DEcision Support system for the Diagnosis and Evaluation of the Maintenance OperatioNs Activities

DESDEMONA

Project monitoring

1 Luglio, 2024

UniParthenope – Villa Doria d'Angri – Napoli

Francesco Facchini – Politecnico di Bari

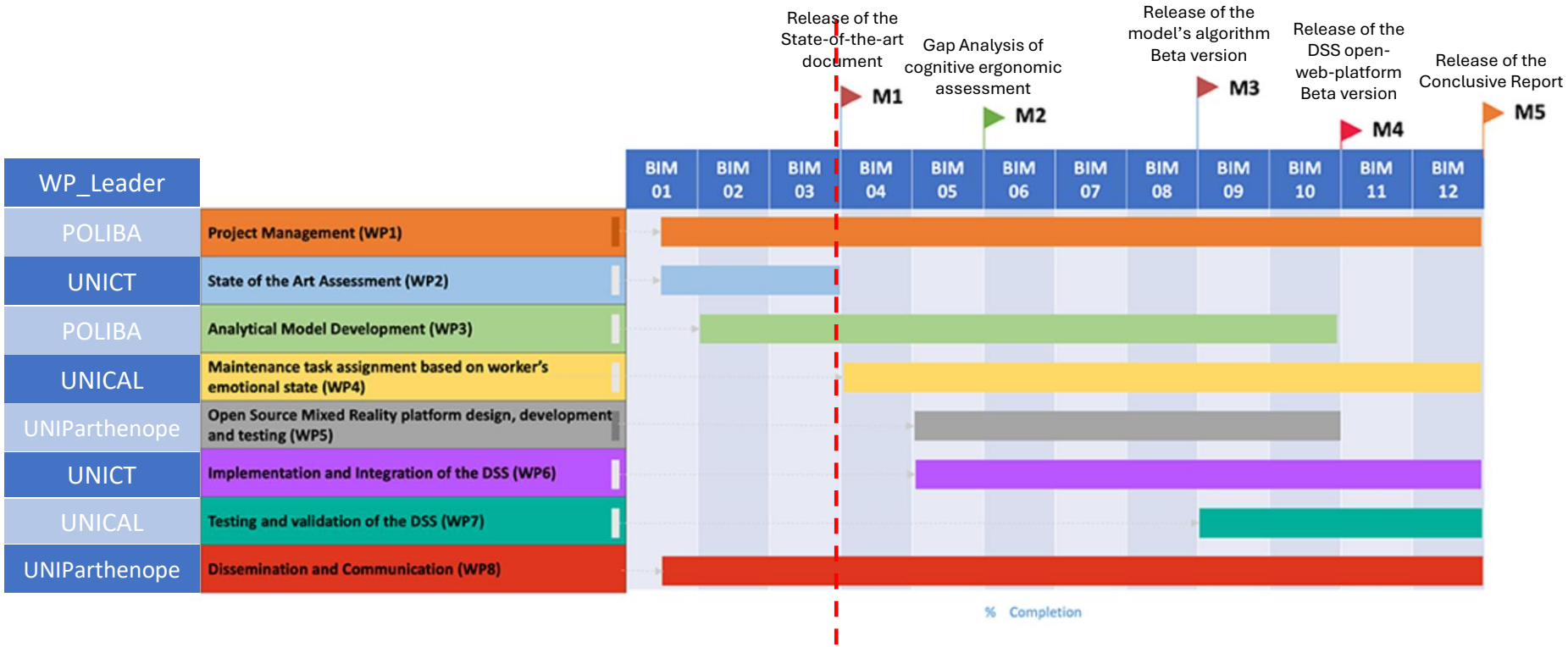
I meeting 1st July 2024

Project's conceptual architecture

- **POLIBA** (et al.) will define the new analytical model considering the complexity of the maintenance tasks, as well as industrial environmental and operators' profile (i.e., competencies, hard skills, age, etc.) affecting workers' behaviour and performances.
- **UNICAL** (et al.) will conduct the emotional analysis of operators supported by facial recognition with bio-signals with the cooperation of all partners and will validate the DSS.
- **UNIParthenope** (et al.) will assess of the most suitable technologies to assist the operators in maintenance tasks.
- **UNICT** (et al.) will integrate and implement the DSS in an open platform in order to allow easy interaction with direct companies and academic stakeholders (e.g., operation maintenance management, human resource staff, researcher, etc.).

