Amaltea

Advancing Green Deal Principles In SMart FacAde TechnoLogies For The ConstrucTion SEctor Based On AI, Data & Robotics

Technical Guidelines

2nd Open Call

Call for SMEs & Start-ups: Innovative Solutions for Sustainable Construction

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1. Introduction

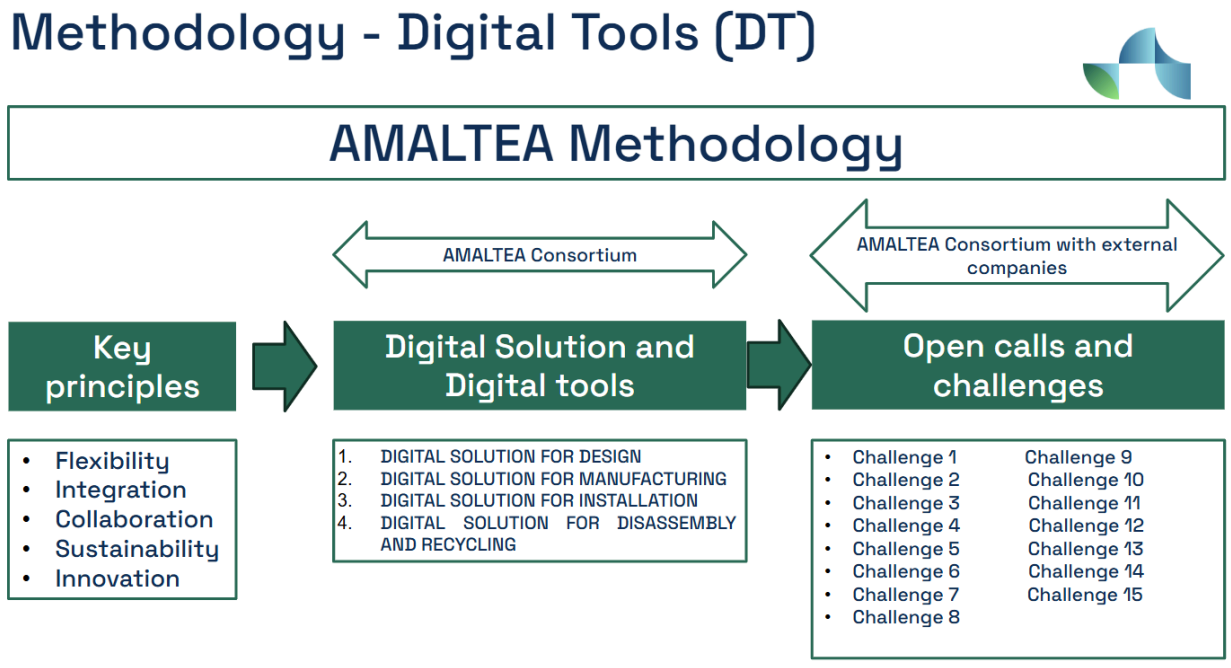
Welcome to the **Technical Guidelines for the AMALTEA 2nd Open Call**. This document is designed to assist SMEs and start-ups in preparing robust, technically aligned proposals that support the AMALTEA project's mission: to transform the construction sector through AI, robotics, and data-driven innovation for sustainable, modular facade systems.

These guidelines outline the core technical structure of AMALTEA and how your solution can contribute meaningfully to its goals. **Please note** that the specific conditions and formal requirements of the open call are detailed in the Guide for Applicants.

More specifically, this document provides:

- **An overview of the Digital Solutions and Digital Tools (DTs)** being developed within AMALTEA, covering the entire facade value chain: design, manufacturing, installation, and disassembly/recycling.
- Insights into **AMALTEA's Pilots**, representing real-world test environments including industrial sites and full-scale building implementations across Europe.
- Descriptions of the **Key Challenges** that applicants' proposals should address.

In particular, this document provides technical insights into AMALTEA's architecture, enabling applicants to align their innovations with ongoing developments across the digital facade lifecycle.



