DESDEMONA Project

Update meeting

Naples – July 1th 2024

Ministero dell'Università e della Ricerca
Finanziato dall'Unione europea NextGenerationEU
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Antonio Forcina - University "Parthenope"

UniParthenope Staff

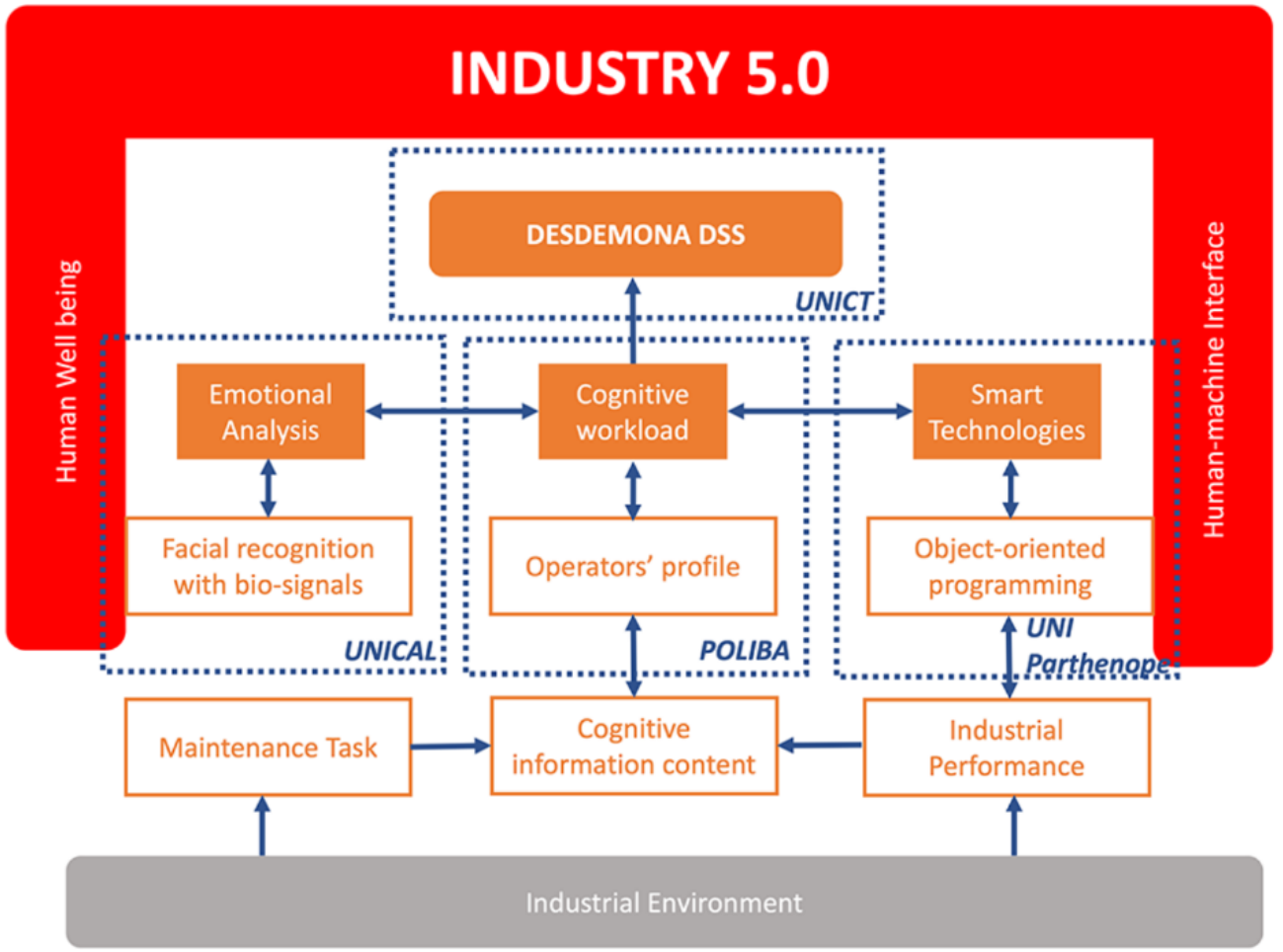
Antonio Forcina
Associate Professor

Cristina De Luca
PhD Student (3rd year)

