LCAMP

Learner Centric Advanced Manufacturing Platform

XR AND AM

WPN° 3 Observatory

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LCAMP partners:

TKNIKA – Basque VET Applied Research Centre, CIFP Miguel Altuna LHII, DHBW Heilbronn – Duale Hochschule, Baden-Württemberg, Curt Nicolin High School, AFM – Spanish Association of Machine Tool Industries, EARLALL – European Association of Regional & Local Authorities for Lifelong Learning, FORCAM, CMQE: Association campus des métiers et des qualifications industrie du future, MV: Mecanic Vallée, KIC: Knowledge Innovation Centre, MADE Competence Centre Industria 4.0; AFIL: Associazione Fabbrica Intelligente Lombardia, SIMUMATIK AB; Association HVC Association of Slovene Higher Vocational Colleges; TSCMB:Tehniški šolski center Maribor, KPDoNE: Kocaeli Directorate Of National Education; GEBKİM OIZ and CAMOSUN college.

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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

CONTENT TABLE

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. TOPIC

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

Some examples of the stakeholders are:

- NVIDIA OMNIVERSE AND AM
- REMOTE ASSITANT USING MR FOR AM
- DIGITAL TWINS IN XR FOR AM;
- AM TRAINING IN COLABORATIVE XR

2.1 VIRTUAL REALITY, AUGMENTED REALITY AND MIXED REALITY

2.1.1 NVIDIA OMNIVERSE AND AM

Introduction

Nvidia Omniverse [1] is the metaverse of NVIDIA, the largest high end graphic card manufacturer of the world, recently they have published a new advance in the metaverse and it will have a direct impact on AM in VET :

- NVIDIA has presented the new IA and XR technology in their Omniverse environment;
- The main problem for the metaverse was the emptiness or lack of continuous interaction, this new development will help with that;
- Omniverse is not only XR but also desktop like environment so this hybrid approach will reduce onboarding costs;
- AR manufacture will get all the benefits of the metaverse.

Contextualisation

The metaverse has been the preferred topic for two years in a row, companies like Meta have suffered changes in their balance sheet of more than 12,000 million euros, and the NVIDIA company has not stopped investigating this.

[1] « GTC 2023: #1 AI Conference », NVIDIA, s. d., https://www.nvidia.com/gtc/.

Figure 1 Logo Omniverse [2]

In their most recent exhibition at Nvidia GTC 2023[3] Nvidia has delved into their metaverse tools that they call Omniverse. Focused on AI and without abandoning the protoverses, this company facilitates the creation and interaction of the three basic components that facilitate teaching in AM within vocational training.

- An increasingly competent AI that serves as the main basis for interacting in metaverses
- An integrated environment where programming the behavior of machines for advanced manufacturing does not require deep programming knowledge
- A powerful yet simple graphical environment for graphical representation (including diagrams) of machine tools.

2.1.2 Objectives / Research question / Problem statement

The primary goal is for AM manufacturing to be integrated into omniverse-type environments with the support of XR immersion and with the AI support that NVIDIA has.

Objectives

Microsoft has closed its metaverse this year for being essentially a desert. Its main attraction that is a fluid interaction has failed due to lack of actors, this is where AI must come into play. A permanent AI trainer to help us with advanced manufacturing experiences will be the best approach. Other companies such as SEAT have already opted for this type of technology with different results[4]

Research question

The first question to be solved is how much will it cost for AM teachers in VET to start with the integration of these tools? Are there alternatives? Are companies interested in this?

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[2] « NVIDIAOmniverseLUM.jpg (1920×1080) », s. d., https://gamefromscratch.com/wp-content/uploads/2021/06/NVIDIAOmniverseLUM.jpg.

[3] « GTC 2023: #1 AI Conference », NVIDIA, s. d., https://www.nvidia.com/gtc/.

[4] « How SEAT Applies VR | SEAT », s. d., https://www.seat.com/company/news/cars/virtual-reality-car-manufacturing.html.