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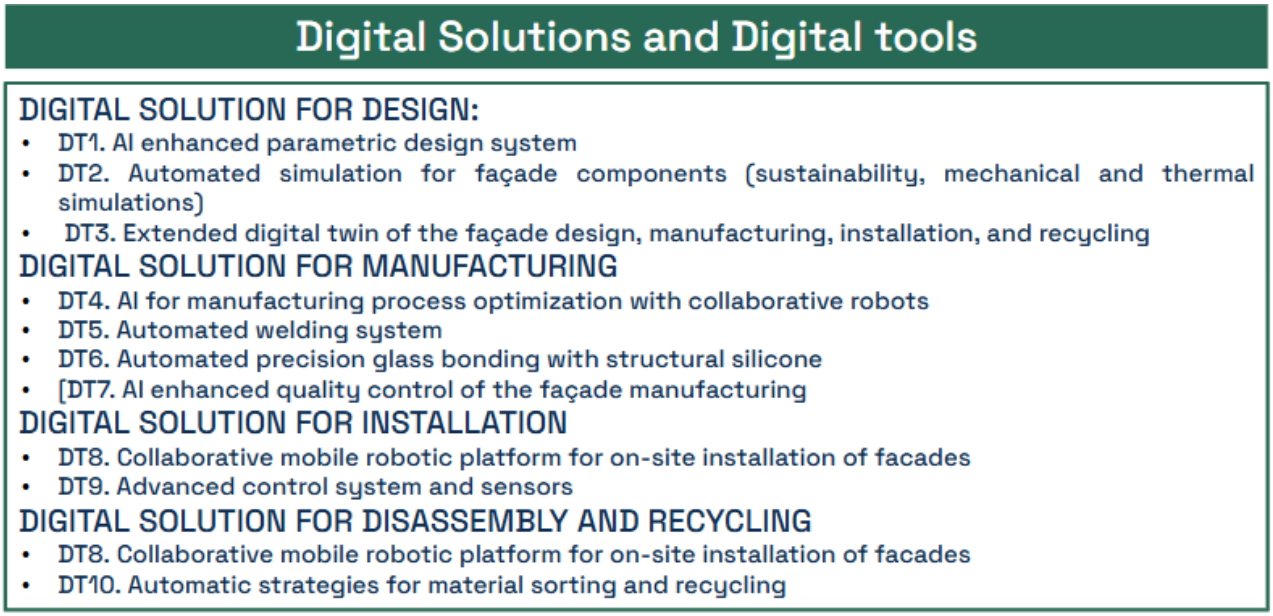
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2. Digital Tools: core technical infrastructure

At the heart of the AMALTEA project lies a suite of **Digital Tools (DTs)** that enable a connected, intelligent, and modular approach to facade system design, fabrication, installation, monitoring, and recycling. These tools form the **digital backbone** of the project, supporting human-machine collaboration, lifecycle tracking, data-driven decision-making, and continuous optimization.

Applicant solutions funded through the Open Calls are expected to **interface with, enhance, or complement** one or more of these DTs.

Here is an overview of the AMALTEA Digital Tools:



DIGITAL SOLUTIONS FOR DESIGN:

○ DT1: AI-enhanced parametric design system

Function: Enables early-stage facade design using AI-assisted parametric modelling.
Capabilities:

- Allows users to choose the best optimized design solutions based on their personal preferences, structural integrity, environmental factors, thermal performance, daylight, aesthetics, and material usage.
- Generates design variants using multi-objective optimization algorithms.
- Integrates with Building Information Modelling (BIM) platforms.

Applicant opportunity: Develop plug-ins or data-driven optimization modules (e.g., life-cycle cost prediction, carbon footprint estimation), Retrieval-augmented generation (RAG) methods, and interactive visualization through a Graphical user interface (GUI).

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○ DT2: Integrated simulation framework

- **Function:** Automates physical and performance simulations during design.
- **Capabilities:**
  - Includes thermal, acoustic, structural, and sustainability simulations.
  - Uses AI surrogate models to speed up multi-criteria decision-making.
- **Applicant opportunity:** Contribute specialized simulation engines.

○ DT3: Extended digital twin

- **Function:** Provides a unified digital representation of the facade throughout its lifecycle.
- **Capabilities:**
  - Integrates real-time and historical data from sensors, robots, and BIM.
  - Supports predictive maintenance, and disassembly planning.
  - Enables AI-driven decision support across all phases (design to recycling).
- **Applicant opportunity:** Standardized data and communication framework.

DIGITAL SOLUTION FOR MANUFACTURING:

○ DT4–DT7: Intelligent manufacturing robotics

- **Function:** Supports automation and quality assurance in off-site production of facade modules.
- **Tools:**
  - DT4. AI for manufacturing process optimization with collaborative robots
  - DT5. Automated welding system
  - DT6. Automated precision glass bonding with structural silicone
  - DT7. AI enhanced quality control of the facade manufacturing
- **Applicant opportunity:** Integrate smart control algorithms, human-machine interfaces, or new inspection sensors.