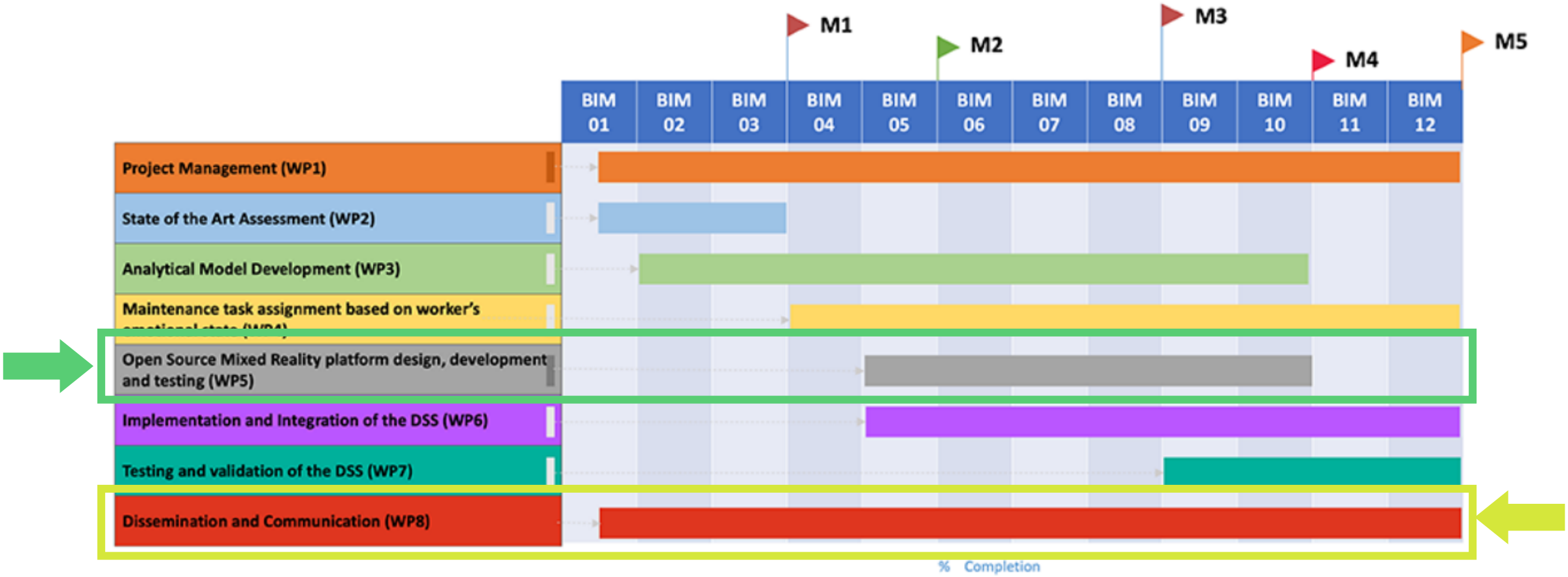
Expected contribution

- UNIParthenope guides the development phases of a dedicated virtual environment to simulate real-world cases of maintenance tasks and evaluate improvements in operator cognitive load resulting from the use of support technologies. These environments are intended to evaluate the improvements in terms of cognitive load of operators resulting from the use of mixed reality.

- UNIParthenope defines communication strategies to disseminate project results in the scientific and industrial communities, playing a crucial role in interacting with companies and disseminating project results to a wider audience.



