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D1.1 CoP targets report

29/04/2025

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D1.1 CoP targets report

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ABBREVIATIONS & ACRONYMS

BEN	Beneficiary
COO	Coordinator
EC	European Commission
HE	Horizon Europe
WP	Work Package
CoP	Community of Practice
AI	Artificial Intelligence
SME	Small and Medium Entrepreneurs
OC	Open Call
TRL	Technology Readiness Level
DIH	Digital Innovation Hub
KUL	KU Leuven (Katholieke Universiteit Leuven)

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AID4SME

Executive Summary

The AID4SME project aims to advance AI and Data-driven solutions tailored for SMEs and startups, fostering innovation and accelerating digital transformation. The project's approach is structured around four key pillars that encompass the full lifecycle of AI and Data technologies: (1) data collection, (2) creation of insights, (3) support, and (4) automation. These pillars are supported by carefully selected high-TRL playgrounds (industrial sectors) and low-TRL playgrounds (academic and research setting), chosen based on two guiding principles: alignment with Green Deal objectives and strong market potential. The low and high TRL playgrounds will provide opportunities for SMEs to test and validate approaches and solutions, together with the AID4SME consortium to solve challenges related to the green deal.

AID4SME provides a platform for SMEs and startups to demonstrate, validate, and scale their AI-driven solutions. Beyond technical validation, the project actively fosters knowledge exchange and ecosystem building through AI & Data events, networking opportunities, and educational programs through the formation of a Community of Practice (CoP). The CoP will guide the SMEs and Start-ups during the development, demonstration and marketing of the challenge solutions with expert knowledge, first-hand market intelligence and independent testing and validation facilities provided by the academic partners, in which the SMEs and Start-ups can safely exchange data and test and validate their low TRL solutions.

The purpose and scope of this report is to provide a comprehensive overview of the CoP established under the AID4SME project. This document outlines how the CoP is designed to support SMEs, the structure and members of the CoP as well as its technical domains and targets, the contributions of partners, and the expected outputs. The report presents an extensive overview of the low- and high-TRL Playgrounds available to the CoP and highlights future recommendations to ensure the CoP's sustainability beyond the project's duration.

Key highlights include:

- Collaborative platforms (e.g., project website, F6S open call platform, CoP group platform) for community interaction.
- Modular, EQF-aligned training programs focusing on AI, green skills, and data literacy.
- Integration with external networks such as AI-on-Demand and DIHs to amplify reach and sustainability.
- Technical playgrounds offering tailored testing environments.

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1 Introduction

A Community of Practice (CoP) is a collaborative structure that brings together individuals who share a common interest or profession, with the goal of learning from each other, solving shared challenges, and advancing knowledge and practice within a specific domain. The structure of any CoP is made up of three core elements:

Domain:

The domain legitimizes the CoP and defines the area of shared interest that binds the members together. It creates common ground and gives meaning to the actions of individuals. In AID4SME, this domain revolves around the application of artificial intelligence (AI) and data technologies in support of sustainable innovation for SMEs specifically aligned with the European Green Deal and the digital transition.

Community:

The notion of a community defines the social fabric of the CoP. It brings together diverse actors who interact regularly to exchange knowledge, co-develop ideas, and support one another. A strong community encourages open dialogue and the sharing of insights and best practices. In AID4SME, the CoP is purposefully designed to be inclusive and diverse.

Practice:

Practice refers to the shared knowledge, tools and methods that the community develops and applies. While the domain provides the overarching topic of interest, the practice is the specific focus that gives depth to community interactions. It evolves as members engage in problem-solving, mentoring, experimentation, and reflection. In AID4SME, the practice encompasses technical infrastructures (low- and high-TRL playgrounds), digital tools, training content, and mentoring.

In the context of AID4SME, the CoP serves as a cross-disciplinary ecosystem that facilitates continuous knowledge exchange, capacity building, and co-creation among stakeholders such as the chosen SMEs, research institutions, digital innovation hubs (DIHs), and industrial partners. The CoP will be used for shared experimentation and applied problem-solving, which can significantly accelerate innovation and adoption of AI and digital transformation.

1.1 Structure of the CoP

The structure of the AID4SME CoP is designed to enable synergies between research, industry, and innovation support actors. Members include:

- **Academic and research institutions**: KUL, JSI, UGENT and LEITAT) offering mentoring and low-TRL playgrounds for early-stage technology development.
- **Industrial partners** (ARC, LTH, ELES and VKR) operate high-TRL environments for real-world validation.
- **Digital Innovation Hubs and support entities** (I2M, LOGI, EWF, F6S, GreeneDIH, LTC, ISQ) providing technical support, training, and OC coordination.
- **SMEs and startups** engaged through the challenges defined in the OCs, receiving access to technical support and infrastructure.

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The CoP governance includes working groups focused on education, mentoring, and the AID4SME technical domains, with coordination roles distributed among partners. Over the project's duration, membership will expand via the OCs, where several SMEs will be chosen to work on the challenges defined in the deliverable D2.1.

2 CoP targets and output

The AID4SME CoP aims to provide targeted **education programs**, dedicated **mentoring**, a **collaborative platform** and **technical support** to the chosen SMEs to accelerate their adoption of AI and data-driven solutions. Its core output includes tailored training paths aligned with digital and green skills, one-on-one mentoring by experts from **academic and research institutions** within the CoP, as well as collaborations to address real-world **challenges defined by industrial partners**. Through this approach, the CoP enables SMEs to co-develop and validate innovative solutions in well-equipped environments, bridging the gap between early-stage innovation and market-ready applications.

Additionally, the CoP will offer educational opportunities for the broader public, fostering AI awareness and literacy, besides the support of the chosen SMEs.

2.1 Education programs

Topics Covered in Training Programs and Workshops

The training programs and workshops under Task 1.2 will encompass a diverse range of topics to support SMEs in AI-driven digital transformation and green skills development. Key topics include:

- AI & Data Technologies: Fundamentals of AI, data analytics, decision support, automation, and data-driven insights.
- Green Skills: Sustainable digital transformation, energy-efficient AI applications, circular-economy considerations in manufacturing.
- Modular Education Framework: Adaptable training modules designed for different levels of expertise (aligned with the European Qualifications Framework - EQF).
- Sector-Specific Applications: Practical implementations of AI & Data technologies tailored for SMEs in various industries.
- Regulatory and Ethical Considerations: Understanding the ethical and legal frameworks surrounding AI deployment in SMEs.