Gantt of the Project

- Start 30st November 2023
- End 29st November 2025 (maximum extension 28th February 2026)



Milestones

- ☑ M1. Release of the State-of-the-art document (BIM3 – 30th May 2024) – *UNICT*
- 🟡 M2. Gap Analysis of cognitive ergonomic assessment (BIM5 – 30th September 2024) - *POLIBA*
- ✚ M3. Release of the model's algorithm ~~Beta~~ version (BIM8 – 30th March 2025) – *POLIBA, UNICAL, UNIParthenope*
- ✚ M4. Release of the DSS open-web-platform Beta version (BIM10 – 30th July 2025) – *UNICT, UNICAL*
- ✚ M5. Release of the Conclusive Report (BIM12 – 29th November 2025) - *UNIParthenope*

Work packages

WP1 Project management (WP Lead POLIBA, participant all) ***[30/11/2023-29/11/2025]***

- T1.1 Scientific coordination and communication: to ensure the communication within the partnership and the information flow, ensuring technical assistance, reporting and commitments of the partners (e.g., milestones, results, documents, meetings, etc.*) (29th November 2025)*.
- T1.2 Quality assurance: to ensure compliance with deadlines and milestones planned, to provide in due time timesheets and supporting documents required, to guarantee the active participation of all partners and the compliance of commitments *(29th November 2025)*.
- T1.3 Ethics and privacy: to plan a Data Ethics Board process flow, assess the data protection impact and prepare a Data Ethics Canvas *(29th November 2025)*.

	BIM1	BIM2	BIM3	BIM4	BIM5	BIM6	BIM7	BIM8	BIM9	BIM10	BIM11	BIM12
WP1 - PROJECT MANAGEMENT (WPL: POLIBA)												
T1.1 Scientific coordination and communication												
T1.2 Quality assurance												
T1.3 Ethics and privacy												

Work packages

WP2 State of the Art Assessment (WP leader UNICT, participant all) *[30/11/2023-30/5/2024]*

- ☑ T2.1 Literature Review: to provide a state-of-the-art related to cognitive demand in human-machine interaction and Digital Solutions for human-centred assessment, with specific emphasis on Maintenance 5.0 *(30th March 2024)*.
- ☑ T2.2 Creation of a Digital Repository: to create an internal repository where to collect documents, papers and other electronic resources *(30th May 2024)*.
- ☑ T2.3 Identification of the findings: to identify the main gaps to be filled by the DESDEMONA project *(30th May 2024)*.

Milestone (M1):

✅ Release of the State-of-the-art document (BIM3 – 30th May 2024) [WEBSITE!!!??]

	BIM1	BIM2	BIM3	BIM4	BIM5	BIM6	BIM7	BIM8	BIM9	BIM10	BIM11	BIM12
WP2 - STATE OF THE ART (WPL: UNICT)												
T2.1 Literature Review												
T2.2 Creation of a Digital Repository												
T2.3 Identification of the findings												

Work packages

WP3 Analytical Model Development (WP leader POLIBA, participant all) ***[29/2/2024-30/7/2025]***

- ☑ T3.1 Identification of maintenance tasks: identify a list of (at least) 20 maintenance tasks with cognitive needs to be assessed. The role of the associated companies (i.e., Bosch, Cestaro Rossi, and AIMAN) will be crucial in assisting the academic partners in identifying the most critical tasks *(30th July 2024)*.
- T3.2 Clusterization of the key maintenance operators' features: A set of key maintenance operators' features (e.g., competencies, training level, role, age, ergonomics requirements, etc.) will be collected using a survey on a sample of employments of (at least) 8 companies. Thus, cluster analysis will identify the features most impactful to human performance in maintenance operations *(30th September 2024)*.
- T3.3 Evaluation of the amount of information content for pre-defined maintenance tasks: the approach to estimating the amount of task information content will be developed by adopting the Information Theory Toolbox included in Matlab® *(30th November 2023)*.
- ✚ T3.4 Development of the alpha-version of the analytical model to assess the cognitive workload for each operator: The analytical model to assess the cognitive workload of each operator will be developed by introducing elements of multi-attribute utility analysis using artificial neural networks. The analytical model will be validated in maintenance tasks simulated in the Laboratory of System Engineering (LISE) at DMMM *(30th March 2025)*.

