



TALOS

Digital and Robotics tools for O&M in land-based PV plants

Training Materials

TALOS Land-based PV Training Materials



Funded by
the European Union

Motivation

"PV plant size is scaling up rapidly, set to become 4x bigger in 2023 compared to 2021."

BloombergNEF, 2Q 2023 Global PV Market Outlook

"Deserts and dry scrubland are used or planned to be used for solar energy. The distance from human settlements complicates the large-scale O&M of solar power."

Nature, 2021, D. van de Ven, et al.

"Solar skills shortage threatens EU targets."

Reuters, 2023

"Solar plants are electricity generating power stations and pose significant hazards which can result in permanent injury or death."

SolarPower Europe, O&M Best Practice Guidelines, 2021

Objectives

1

CUTTING-EDGE ROBOTICS

Develop high-quality robot navigation and mission execution for each PV scenario, promoting optimal human-robot and robot-robot collaboration.

2

WIDE RANGE OF O&M TASKS

Demonstrate increased robotics capabilities for monitoring, inspection, cleaning and vegetation mowing tasks.

3

ADVANCED AI ALGORITHMS

Increase PV plant availability through AI models for detecting and classifying PV plant anomalies based on multimodal data.

4

DUAL LAND USE SYNERGIES

Address the energy-food nexus in the growing AgriPV sector, combining energy performance and crop growth models into decision support tools.

5

CO-CREATION MODELS

Actively engage different TALOS end-users to co-create design models for the robotic solutions that will be developed in the project.

6

1.8M€ TO FUND 12 START-UPS/SMEs

Bring external partners to address other challenges in O&M (backsheet inspections, BVLOS inspections, wildlife monitoring) to increase the project's scope.

Outcomes

REDUCTION OF

10%

UNDERPERFORMANCE

90%

HUMAN RISK EXPOSURE

>70%

MAINTENANCE PERIOD

>450

CO₂ EMISSIONS

5%

O&M COSTS

IMPROVEMENT OF

10%

RESOURCE EFFICIENCY IN O&M TASKS

3 years

LIFECYCLE OF PV PANELS

35%

WATER SAVING IN CLEANING PROCESSES

LAND-BASED PV



Cruz del Hierro hybrid plant (Ávila)

- 2 Hybridization plants (CdH + VC)
- PV capacity: 28 MW (14 + 14)
- Total capacity: 56 MW (PV + wind)

TALOS Solutions

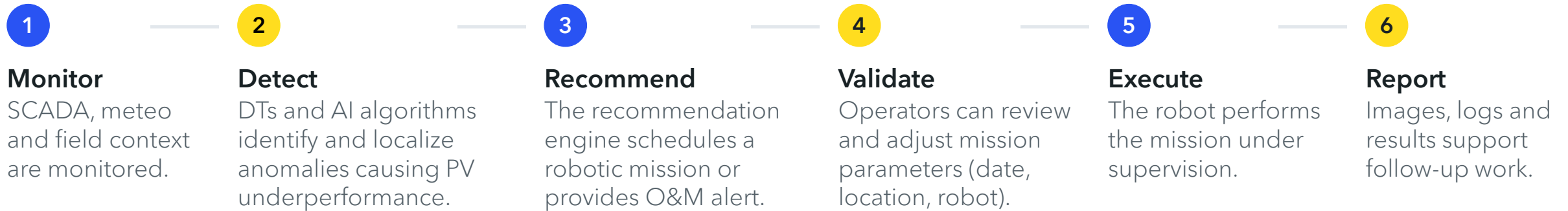
- Inspection drone (UAV)
- 2 Cleaners (AGV)
- Mower (AGV)

TALOS solution ecosystem for land-based PV O&M

Domain	Solutions	Developer
TALOS Platform	Robot and mission management platform	ALISYS
	Digital Twin (DT) and topological scene understanding	ISOTROL, INESC
	AI fault detection and classification based on DTs	INESC
	Recommendation engine for O&M actions	INESC
PV Inspection	Inspection UAVs for PV fault detection with edge intelligence	INESC
Land-based PV O&M	Autonomous AGV robomower	DTA
	Autonomous AGV robocleaner	DTA
	Autonomous AGV cleaner + water carrier	SCL

