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of the European Union

619130-EPP-1-2020-1-FR-EPPKA2-CBHE-JP

Selection: 2020

KA2 – Cooperation for innovation and the exchange of good practices –
Capacity Building in the field of Higher Education

strENgtHening skills and training expertise for TunisiAN and MorocCan transition to industry 4.0 Era / ENHANCE

D4.3 Project website

Deliverable Identifier	D4.3
Deliverable Date	M41 – 14/06/2024
Deliverable Version	V 1.4 – 2024
Deliverable Leader	UCAR
Deliverable participants	All
Dissemination Level	Public

Document Control Page

Title	Project website
Version	V1.4 – 2024
Deliverable number	D4.3
Work-Package	WP4
Status	☐ Draft ☐ Under Review ☐ Under Update ☐ Accepted by the coordinator ☒ Submitted to the commission
Authors	
Contributors	All partners
Peer Reviewers 1:	Youssef ROCHDI
Assigned Date	19/12/2023
Received Date	19/12/2023
Peer Reviewers 2:	Saber Darmoul (ECC)
Assigned Date	December 19th, 2023
Received Date	December 25th, 2023
Date of Delivery	14/06/2024
Dissemination level	☒ Public ☐ Confidential, only for ENHANCE Consortium (including EC) ☐ EU-Restricted

Version History

Version	Date	Description	Edited by
1.0		Initial Version	Sabeur Elkosantini
1.1		Draft for Consortium sharing	Sabeur Elkosantini
1.2		Final Draft with integration of comments from reviewers	Sabeur Elkosantini
1.3		Final Version	Sabeur Elkosantini
1.4		Submitted to the commission	Nejib Moalla

Executive Summary

The purpose of D 4.3 is to present the project website and its main components and sections.

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1. ENHANCE project Overview

ENHANCE - strENgtHening skills and training expertise for TunisiAN and MorroCan transition to industry 4.0 Era – is a Erasmus Plus project founded under the KA2 Cooperation for innovation and the exchange of good practices (Capacity Building in the field of Higher Education) programme by the European Commission under Grant Agreement N° 619130 and conducted in the period January 2021 until January 2024. It engages 7 partners from 5 countries with a total budget of 779k€. Further information can be found at http://eplus-enhance.eu/.

The emergence of industry 4.0 concepts and applications brings new paradigms impacting all the industrial business domains when they need to conduct successful digital transformations or increase workshops connectivity. The evolution of Maintenance, Production and Quality engineering (MPQ 4.0) represents the main application domains where Industry 4.0 produces effective beneficial results.
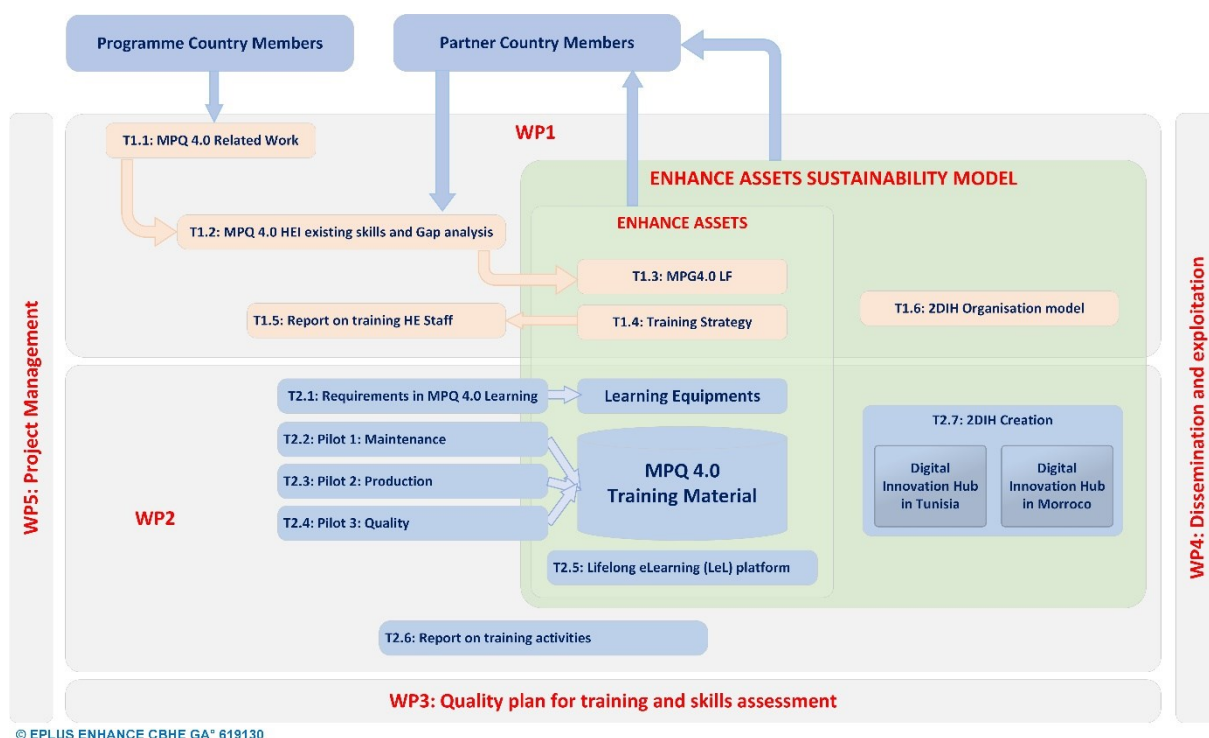
Figure 1 - ENHANCE Project Organisation