UniParthenope Contribution



Planned activity: Work Package 8

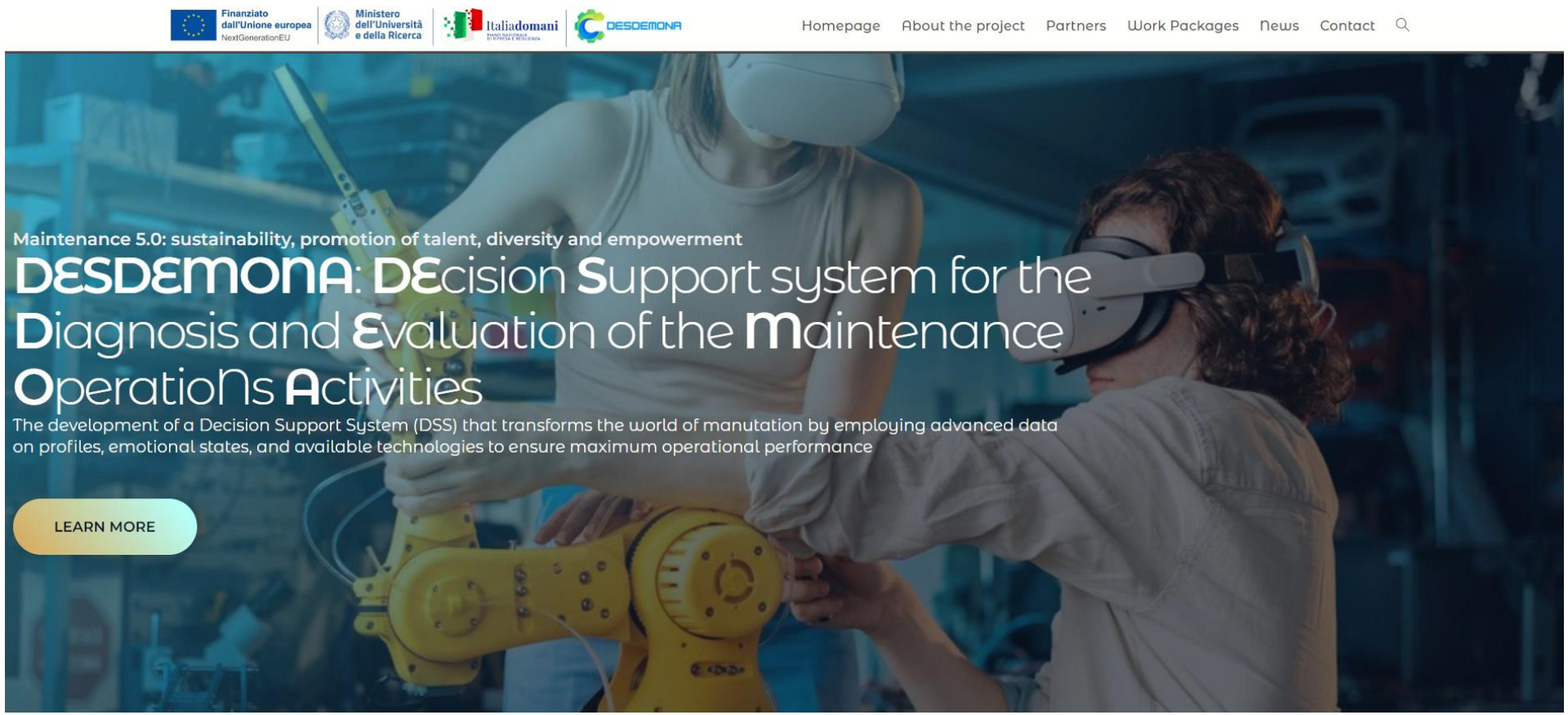
WP 8 - Dissemination and Communication

8.1 Website and Project identity: develop a website to promote and share the project information, news and findings.

8.2. Mid-term Project Report: This activity consists of reporting the mid-term results of the project.

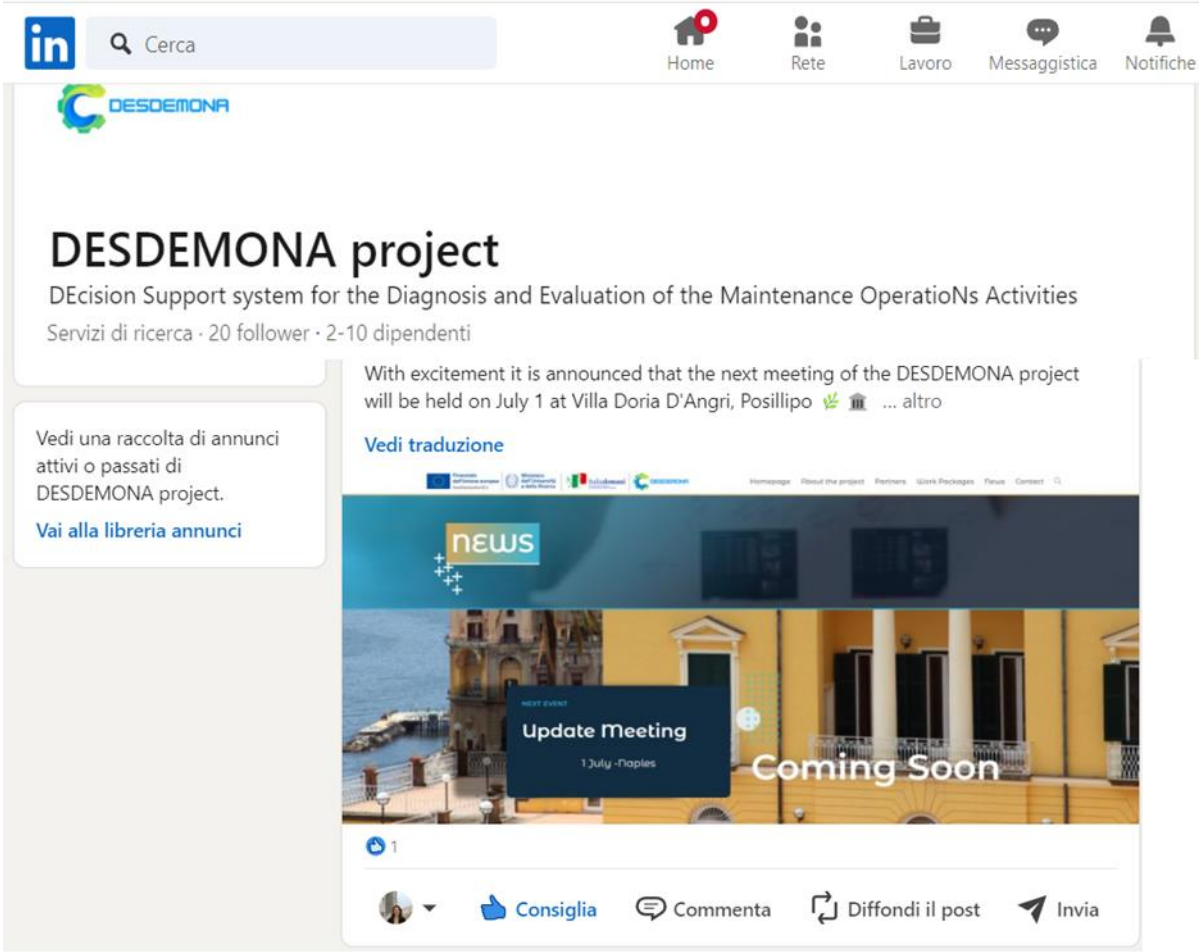
8.3. Results-oriented dissemination: this activity deals with the dissemination of the project, its objectives, and intermediate and final results. The technical report will summarize all the activities performed for this Task during all the projects.