Identification of Required Topics and Prioritization

To ensure relevance and impact, the identification of training topics will follow a structured approach:

- Needs Assessment: SME mentor (T1.3) will evaluate SME-specific skill gaps through engagement with industry stakeholders.
- Customization & Prioritization: Topics will be tailored to the needs of SMEs, ensuring that basic AI and data literacy modules are accessible to a wide audience, while advanced AI applications are targeted at specialists.
- Expert Contributions: Project partners will support the definition of program content by integrating state-of-the-art knowledge in AI, green skills, and data-driven decision-making.

Programs for the Selected SMEs (Individual and Groups of SMEs)

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For SMEs selected through the OCs, customized training paths will be developed based on individual or group needs. These will include:

- Tailored Educational Paths: Designed after a structured needs assessment to match the SME's digital maturity and sector-specific challenges.
- Workshops & Hands-on Training: Focused training sessions to ensure practical application of AI and data technologies in SME operations.
- Mentored Learning: Continuous engagement with SME mentors to facilitate learning and implementation of AI-driven solutions.
- Collaborative Learning: Group-based training for SMEs facing similar challenges, promoting knowledge exchange and best practices.

Programs for the Public

Beyond SME-focused programs, the CoP will offer educational opportunities for a wider audience, fostering AI awareness and literacy. These programs will include:

- Awareness and Introductory Sessions: Public webinars and e-lectures on AI, digital transformation, and green skills.
- Open Online Courses: Modular online training available to the general public, addressing various EQF levels.
- Community Engagement: Dissemination through connected platforms, industry events, and workshops to enhance AI adoption across sectors.

By implementing these structured training programs and workshops, AID4SME aims to drive digital upskilling and reskilling among SMEs, ensuring they are equipped to navigate the evolving AI and green economy landscape.

Initial Action Plan for Training Development

Identify SME Training Needs

- Conduct a survey and interviews with SMEs to assess their current skill levels and training gaps.
- Engage industry stakeholders and SME mentors to validate skill gaps and tailor training programs accordingly.
- Categorize SMEs based on digital maturity and specific training needs.

Identify Partners Training Options

- Map existing training programs offered by project partners
- Assess alignment of partner training content with SME needs and identify any gaps.
- Develop a structured repository of partner-led training options for seamless integration into the SME training programs.

Identify Other Relevant Training

- Research and compile additional training materials from external sources such as OECD, European Commission, and industry bodies.
- Explore open-access courses, certifications, and e-learning resources to complement SME training needs.
- Establish partnerships with training providers to broaden the scope and accessibility of the programs.

2.2 Mentoring

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In order to assist the chosen SMEs with the development, deployment and exploitation of the solutions, as well as ensuring SMEs stay on track with the envisioned pace of the work, the mentor role is foreseen within AID4SME. Mentoring belongs to T1.3, due to start in M9. However, the consortium has decided to frontload the definition of mentor to facilitate the process of forming the CoP and its responsibilities, as well as having a better view on the workload that mentoring requires.

Mentors belong to the CoP and are employed by one of the beneficiaries, specifically the ones owning the playgrounds related to each SME project. Their role involves both duties as a facilitator between the SME and the beneficiary, and scientific involvement within the SME projects. A more detailed list of tasks for the mentor, including a checklist of requirements and a list of responsibilities, will be made available within T1.3. The expected frequency of the occurrence of mentoring sessions will depend on the playgrounds and on the nature of related SME projects. Following the mentoring sessions, an alignment with the CoP is foreseen. The mentor assignment will happen immediately after accepting an SME project: a list of mentors will be included both in D3.1 at M11 and in D3.2 at M23. If multiple SMEs are assigned to the same beneficiary, the latter can appoint one or multiple mentors. When publishing challenges in the OCs and accepting SMEs, care needs to be taken to ensure that the load among playground owners is properly and fairly distributed.

2.3 Collaboration Platforms

AID4SME project website

The AID4SME project website (https://aid4sme.eu/) acts as the main online interface for communication purposes with the public, being a suitable platform to address the different target audiences of the project, who will be able to access AID4SME goals, challenges, services and results in a quick click. The project website is a fundamental tool that allows the reach of all stakeholders coming from different geographical locations, industries and expertise. It will work as the project digital hub for SMEs and other stakeholders to keep connected.

The website will be the focal point of AID4SME display of key information such as the project OC challenges and the Community of Practice, in addition to being a repository for the project updates and link with the AI-on-Demand platform. Additionally, the website will be the entry point for the SMEs to the AID4SME CoP. The CoP is accessed through the website, will act as the support for community building and information exchange and is hosted by F6S.

Open call Platform

The OC platform is part of the F6S solution that provides the leading platform for application management for commercial, corporate, government, and university worldwide. Every year F6S processes more than 700.000 applications and delivers about €2 billion to start-ups/SME. This provides a form to be completed and submitted by the OC applicant. The platform follows GDPR principles and ensures that applicant information is confidential and used only for OC purposes.

The OC applications will be submitted through the F6S platform. Applicants will click on a link on the website to open a form on the platform. This allows the submission and evaluation of applications, and the extraction reports to support other documents like analytics and statistics reports.

Ai-on-Demand platform

The AID4SME project will actively collaborate with the AI-on-Demand digital platform, with the objective of providing AID4SME tools and framework to that platform, in addition to offering to AID4SME SMEs the tools offered by AI-on-Demand. The goals are to enrich the AI-on-Demand platform repository with AID4SME

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innovative solutions while enabling the deployment of technology bricks from the platform in AID4SME, increasing the adoption of combined AI and data technology.

Data sharing during the use case implementation

During the development and implementation of the use cases, data exchange between the chosen SMEs and the respective playground providers is essential for effective collaboration. To ensure secure, centralized, and well-structured data sharing, a dedicated SharePoint environment hosted by KUL may be used. This platform can serve as the main file exchange hub for each use case, allowing SMEs and playground owners to upload, manage, and access relevant datasets, documentation, test results, and reports. Access will be restricted to the parties involved, ensuring data confidentiality.

3 Technical Domains of the CoP

The AID4SME CoP is structured around four technical domains that combine AI and data technologies: **Automation**, **Data Collection**, **Decision Support**, and **Insights**. These domains are represented by concrete use cases, called "challenges", (see details in D2.1) from industrial partners and are accessible through the CoP's low- and high-TRL playgrounds.