Work packages

WP3 Analytical Model Development (WP leader POLIBA, participant all) ***[29/2/2024-30/7/2025]***

- T3.5 Development of the beta-version of the analytical model to assess the cognitive workload for each operator: The analytical model will be tested and validated according to experimental analysis planned in LISE at DMMM *(30th July 2025)*.

Milestone (M2-M3):

Gap Analysis of cognitive ergonomic assessment (BIM5 – 30th September 2024)

Contribution to Release of the model's algorithm ~~Beta~~ version (BIM8 – 30th March 2025)

	BIM1	BIM2	BIM3	BIM4	BIM5	BIM6	BIM7	BIM8	BIM9	BIM10	BIM11	BIM12
WP3 - ANALYTICAL MODEL DEVELOPEMENT (WPL: POLIBA)												
T3.1 Identification of maintenance tasks												
T3.2 Clusterization of the key maintenance operators' features												
T3.3 Evaluation of the amount of information content for pre-defined maintenance tasks												
T3.4 Development of the alpha-version of the analytical model to assess the cognitive workload for each operator												
T3.5 Development of the beta-version of the analytical model to assess the cognitive workload for each operator												

Work packages

WP4 Maintenance task assignment based on worker's emotional state (WP leader UNICAL, participant all) ***[30/5/2024-29/11/2025]***

- T4.1 Analysis of factory and maintenance workers' emotional states and predictors: to identify the most relevant emotional states of factory and maintenance workers and define a multimodal framework for their accurate smart detection *(30th November 2024)*.
- T4.2 Mapping factory workers' characteristics with emotional states and task performance: to create a map between emotional states and task performance and characteristics in order to drive the subsequent development activities of a deep learning algorithm *(30th March 2025)*.
- T4.3 Development of an alpha-version AI-driven emotion classification algorithm for factory workers: to provide a first-stage version of the deep learning algorithm for the identification of the emotional state of maintenance workers during the execution of a task for preliminary testing, calibration, integration and experimentation ~~*(30th July 2025)*~~ *(30th March 2025)*.

Work packages

WP4 Maintenance task assignment based on worker's emotional state (WP leader UNICAL, participant all) ***[30/5/2024-29/11/2025]***

- T4.4 Development of beta-version AI-driven emotion classification algorithm for factory workers: to provide a fully tested, integration-ready and accurate deep learning algorithm for the identification of the emotional state of maintenance workers during the execution of a task *(29th November 2025)*.

Milestone (M3):

Contribution to Release of the model's algorithm ~~Beta~~ version (BIM8 – 30th March 2025)

	BIM1	BIM2	BIM3	BIM4	BIM5	BIM6	BIM7	BIM8	BIM9	BIM10	BIM11	BIM12
WP4 - MAINTENANCE TASK ASSIGNMENT BASED ON WORKER'S EMOTIONAL STATE (WPL: UNICAL)												
T4.1 Analysis of factory and maintenance workers' emotional states and predictors												
T4.2 Mapping factory workers' characteristics with emotional states and task performance												
T4.3 Development of an alpha-version AI-driven emotion classification algorithm for factory workers												
T4.4 Development of beta-version AI-driven emotion classification algorithm for factory workers												

Work packages

WP5 Open Source Mixed Reality platform design, development and testing (WP leader UNIParthenope, participant all) *[31/7/2024-31/7/2025]*

- T5.1 Platform Requirements Collection: to identify the functional requirements collection of the Open Source Mixed Reality Platform *(31th January 2025)*.
- T5.2 Development of the alpha-version of the Mixed Reality platform: to develop a dedicated virtual environment to simulate real cases of maintenance tasks or train on future activities *(30th March 2025)*.
- T5.3 Mixed reality platform development (beta-version): The prototype tools developed will be tested in real cases by the companies which, in the previous phases of the project, have contributed, providing the necessary information to the identification of the characteristics of the tools *(31th May 2025)*.

Work packages

WP5 Open Source Mixed Reality platform design, development and testing (WP leader UNIParthenope, participant all) *[31/7/2024-31/7/2025]*

- T5.4 Assessment of cognitive workload in compliance with support technology adopted: to evaluate the improvements in terms of the operator's cognitive load deriving from the use of mixed reality. The evaluation will take place thanks to comparing the cognitive load values with and without the aid of the proposed technology *(31th July 2025)*.