WP8: Website



https://www.prin-desdemona.it

WP8: LinkedIn Page



Planned activity: Work Package 5

WP5 - Open-Source Mixed Reality platform design, development, and testing

5.1 Platform Requirements Collection
Focus: Collection of functional requirements for the Open-Source Mixed Reality Platform.
Timeframe: To be performed within the first year of the project, with completion by the 12th month.
Output: Technical report containing software and hardware specifications of the platform, including device and programming language requirements.

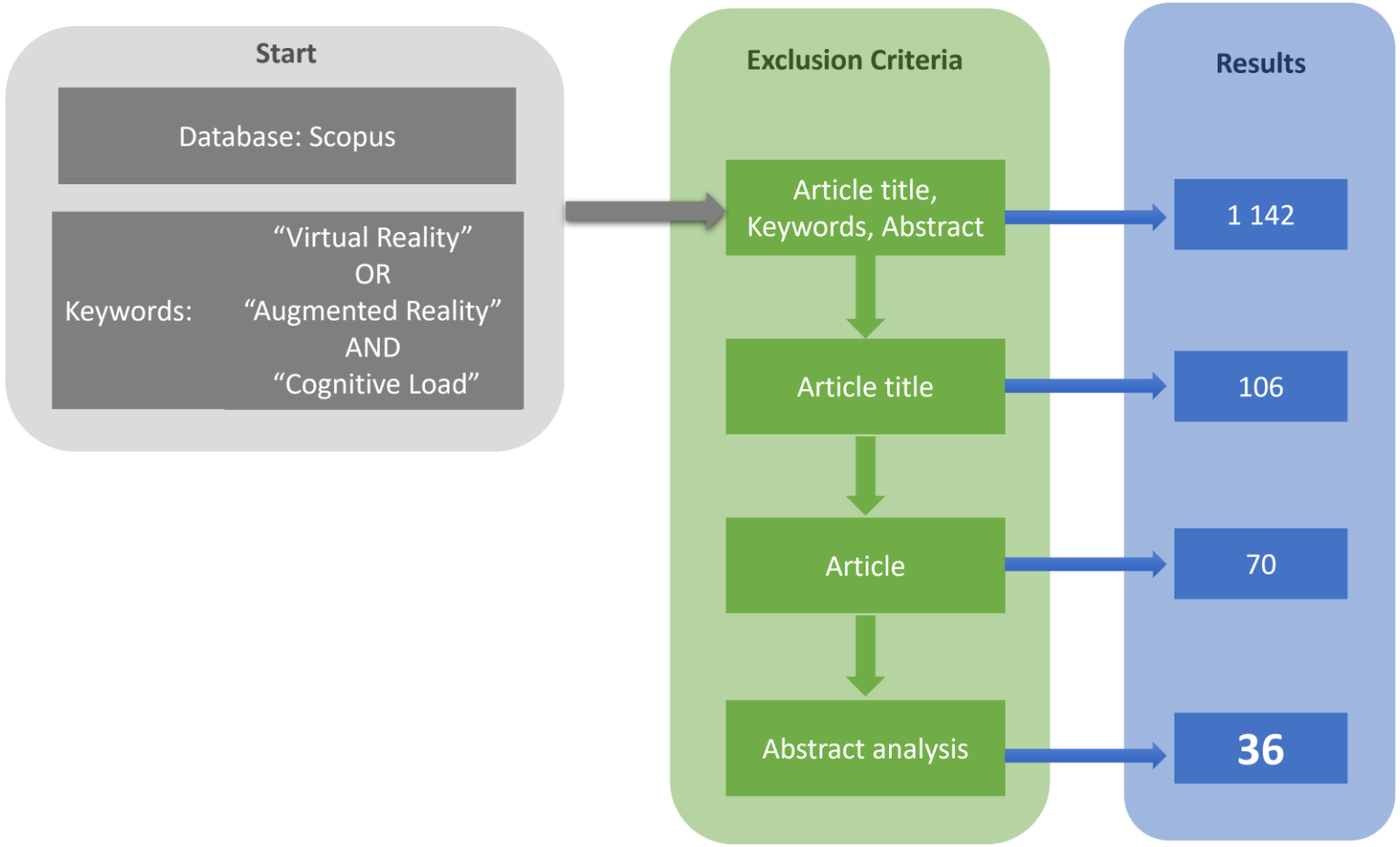
5.2 Choice of platform
Focus: Analysis to determine the most suitable commercial platform meeting technical requirements.
Result: Comparison report justifying the chosen platform for subsequent project phases.