DIGITAL SOLUTION FOR INSTALLATION

○ DT8: Collaborative mobile robotic platform for on-site installation of facade

- **Function:** Automates transport, positioning, and installation of facade elements on the construction site.
- **Capabilities:**
  - Use and coordinate the crane with the collaborative mobile robotic platform.
  - Design end effectors for the collaborative on-site process.
- **Applicant opportunity:** Provide localization and mapping modules (SLAM), task planning, or AR interfaces for operator interaction.

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○ DT9: Advanced control system and sensors

- **Function:** Monitors and controls sensors and actuators embedded in the facade for smart operation.
- **Capabilities:**
  - Real-time environmental data processing.
  - Decision logic for adaptive energy management (e.g. shading, ventilation).
- **Applicant opportunity:** Add advanced AI algorithms for occupant-aware optimization, anomaly detection, or integration with building energy systems.

DIGITAL SOLUTION FOR DISASSEMBLY AND RECYCLING

○ DT10: Automatic strategies for material sorting and recycling

- **Function:** Supports automated dismantling, classification, and reuse of facade materials.
- **Capabilities:**
  - Identifies material types and conditions using vision and sensor data.
  - Suggests disassembly sequences based on component tracking and BIM.
- **Applicant opportunity:** Develop ML-based material classifiers, robotic manipulators, or recycling prediction models.

All DTs are designed to follow **open standards** where possible (e.g., IFC, OPC UA, ROS, ISO 19650) and are expected to communicate through standardized **data exchange interfaces**. Proposals must demonstrate compatibility or propose middleware/adapters to ensure smooth integration.

When proposing your solution, clearly specify:

- Which DT(s) your solution interacts with
- What technical interface (API, middleware, data model) will be used
- How your solution improves performance, safety, sustainability, or user experience
- Any validation methods you propose to test your tool in a Pilot environment

3. Pilots: real-world testing grounds for innovation

Selected solutions will be tested and validated in large-scale **Pilots** representing realistic deployment contexts:

- **AI parametric design and Extended digital twin with all the data workflows**
- **Industrial manufacturing site for facade production**
- **Residential/Hospital building in southern Europe**
- **Office/Tertiary building in central Europe**

Each pilot enables full integration and validation across different phases of the value chain and environmental conditions.

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The pilots are the cornerstone of AMALTEA's validation strategy, serving as **living laboratories** where cutting-edge digital and AI technologies are deployed, tested, and refined in operational environments across Europe. Each pilot targets different phases of the facade lifecycle—from parametric design and automated production to on-site installation and end-of-life disassembly.

A **pilot** in AMALTEA refers to a real-world site or construction project where integrated solutions are deployed and evaluated under realistic conditions. Each pilot aligns with a Key Application area and incorporates several use cases and challenges.

Key objectives of the pilots include:

- Demonstrating the technical feasibility and scalability of AMALTEA solutions
- Enabling real-time feedback loops between users and developers
- Supporting innovation across the full building lifecycle—from design to recycling
- Validating Digital Tools and applicants Digital Solutions
- Accelerating the market readiness and adoption of AI-driven facade technologies

Pilot Case 1: AI parametric design and Extended digital twin with all the data workflows

This pilot focuses on the use of an **AI-enhanced parametric design system** to optimize facade materials and geometries based on energy efficiency, cost, environmental impact, and occupant comfort. The system employs simulation and generative design techniques to assist the human design into the deliver of highly customized, high-performance facade configurations, similar to co-pilot design assistant. This system is aimed at enhancing the design and decision-taking process to a higher level, ensuring an augmented, data-informed facade design.

A key feature is the **Extended Digital Twin**, which offers a real-time, holistic view of the facade throughout its lifecycle—from design to recycling. This is enabled by the **Apollo Protocol**, which ensures interoperability across the built environment and manufacturing sectors.

Expected outcomes:

- Greater efficiency and design flexibility
- Enhanced lifecycle transparency
- Stronger alignment with circular economy goals
- Improved adaptability to diverse architectural and environmental contexts

Pilot Case 2: Automation and AI in facade manufacturing (FDB facilities)

This pilot, hosted at FDB's manufacturing site, demonstrates the transition from traditional manual production to a **semi-automated, AI-supported manufacturing line**.

Key innovations include:

- **Collaborative robots (cobots)** to assist workers in complex assembly tasks
- **Adaptive welding systems** to replace screw connections, enhancing recyclability
- **AI-driven weld quality assessment** via visual inspection systems
- **Robotic glass bonding** using structural silicone for precision and consistency

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- **AI and computer vision** for real-time quality control
- **User-friendly human-robot interfaces** to ensure safe and intuitive collaboration

All systems will be pre-tested in partner facilities before being deployed at the FDB site.

