Amaltea

# TECHNICAL GUIDELINES

## 1st Open Call

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

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# 1.

# INTRODUCTION

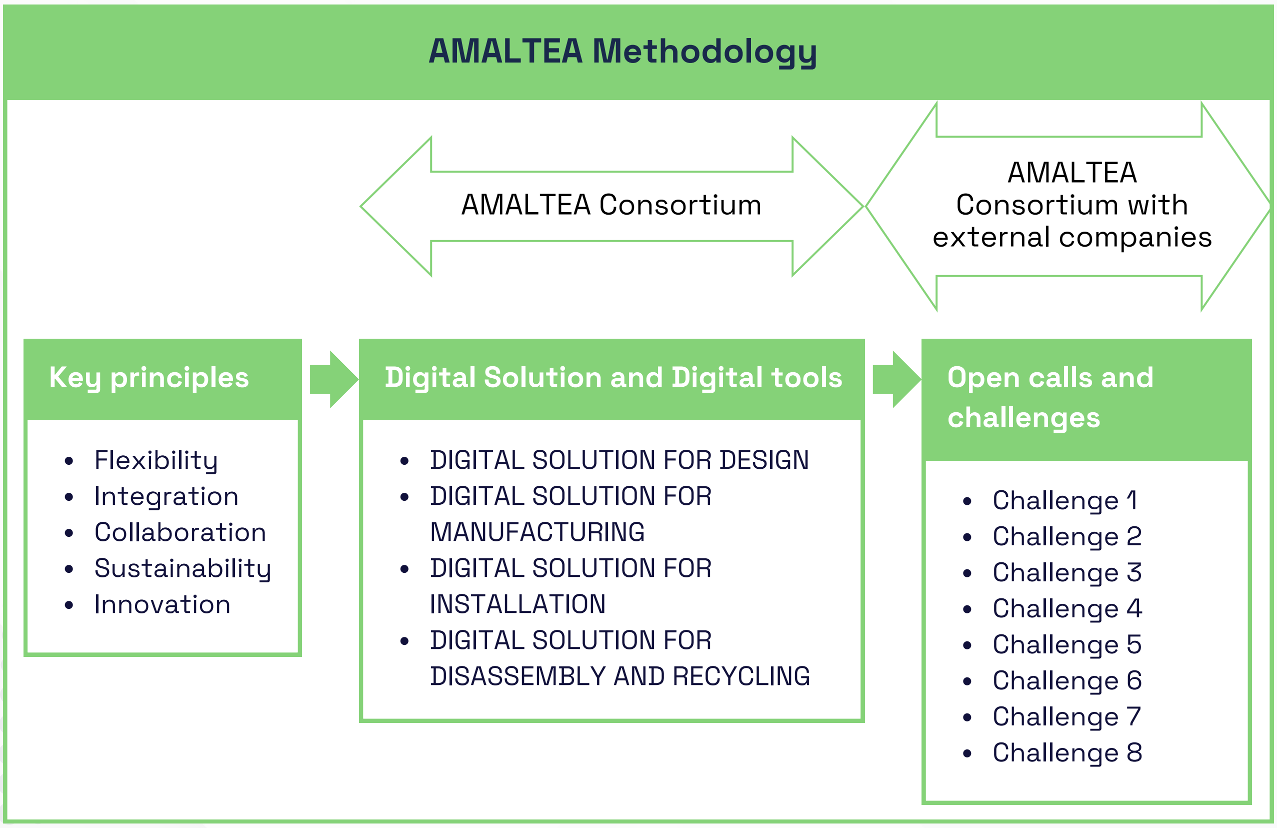
Welcome to the **Technical Guidelines for the AMALTEA First Open Call.** This document is designed to assist SMEs and start-ups in preparing robust, technically aligned proposals that support the AMALTEA project's mission: to transform the construction sector through AI, robotics, and data-driven innovation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