PROBLEM STATEMENT

The implementation of new technologies always implies uncertainty, losses but also benefits. The human factor, including the fear of losing teachers' jobs, can have a negative impact on the adoption of new technologies. In the case of NVDIA it must be added that the costs associated with the platform are high and if payment plan shoots up quickly

2.1.3 FINDINGS

The adoption of tools like NVIDIA's Omniverse is going to be slower than desired by what was written before. Although the integrated development environment is straightforward and many companies are linking up with NVIDIA, teachers need more training to be able to deploy effectively.

2.1.4 CONCLUSIONS

The conclusion we can draw from all this is the unlimited potential use but really removing a few small local experiments, there is not enough computing power in the local servers or enough training to be applied on a large scale. That said, it is a technology with a promising future and we cannot lose sight of it.

2.2 REMOTE ASISTANT USING MR FOR AM

Mixed reality devices to improve remote assistance of the operators using TeamViewer technology is serving better timings and saving logistic problems with people ubiquity problems. Invelon[5] has already created a technology that makes this kind of operations an must teach in VET.

2.2.1 INTRODUCTION

Remote assistant using MR helps solving AM maintenance without the inconvenience of travelling. Teaching our VET students about this technology in the two sides of the holo-conference (the guider and the operator) will make their work easier in the future.

[5] « Teamviewer Fontline XPick Vision Picking for Logistics and Warehousing | Invelon Technologies », invelon, s. d., https://www.invelon.com/en/teamviewer-xpick/.

2.2.2 CONTEXTUALISATION

Figure 2 Logo TeamViewer call using hololens2[6]

Sending expert technicians to different parts of the planet every time a specialized machine like advanced manufacturing breaks down is expensive and unproductive. Having a machine stopped by a query that is solved "knowing which screw to tighten" is something that telepresence can help solve. Through videoconferencing technologies, much progress has been made but we can go further through MR and holographic projection

2.2.3 OBJECTIVES / RESEARCH QUESTION / PROBLEM STATEMENT

Highlight the convenience of VET entry of MR-type holographic telepresence tools thanks to Microsoft Hololens2 hardware and its technology partner TeamViewer

OBJECTIVES

Demonstrate that the use of telepresence and its training in VET saves costs and speeds up repairs in AM

RESEARCH QUESTION

How expensive is an MR deployment? What are the connectivity limitations?

PROBLEM STATEMENT

Hardware is expensive and global 5g mobile network connectivity is still limited. Without a reliable communications network, videoconferencing or holoconferencing will fail and there will be no way to support the learner or operator.

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[6] N. V. Vijayakumar, « TeamViewer Brings Workflows to TeamViewer Pilot, Adds Microsoft HoloLens 2 Support - The NFA Post », *NFA Post* (blog), 3 décembre 2020, https://thenfapost.com/teamviewer-brings-workflows-to-teamviewer-pilot-adds-microsoft-hololens-2-support/, https://thenfapost.com/teamviewer-brings-workflows-to-teamviewer-pilot-adds-microsoft-hololens-2-support/.

Figure 3 Hololens2[7] with security helmet.

Off-line operations do not meet the objective of remote assistance that we want to discuss here.

2.2.4 FINDINGS

There are several alternatives listed below but they require a paradigm shift for technical support companies. If we train our VET students

2.2.5 CONCLUSIONS

The conclusion we can draw from all this is that the use of MR for telecare is already implemented in some companies in the environment but that training within VET to assist in AM problems is still expensive.

2.3 AM TRAINING IN XR ENVIRONMENTS

Collaborative XR training[8] for teachers and VET students. The safest and more cost effective way to train AM.

[7] « Tecnología de realidad mixta para empresas », Microsoft HoloLens, s. d., https://www.microsoft.com/es-es/hololens.
[8] « The Virtual Reality Company », Virtualware, s. d., https://www.virtualwareco.com/.

2.3.1 INTRODUCTION

The Basque Vocational Training System is committed to immersive collaborative virtual reality experiences as the best system to train our VET students safely and with reduced costs.