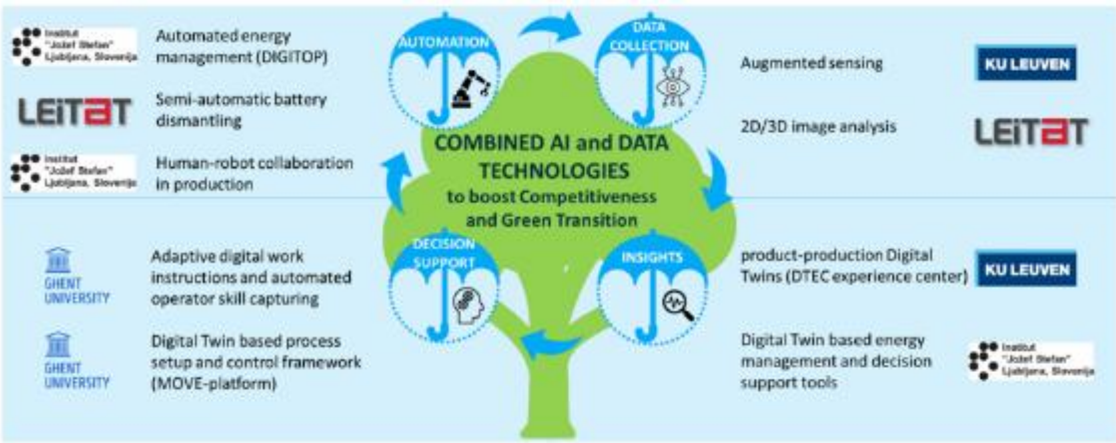

FIGURE 1: OVERVIEW OF THE TECHNICAL DOMAINS OF THE COP AND THE CORRESPONDING SCIENTIFIC PARTNERS

3.1 Low-TRL Playgrounds

The scientific, low-TRL playgrounds in the CoP provide a safe and flexible environment for **early-stage experimentation and prototyping** of AI and data solutions. Hosted by research partners within the CoP, these playgrounds offer access to advanced testing infrastructure, simulation tools, and expert mentoring to help SMEs explore innovative ideas before deployment. These include for example a platform for data analytics (UGENT), a Digital Twin Experience Center (KUL), robotic testbeds (JSI) and the labs for EV battery disassembly and photonics-based 2D/3D image analysis (LEITAT).

3.1.1 KUL playgrounds

The playgrounds offered by KU Leuven are:

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- Fully instrumented dynamic lab
- Virtual sensing demonstrators
- Industrial dynamic systems
- DTEC
- Digital polymer processing pilot plant
- Re-/Demanufacturing lab

1. Fully instrumented dynamic lab

A fully instrumented lab for electromechanical dynamic (noise, vibration, motion) testing and monitoring

Component and system-level testing and identification are key steps in designing and operating mechanical systems. This playground consists of several characterization and testing facilities, aiming to fully identify a wide variety of mechanical components. More specifically, these include:

- **Bushings**
  A combination of a quarter car suspension test rig, a high-frequency 6-DOF shaker table and a servo-hydraulic high-frequency testing system allows characterization of elastomeric components in various loading conditions to support validation of novel designs and materials.
- **Tires**
  The tire-on-tire NVH test setup allows testing and validation of different scenarios under controlled conditions for speed and adjustable preload, while measuring vibration levels, reaction forces or radiated acoustics.
- **Acoustics**
  standard (impedance tube, semi-anechoic chamber) and non-standard (flow acoustic characterization of duct systems, vibro-acoustic characterization of panels) test-rigs are available, as well as a wide range of acoustic exciters, sensors and probes to conduct vibro-acoustic testing and source-identification.
- **Vibrations**
  Testing facilities are available for various mono and multi-axial vibrational tests, such as modal analysis, durability and shock tests. With an advanced set of data acquisition systems, sensors, exciters and more, both frequency and time domain studies are possible.
- **System dynamics**
  Novel identification tools to identify physics and data-driven models.
- **Signal processing**
  Advanced signal processing solutions to extract the hidden patterns and information related to the system dynamics from sensor data.

FIGURE 2: TEST SETUPS WITHIN THE DYNAMIC LAB

2.Virtual sensing demonstrators

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Lab-scale, yet industrially relevant demonstrators of digital-twin-based virtual sensor developments to reveal hidden information

Virtual sensors are a valuable tool to identify and monitor the operational conditions of common mecha(tro)nic systems. LMSD leverages Augmented Reality (AR) and Virtual Reality (VR) technologies to enhance the design, analysis, monitoring and maintenance of complex mecha(tro)nic systems. This approach enables a more intuitive understanding of mechanical interactions, spatial configurations and performance under various conditions.

3. Industrial dynamic systems

Full-scale operational industrial machine demonstrators (hybrid vehicles, weaving looms, drivetrains, compressors, etc) for higher TRL developments

Other than facilities and equipment for identification purposes, a variety of full-scale platforms are available for their validation, including integration of sensors and models to monitor changes in dynamic behavior. These span a wide range of applications:

- **Vehicle dynamics**
  The hybrid concept car and e-rod kit car are available for testing various automotive design, (virtual) sensing and control approaches. These platforms are being continuously instrumented with sensors and actuators, with a modular architecture that allows them to accommodate different scenarios.

FIGURE 3: HYBRID CONCEPT CAR (LEFT) AND E-ROD KIT CAR (RIGHT)

- **Gearbox and bearings**
  Modular back-to-back test rigs for fault detection, diagnosis and prognosis of gearboxes and bearings. They are equipped with actuators, accelerometers, microphones, torque meters, encoders, zebra tapes and thermo-sensors and operate under different conditions.

FIGURE 4: GEARBOX AND BEARINGS TEST RIG

- **Vibration**
  A weaving loom machine is available to perform virtual sensing-based vibrational forces assessment.

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FIGURE 5: WEAVING LOOM MACHINE

4. DTEC

Digital Twin Experience Centre for mecha(tro)nic augmented sensing

Product lifecycle is the core focus of the "Infinity Loop" paradigm, a straight-through digitalization framework that uses digital twins to seamlessly integrate digital information across different lifecycle stages. LMSD is equipped with the necessary hardware and software components that target selected products. This approach allows for improving not only production quality and product performance but also optimizing maintenance strategies and extending the lifespan of systems.