Planned activity: Work Package 5

5.3 Mixed Reality Platform Development and Testing
Objective*:* Development of a dedicated virtual environment for simulating real maintenance tasks or training.
Result: Development of at least 5 prototype simulation or training tools (MS 5.3.1).
Method: *Testing* of prototype tools in real cases, with a joint technical document highlighting strengths and issues.

5.4 Assessment of Cognitive Workload in compliance with support technology adopted:
Objective: Evaluate improvements in operator cognitive load with mixed reality technology.
Method: Compare cognitive load values with and without the proposed technology.
Result: Dedicated technical report summarizing the assessment

WP5: Literature analysis



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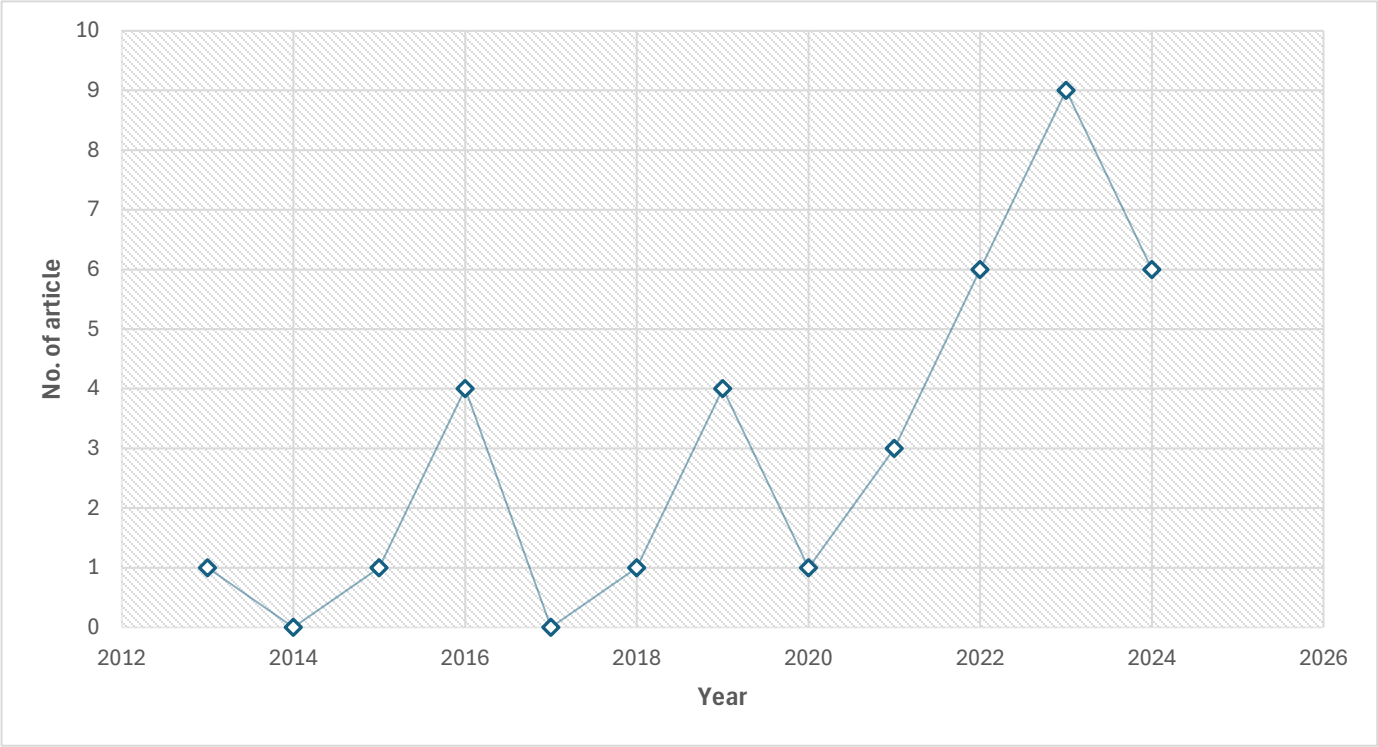
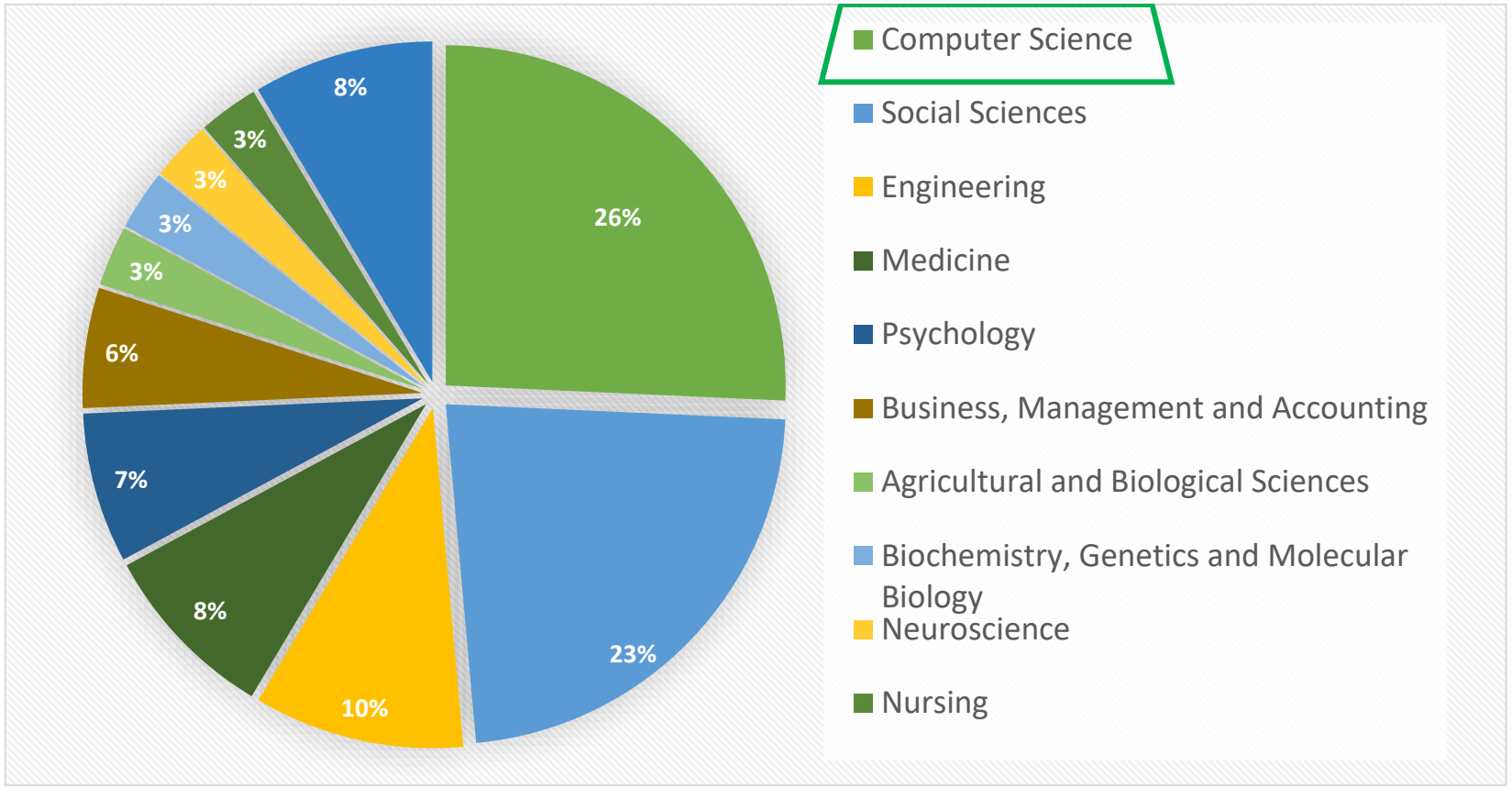
WP5: Literature analysis