TALOS Platform - From O&M need diagnosis to autonomous robot missions

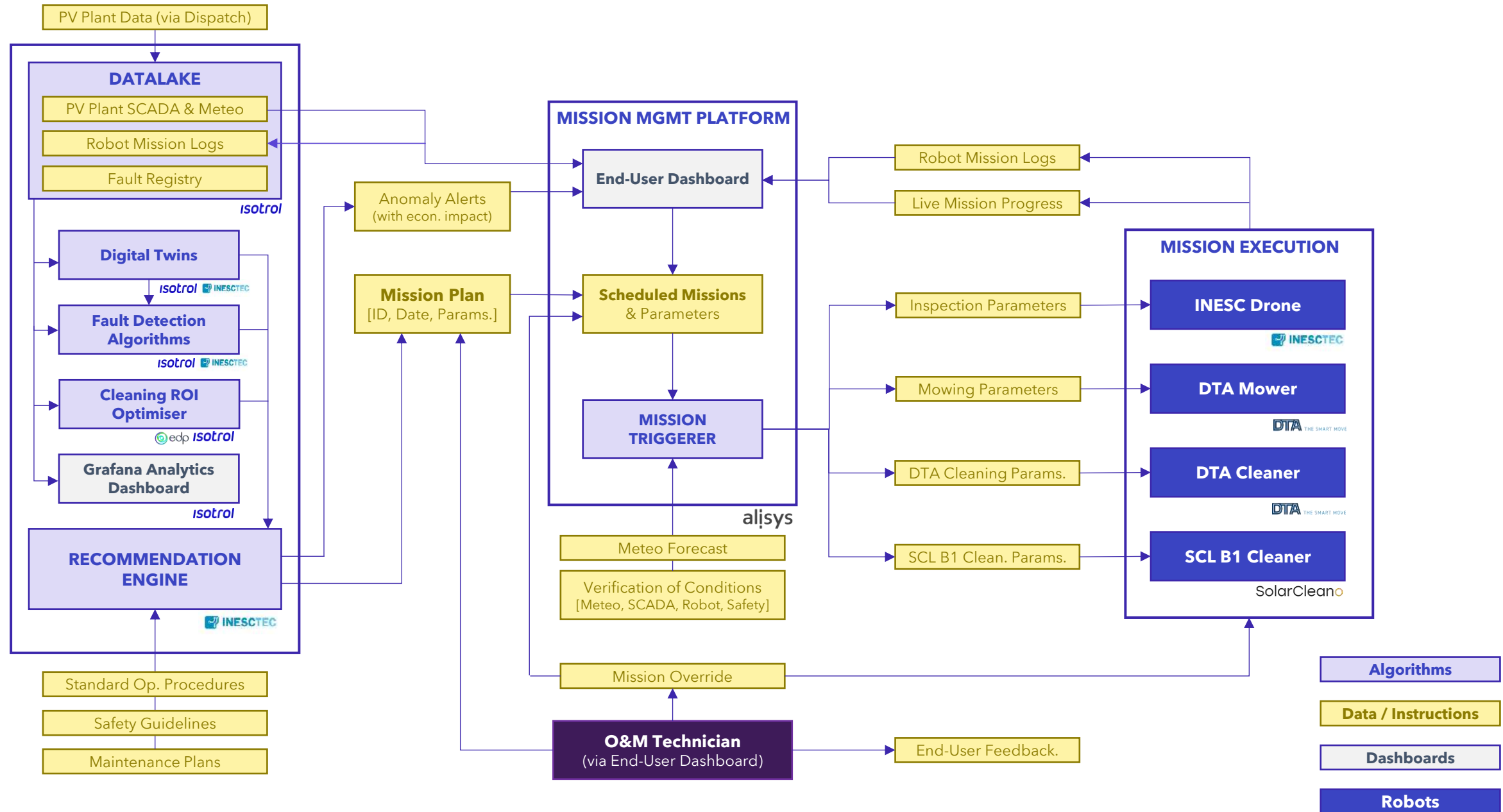
Through its Digital Twins and AI-based algorithms, the TALOS platform can provide O&M alerts and schedule autonomous robotic missions, while giving the O&M technician the tools to supervise and manage the operations.



What changes for operators

- 1 More straightforward process**
O&M recommendations arrive as actionable alerts or mission plans, not disconnected technical data.
- 2 Human control remains explicit**
Operators can validate, adapt or reschedule planned missions.
- 3 Evidence is captured by default**
Mission outputs become structured records for O&M decisions.