5. Digital polymer processing pilot plant

Digital polymer processing pilot plant Product-production Digital Twin (polymer processing pilot lab – injection moulding)

This playground provides a fully digitised polymer processing lab complemented with a digital twin of an injection moulding process, linking process parameters with product performance. Samples can be produced on a 100-tonnes full electric injection moulding machine, equipped with conveyor, high injection temperature (<400°C) and high injection speeds. Maximum sample sizes are 30x20x800 mm with wall thickness up to 5mm.

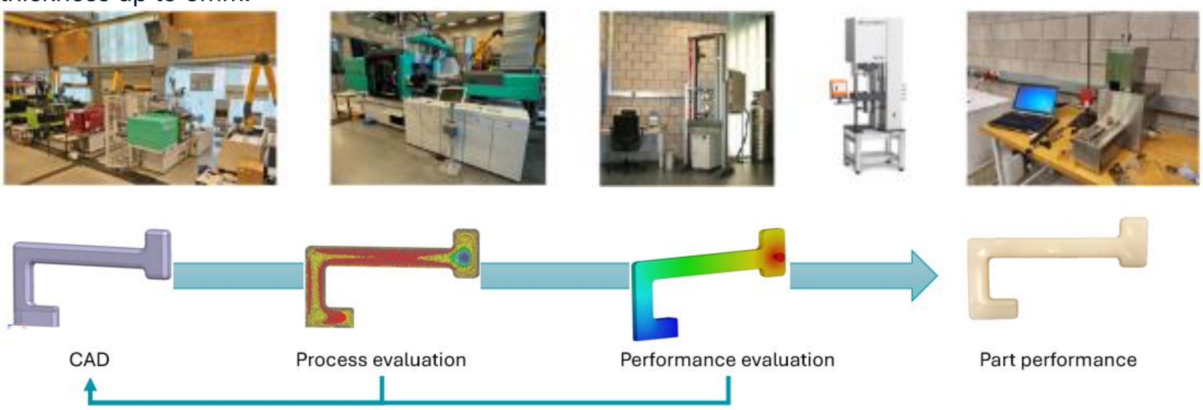

FIGURE 6: POLYMER PROCESSING LAB WITH DIGITAL TWIN

Available (digital) infrastructure

- product-production simulation framework allowing to account for injection moulding manufacturing process effects on the final structural dynamic performance of parts during the part design phase [1]. In this manners insight is generated in the process induced geometry changes (shrinkage, warpage), property distributions (density, fiber orientations), as function of the used material and IM process settings.

- Sensorised moulds are available to calibrate process simulation models whereas a specific sensor location optimization tool is in development to ensure sensor placement in the best suitable location for tracing back performance issues caused by differences in the process conditions.
- Performance can be validated using the available equipment for static and dynamic product characterization (see lab infrastructure Leuven).
- Input material properties can be characterised based on thermo-rheological property measurements of polymers (viscosity, pvT, thermal conductivity)
- As of fall 2025 a shredder and compounder is available for recycling polymers and investigating the use of recycled materials.

6. Re-/Demanufacturing lab

Fully instrumented lab for (semi) automated demanufacturing of products into their components or composing materials in support of product reuse, repurposing, remanufacturing, recycling, refurbishing, etc.

The transition towards a circular economy will go hand in hand with the transition to an industry 4.0. The technologies that characterise the industry 4.0 also offer great opportunities for the development of more flexible and intelligent re- and demanufacturing systems. Both for the purpose of reuse and material recycling robotic systems are developed that can non-destructively or destructively disassemble or dismantle products in a man-machine cooperation, leaving only some of the complex tasks for operators. To demonstrate the technical feasibility and economic viability of such innovative processes, lab and industrial pilots are developed, as well as the related software adopting various state-of-the art (deep learning) computer vision technologies.

FIGURE 7: FACILITIES OF THE RE-/DEMANUFACTURING LAB

The first step in an enhanced re- and demanufacturing process is the inspection and recognition of the product type or model, as well as the product condition. To increase the overall efficiency of an organization performing reuse, repair, repurposing, refurbishing and remanufacturing applications, computer vision technologies are developed. These (web based) applications are developed to assist in product recognition, disassembly, testing, reassembly and reselling by providing information and guidance.

3.1.2 UGENT playgrounds

MOVE data analytics platform

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Data analytics platform for AI & data technology applications in a production environment that can be used to test general aspects of data analytics and AI with proprietary business data in a vendor-neutral way.

MOVE is a flexible, microservices-inspired platform designed for orchestrating processing chains to ingest, process, and extract insights from data streams. It supports a wide range of operations, including data filtering, augmentation, outlier detection, sampling, clustering, and classification, among others. MOVE is built to facilitate both research activities and pilot initiatives, providing capabilities for data collection as well as integration with higher-level services such as dashboards and API endpoints.

The playground can be utilized for a number of applications, among others, including:

- Data integration
- Generation of production knowledge

  Including, among others, data quality analysis, visualizations of missing data, incorrect data, validation of data quality handling strategies, etc.

- The development of ML/AI models

  For instance, predicting the quality status of the casted parts to allow the domain expert from the R&D department to optimize process parameters and thereby reduce waste in the process and assist the operator to take informed decisions about the quality of the casted part (early detection of defects, i.e., parts with insufficient quality will be removed from the process chain).

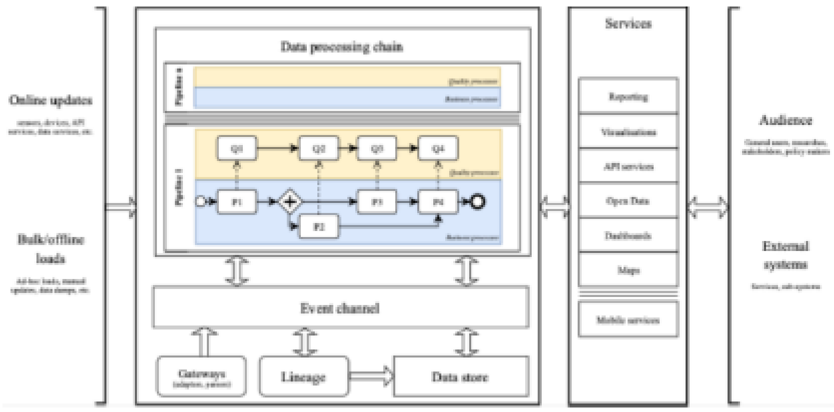

FIGURE 8: SYSTEM ARCHITECTURE OF THE MOVE PLATFORM

Smart and Agile Assembly Lab (SAAL)

The Smart and Agile Assembly Lab provides a near-industrial environment to test and validate assembly concepts and technologies for medium to large product assembly environments.