The ENHANCE project focuses on building new MPQ training capacities at Higher Education institutions in Tunisia and Morocco to establish interactions between the following stakeholders:

- European universities and research institutions (from France, Germany and Portugal) confirmed MPQ 4.0 competencies, training materials, collaborative research projects, full operational DIHs, technology transfer experiences, etc.
- Partner country universities (from Tunisia and Morocco) with teaching and training activities in MPQ and existing connections with their local industrial partners.

The ENHANCE project will create several outputs and two primary tangible outcomes:

- New MPQ 4.0 equipment acquisition and training materials developed in connection with the existing training programmes and consolidated through three industrial pilots. The new material will be used to train the trainers and the students in the different partner country universities.
- Two DIHs, one in Tunisia and one in Morocco to sustain the project outcomes through their reuse for training in industry.

ENHANCE aims to become the reference model for creating effective and sustainable training material for MPQ 4.0 in both partner countries with content approved by academia and industry.

2. Introduction

In recent years, the industry in North Africa (also called Maghreb) region, especially Morocco and Tunisia, is facing a historical turning point when considered on a global scale. The digital age comprises a new way of thinking regarding manufacturing and operations. To improve the attractiveness for investment and to meet market requirements of competitiveness, in terms of performance, quality, and sustainability, both Morocco and Tunisia need to support industrialization. In this context, this project focus on industry 4.0 and particularly on the three following topics: Production 4.0, Maintenance 4.0 and Quality 4.0, which represent key industrial business processes that particularly need attention, investment and improvement. Through this project, several Tunisian and Moroccan universities and companies showed their interest to develop skills and knowledge to take full advantage of industry 4.0 paradigm and technologies related with these three core business processes of Industry 4.0.

2.1. Purpose of the document

This document is developed as part of the ENHANCE project to present the project website and its structure.

2.2. Reference documents

N/A

2.3. Definitions

N/A

2.4. Structure of the document

Apart from this chapter, the core of this document starts with chapter (3) which presents the adopted approach to design the website and used tools. Then the chapter (4) briefly sums-up different components of the website. Finally, chapter (5) presents the dissemination of the website

2.5. List of acronyms

- DIH – Digital Innovation Hub
- PC – partner country
- LeL: Long e-Learning
- CBHE: Capacity Building in Higher Education
- CMS : Content Management System
- WP: Work package

3. Project design and tools

The chosen website design and structure is based on the Wordpress CMS platform. The platform allows an unlimited number of pages to be created/posted and it integrate a text editor.

Since February 2021, the website content is being developed and being published. The website is managed by both ULL and UCAR feeding the website with content suggested by project partners, and reviewing existing content when needed). The website will be maintained over the project's lifecycle. Together, ULL and UCAR are responsible for:

- Feeding the website with content suggested by project partners and updating the content of the website,
- Checking the quality of the content of the website

In addition, all partners will also contribute to the project website content and periodically provide updates and communication material such as those related to project workshops and other dissemination activities.