TALOS Platform - From O&M need diagnosis to autonomous robot missions

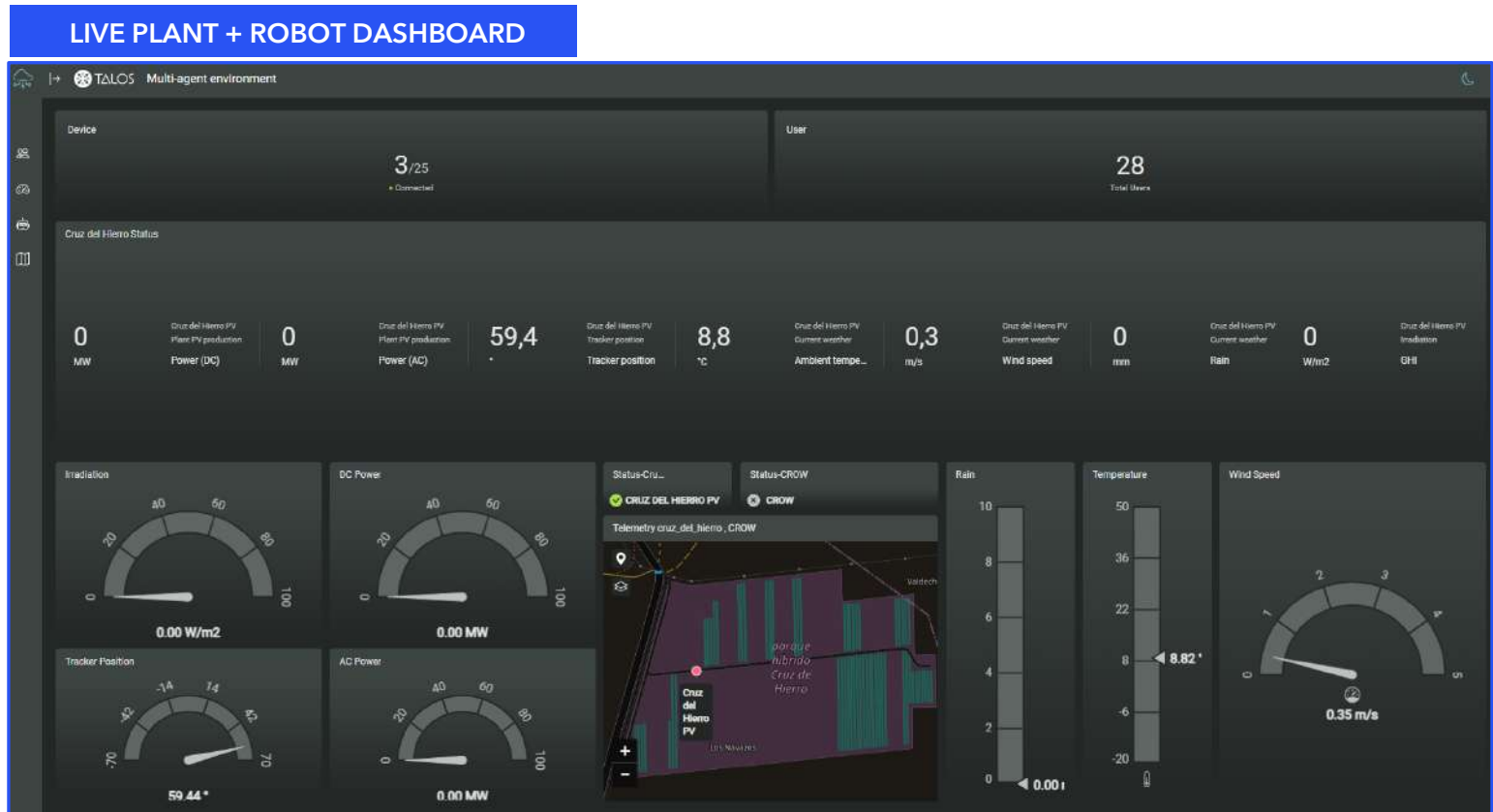


TALOS Platform – Enabling autonomous missions with human supervision

The TALOS platform dashboard provides a single interface to plan and manage missions, monitor robots and receive O&M insights.

What operators can do in the dashboard

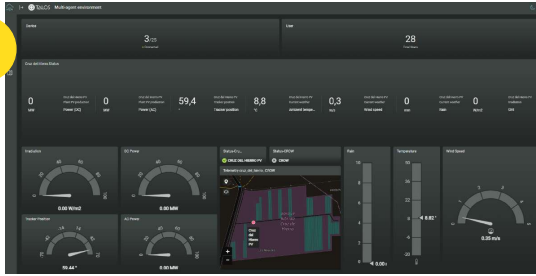
- 1 View PV plant status**
Receive live data from SCADA and meteo station to assess plant status.
- 2 Plan and adjust missions as needed**
Set inspection, cleaning or mowing missions; view and adjust recommended missions.
- 3 Monitor robots live**
Track location, battery, progress, telemetry and media streams.
- 4 Coordinate execution**
React safely when conditions change or a mission needs attention.
- 5 Collect field evidence**
Centralize mission logs, images and robot outputs.
- 6 Review outputs**
Open post-mission reports and fault maps for O&M follow-up.