This Flexible infrastructure includes test equipment to demonstrate and validate flexible assembly concepts incl. a digital work instructions platform, work cells with various operator support (e.g., human interface Mate – HIM, Iristick), collaborative workspaces and operator monitoring system (e.g., smart floor).

The work area can be reconfigured quickly. Infrastructure to build multiple **manual assembly workstations** is available. The area consists of a zone where all activities can be monitored using 10 RGB cameras. In addition, a gantry system is hanging above the work zone. Sensors or assistive technologies can be mounted on a slider of the gantry system, allowing them to be mobile and follow a target (either an object or a person).

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The infrastructure consists of a 100m² controlled, realistic environment for validating and demonstrating smart, flexible assembly of large products with high variability. Using a multi-criteria performance analysis, we will be able to look at:

- Workstation concepts incl. those using mobile & connected resources.
- The impact of various operator's support tools in your production context.
- Assess the feasibility of flexible automation concepts for real, complex assembly tasks.

FIGURE 9: EXAMPLE OF THE SAAL PLATFORM AT UGENT.

Furthermore, there is an in-house developed use case, **ProoVit** (**Pro**duct range **of** **V**ehicle util**it**y beds) for which all design and engineering information is available. This includes CAD files, work sequence, work instructions, etc.

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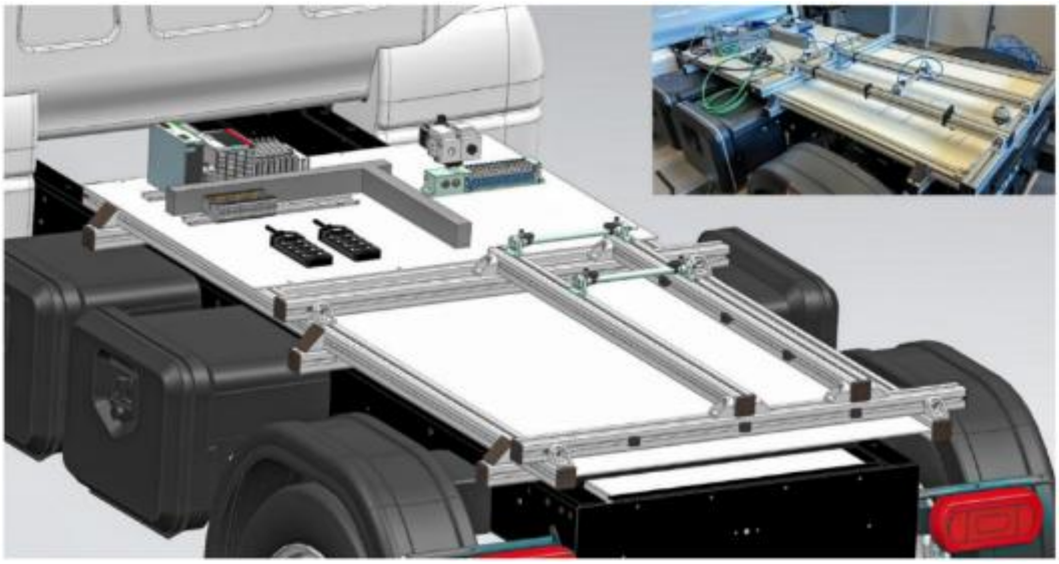

FIGURE 10: PROOVIT, IN-HOUSE DEVELOPED CASE.

Operations Experience Center (HEAL)

This playground is specifically built to showcase simulation models of industrial processes and test 'what if' scenarios. Digital models can be presented and run on the 32 screens.

Equipment is also being prepared to capture data on site and either transfer the data live to a digital twin or store it locally in order to use it later as input for simulation models or for analysis.

FIGURE 11: EXAMPLE OF THE HEAL PLATFORM AT UGENT.

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3.1.3 JSI playgrounds

1. Human-Robot collaboration playground

The JSI collaborative robotics low-TRL playground is a modular robotic cell with two Franka Emika FR3 collaborative robots and several modular tables, which can be arranged around the robot-modules as required by the process. The robots themselves are equipped with grippers and with internal joint-torque sensors. The latter are used to estimate also the forces at the end-effector of the robot. Additional external sensors, such as cameras and depth cameras can be added to the cell. The cell is readily available and operational and provides mock-ups of workplaces for human-robot collaboration. The robots are depicted in Figure 12. Note that the cell-setup will be modified to suit the task as described in the next paragraphs.

FIGURE 12: MODULAR ROBOTIC CELL WITH TWO FRANKA EMIKA FR3 COLLABORATIVE ROBOTS

As identified already in the project preparation phase, development of new AI and data-based automation technologies for the manufacturing industry directly contribute to efficiency, safety, and human factors. One of these developments is modular, reconfigurable, energy-efficient and collaborative robots, which can enable industries to optimize their operations, reduce waste, lower their environmental impact, and improve human operator job attractiveness. The whitegoods factory of ARC is one area where collaborative robots that utilize AI and data solutions can make this difference. JSI's low-TRL playground will be used to implement a basic collaborative robot solution for the ARC use-case for their refrigerator production line, where refrigerator gaskets of different shapes/sizes are installed on the refrigerator doors.

Manual installation of the refrigerator gaskets poses ergonomic challenges, resulting in inefficiencies and potential product rejections. Partial (co-bot) automation of gaskets installation, particularly flexible elastomer gaskets, presents unique challenges that require the integration of collaborative robotics and AI to optimize the installation process, ensuring precision, safety, and adaptability to the deformable nature of elastomers: the co-bot must apply the right force on the flexible material without causing material deformation. Furthermore, the collaborative robot must work safely together with the operator, allow for operator intervention in case of failures and adapt to the state of the task. Such behaviour is based on advanced AI

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and data technologies in recognition of the state, change of actions or scheduling, adaptation of motion and force profiles and error handling, all to increase worker conditions and efficiency, and product quality, while at the same time reducing energy consumption and waste.