4. Website architecture
4.1. Website structure

Each page of the website is constituted by a header (Figure 2), a footer (Figure 3) and a body of the page. The header is composed of the project identity and the menu. The menu is composed of the following items:

- Project landing page: presenting the 3 topics related to industry 4.0 that are addressed by the project
- Project: presents summary of the project
- Partners: presents partners, members and associate partners of the project
- LeL: contains a direct Link to eLearning platform as well as the description of the three pilots of the project.
- CBHE: presents the results of the training sessions and the student mobility
- Results: gives an overview of the project results and deliverables
- Sustainability: introduces the competences centers of partner countries and DIH (Digital Innovation Hubs) of the three EU partners
- Events: presents the communication and dissemination activities.
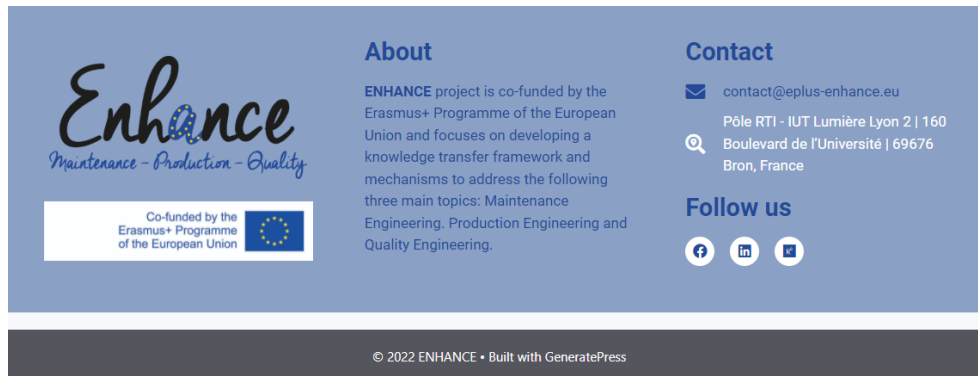
Figure 2 – website header

Figure 3- website footer

4.2. ENHANCE landing page

The project landing page is divided into two parts: the banner and the presentation of the three topics of the projects : maintenance, production and quality (see Figure 4).

Figure 4- Project landing page

4.3. ENHANCE project
4.3.1. Project aims

The Figure 5 shows the section in Homepage where the aims of the project are listed.

Project Aims

ENHANCE targets constructive objectives which are crucial for the development and the modernization of both Tunisian and Moroccan industry.

The overall objective of ENHANCE is to contribute to strengthening the skills and training expertise of both Tunisian and Moroccan universities in the three targeted topics for inciting and assisting the PC transition to industry 4.0 era.

Indeed, regarding the current performance of the PC industry, it seems to be considerably inefficient compared to those of EU countries.For that, there is a real need of alternative tools to develop new industrial process which will help Tunisian and Moroccan transition to the new industry 4.0 era.

In addition, this project will be a great opportunity to build interesting and constructive collaboration between EU and both Tunisian and Moroccan universities in order to share our knowledge and mutual expertise.

Figure 5- Project aims

4.3.2. Project objectives

The Figure 6 shows the objective of the project.

Objectives

Specific objectives are also important for the achievement of ENHANCE. The fixed specific objectives in this context are:

- Analyse the gap between acquired skills in HEIs and the required MPQ4.0 skills by industry of the future.
- Develop a learning framework addressing MPQ4.0 skills (denoted LF-MPQ4.0).
- Building partner HE staffs according to the LF-MPQ4.0 and using Train the Trainer Approach.
- Develop innovative teaching materials using learner-centred learning methodology. These materials will include 5 courses and 3 case studies that will be produced for the three bachelor programs in industrial engineering of partner universities. Materials will be in English and French.
- Create a Lifelong e-learning (LeL) platform for practitioners.
- Create 2 Digital Innovation Hubs (DIH) in each PC.
- Define a quality assurance plan for the learning programs based on quality audits to ensure the sustainability.
- Develop a successful exploitation and dissemination strategy.

Figure 6- Project objectives

4.3.3. Project organisation

Figure 7 presents the organisation of the project into WPs and tasks.

Figure 7 – Project Organisation

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4.3.4. Project schedule

Figure 8 presents the different milestones of the project.

Figure 8 – Project schedule

4.4. Project partners
4.4.1. Partners

The logos of the seven partners of the projects are presented.