Pilot objectives:

- Increase production throughput and quality
- Improve worker safety and ergonomics
- Reduce material waste and environmental impact
- Demonstrate scalable digital manufacturing in real conditions

Pilot Cases 3 & 4: Real-world demonstration buildings

Two demo buildings will be selected during the first year of the project. They will evaluate AMALTEA's **digital installation, disassembly, and recycling tools** in actual construction environments. Testing in the buildings will be carried out subject to their availability. Should it not be possible to gain access to the buildings, alternative locations at the consortium partners' premises will be used.

Pilot 3: Southern Europe – Hospital/Residential Typology (ACC)

This pilot focuses on healthcare and residential buildings with high requirements for:

- Hygiene and fast installation
- Energy efficiency and sustainability
- Natural lighting and thermal comfort

The prototyped facade systems to be installed, un-installed and later processed will include curtain walls, aluminium or steel panels, and glass. The digital tools will be tested for their effectiveness in accelerating construction, enhancing human safety in the construction site while ensuring high performance in health-sensitive environments.

Pilot 4: Central Europe – Residential/Office Typology (ZUB)

This pilot addresses mixed-use buildings that prioritize:

- High energy performance
- Aesthetic design and daylight use
- Advanced curtain wall systems with composite or metallic panels

This case highlights the **versatility and modularity** of AMALTEA's digital solutions in modern, high-performance architecture.

Both pilots will evaluate:

- Installation simulation and digital planning workflows
- Disassembly and end-of-life strategies
- On-site performance monitoring and data feedback

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Through these four diverse pilot cases, AMALTEA validates its solutions across different climates, building typologies, and stages of the facade value chain. This real-world testing is crucial to ensuring that the project's innovations are not only technically sound, but also scalable, sustainable, and ready for market adoption.

4. Use cases and challenges

Within the AMALTEA Pilots, concrete use cases have been defined. Each use case includes specific challenges that require innovative solutions:

- **Design phase challenges**: Optimization algorithms for sustainability, recyclability, and cost-efficiency; AI-driven surrogate models for simulation.
- **Manufacturing phase challenges**: Intelligent control systems, collaborative robot integration, and automated bonding and welding systems.
- **Installation phase challenges**: Mobile robotic navigation and positioning; human-robot interfaces for collaborative tasks; site logistics coordination.
- **Disassembly & Recycling challenges**: Material classification systems; AI-based reuse assessment; and robotic dismantling techniques.

Applicant proposals must clearly identify which use case(s) and challenge(s) they address, and explain how their solution integrates into the broader AMALTEA digital ecosystem.

The following **challenges have been selected for the 2nd Open Call**:

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Challenge 1: IFC extraction to inform parametric façade design modelling

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Contextualization of the Challenge

Problem: Parametric façade optimization models require precise, building-specific input data, such as opening dimensions, slab geometry, floor heights, column locations, building orientation, and site location. Today, extracting these parameters from an IFC file is a manual process that is slow and requires BIM expertise, which creates a bottleneck between raw model data and the parametric design tool.

Challenge description

Goal: Prototype a system that reliably extracts targeted geometric/spatial parameters from an IFC file and outputs structured values usable directly as inputs to a parametric façade model. The parameters include the total length and width of the open façade, as well as slab dimensions, building height, column locations, and orientation/geolocation.
Innovation Focus: Grounded extraction of geometric parameters (not just textual property lookup), to obtain dimensions, orientation, and spatial relationships, with outputs accurate and traceable back to the source IFC elements. If direct extraction proves unreliable, consider augmenting the IFC with auxiliary reference points/geometry to guide extraction.

Pilot and testing environment

Pilot setup: The prototype will be tested against IFC models of increasing complexity, from a simple rectangular single-storey building to a multi-storey model with non-orthogonal façade planes. Python and IfcOpenShell is preferred for the Rhino/Grasshopper integration that extracted parameters directly inform and update the parametric façade model, with a structured JSON log stored for traceability.

Expected impact

Industry impact: Automating the process of extracting parametric data from IFC files eliminates the manual bottleneck between BIM authoring and façade design and enables more frequent, performance-driven iterations.
SME Benefits: Beyond façade modelling, the extraction algorithm can be repurposed across projects for other metadata such as cost estimation, element quantity takeoff, and procurement list generation.

Evaluation criteria and success metrics

Criteria: The solution will be evaluated on extraction accuracy against ground-truth BIM dimensions, parameter completeness, robustness to varying modelling conventions, traceability to source IFC entities, and usability without programming skills.
Metrics: Key metrics include dimensional deviation from reference values, parameter completeness rate, Global Id traceability, and end-to-end processing time.