2.3.2 CONTEXTUALISATION

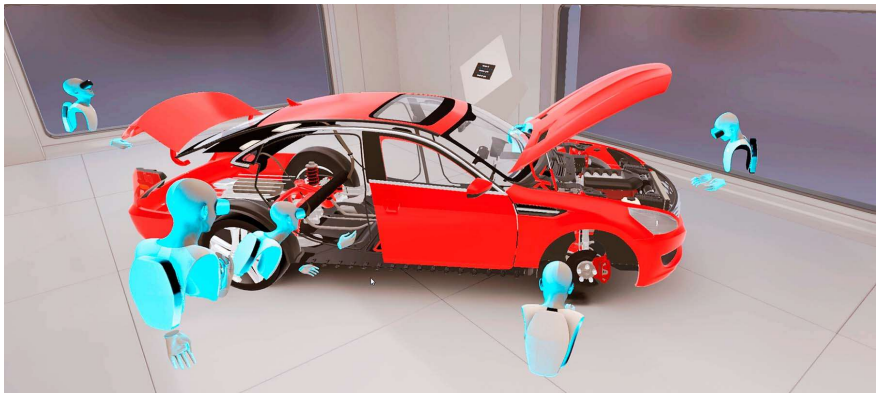

Figure 4 Collaboration in Advance Manufacturing and Assembling[9]

Once the virtual reality market is mature in terms of hardware and software, it is time to apply it in VET. The idea of FP Euskadi is that our students trained under this environment serve as a spearhead in companies to bet on this type of technology.

2.3.3 OBJECTIVES / RESEARCH QUESTION / PROBLEM STATEMENT

Expand the use of collaborative VR designed by teachers in VET.

OBJECTIVES

VET teachers in a large minority have knowledge of video game development, that is, knowledge of a development IDE such as Unity or Unreal as well as modeling with Blender or Maya. This prevents them from developing their own VR experiences and even more from being collaborative. The goal is for teachers to be able to create ad-hoc exercises in a versatile way.

[9] « The Enterprise VR Platform powered by Virtualware | VIROO® », The VR Enterprise Platform, s. d., https://www.virtualwareco.com/viroo/.

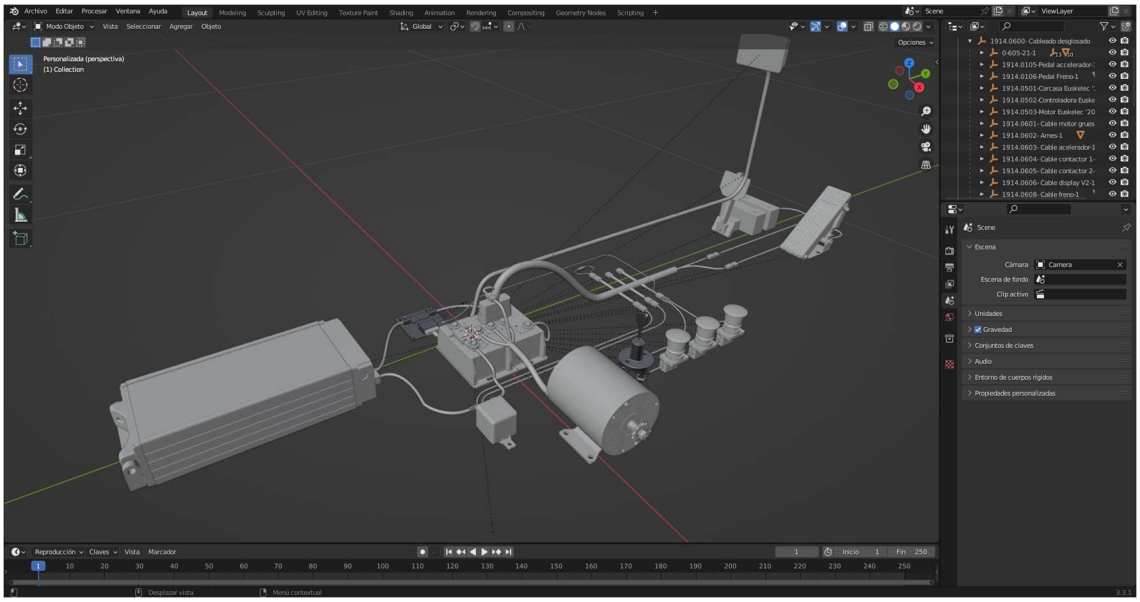

Figure 5 Blender modeling an electric car[10].