- The EU partners : University Lumière Lyon 2 (ULL), Bremer Institut für Produktion und Logistik GmbH (BIBA) and Universidade NOVA de Lisboa (UNL)
- The PC partners : University of Carthage (UCAR), International institute of management in technology (IIT), École Centrale Casablanca (ECC) and Université Ibn Tofail (UIT)

Figure 9 – Project Partners

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4.4.2. Members

Figure 10 presents all the members of the project's consortium.

Figure 10 – Project members

4.4.3. Associated partners

Figure 11 presents the associated partners of the project.

Associated partners

ADVISORY BOARD

SOPAL
SOPAL
TUNISIA

APR
Applications Plastiques du Rhône
APR
FRANCE

MAGHREB STEEL
Maghreb steel
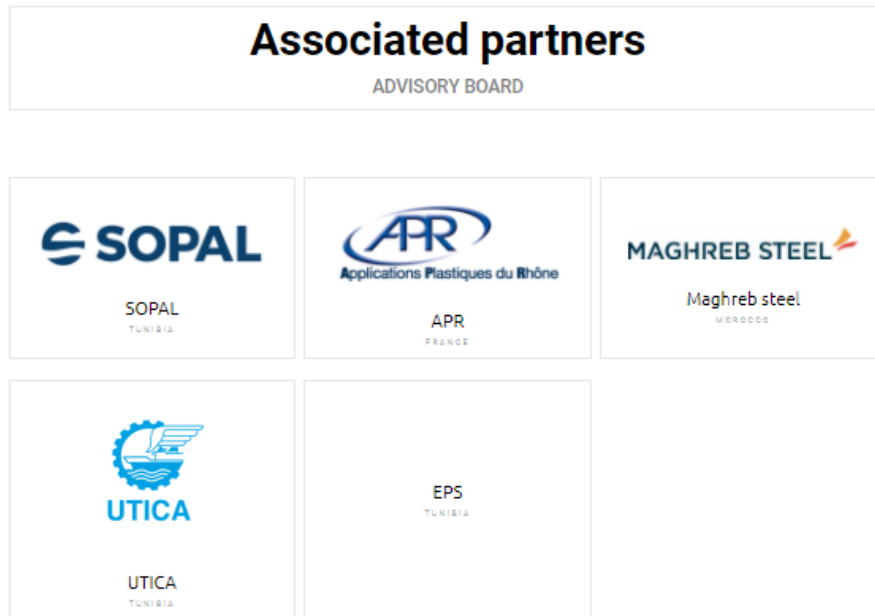MOROCCO

UTICA
UTICA
TUNISIA

EPS
TUNISIA

Figure 11 –Project associated partners

4.5. LeL
4.5.1. Pilot 1: Maintenance Engineering

This section of the website presents all deliverables of the pilot 1 (syllabus, activities, courses and link the activity in the learning platform, see Figure 12)

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The set of activities related to the maintenance engineering pilot are summarised in the following table. These activities are developed between M10 and M30 and released to be presented during the four train the training sessions organised throughout the ENHANCE project.

Search

Course / Use Case	Activities
Course 1: Advanced Maintenance strategies	**Act 1.1** Use cases of eXtended Reality (XR) in Smart Maintenance 4.0 contexts
	Act 1.2 Sensor Network Design in Smart Maintenance 4.0 contexts
	Act 1.3 Failure Modes, Effects & Criticality Analysis (FMECA) in Smart Maintenance 4.0 context
	Act 1.4 Contributions of Smart Maintenance 4.0 to Energy Management & Energy Efficiency of Industry 4.0 Assets
	Act 1.5 Sustainability Driven Smart Maintenance 4.0
Course 2: Integrated maintenance planning	**Act 2.1** Data-Driven Reliability for Smart Maintenance 4.0
	Act 2.2 Maintenance planning and scheduling
	Act 2.3 Contributions of Industry 4.0 technologies to Total Productive Maintenance
	Act 2.4 Downtime forecast and optimal maintenance planning
	Act 2.5 Industry 4.0 Asset & Maintenance Management Systems

Figure 12 –Pilot 1

4.5.2. Pilot 2: Production Engineering

This section presents all deliverables of the pilot 2 (syllabus, activities, courses and link the activity in the learning platform)

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Enhance
Maintenance – Production – Quality