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Challenge 2: Real-Time Manufacturing Process Intelligence for the Extended Digital Twin

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Contextualization of the Challenge

Problem: T2.5 (Extended Digital Twin) covers high-level lifecycle information, and WP3 develops manufacturing process monitoring. An external company will add detailed component histories, adding live manufacturing data and quality evidence to the EDT.

Challenge description

Goal: Develop a manufacturing intelligence extension that provides a continuously updated view of each component's production status and a traceable record of how it was manufactured.
Innovation Focus: Link component, joint and operation identifiers to timestamped welding and bonding data, workstation states and inspection results. Associate rework and waste records with each operation. Deliver a process-history model with live status, event replay, data-freshness indicators and links to design requirements. Share detailed records and summaries through agreed project interfaces.

Pilot and testing environment

Pilot setup: Proposed testing on selected WP3 welding, silicone-bonding and inspection workflows using available live streams and recorded datasets. Verify synchronisation with the extended digital twin, component traceability and recovery after data gaps. Compare reconstructed histories with independent production records.

Expected impact

Industry impact: Help engineers investigate deviations and trace quality outcomes to manufacturing conditions, while making detailed production evidence available across the façade lifecycle.
SME Benefits: Provide an adaptable extension that manufacturers can connect to heterogeneous workstations through existing interfaces.

Evaluation criteria and success metrics

Criteria: Traceability, temporal consistency, interoperability and usability. Reuse T2.5 integration and T3.7 adapters. Extend process detail and diagnostic access, keeping robot control, scheduling and WP3 optimisation algorithms with consortium partners.
Metrics: Components with complete process histories (%), correctly linked events (%), update latency, timestamp alignment, missing-data detection, recovery after disconnection and time to retrieve defect-related evidence.

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Challenge 3: Building the Data Foundation for Robotic Process AI

2nd Funding Instrument: Hardware Solutions for facade Applications

Contextualization of the Challenge

Problem: In-project trials for robotic laser welding of thin aluminium profiles and structural silicone bonding are slow and costly. The real bottleneck is not algorithms but insufficient process data.

Challenge description

Assemble and harmonise external process datasets from public repositories, scientific archives, and prior projects covering laser welding and adhesive dispensing. Curate them into a shared schema, assess transferability to target processes, and use them to pre-train models adapted to limited in-project data. Alternatively, generate synthetic or experimental datasets using your own systems to supplement or replace external sources where availability is limited.

Pilot and testing environment

A containerized data pipeline (ETL + validation) feeding harmonized datasets into a transfer-learning sandbox where pre-trained models are fine-tuned on limited in-project data and exposed via REST APIs

Expected impact

A reusable, documented dataset and schema for the domain; usable models available far earlier than a from-scratch campaign would allow; fewer physical trials, less material consumed; a transferable method for data-scarce manufacturing processes.

Evaluation criteria and success metrics

Volume, relevance and licensing clarity of the assembled data · quality of harmonisation and metadata · evidence of transfer gain over a baseline trained on in-project data alone · openness of the resulting dataset · integration into the project's AI inference layer via documented APIs.

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Challenge 4: CAD-Free Adaptive Silicone Application

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Contextualization of the Challenge

Problem: Robotic Silicone application trajectories are currently derived from the parametric design model, while real frames deviate through fabrication tolerance, welding distortion and clamping. Bead defects are detected only after application, so deviations become rework rather than corrections.

Challenge description

Generate the bead path directly from the physical part by vision or profile sensing, without depending on an accurate CAD reference, and close the loop during dispensing — sensing bead width, height and continuity in real time and adjusting dispense pressure and robot speed to hold the target cross-section.

Pilot and testing environment

A closed-loop vision-control cell with 3D profile sensor (e.g., laser line or structured light) and synchronized robot motion stack,

Expected impact

Higher first-time-right bonding, less rework and wasted sealant, robustness to as-built deviation across varying frame geometries, and a step towards autonomous in-line quality assurance.

Evaluation criteria and success metrics

Bead consistency and defect reduction versus open-loop application · tolerance to part-to-model deviation · control latency and synchronisation with robot motion · interoperability with the production control layer and compliance with the dispensing safety envelope

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Challenge 5: Risk Assessment and Safety Validation in Shared Human-Robot Environments

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Contextualization of the Challenge

Problem: Collaborative robots in facade installation work alongside humans in dynamic, uncontrolled environments—variable geometry, outdoor hazards, weather, and changing site layouts. Current safety frameworks are static and laboratory-derived, failing to adapt to site-specific constraints and real-time variability, limiting deployment speed and creating certification bottlenecks.