TALOS Platform - What operators see in the platform dashboards

Using the TALOS platform, the operator can check the PV plant status, review scheduled missions and create new ones, monitor robots and review outputs.

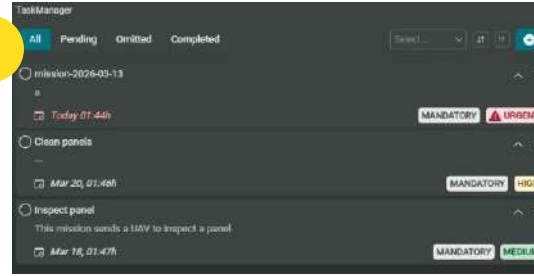
1



Plant status

Check SCADA, meteo and overall plant context.

2



Planned tasks

Review recommended and scheduled missions.

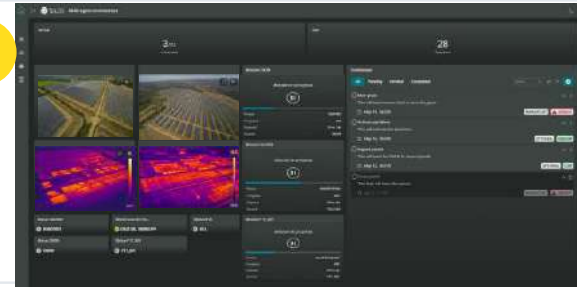
3

A screenshot of the TALOS Mission setup form. It includes fields for 'Name', 'Robot', 'Mission Parameters', 'Mission', 'Execute At', 'Type', 'Priority', and 'Description'. There are 'Cancel' and 'Accept' buttons at the bottom.

Mission setup

Create or adapt the mission before execution.

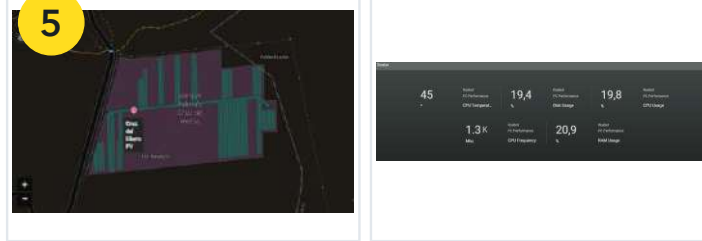
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Mission monitoring

Follow progress and real-time media.

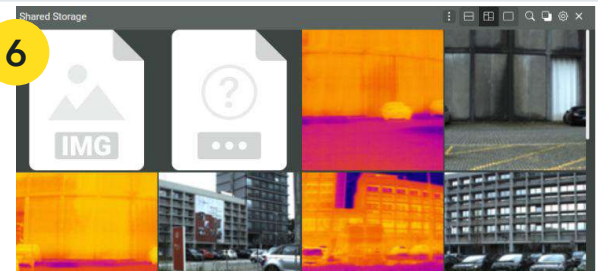
5



Robot status

Check location, telemetry and live indicators.

6



Outputs & reports

Review images, reports and mission evidence.

TALOS land-based PV robot portfolio

Robotic missions for aerial inspection, PV module cleaning and vegetation mowing can be executed via TALOS platform.

UAV inspection systems

Aerial RGB and thermal inspection, fault localization in PV modules, and mission reports.



AGV cleaner + mower

Ground robot for panel wet cleaning and vegetation mowing.



AGV cleaner + trailer

Coordinated autonomous cleaner and water carrier system.



UAV inspections for anomaly detection and localisation

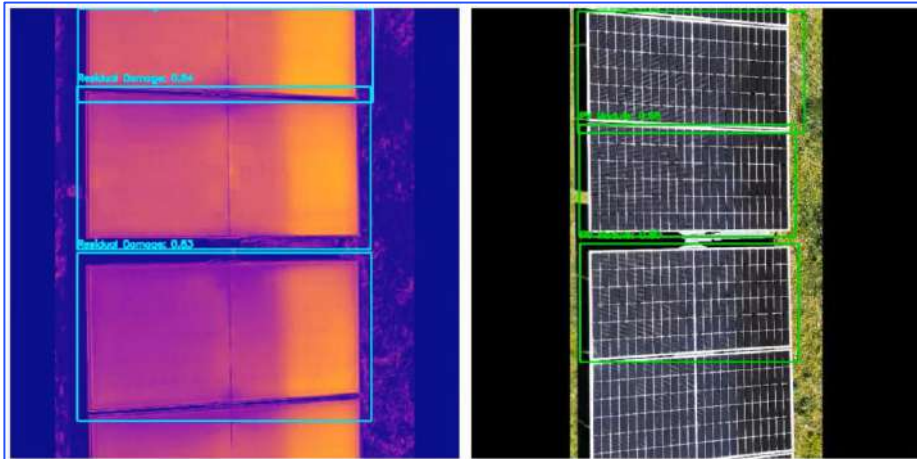
UAVs support faster, repeatable aerial inspections and help reduce reliance on sporadic manual visual checks.