# 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 AND DIGITAL TOOLS |
| --- |
| **DIGITAL SOLUTION FOR DESIGN:**<br>• DT1. AI enhanced parametric design system<br>• DT2. Automated simulation for façade components (sustainability, mechanical and thermal simulations)<br>• DT3. Extended digital twin of the façade design, manufacturing, installation, and recycling<br>**DIGITAL SOLUTION FOR MANUFACTURING**<br>• DT4. AI for manufacturing process optimization with collaborative robots<br>• DT5. Automated welding system<br>• DT6. Automated precision glass bonding with structural silicone<br>• [DT7. AI enhanced quality control of the façade manufacturing<br>**DIGITAL SOLUTION FOR INSTALLATION**<br>• DT8. Collaborative mobile robotic platform for on-site installation of facades<br>• DT9. Advanced control system and sensors<br>**DIGITAL SOLUTION FOR DISASSEMBLY AND RECYCLING**<br>• DT8. Collaborative mobile robotic platform for on-site installation of facades<br>• DT10. Automatic strategies for material sorting and recycling |

## 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)

### 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:**
  - Navigates dynamically in semi-structured environments.
  - Cooperates with human workers via gesture or tablet interfaces.
- **Applicant opportunity:** Provide localization and mapping modules (SLAM), task planning, or AR interfaces for operator interaction.

### 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.

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 ofhighly 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
- **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.

### 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

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 first Open Call**:

## Challenge 1: Integrated data storage and standardization for digital facade systems

1ST FUNDING INSTRUMENT: **SOFTWARE SOLUTIONS** FOR FACADE APPLICATIONS

**Contextualization:**

Problem: The AMALTEA project targets the digital transformation of facade systems, optimizing the entire value chain—from design and manufacturing to installation and recycling—through advanced digital and robotic technologies. Currently, fragmented data storage systems and non-standardized data formats create significant inefficiencies, limiting real-time data accessibility, collaboration, and effective use of digital twins.

**Challenge description:**

Goal: This combined challenge addresses the need for an integrated, robust, and scalable data storage solution, alongside a standardized data and communication framework to ensure seamless interoperability among diverse digital tools, robotic systems, and digital twins.

Innovation Focus: It involves developing unified platforms and standardized protocols for effective real-time data consolidation, management, and exchange across all phases of the facade system lifecycle.

**Pilot environment:**

Pilot setup: Solutions will be tested in realistic construction scenarios involving complex facade installations, with diverse stakeholders (architects, engineers, robotics operators, quality inspectors) requiring simultaneous access to standardized, integrated data.

The validation will assess integration capability with parametric design tools, robotic manufacturing and installation equipment, environmental sensors, and digital twin platforms.

**Expected impact:**
Industry Impact: The implementation of integrated data storage combined with standardized interoperability will significantly enhance efficiency, accuracy, and collaboration throughout the facade lifecycle. It will notably reduce data retrieval delays, improve decision-making processes, decrease data translation errors, shorten project timelines, and elevate overall quality.
SME Benefits: SMEs will specifically benefit from affordable, advanced digital solutions, empowering their competitive participation in complex construction projects.

**Evaluation criteria and success metrics:**
Criteria: include integration capability, data retrieval speed, compatibility with existing tools, robustness, scalability, ease of implementation, and effectiveness of real-time data exchange.
Metrics: Metrics for success include achieving at least a 40% improvement in data retrieval speed, a 50% reduction in data integration and translation time, confirmed compatibility across all AMALTEA digital solutions, and positive stakeholder validation in pilot tests.

## Challenge 2: Parametric solution generator for AI training

1ST FUNDING INSTRUMENT: **SOFTWARE SOLUTIONS** FOR FACADE APPLICATIONS

**Contextualization:**
Problem: facade design increasingly depends on AI, which requires robust and extensive datasets. While abundant facade data exists, linking geometry with accurate material properties remains a key challenge for precise simulations. Automating data integration and transforming raw inputs into structured datasets suitable for training advanced surrogate models is essential.

**Challenge description:**
Goal: Develop a parametric tool in Rhinoceros/Grasshopper that compiles external parameters with design geometries and automates the integration of material performance properties with the support of the consortium team.
Innovation Focus: Extend current methodologies to identify and collect relevant data from the facade industry and enable consortium partners to efficiently generate and manage thousands of parametric design samples using their own infrastructure. This includes delivering the logic, workflows, and tools needed to run large-scale simulations iteratively and independently—ensuring reproducibility and adaptability for future use cases.