Challenge description

Goal: Develop safety assessment frameworks and validation methodologies for shared human-robot workspaces in facade installation. Solutions must address dynamic risk evaluation adapted to site constraints (geometry, weather, surface conditions, worker proximity), compliance with ISO standards, and construction safety regulations, and context-aware strategies that adjust in real time to task, geometry, site conditions, and human proximity.

Pilot and testing environment

Real or virtual building site

Expected impact

A validated safety framework for diverse facade scenarios, reduced deployment time and certification burden, demonstrated risk mitigation enabling faster human-robot collaboration scaling.

Evaluation criteria and success metrics

Framework coverage of both controlled and dynamic environments, compliance validation against relevant standards, evidence of risk reduction in pilot environments, scalability to other applications, and clarity of monitoring protocols and intervention triggers

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Challenge 6: Material Traceability & Waste/Carbon Dashboard

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Contextualization of the Challenge

Problem: Waste events are not currently linked to their material origin, process context and quality outcome. Scrap therefore cannot be attributed to a root cause, and the environmental performance of the manufacturing line cannot be quantified.

Challenge description

Implement traceability from incoming material batch through cutting, welding, bonding, inspection and dispatch, using common identifiers, timestamps and component references across heterogeneous data sources. Build on it a role-adapted dashboard converting these records into indicators: planned versus actual consumption, avoidable versus unavoidable waste, quality-related losses, reuse and recovery rates, and energy and embodied carbon per component or per m² of façade.

Pilot and testing environment

Production control system + material batch database + sensor logs (cutting, welding, bonding, inspection) → unified traceability pipeline → role-adapted dashboard with waste/carbon indicators and drill-down to root cause.

Expected impact

Root-cause attribution of scrap and evidence-based process improvement; quantified environmental performance in place of estimates; reporting structured for EPD and Digital Product Passport obligations under the ESPR.

Evaluation criteria and success metrics

Completeness and robustness of the traceability chain · drill-down from an aggregate indicator to the originating manufacturing event · soundness and transparency of the carbon accounting methodology · ingestion from production control and sensor data sources · usability for operators, process engineers and circularity experts.

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Challenge 7: Autonomous Calibration Strategies for Multi-Axis Robotic Fabrication Cells

2nd Funding Instrument: Hardware Solutions for facade Applications

Contextualization of the Challenge

Problem: Cells combining a gantry, robot arm, interchangeable end-effectors and a 3D sensor lose absolute accuracy through thermal drift, wear and tool changes. Reallocating one asset across welding, bonding and inspection makes re-calibration a recurring event, yet it stays manual, expert-dependent and disruptive to production.

Challenge description

Develop calibration routines the cell runs by itself: kinematic identification across the extended workspace, automatic TCP and hand-eye determination after each tool change, and drift detection that triggers re-calibration only when accuracy thresholds are breached — using the onboard 3D sensor instead of external metrology.

Pilot and testing environment

Multi-axis robotic fabrication cell (gantry + robot arm + interchangeable end-effectors + onboard 3D sensor) integrated with motion planning, orchestration layer, and digital twin for validation.

Expected impact

Sustained accuracy without expert intervention, shorter changeover and commissioning times, fewer position-related defects, and a transferable method for reconfigurable robotic cells.

Evaluation criteria and success metrics

Absolute accuracy and repeatability achieved · sensitivity and false-trigger rate of drift detection · calibration cycle time and degree of autonomy · independence from external metrology · integration with orchestration, motion planning and the digital twin.

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Challenge 8: Smart Interaction Interfaces for Human-Guided Robotic Manufacturing

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Contextualization of the Challenge

Problem: The manufacturing process for façade panels involves the automation of welding, glass bonding and quality control tasks, whilst keeping the human operator permanently in the loop, both during the programming and execution stages.

Challenge description

This challenge seeks innovative human-machine interaction solutions that empower shop floor operators to intuitively guide, supervise, and collaborate with robotic manufacturing systems. Proposed interfaces should go beyond conventional teach pendants or basic touchscreen controls, exploring modalities such as augmented reality, gesture recognition, or adaptive task delegation to enhance operator efficiency and reduce programming complexity.

Pilot and testing environment

A facade panel manufacturing cell (welding, glass bonding, quality control stations) with augmented reality overlay, gesture recognition interface, adaptive task delegation UI, integrated with cell control system.

Expected impact

Development of new human-robot interaction technologies to improve usability, safety and efficiency in manufacturing processes.

Evaluation criteria and success metrics

Ease of use, streamlined processes, guaranteed security, connection to the cell control system and the main interface.

