility

Digital twins facilitate remote collaboration and accessibility, allowing students and instructors to work together from different locations. This expands the reach of vocational training programs and provides opportunities for students who may not have access to physical facilities or resources.

During the COVID-19 pandemic, digital twins played a crucial role in maintaining the continuity of education and vocational training. They facilitated remote collaboration and accessibility, enabling students and instructors to work together from different locations. Key benefits included



promoting remote learning, providing realistic simulations for practice, reducing costs and resource requirements, and enhancing collaboration and communication. Digital twins allowed students and instructors to adapt to remote learning while preserving the quality of training and access to practical experiences.

2.3.2 BENEFITS AND ADVANTAGES

Enhanced student engagement and motivation

The use of digital twins in vocational training can lead to increased student engagement and motivation by providing immersive and interactive learning experiences that closely resemble real-world scenarios.

Improved learning outcomes and skill development

Digital twins can help students develop practical skills and apply theoretical knowledge in a realistic context, leading to improved learning outcomes and better preparation for the workforce.

2.3.3 CHALLENGES AND LIMITATIONS

Technological barriers and infrastructure requirements

Implementing digital twins in vocational training may require significant investments in technology and infrastructure, which could be a barrier for some institutions or organizations.

Integration with existing curricula and teaching methods

Integrating digital twins into existing curricula and teaching methods may require a shift in pedagogical approaches and educator training, presenting another challenge for the successful implementation of digital twins in vocational training education.

2.4 FUTURE PERSPECTIVES

2.4.1 EMERGING TRENDS AND TECHNOLOGIES IN DIGITAL TWINS AND VOCATIONAL TRAINING

The landscape of digital twins and vocational training is constantly evolving. Emerging trends and technologies, such as augmented and virtual reality, edge computing, and 5G connectivity, could further enhance the capabilities of digital twins in education. These advancements may lead to more immersive and interactive learning experiences, more accurate simulations, and improved real-time data processing and communication.



2.4.2 POTENTIAL NEW APPLICATIONS AND OPPORTUNITIES

As digital twin technology continues to develop, new applications and opportunities may arise within vocational training education. For instance, digital twins could be integrated with adaptive learning systems to create personalized learning experiences tailored to individual students' needs and progress. Additionally, digital twins could be used to simulate real-world scenarios in industries that are difficult to access or hazardous.



3. CONCLUSION

3.1 RECAP OF THE IMPORTANCE OF DIGITAL TWINS IN VOCATIONAL TRAINING EDUCATION

Digital twins hold great potential for transforming vocational training education by providing immersive, hands-on learning experiences, personalized learning paths, and effective training for complex tasks. Despite existing challenges, such as technological barriers and the need for integration with current curricula, the benefits of digital twins in this field are substantial and warrant further exploration and investment.

3.1.1 RECOMMENDATIONS AND NEXT STEPS

To fully leverage the capabilities of digital twins in vocational training education, the following recommendations and next steps are suggested:

1. Foster collaboration: Encourage cooperation among educational institutions, industry partners, and policymakers to share knowledge, resources, and best practices related to digital twins in education.
2. Invest in research and development: Support ongoing research and development to advance digital twin technology and explore innovative applications in vocational training education.
3. Address infrastructure needs: Ensure that educational institutions have the necessary technological infrastructure and support to effectively implement and utilize digital twins in their programs.
4. Develop training programs: Create training programs for educators and trainers to equip them with the necessary skills and knowledge to effectively use digital twins in their teaching.
5. Assess and iterate: Continuously evaluate the impact of digital twins on student outcomes, skill development, and overall educational experiences, and refine the implementation strategies accordingly.



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