**Pilot environment:**

Pilot setup: The solution will be evaluated within a collaborative consortium environment, focusing on usability, dataset quality, and performance in supporting AI model training workflows.

**Expected impact:**

Industry Impact: Streamlined creation of comprehensive datasets required for advanced AI training will advance facade design and facilitate the development of AI models capable of delivering transformative and sustainable design solutions.

SME Benefits: Developing scalable data generation tools within the consortium paves the way for future accessible solutions, helping SMEs adopt AI-driven design innovation.

**Evaluation criteria and success metrics:**

Criteria: Usability, dataset completeness and accuracy, scalability of computational workflows, and integration with consortium infrastructure.

Metrics: Generation of at least 5,000 facade design iterations over nine months within the consortium infrastructure, including relevant performance properties, the demonstration of scalable computation workflows, and positive validation of the consortium partners.

## Challenge 3: Web-based GUI for design decisions of platform-independent accessibility

1ST FUNDING INSTRUMENT: **SOFTWARE SOLUTIONS** FOR FACADE APPLICATIONS

**Contextualization:**

Problem: As facade design becomes more data-driven, the need for tools that balance aesthetics, performance, and sustainability grows. AMALTEA systems use multi-objective optimization (MOO) and surrogate models to explore design alternatives, but interpreting complex datasets remains challenging. Integrating a Retrieval-Augmented Generation (RAG) system can help users by providing relevant data, past solutions, and real-time insights, improving decision-making.

**Challenge description:**

Goal: Develop a web-based, platform-independent graphical user interface (GUI) that supports the selection and exploration of optimized AMALTEA facade designs.

Innovation Focus: The tool should visualize outputs from computational simulations and surrogate models with interactive features like Pareto fronts and parallel coordinates plots. It must integrate a RAG system to provide contextualized suggestions and retrieve relevant design data to assist with user queries. The responsive, browser-based, platform-independent interface should support intuitive exploration and informed decision-making.

**Pilot environment:**

Pilot setup: A virtual design environment will simulate the development of early-stage facades, allowing architects and engineers to test and evaluate design alternatives using AMALTEA's parametric design system. The environment allows for the iterative refinement of GUI and RAG features based on user feedback.

**Expected impact:**

Industry Impact: The tool will accelerate facade design decision-making, reduce iteration times, and promote sustainable, cost-effective solutions.
SME Benefits: An easy-to-use, browser-based solution will empower SMEs with limited resources or expertise to efficiently explore complex facade design options, enhancing competitiveness through smart, informed decision-making.

**Evaluation criteria and success metrics:**

Criteria: Usability and intuitiveness of the GUI, clarity and effectiveness of data visualizations, relevance and accuracy of RAG-generated insights, responsiveness and interactivity of the interface, accessibility as a fully browser-based platform, and compatibility with AMALTEA's digital design tools.
Metrics: Faster design decisions, improved design quality, increased data-driven choices, and positive user feedback on usability and impact.

## Challenge 4: Advanced inspection and control systems for quality assessment in robotic manufacturing

2ND FUNDING INSTRUMENT: **HARDWARE SOLUTIONS** FOR FACADE APPLICATIONS

**Contextualization:**

Within the AMALTEA project, ensuring high-quality standards during off-site manufacturing of facades—particularly for welding and glass bonding (sealing) processes—is critical. Current quality inspection and control methods are predominantly manual, inefficient, time-consuming, and prone to inaccuracies, negatively affecting productivity and safety.

**Challenge description:**

This integrated challenge involves developing automated inspection and control systems that utilize advanced sensor technologies, artificial intelligence (AI), machine learning (ML), deep learning (DL), and computer vision algorithms. The solutions should accurately detect and classify welding and sealing defects, as well as optimize process parameters proactively to achieve zero-defect outcomes.

**Pilot environment:**

Testing and validation will be conducted within realistic manufacturing environments typical of facade production lines, focusing on robotic welding cells and sealing stations. The pilots will evaluate the systems' capabilities to detect, classify, and prevent various types of welding and sealing defects swiftly and precisely.

**Expected impact:**
Implementation of advanced automated inspection and control systems will significantly enhance the accuracy, consistency, and efficiency of quality assessment processes. It will reduce inspection times, eliminate defects proactively, and elevate overall manufacturing productivity and reliability. SMEs will benefit by accessing innovative, efficient, and reliable quality assurance technologies, enabling their competitive participation in advanced construction and manufacturing markets.