Milestone (M3):

Contribution to Release of the model's algorithm ~~Beta~~ version (BIM8 – 30th March 2025)

	BIM1	BIM2	BIM3	BIM4	BIM5	BIM6	BIM7	BIM8	BIM9	BIM10	BIM11	BIM12
WP5 - OPEN SOURCE MIXED REALITY PLATFORM DESIGN, DEVELOPMENT AND TESTING (WPL: UNIParthenope)												
T5.1 Platform Requirements Collection												
T5.2 Development of the alpha-version of the Mixed reality platform												
T5.3 Mixed reality platform development (beta-version)												
T5.4: Assessment of cognitive workload in compliance with support technology adopted												

Work packages

WP6 Implementation and Integration of the DSS (WP leader UNICT, participant all) ***[1/8/2024-29/11/2025]***

- T6.1 Analysis of the input of the model algorithms of WP3 and WP4: to identify the most suitable software tool or coding language that allows the implementation of the platform where the DSS *(31th January 2025)*.
- T6.2 Design of the User Interface of the DSS: to develop a user-friendly User Interface for the operators to load the operational scenarios of the maintenance tasks and retrieve as output the ranking of the maintenance operators related to the task given to the DSS as input *(31th March 2025)*.
- T6.3 Implementation and development of DSS platform: to develop an adaptive and learning system to pivot on the data stored acquired during the use of the platform. The DSS will use python, Java or any other portable software language that can expose a set of Endpoints (APIs) of the DSS functionalities to external and other applications *(31th July 2025)*.

Work packages

WP6 Implementation and Integration of the DSS (WP leader UNICT, participant all) *[1/8/2024-29/11/2025]*

- T6.4 Unit Test Validation: a Unit Test activity to validate the functioning of the DSS (Unit Test Plan, document) will be performed by fabricating a set of operational scenarios also via simulation *(29th November 2025)*.

Milestone (M4):
Contribution to Release of the DSS open-web-platform Beta version (BIM10 – 31th July 2025)

	BIM1	BIM2	BIM3	BIM4	BIM5	BIM6	BIM7	BIM8	BIM9	BIM10	BIM11	BIM12
WP6 - IMPLEMENTATION AND INTEGRATION OF DSS (WPL: UNICT)												
T6.1 Analysis of the input of the model algorithms												
T6.2 Design of the User Interface of the DSS												
T6.3 Implementation and development of DSS platform												
T6.4 Unit Test Validation												

Work packages

WP7 Testing and validation of the DSS (WP leader UNICAL, participant all) *[1/4/2025-29/11/2025]*

- T7.1 Testing, Verification and Validation of the DSS: This task takes as input the DSS software (developed in WP5) to assess that all the requirements specified initially (WP2) are properly met *(29th November 2025)*.
- T7.2 Experimentation: The DSS is tested in a laboratory-controlled case study defined in WP2. This task might provide feedback for further refinement and calibration of the DSS. Benefits, limitations, and future work will be defined *(29th November 2025)*.

Milestone (M4):
Contribution to Release of the DSS open-web-platform Beta version (BIM10 - 31st July 2025)

	BIM1	BIM2	BIM3	BIM4	BIM5	BIM6	BIM7	BIM8	BIM9	BIM10	BIM11	BIM12
WP7 - TESTING AND VALIDATION OF THE DSS (WPL: UNICAL)												
T7.1 Testing, Verification and Validation of the DSS												
T7.2 Experimentation												

Work packages

WP8 Dissemination and Communication (WP leader UNIParthenope, participant all) ***[30/11/2023-29/11/2025]***

- ☑ T8.1 Website and Project identity: develop a website to promote and share the project information, news and findings *(31th May 2024)*.
- ✚ T8.2. **Mid-term Project Report**: This activity consists of reporting the mid-term results of the project *(30th November 2024)*.
- ✚ T8.3. 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 *(1st December 2025)*.

Milestone (M5):

Release of the Conclusive Report (BIM12 – 29th November 2025)

	BIM1	BIM2	BIM3	BIM4	BIM5	BIM6	BIM7	BIM8	BIM9	BIM10	BIM11	BIM12
WP8 - DISSEMINATION AND COMUNICATION (WPL: UNIParthenope)												
T 8.1 Website and Project identity												
T8.2 Mid-term Project Report												
T8.3 Results-oriented dissemination												

Project Impact (no quantitative?!)