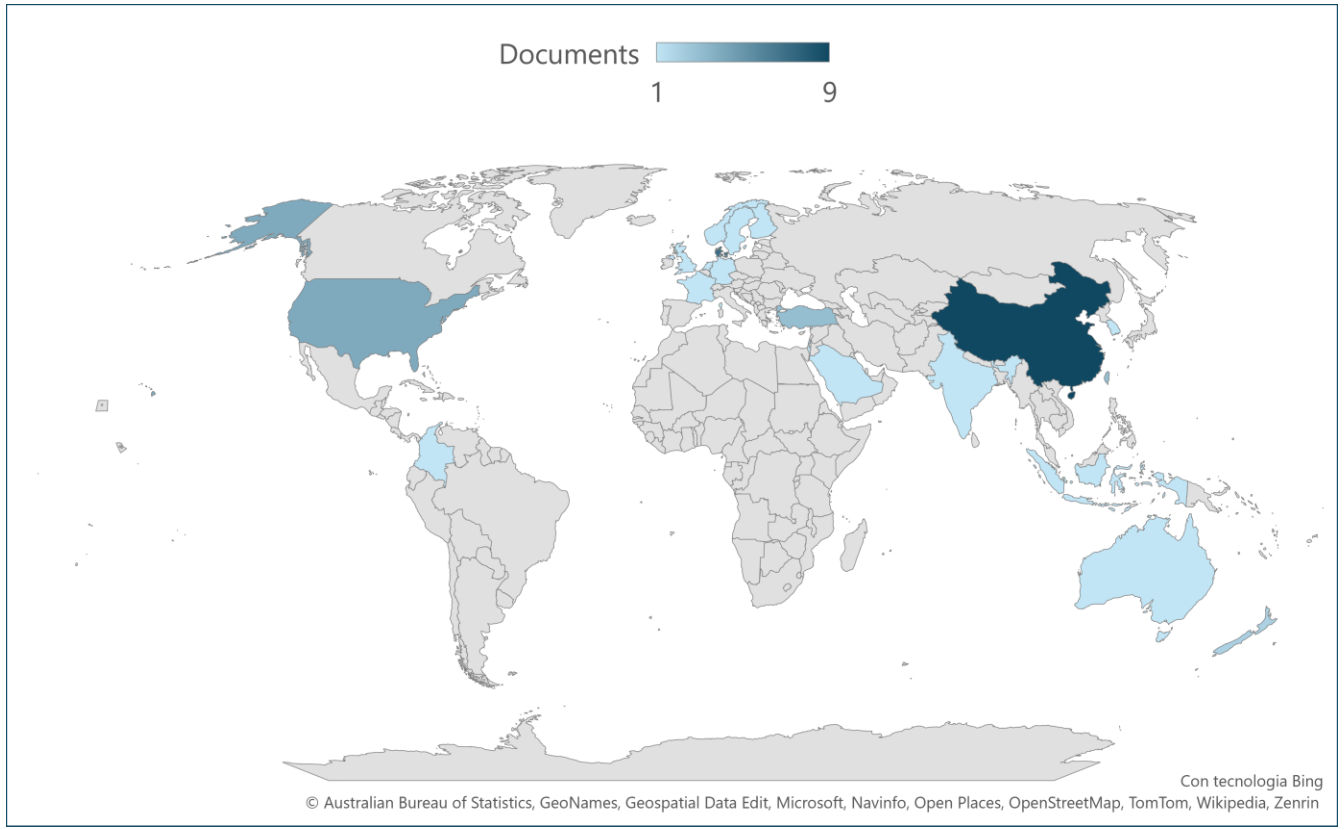
Temporal distribution of publications on the topic