**Evaluation criteria and success metrics:**
Criteria include accuracy, precision, speed, and the effectiveness of defect detection and prevention models. Key performance metrics are achieving over 90% accuracy, precision above 75%, and inspection/control processing times below 0.5 minutes per item for glass bonding and achieving an 80% reduction in welding inspection times while maintaining high consistency across diverse weld geometries.

## Challenge 5: Adaptive manufacturing and quality control

2ND FUNDING INSTRUMENT: **HARDWARE SOLUTIONS** FOR FACADE APPLICATIONS

**Contextualization:**
Traditional manufacturing relies on predefined shop drawings and precise positioning. This limits flexibility when producing unique facade geometries. A new adaptive system is needed to overcome these constraints.

**Challenge description:**
The aim is to develop an adaptive manufacturing process capable of handling any panel geometry without requiring predefined CAD files or strict positioning. Using computer vision and mesh generation, the system will automatically generate toolpaths for welding (profiles)or sealing (glass).

**Pilot environment:**
Testing will take place at the FDB manufacturing facility (Budapest, Hungary) under the AMALTEA project. A variety of facade modules with different geometries and alignment conditions will be used to assess the system's flexibility and performance. Vision systems (camera or LiDAR), real-time mesh generation, and robotic execution will be validated under real-world production constraints. Integration with QA tools will also be explored to close the loop between fabrication and inspection.

**Expected impact**:
The proposed solution will enable manufacturers to process custom designs without modifying production lines or generating new templates. This will significantly reduce time and cost for small batches and unique projects, while improving responsiveness to architectural demands. It will also increase the use of robotics in flexible construction settings and enhance quality control by leveraging the same vision system for inspection tasks.

**Evaluation criteria and success metrics:**
The solution will be evaluated based on its ability to accurately recognize geometries using vision-based systems, generate and execute precise toolpaths without relying on predefined drawings, and maintain robust performance despite variations in profile placement. Integration with quality assurance processes and compatibility with existing robotic systems will also be essential to ensure practical deployment in manufacturing environments.

Success will be measured by the percentage of panels produced without the need for shop drawings, the reduction in setup and production times, and the consistency and quality of welds or sealings across diverse geometries. Additional metrics include improvements in traceability, error detection, and defect identification through automated QA processes.

## Challenge 6: Advanced sensor integration for precise positioning in mobile robot navigation and building operations

2ND FUNDING INSTRUMENT: **HARDWARE SOLUTIONS** FOR FACADE APPLICATIONS

**Contextualization:**
During the panel installation phase, the mobile robotic platform will work on a construction site, which is an unstructured environment. The system needs to map its environment through multiple sensors (3D LIDAR, depth/stereoscopic cameras and total station, etc.) and be able to identify elements in relation with the construction site to perform its work.

**Challenge description:**
Irregular environments like construction sites pose significant challenges for tracking and localizing mobile robotic platforms. As the AGV navigates in real time, it must reconstruct its surroundings by fusing sensor data into a unified point cloud. The core challenge lies in developing sensor fusion middleware capable of real-time point cloud integration while the robot is in motion. This fused cloud—generated from 3D LiDAR and depth/stereo cameras—offers higher resolution in targeted areas and enables object and marker detection (e.g., supports, construction elements, AprilTags and other visual markers) through custom segmentation algorithms. By combining imaging data with total station prism coordinates, the system produces an RGB point cloud accurately referenced to the building. This enriched point cloud enables reliable object recognition, collision avoidance, and real-time segmentation, with standardized ROS 2 output for autonomous navigation or assisted robotic control.

**Pilot environment:**

The solution will first be tested for objected detection and collision avoidance in tests implement in a laboratory following similar conditions of the processes found in the final pilot construction site. It will focus on the capabilities of the self-sufficient navigation with sub-cm accuracy, with a previous simulated environment located at Tecnalia facilities.

**Expected impact:**

Reduction of calibration time, flexible sensor operations, improvement of the human-machine operations and reduction or elimination of the human errors during the installation with the collaborative equipment.