Simultaneous inspection with 2 autonomous UAVs

Key functions

- 1 Waypoint-based inspection**
Follows waypoint routes defined by recommendation engine or operator, ranging from single-point detections (e.g. PV module) to extended areas (e.g. full inverter and beyond)
- 2 RGB + thermal image collection and live streaming**
Visual and thermal data captured for anomaly detection.
- 3 Detect anomalies on edge**
Edge algorithms enable identification and localisation of potential hotspots, soiling, bird drops.
- 4 Post-mission reports**
Reports, images and maps with georeferenced anomalies become available in the TALOS platform.



Thermal and RGB live streaming and report

AGV autonomous cleaner and mower

A single, reconfigurable autonomous ground robot performs panel cleaning and vegetation control, two of the most time-consuming and demanding tasks in PV O&M, increasing safety and reducing human exposure to challenging field conditions



Cleaner configuration



Mower configuration

Key functions

- 1 Dual-purpose AGV with self-reconfiguration capability**
 - Cleaner mode with sensorised cleaning arm + water tank
 - Mower mode with retractable cutting-chains system
 - Automatic charging and operating mode swap.
- 2 Autonomous navigation**

LiDAR and GPS systems support navigation from the base to the designated rows, safe operation along the rows, and controlled turning manoeuvres.
- 3 Safety systems**

Includes HMI/remote monitoring, E-stops, bumpers and sensors to avoid obstacles and mitigate collision risks.
- 4 TALOS platform integration**

Enables real-time mission supervision and post-mission centralisation of cleaning and mowing activity records

AGV autonomous cleaner with water carrier

A coordinated robotic system that automates large-scale PV panel cleaning, combining continuous water supply, sensor-guided alignment, and TALOS platform supervision to improve cleaning consistency and reduce manual effort.



Integrated cleaner + water carrier system

Key functions

- 1 Coordinated cleaning system**
The leading robot cleans the PV panels while the water trailer follows, supplies water, and manages the hose dynamically.
- 2 Autonomous navigation and spatial awareness**
LiDAR, tag-based following, distance control, and onboard sensors support smooth row navigation, safe turning manoeuvres, panel alignment, and automatic stopping when operating conditions are not met.
- 3 Solar-assisted charging**
PV modules mounted on the system enable charging during operation, helping reduce charging pauses and extend available working hours in the field.
- 4 TALOS platform integration**
Enables real-time mission supervision and post-mission centralisation of cleaning activity records.

How TALOS supports better PV O&M

The value proposition combines safer work, better evidence and more scalable operations.

1

For operators

- Mission visibility and control via TALOS platform
- Reduced time performing inspection, cleaning and mowing activities

2

For asset managers

- Traceable records, reports and evidence for follow-up decisions
- Data-driven identification of anomalies and O&M planning

3

For plant owners

- More scalable inspection, cleaning, mowing and maintenance routines
- Potential reduction of long-term costs and improved RoI

TALOS helps turn robotic capabilities into operational workflows that PV O&M teams can supervise and trust.

Lessons learned and recommendations for end-users

Autonomous O&M should be introduced as part of a supervised, scalable ecosystem – with humans central to trust-building and continuous improvement.

1

Supervise autonomy, specially during early roll-out

Keep operator validation of scheduling and mission execution to reduce risk, detect improvement points and build confidence in autonomous workflows.

3

Adapt roles, SOPs and training

Operators and asset managers need updated procedures, safety rules and new skills to supervise autonomous workflows effectively and safely.

5

Refine the recommendation engine over time

New or upgraded algorithms and O&M intelligence modules can be progressively integrated into the recommendation engine to support the automation of additional O&M use cases.

2

Plan the logistics that make autonomy work

Robotics can increase the frequency of costly or labour-intensive tasks, but smooth operation requires adequate robot maintenance and support infrastructure (e.g. water availability)

4

Use the TALOS platform as a future-proof robotics layer

As autonomous inspection, cleaning and mowing become trusted operational routines, the agnostic robot management platform is ready to integrate additional robots for complementary O&M tasks.



roboTics and Artificial intelligence Living labs improving Operations in PV Scenarios

Thank you!



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