The basic co-bot solution implemented at JSI low-TRL playground will from the onset serve to identify the major technological challenges and the data that needs to be collected to train appropriate AI models. Primarily, it will be used as the playground to overcome the identified challenges, while aligning with the Green Deal's focus on promoting worker well-being and safety.

To support the integration of various industrial protocols and communication buses, LOGI will provide a ROS2-based bridge. This bridge will enable SMEs to test and optimize collaborative robotics solutions. Additionally, SMEs will be able to implement AI-based edge processing directly on LOGI's FPGA platform. LOGI will also provide the necessary hardware platform, firmware, and control package to facilitate system evaluation. The ROS2 bridge will support integration with up to two cameras, typically a standard RGB camera and a depth camera, enabling enhanced perception capabilities for robotics applications.

2. DigiLab playgrounds

The DigiLab is located at Jožef Stefan Institute at the Department of Systems and Control. DigiLab will contribute three low TRL playgrounds: (i) **Playground for Energy Component Scaling and Energy Management**, (ii) **Playground for Production Energy Consumption Prediction**, and (iii) **Playground for Operator Skill Capture**. Each playground is supported by the simulation environment tool and prototype algorithms that can be used for development of real-life application solutions.

Playground for Energy Component Scaling and Energy Management

Goals and use cases

To balance power generation and demand, different energy storage technologies can be used. However, energy conversion and storage equipment cause capital (investment) and operational expenditures that influence the final price of electric energy.

This playground will primarily address the issue of optimal sizing of local renewable sources and energy storage to achieve an economically optimized energy system. In addition, the playground and its digital twin environment can serve for developing and testing in a safe environment several different types of energy management approaches.

This low TRL playground will address the project ambition A2b, i.e. Digital Twin-based energy management and decision support tools and it is linked with the KER5 (ELES high TRL playground).

Tools and environments available

- Digital Twin of Energy System Environment
- Optimisation Algorithm for Scaling of Energy System Components
- LOGI's Hardware & Firmware

Playground for Production Energy Consumption Prediction

Goals and use cases

Automated prediction and optimization of electric energy consumption of energy intensive production processes can have a large positive impact for the company. Based on factory daily production plans, the electric energy consumption time profile can be predicted. As a next step, the time distribution of production

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steps can be optimized to always keep electric energy consumption within limits or to develop smart energy management approaches that will reduce overall energy costs.

This low playground will primarily address the problem of predictability of energy consumption for the energy production processes. The playground will support means to develop transferable ML/AI solutions for automatic determination of the relation between energy consumption time profile and production plans using historic data about production plans and related energy consumption profiles. The developed energy predictive models could be then utilized for smart energy management, smart control and monitoring of energy intensive devices, etc.

This low TRL playground will address the project ambition A4a, i.e. Automated energy management and it is linked with the KER10 (LTH high TRL playground) and KER11 (VKR high TRL playground).

Tools and environments available

- Energy Simulation Model of Discrete and Batch Production Processes
- Algorithm for Automated Identification of Energy Prediction Models from Historical Process Data
- LOGI's Hardware & Firmware

LOGI's hardware and firmware solutions are available for the JSI Playgrounds for Energy Component Scaling and Energy Management and Production Energy Consumption Prediction. Including the Omnipower motherboard, which enables comprehensive data acquisition, processing, control algorithm implementation, and support for digital twin applications. The system facilitates real-time data sharing through USB, Bluetooth Low Energy (BLE), and WiFi, allowing for over-the-air (OTA) updates and seamless integration with cloud-based processing. When required, connectivity via 5G can also be incorporated to ensure robust and high-speed data transmission.

Playground for Operator Skill Capture

Goals and use cases

Many production processes are still (partially) controlled by operators with highly specialized knowledge and skills which are hard to formalise and document as they exist only in the operator's mind. If this knowledge is lost, then product quality or even the entire production process is at risk.

This playground will address the problem of identification of the operator corrective actions that yield best final production performance results. The goal is to apply ML/AI solutions to identify and suggest actions that improve the process quality or production throughput. The playground will be focusing on the segment of batch production, where recipes are used for controlling the process and the operator's corrections of the recipes are crucial for improving and stabilizing the process yield.

This low TRL playground will address the project ambition A3a, i.e. Adaptive digital work instructions and automated operator skill capturing.

Tools and environments available

- Simulation Model of the Batch Production Process (Penicillin Production)
- Algorithms for Skill Capturing using Machine Learning and Recommendation Systems

3.1.4 LEITAT playgrounds

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Battery disassembly lab

The actual battery disassembly lab has an IRB6620 150kg payload capacity robot. The arm is not fixed on the floor but mounted on a stable movable support to modify the layout easily.