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Challenge 9: Optimization of Multi-End-Effector Systems for Robotic Façade Installation

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Contextualization of the Challenge

Problem: Within AMALTEA WP4, robotic systems are used for the installation of anchors and façade panels through a multi-end-effector framework. This includes vacuum grippers for panel handling, pneumatic grippers for anchor manipulation, and a robotic wrench for fastening operations. The current solutions are functional , but further development is needed to improve performance, reliability, and system integration.

Challenge description

Optimize and upgrade the existing end-effector system by refining relevant design parameters, and by integrating additional sensing capabilities, e.g. tactile, force, or pressure sensors. All upgrades must remain compatible with the existing PLC–ROS 2 control architecture.

Pilot and testing environment

Initial laboratory testing and validation, followed by demonstration in a representative construction-site environment using full-scale curtain wall panels and the integrated robotic installation setup.

Expected impact

Improved performance and operational reliability across the different end-effectors, better manipulation and fastening accuracy, enhanced monitoring of task conditions and increased robustness.

Evaluation criteria and success metrics

Comparison with the current baseline based on: 1) Task performance, accuracy, repeatability, and reliability. 2) Integration of commands, sensor data, system states, and alarms into the PLC–ROS 2 architecture and UI. 3) Safe system response in case of communication loss or gripping-related failures.

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Challenge 10: Curtain Wall Handling and Pre-Positioning System

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Contextualization of the Challenge

Problem: Curtain wall panels arrive at the construction site stored on transport racks. Before robotic installation can begin, each panel must be safely transferred from the rack to a controlled position and orientation where it can be picked up by the crane and transferred to the installation location.

Challenge description

Develop an automated handling and positioning system capable of safely extracting, tilting and moving curtain wall panels from the transport rack into the required position and orientation for crane pick-up and subsequent robotic installation.

Pilot and testing environment

Demonstration in a representative construction-site environment using full-scale curtain wall panels

Expected impact

Safer and more efficient panel handling, with reduced manual intervention and risk of damage.

Evaluation criteria and success metrics

Safe and repeatable handling, accurate positioning, reduced handling time and compatibility with the AMALTEA installation workflow.

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Challenge 11: Enhance industrial Crane Communication and ROS 2 Integration

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Contextualization of the Challenge

Problem: Curtain wall installation within the AMALTEA project requires the integration of an industrial spider crane into the overall robotic workflow. Beyond the mechanical lifting capabilities, a key challenge is to establish a reliable communication interface between the crane and the project control architecture. This requires analysing the industrial communication protocols supported by commercial cranes and defining the most suitable strategy for their integration with ROS 2.

Challenge description

Study and validate industrial communication protocols supported by commercial cranes, such as CAN Bus, CANopen, Modbus TCP, EtherCAT or OPC UA. Define the best approach to exchange crane status, sensor data and control commands with ROS 2. Add Real Time and safety protocols restrictions.

Pilot and testing environment

Validation with a spider crane or representative crane control system integrated with the AMALTEA architecture.

Expected impact

Reliable and reusable communication between industrial cranes and ROS 2-based robotic systems.

Evaluation criteria and success metrics

Reliable ROS 2 bidirectional communication and integration, enabling low-latency exchange of crane commands and state information.

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Challenge 12: Configurable Simulation Framework for Robotic Installation

1sr Funding Instrument: Software Solutions for facade Applications

Contextualization of the Challenge

AMALTEA installation scenarios rely on information coming from different digital sources, such as CAD models of panels and anchors and BIM/IFC models of the building. Preparing these data manually for robotic simulation is time-consuming.

Challenge description

Develop a configurable workflow that converts heterogeneous digital input data and model formats into a consistent MuJoCo installation environment, while supporting robots, end-effectors, and reuse of existing simulation logic, including control strategies and task-specific functionalities.

Pilot and testing environment

Validation using different formats and geometries, component models, and robot configurations, followed by testing of representative anchor and panel installation tasks in MuJoCo.

Expected impact

Reduce the effort required to create and adapt robotic simulations for new buildings and façade configurations.

Evaluation criteria and success metrics

1) Support for different input formats and geometries. 2) Correct generation and configuration of the MuJoCo environment. 3) Reuse and integration of existing simulation logic and control strategies. 4) User-friendliness and reduced manual effort for setting up new scenarios.

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Challenge 13: Digital Product Passport for Circular Façade Components

1st Funding Instrument: Software Solutions for facade Applications

Contextualization of the Challenge

Problem: Fragmented lifecycle records limit component reuse. WP5 develops recycling strategies and Trac-Line sorting. An external company will add a transferable product passport that connects this information across organisations.