Course / Use Case	Activities
Course 3: Production, planning, scheduling and control in industry 4.0	**Act 3.1** Design and development of smart Production Planning/Scheduling systems
	Act 3.2 Planning and scheduling techniques and approaches in industry 4.0
	Act 3.3 Methods and frameworks for control systems in agile manufacturing
	Act 3.4 Data-driven planning/scheduling models and algorithms
	Act 3.5 Big data and predictive inventory analytics
Course 4: Factory 4.0: Concepts, techniques, and application	**Act 4.1** PLM and Digital Factory
	Act 4.2 VSM for production 4.0
	Act 4.3 Virtual Reality for simulation
	Act 4.4 KPI, Dashboarding and data visualisation
Use case 2	**Act U.2.1** Emerging uses of smart technologies for production planning and scheduling

« 1 2 »

Figure 13 –Pilot 2

4.5.3. Pilot 3: Production Engineering

This section presents all deliverables of the pilot 3 (syllabus, activities, courses and link the activity in the learning platform)

Course / Use Case	Activities
Course 5: Advanced PSS Quality Design	**Act 5.1** Integrated thinking system modelling and development
	Act 5.2 Non-Conformities RCA and Quality gates design
	Act 5.3 QC model design
	Act 5.4 Design for X applied for Quality
	Act 5.5 IoT and BPM for Integrated VSM
Course 6: QC analytics for Zero defect manufacturing	**Act 6.1** Integrated process improvement
	Act 6.2 Quality Process maturity self-assessment and lifecycle management
	Act 6.3 Inspection Methods, sampling, Inspection Plan
	Act 6.4 Prescriptive and adaptive decision for Quality Control
	Act 6.5 Quality Planning, Control and Management functions

« 1 2 »

Figure 14 –Pilot 3

4.6. CBHE

4.6.1. Training

This section contains all deliverables of the project. Therefore, for each one, the following information are available :

- Task name
- Task description
- Link the related deliverable if it is available

Following the list of the ENHANCE deliverables released until month **M21**

WP1: Analysis & Trainers Skills Enhancement

Deliv	Title	Short description	Release Month	Leader	Files
D1.1	Literature review about required skills related to MPQ4.0	This document, a public report, is developed as part of the ENHANCE project to explain the state of the art about the required skills related to MPQ4.0. The findings of this work provide a supportive guideline for HEIs in Partner Countries (PC) to acquire new MPQ4.0 training expertise (by faculty members) and skills (by students, researchers, and industrial staff) for supporting local industries in the appropriation of the MPQ4.0 concepts and solutions. This report highlights the nine pillars, enabling technologies, of Industry 4.0 and the SoA reference architectures. In addition, it explains the European, Tunisian and Moroccan strategic plan and roadmaps. The work describes the actual implementation of these technologies in the predefined and new identified concepts for the topics maintenance, production and quality 4.0. Numerous related practices and finished/ongoing R&D projects are introduced. Finally, the document provides an abstraction framework based on the resulting competencies, skills, and abilities for a successful industry 4.0 transition.	M6	BIBA	📕
D1.2	Gap analysis between HEIs and industry 4.0 skills related to MPQ4.0	The main objective of this deliverable is to present the result of the analysis of the gap that exist between the skills acquired in trainings in HEIs and the skills required by MPQ4.0 which are defined in task T.1.1. A set of recommendations will be proposed including the set of skills and technologies to develop in the different learning activities.	M8	UCAR	📕
D1.3	MPQ4.0 learning framework (LF-MPQ4.0)	The purpose of the document is to develop the MPQ4.0 learning framework (LF-MPQ4.0). To overcome the gap between targeted MPQ4.0 techniques and teachers' knowledge on MPQ4.0. The LF will be elaborated with given objectives, clear results, and activities.	M12	UNL	📕
		The purpose of D1.4 is to define the training strategy that permits to define the scientific contents to develop in order to update the current programs of HEI with respect to			

Figure 15 –List of deliverables

4.6.2. Publication

This section of the website contains the list of publications made during the project.

Scientific Publications:

Pub6: ZAMIRI, Majid, SARRAIPA, Joao, MARCELINO-JESUS, Elsa, *et al.* Supporting Mass Collaborative Learning Communities Through Digital Innovation Hubs. In : *2023 24th International Conference on Control Systems and Computer Science (CSCS)*. IEEE, 2023. p. 363-370.