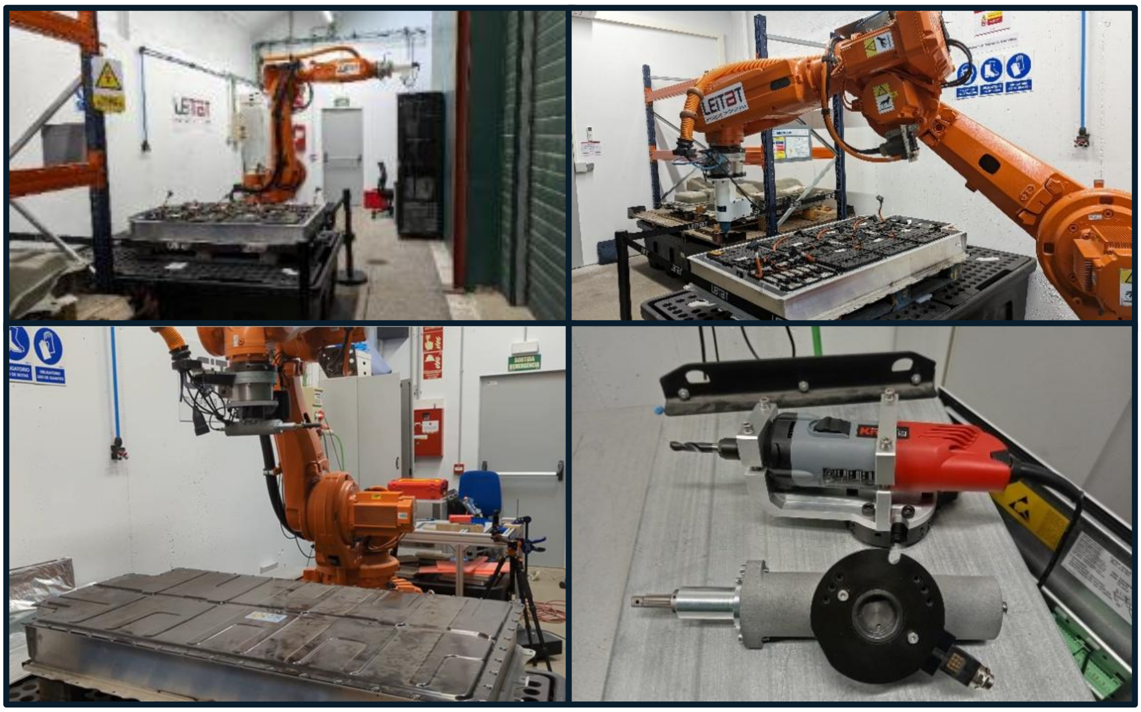

FIGURE 13: MOVABLE IRB6620 ROBOT ARM WITH SOME OF THE AVAILABLE TOOLS

The robot Has a force sensor (ATI Omega 160). This sensor has a force sensitivity of 0.25N in any axis and a torque sensitivity 0.025 Nm in all directions. This allows us to use the robot arm in force controlled applications instead pure position-based programming.

The robot is calibrated with absolute accuracy, maintaining a positional precision of within 1 mm across 100% of its working envelope. Movement repeatability is even better, reaching a maximum error of 0.03mm.

The Robot is equipped with a manual tool change system and many tools are available:

- Screwdriver with automatic torque control and revolutions count for screw and unscrew operations
- Different deburring tools
- Power scissors with capacity to cut think cables (until 30-40 mm diameter, depending on materials)
- Power drill (without tool changer)
- Fixed 3D camera (ZIVID Two M60) compatible with all previous tools, except power drill.

The actual lab has tables to support batteries in place, with a plastic tank to collect any liquid leakage from the batteries.

The new battery lab will include additional safety measures:

- A special battery table to hold battery. In case of gas detection or temperature increase, the table opens, and the battery is immersed in a tank filled with water or extinguishing liquid.
- Special storage areas with segmented shelf areas and automatic fire extinguishing system.
- REGATRON system to cycle (charge/discharge) batteries and calculate battery health

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- Glow box to manipulate chemicals and small batteries.
- Many working spaces for manual operations

In case of danger, the table with the battery inside can be moved quickly outside the premises for safety reasons

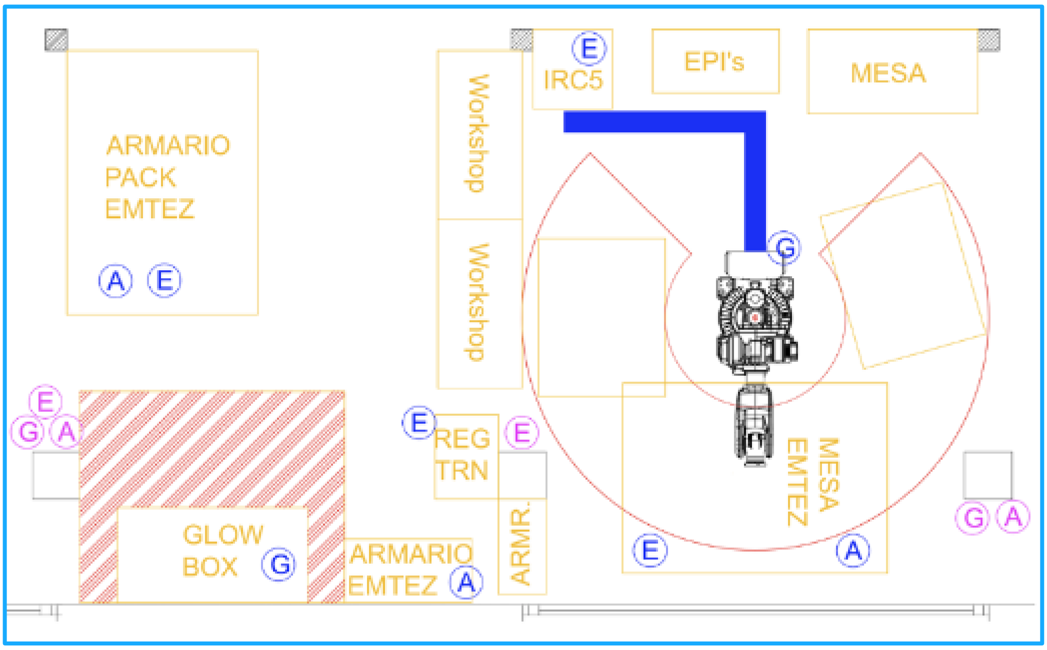

FIGURE 14: LAYOUT OF THE BATTERY LAB

LEITAT has additional robots, sensors and control systems available. If a process needs another robotic arm, we can add it to the actual layout. The robotic lab has the following arms:

- Universal robots UR10 with both 220V AC and 48V DC power supplies
- Movable AMR platform ROBOTNIK 500kg payload, capable to carry the UR10 arm if required
- Doosan M1013 cobot
- KUKA IIWA with KMR mobile platform
- Staubli TX2 160
- In addition, we have cobots (UR10, Doosan M1013, Kuka IIWA), cameras and VR/AR googles.

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FIGURE 15: OVERVIEW OF THE ADDITIONAL ROBOTS AVAILABLE AT LEITAT

Finally, LEITAT has an IRB52, long version. This robot is used for surface coatings. Robot is ATEX (can work in explosive atmospheres without risk) and has low pressure (spray) and high pressure (airless) application equipment.

In addition, many cameras, sensors, servo grippers and PLC are available to automate robotic processes.

LEITAT robotic expertise includes (but not limited to):

- ***Mobile robotics:*** Mobile industrial robots with medium/high payload. AGV's.
- ***Interaction:*** Person gesture detection, movements and actions. Robot response control.
- ***Collaboration:*** Prediction of robot and human actions. Robot response control. Collaborative shared space and tasks.
- ***Communication:*** Industrial communications. Field buses control based on open software.
- ***Modeling and monitoring:*** Kinematic model development. External control of robots and monitoring (depending on robot manufacturers).
- ***End effectors:*** Single block end effectors (together with additive manufacturing R&D area). Different gripper systems (mechanical, vacuum, electrostatic, needles, …)
- ***Robot applications:*** Force control. Compliant control. In line metrology. Specific industrial processes (machining, joining, assembly, coating…). Innovative industrial processes (laser cladding, robot 3D printing). Flexible parts manipulation.
- ***Advanced functionalities and AI applications:*** 2D y 3D vision. Grasping and manipulation. Navigation and environment. Easy programming by demonstration and automatic path generation. Sensor controlled path (real time). Robot tasks exchangeability.
- ***Simulations:*** Robot application simulations.