Knowledge advances

- Well-being assessment of operators and scheduling of maintenance activities by assigning **no-stressor tasks, promoting job rotation** and organizational practices based on **cognitive workload balancing**.
- Development of an **emotion detection algorithm** and analysis of challenges in the industrial sector.
- Identify the proper digital support to ensure **maximum maintenance performance and minimum cognitive workload.**
- Provide a DSS on an open digital tool that **is easy to use** for the **main stakeholders** of the maintenance sector and **human resources**.

Technological innovation and industrial application

- A demo prototype (TRL4-5) will be developed to show the UVP (Unique Value Proposition) of the novel solution developed within DESDEMONA

Project Impact

Scientific community

- ✓ Scientific publications on academic journal or conferences.
- ✗ Models, algorithms, APIs, systems, protocols, and workflows, will be developed according to the FAIR principles and be released in Open Access.
- ✗ Partners will also adopt Open-Source standards and existing off-the-shelf Free and Open-Source Software (FOSS) components.

Research internalization

- ✓ The consortium (with delegates) will participate in at **least 3 international events** and conferences to showcase the research results and present the advances of scientific knowledge achieved (IJCIEOM, ISM, AMEST?, APMS?).
- ✗ coauthorship and collaboration on joint articles with international colleagues **at least 2 articles on high-quality journals** will be submitted with highly cited colleagues).

Social well-being and cultural development

- ✗ (at least) **one Open Day** will be organized with the aim of giving the audience a wider insight about Industry 5.0 concepts, models, theories, and technologies developed in DESDEMONA.
- ✗ (at least) **one upskilling/reskilling event** will be organized to train citizens in the disciplines of the project.

Project Impact

Dissemination

- ✓ **Project website** will be developed in the very early phase of the project.
- ✓ **Social media** channels will also be implemented to showcase the progress of the project.
- ✓ **Scientific and technical articles** and public results will be published in scientific refereed international journals of high standard and platforms preferably in the *Open Access form*.
- ✗ **Workshops** will be organized in order to present partial and final results and to possibly involve scientific and technical partners in the research.
- ✓ Technical discussions and workshops and **surveys** (i.e. interviews, surveys, etc.) also in collaboration with chambers of commerce and trade associations.
- ● Promote technology transfer.
- ● Collaboration with other academies.
- ✗ Promote social well-being and/or cultural development through outreach and public engagement initiatives (i.e., meetings at large companies, workshops in schools, etc.).

Feedback I Technical Report (PI)

Deadline

✓ 31th March, 2024 (click here)

🟡 31th July, 2024 (click here)

❌ 30th November, 2024

❌ 31th March 2025

❌ 31th July, 2024

❌ 29th November, 2025

Approved budget (updated)

- Il budget ha ricevuto un **taglio del 20%** rispetto alla quota inizialmente richiesta ed il contributo aggiornato è stato proporzionalmente ridotto

Partner	Item A.1	Item A.2	Item B	Item C	Item D	Item E	Item F	Total
POLIBA	10.045	35.835			6.882		11.143	**63.905**
UNICAL	3.100	44.881	800		7.197		4.000	**59.978**
UNICT	47.400				7.110		4.000	**58.510**
UNIParthenope	36.000			8.000	5.400		8.000	**57.400**
Totale								**239.793**

Item A.1: Personale scientifico dipendente e non dipendente dall'ateneo/ente/istituzione sede dell'unità di ricerca direttamente impegnato nelle attività di ricerca
Item A.2: Personale appositamente da reclutare per il progetto
Item B: Strumenti e le attrezzature
Item C: Servizi di consulenza e beni immateriali
Item D: Spese generali
Item E: Materiali
Item F: Altri costi - partecipazione a seminari, congressi, convegni, workshop. organizzazione, presso la sede dell'unità di ricerca, di seminari, congressi, convegni, workshop pubblicazione di libri e/o di articoli su riviste scientifiche spese per open access.

Item A.1
Costo personale
PO 73 €/h
PA 48 €/h
Ric 31 €/h

Administrative report (all RUs)

Deadline

- ✓ 31th March, 2024
- 🟡 31th July, 2024
- ❌ 30th November, 2024
- ❌ 31th March 2025
- ❌ 31th July, 2024
- ❌ 29th November, 2025

Worksheet

Comunicazioni variazione budget - template

Next meeting

Kick-off meeting	18 January 2024	Politecnico di Bari
Progress meeting	**1° July 2024**	**UniParthenope**
Progress meeting	Jan 2025	Unical
Progress meeting	July 2025	Unict
Final meeting	Dec 2025	Poliba

Q&A