Pub5: Sarraipa, J., Zamiri, M., Marcelino-Jesus, E., Artifice, A., Jardim-Goncalves, R., & Moalla, N. (**2023**). A Learning Framework for Supporting Digital Innovation Hubs. Computers, 12(6), 122.

Pub4: Elkosantini, S., Hajri-Gabouj, S., Darmoul, S., Kacem, R. B., Ammar, A., Elouadi, A., … & Sarraipa, J. (**2023**). Industrial needs v. Engineering education curricula related to maintenance, production and quality in industry 4.0: A gap analysis case study in Tunisia and Morocco. Industry and Higher Education, 09504222231153782.

Pub3: Artem A. Nazarenko, Majid Zamiri, Joao Sarraipa, Paulo Figueiras, Ricardo Jardim-Goncalves, Néjib Moalla (**2023**). Integration of AI Use Cases in Training to Support Industry 4.0. 2023 The 3rd International Conference on Big Data Engineering and Education (BDEE 2023).

Pub2: Zamiri, M., Camarinha-Matos, L. M., & Sarraipa, J. (**2022**). Meta-Governance Framework to Guide the Establishment of Mass Collaborative Learning Communities. *Computers*, *11*(1), 12.

Pub1: Zamiri, M., Ferreira, J., Sarraipa, J., Sassanelli, C., Gusmeroli, S., & Jardim-Goncalves, R. (**2021**, June). Towards a conceptual framework for developing sustainable digital innovation hubs. In *2021 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC)* (pp. 1-7). IEEE.

Figure 16 –List of publications

4.7. Sustainability

This section presents the description of the three recently created competence centres of the PC and that will be transformed to DIH (Digital Innovation hubs) with their links.

The **InnoTech Competence Centre** (https://innotech.eplus-enhance.eu/) is proposed by the **Faculty of Economics and Management of Nabeul** (member of the University of Carthage) as one-stop-shop for digital transformation support in the Nabeul region in the north-east of Tunisia.

InnoTech will focus on cutting-edge digitalization and Industry 4.0 technologies, specifically targeting the agrotourism and industrial sectors. The center will serve as a conduit between the university and the local ecosystem of the region of Nabeul and provide industry partners with advanced expertise and infrastructure. The center's activities will fuel economic growth and job creation in the agrotourism and industry sectors, while also strengthening the university's strategic partnerships with local industry leaders. The center will focus on digitalization, as well as the implementation of Industry 4.0 technologies such as IoT devices, big data analytics, and AI, to enable industry partners to stay at the forefront of technological developments and remain competitive in the global marketplace.

2. SmartecH (IIT)

The **SmartecH Competence Centre** (https://smartech.eplus-enhance.eu/) as "***Smart technologies for industrial Engineering Hub***" is proposed by the **International Institute of Technology** (North American Private University) as one-stop-shop for digital transformation support in the Sfax region of Tunisia.

SmartecH will focus on digital transformation based mainly on Industry 4.0 technologies and how they can be used in production, Maintenance and Quality domains. The center will provide regional and national industrial campanies with advanced knowledge that help to improve their services using innovative technologies. The implementation of Industry 4.0 technologies such as IOT devices, Cloud Manufacturing, data Anlytics, Augmented and virtual reality will be helpful for the industrial companies to remain competitive and keep in tuch with technological development. Aditionnaluy, SmartecH will provide training for industrial experts and academics using the relevant courses created as part of Enhance Project. The different equipments in this center will be used to animate the different training sessions and to provide technological solutions for real industrial problems.

3. Cosinus (UIT)

The **Cosinus Competence Centre** (https://cosinus.eplus-enhance.eu/) as "***COmpetence center of incluSIve digital traNsformation for***

Figure 17 – the 3 CC and DIH

4.8. News and events

This section presents the list of events and industrial workshop. Therefore, a brief overview and some statistics for each event. See Figure 18 for the 4th enhance industrial workshop.

4th ENHANCE Industrial Workshop, UCAR (Nabeul TN), December 2022

The fourth industrial workshop was organized on December 19th 2022 in Hammamet (Tunisia) during train the trainer session hold in University of Carhtage (Tunisia) during the same period. The title of the workshop was **"Contribution of the ERASMUS+ programme to tge development of industry 4.0 in Tunisian universities"**. This workshop was co-organized with 3 other ERASMUS+ CBHE projects (NEPREV, SMTMC and MSCPS). More than 70 participants (professors, industrials and students) were present.

Figure 18 – Events