RESEARCH QUESTION

How many hours of training do inexperienced teachers (in VR development) need to be able to create a useful collaborative experience?

PROBLEM STATEMENT

All technologies need a time of development and learning, and the tool we choose has to enable a very fast training time.

2.3.4 FINDINGS

The tool of the company VIRTUALWARE allows to create these scenes or collaborative rooms to the teachers of VET. From a 20-hour training session and with the support of Tknika and the company itself, the teachers have been able to create a collaborative room to simulate a complex machine. From this experience (a CNC machine and its start-up) different Advance Manufacturing machines will be created to make the training of the students safer.

2.3.5 CONCLUSIONS

Training in collaborative VR with materials created by the teachers themselves inexperienced in 3d development is possible and is demonstrated in the experience created by the Miguel Altuna center.

[10] « Tknika », *Tknika* (blog), s. d., https://tknika.eus/en/.

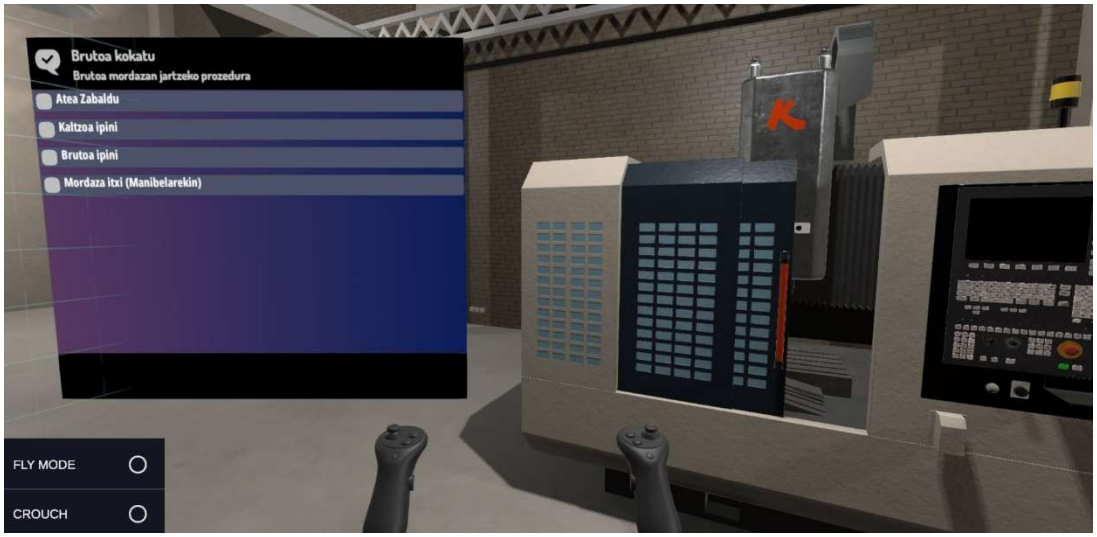

Figure 6 CNC machinery in VIROO environments[11]. (source tknika.eus)

[11] « Tknika ».

3. CONCLUSION

Statement 1: Integrate ergonomic principles and digital technologies into vocational education and training programs: By incorporating ergonomic principles and digital technologies into vocational education and training programs, students can learn the skills and knowledge necessary to thrive in a rapidly changing manufacturing landscape. This includes training in ergonomics, human factors, and digital technologies, as well as hands-on experience with digital workstations and equipment.

Statement 2: Invest in infrastructure and equipment: To fully leverage the capabilities of digital workplaces and ergonomics in vocational education, institutions must invest in the necessary infrastructure and equipment. This includes providing access to state-of-the-art digital workstations, equipment, and software, as well as ensuring that the physical environment is designed with ergonomics in mind.

Statement 3: Prioritize worker health and safety: While digital workplaces and ergonomics can provide many benefits, they also present new challenges related to worker health and safety. Institutions must prioritize worker health and safety by incorporating ergonomic principles into the design of work environments, providing training in ergonomic practices, and ensuring that workers have access to the necessary tools and resources to maintain their health and well-being.

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