**Evaluation criteria and success metrics:**

A stable and accurate PC merging and fusion solution featuring ROS compatibility, open-source architecture, simple sensor calibration routines, sub-centimeter accuracy, reliability on PC fusion, minimized deviation and objects and markers detection.

## Challenge 7: Positioning of the robot platform and navigation with collision and interference detection

2ND FUNDING INSTRUMENT: **HARDWARE SOLUTIONS** FOR FACADE APPLICATIONS

**Contextualization:**

Within the AMALTEA project, precise positioning of the robotic platform and its navigation is critical. Current 3D navigation methods are limited, lack accurate total referenced navigation positioning in non-tracked environments which leads to poor robotic autonomy and human-robot collaboration.

**Challenge description:**

The challenge aims to develop an advanced 3D localization and navigation software stack that enables real-time navigation based on a dynamically generated 3D map. This map is converted into a navigation-ready format for path planning, obstacle detection, and avoidance. The solution integrates advanced sensors, AI-driven algorithms, and dynamic positioning systems to ensure accurate, real-time navigation in unstructured environments. A user-friendly HMI, accessible via the robot's onboard web server, will allow full operation without accessing system terminals—ideal for field use and non-technical users. The system will be deployed as a ROS 2 package, providing the core infrastructure for autonomous behavior in environments without fixed landmarks or predefined layouts. Innovation focuses on the environment, live 3D mapping technologies, AI navigation, and high-precision positioning using 3D RGB point clouds and total station referencing to enable object recognition, collision avoidance and precise self-localization.

**Pilot environment:**

The solution will first be optimized in a laboratory setting before deployment on a construction site. Testing will take place in realistic, unstructured environments—with features like fall-out openings—to validate the precision and efficiency of the navigation system.

**Expected impact:**

Enabling robotic navigation in unstructured environments advances construction automation, sets a new standard for autonomous construction robotics, and supports the integration of larger, AI-driven systems in complex large-scale assemblies.

**Evaluation criteria and success metrics:**

The system enables motion control of the robotic platform through an HMI interface in two modes: autonomous and assisted navigation. In autonomous mode, the platform follows a planned path from point A to B using a 3D map while avoiding obstacles. In assisted mode, the operator manually controls the platform via the HMI, with software overrides that prevent collisions and reduce human error—ensuring safe use even by non-technical users. The solution aims for ±5 mm positioning accuracy, reliable performance under varying site conditions, and easy integration with existing robotic systems. It will be validated using a specific robotic platform and sensor setup in diverse real-world environments.

## Challenge 8: Life cycle and cost assessment

1ST FUNDING INSTRUMENT: **SOFTWARE SOLUTIONS** FOR FACADE APPLICATIONS

**Contextualization:**

Problem: LCA and LCC assessments for facade modules are complex due to limited and fragmented data. Emerging sustainable materials and construction techniques are often poorly represented in conventional databases. Advanced AI-driven data extraction and analytics offer new ways to close data gaps and enhance assessment accuracy..

**Challenge description**

Goal: Evaluate the environmental impact and cost of the complete facade value chain in AMALTEA.

Innovation Focus: Development of intelligent, user-friendly tools that automate and streamline LCA and LCC using AI for data inference, enrichment, and predictive modeling—enabling more accurate, dynamic, and holistic assessments.

**Pilot and testing environment**

Pilot setup: Testing will be carried out within the AMALTEA project using real-world data from manufacturing, installation, operation, and end-of-life stages of facade modules. AI will assist in harmonizing and processing multi-source data for improved lifecycle evaluation.

**Expected impact**

Industry impact: The solution will support manufacturers and construction stakeholders in making data-driven, sustainable decisions—minimizing waste and energy use while optimizing materials and lowering costs through intelligent analytics.

SME Benefits: Easy-to-use tools powered by AI and smart data integration will enable SMEs to perform reliable assessments with reduced expertise and effort

**Evaluation criteria and success metrics:**

Criteria: Usability, precision in LCA and LCC outcomes, AI integration for data acquisition and processing, and compatibility with BIM and other design tools

Metrics: Shorter assessment times, broader use of circular economy practices, enhanced environmental performance, and decreased lifecycle costs in design and implementation phases

# 5.

# MEET THE CONSORTIUM