Challenge description

Goal: Develop an interoperable passport for façade modules, subcomponents and recovered materials, linked to data carriers and the AMALTEA digital twin.
Innovation Focus: Record composition, origin, recycled content, manufacturing and installation history, maintenance, exposure, disassembly instructions and recovery routes. Deliver a versioned passport prototype with data exchange interfaces, reusing existing traceability identifiers.

Pilot and testing environment

Pilot setup: Proposed testing with representative AMALTEA components and lifecycle records. Verify identification, record updates and exchange with Trac-Line and the digital twin, using interfaces agreed with partners.

Expected impact

Industry impact: Preserve reliable product information through ownership changes and support informed reuse and recycling decisions.
SME Benefits: Provide a reusable passport service for manufacturers and recovery operators, reducing manual documentation and information loss.

Evaluation criteria and success metrics

Criteria: Data completeness, identifier continuity, interoperability, access control and usability. Scope covers product information exchange, with LCA/LCC calculation outside this challenge.
Metrics: Complete passport records (%), successful identifier reads and data exchanges (%), update time and traceability gaps detected.

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Challenge 14: Labelled VSWIR Material and Defect Database for AI Training

1st Funding Instrument: Software Solutions for facade Applications

Contextualization of the Challenge

Problem: Reliable AI condition assessment requires many representative, verified examples. An external company will build a reusable training database of façade materials and defects, providing the training foundation for the in-situ inspection system in Challenge 14.

Challenge description

Goal: Create a large, curated dataset covering glass, aluminium, steel, wood, rubbers, polyamides, silicones and insulation. Extend coverage to other materials or assemblies where justified.
Innovation Focus: Acquire VSWIR images with a Goldeye G-130 VSWIR TEC1 or equivalent, using calibrated illumination and band selection where needed. Include sound, aged and damaged samples. Label material, defect type, location and severity using expert review and reference tests. Record specimen identity, provenance and acquisition settings. Deliver versioned data, annotations, reuse rights and a reproducible baseline training workflow.

Pilot and testing environment

Pilot setup: Proposed acquisition from diverse physical specimens and field-relevant conditions. Include material-specific examples such as cracks, scratches, corrosion, deformation, contamination and verified moisture states. Separate training, validation and test sets by specimen and source to prevent leakage.

Expected impact

Industry impact: Provide trustworthy examples for learning material condition and comparing AI performance across materials and defects.
SME Benefits: Reduce the cost of collecting and labelling training data for inspection solution developers.

Evaluation criteria and success metrics

Criteria: Coverage, label reliability, data quality, class balance and reproducibility. Focus on dataset creation and baseline training. Camera deployment and field assessment belong to Challenge 14.
Metrics: Unique specimens and images per material/defect/severity, annotation agreement, metadata completeness, class coverage and per-class baseline precision/recall on an independent test set.

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Challenge 15: In-Situ Material Condition Classification through VSWIR Machine Vision

2nd Funding Instrument: Hardware Solutions for facade Applications

Contextualization of the Challenge

Problem: On-site recovery decisions need consistent condition evidence before transport or conveyor sorting. An external company will turn the training resources from Challenge 15 into a portable inspection system that complements WP5 Trac-Line.

Challenge description

Goal: Deploy AI trained on the Challenge 06 database to classify observed material condition in situ, locate defects and flag uncertain or unfamiliar cases for expert inspection.
Innovation Focus: Integrate a Goldeye G-130 VSWIR TEC1 or equivalent (400–1700 nm, 1280 × 1024 pixels) with suitable optics, controlled illumination and band selection where needed. Adapt the trained model to field acquisition. Deliver a portable prototype with confidence scores and component-linked condition reports. Address lighting and viewing changes and refer unsupported cases for review.

Pilot and testing environment

Pilot setup: Proposed testing before or after disassembly on supported materials, initially glass, aluminium, steel, wood, rubbers, polyamides, silicones and insulation. Compare predictions with expert labels and reference measurements on unseen components and sites. Assess damage, contamination and moisture indications only where validated for each material.

Expected impact

Industry impact: Support consistent on-site triage and preserve evidence for downstream sorting and recovery decisions.
SME Benefits: Provide recovery operators with a portable inspection service using established training resources and reducing manual screening effort.

Evaluation criteria and success metrics

Criteria: Field reliability, confidence calibration, usability and traceability. Challenge 15 owns the core database and baseline training. This challenge covers deployment and field adaptation, excluding remaining-life prediction, certification and LCA/LCC.
Metrics: Per-class precision/recall on unseen sites, critical-defect miss rate, localisation accuracy, inspection time and expert-review rate. Compare field performance with the Challenge 15 baseline and visible-only inspection.

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