WP5: Literature analysis

Main **subject areas** of publications on the topic



WP5: Literature analysis



Geographical distribution of publications on the subject

WP5: Literature analysis

Title	Usage of Augmented Reality Glasses in Automotive Industry: Age-Related Effects on Cognitive Load
Authors	Ikiz, Y. D., Atici-Ulusu, H., Taskapilioglu, O., & Gunduz, T.
Year	2019
Goal of study	Investigate whether the use of AR glasses affects the cognitive load of operators on an automotive assembly line.
Methodology	Use of EEG to detect brain activity; comparison between standard work methods and the use of AR glasses. Data analyzed with BrainVision Analyzer 2.
Participants	4 operators from an automobile factory, divided into two age groups: two under 35 years and two over 35 years.
Devices Used	AR glasses 'SmartEyeglass SED-E1' by Sony and EEG with a 24-channel EasyCap electrode cap.
Main Measurements	Recording of beta and gamma waves during work, with and without AR glasses. Impedances kept below 10 kΩ.
Results	• No significant difference between ages • Average EEG area under the curve value with glasses: 18.96, without glasses: 5.24, indicating lower cognitive load with AR glasses ($p < 0.05$, specifically $p = 0.00$). • Analysis of variance (ANOVA) confirmed the significance of the results.
Subjective Assessments	Use of NASA-TLX to assess perceived workload, showing consistency with EEG results indicating lower load with AR glasses.
Conclusions	The use of AR glasses reduced cognitive load in operators without significant age-related differences. Performance was not negatively affected by the introduction of AR technology.
Practical Implications	The reduction in cognitive load suggests potential to improve safety and efficiency in automotive production through the use of AR glasses. Companies might consider investing in this technology to enhance ergonomics and work effectiveness.

Title	Measuring cognitive load in virtual reality training via pupillometry.
Authors	Lee, J. Y., de Jong, N., Donkers, J., Jarodzka, H., & van Merriënboer, J. J.
Year	2023
Goal of study	To evaluate if pupillometry can accurately measure cognitive load in VR training.
Methodology	Use of TEPRs corrected for light reflex to measure cognitive load during observation tasks in VR scenarios.
Participants	14 health sciences students.
Devices Used	VR system with integrated eye tracker and photosensor to measure pupil diameter and light intensity.
Main Measurements	TEPRs, performance evaluation, and self-assessment of cognitive load using the Paas Scale.
Results	- Difficult tasks cause greater TEPRs - Positive correlation between TEPRs and performance in difficult tasks - Validation of TEPRs as reliable measures of cognitive load in VR.
Conclusions	TEPRs corrected for light reflex are effective indicators of cognitive load in VR environments.
Practical Implications	Potential use of TEPRs for real-time monitoring and instructional design in VR environments. Further studies are needed to confirm these findings in broader contexts.

WP5: Literature analysis

Title	Influences of augmented reality assistance on performance and cognitive loads in different stages of assembly task.
Authors	Yang, Z., Shi, J., Jiang, W., Sui, Y., Wu, Y., Ma, S., ... & Li, H.
Year	2019
Goal of study	To assess how AR assistance affects assembly task performance and cognitive load across different stages.
Methodology	Splitting the assembly task into commissioning and joining subtasks, analyzing the impact of AR in each stage.
Participants	Participants involved in complex assembly tasks using AR and traditional methods for comparison.
Devices Used	Use of integrated AR systems to facilitate assembly tasks and comparison with traditional methods.
Main Measurements	Evaluation of task completion times, errors, and cognitive load through direct measurements and self-assessments.
Results	Reduction in assembly times and errors across all tasks. Variable effects of AR on cognitive load depending on task complexity and stage.
Conclusions	AR assistance is effective in improving task performance and reducing errors, with impacts varying by task complexity and stage.
Practical Implications	AR can be considered to enhance efficiency and accuracy in industrial assembly tasks, with careful consideration of complexity conditions.

Title	Effects of augmented reality glasses on the cognitive load of assembly operators in the automotive industry
Authors	Atici-Ulusu, H., Ikiz, Y. D., Taskapilioglu, O., & Gunduz, T.
Year	2021
Goal of study	To assess the impact of AR glasses on the cognitive load of assembly operators.
Methodology	Use of EEG and NASA-TLX to measure cognitive load during standard and AR-based procedures.
Participants	Four employees from an automotive company, involved in real tests on the assembly line.
Devices Used	AR glasses and EEG equipment for collecting neurological data and cognitive load assessments.
Results	Reduction in cognitive load with AR glasses; rapid adaptability to the device with no increase in cognitive load over time
Conclusions	AR glasses effectively reduce cognitive load and facilitate quick adaptation among assembly line workers without increasing stress.
Practical Implications	Potential for using AR technology to enhance efficiency and reduce cognitive load in industrial settings.

Expected Results

Create and evaluate *five virtual scenarios*, each simulating specific maintenance activities, and then validate them through practical applications in real-world situations

Thank you !

...Any question?

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