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- ***Services:*** Project management and development. Assessment and robot introduction in company. Robot lab. Testing and benchmarking. Technical demonstrators and pilots.

LOGI's Hardware & Firmware available for LEITAT Playgrounds:
The Omnipower motherboard designed for comprehensive grading and testing of batteries in alignment with the 9R framework (refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover). The system supports real-time data sharing via USB, Bluetooth Low Energy (BLE), and WiFi, enabling over-the-air (OTA) updates and seamless cloud processing. When necessary, 5G connectivity can be incorporated to support higher data throughput and low-latency applications.
Beyond data acquisition, the Omnipower platform enables advanced data exploitation for AI model development. Fully trained and validated models can integrate chemical, data-driven, physical, and hybrid approaches. In addition, Omnipower supports Digital Twin technology, with flexible adaptation to battery cells, modules, and systems, facilitating scalable solutions for battery reuse and recycling.

Photonics and Vision Lab

The Photonics & Vision laboratory is located at the LEITAT facilities in the DFactory and has a variety **of light sources** and their respective detectors: UV (254, 340, 365 nm), IR, white (290-1000nm) lamps. The different lamps allow us to make different lighting systems for optical and photonic characterizations. **Light detectors** at different wavelengths, including power meter and sensors with amplifiers complete the basic electrooptical setups. Normally, those lamps are used to make setup where cameras are used. RGB, IR, NIR hyperspectral cameras (900 nm to 1800 nm) are commonly used for capture images in laboratory framework or integrated in some pilots into LEITAT sites.

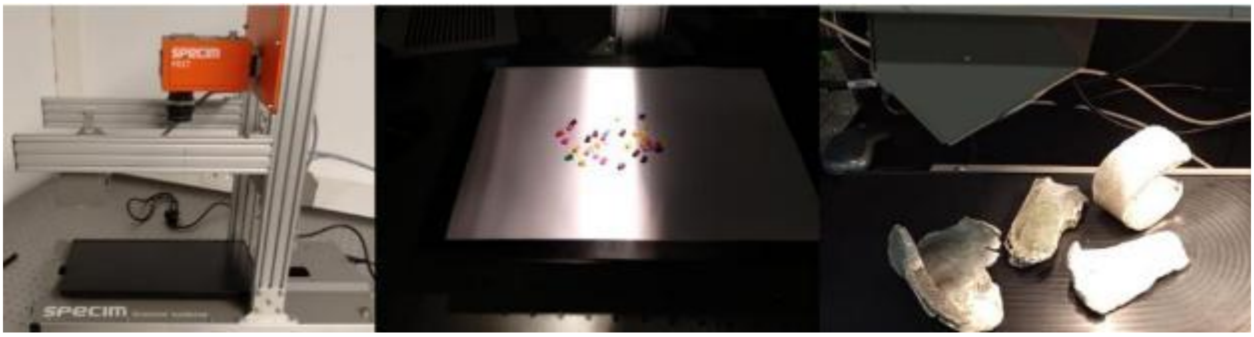

FIGURE 16: FROM LEFT TO RIGHT: HYPERSPECTRAL CAMERA, CAPTURE OF IMAGE OF POLYMERIC SAMPLES AND METALLIC SAMPLES.

Lasers and their detectors, from supercontinuous target (450-2400 nm), continuous monochromatic (440-480nm, 450 nm, 488 nm, 532 nm, 633 nm, 980 nm, 1550 nm), pulsed (532 nm), are mainly used for photonic characterization. These light sources with monochromators for 250 to 2500 nm with signal amplifiers are usually used for spectroscopy, optical characterization and chemometric. Integrating spheres of different diameters are used for whole optical characterization of materials, or samples in very controlled conditions. All these components are installed onto an optical table with laminar flow system (ISO Class 6.) as it is shown in Figure 17.

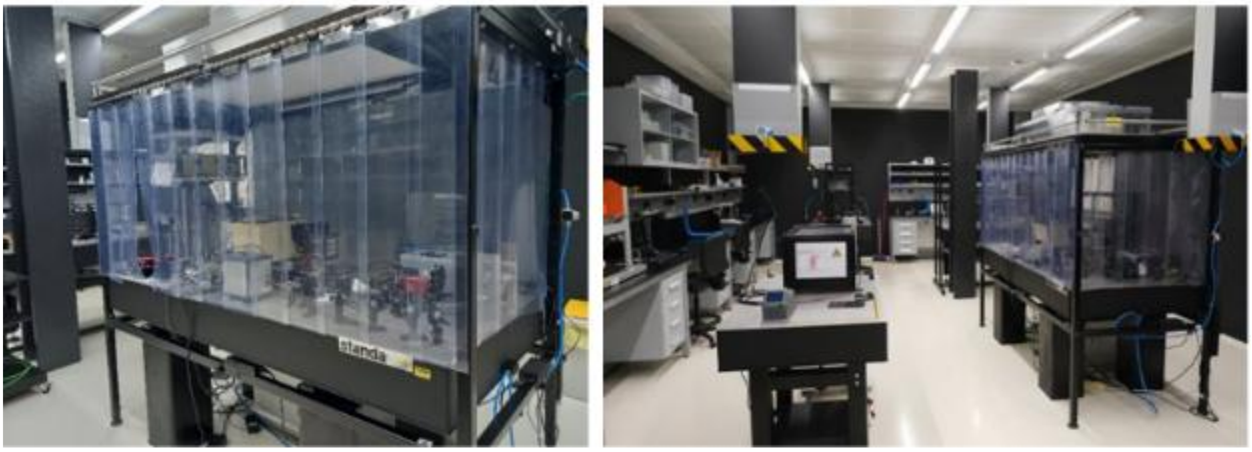

FIGURE 17: OPTICAL TABLE WITH LAMINAR FLUX WHERE LASERS, DETECTORS AND OTHER OPTOMECHANICAL COMPONENTS ARE USED (LEFT. FULL IMAGE OF P&V LABS (RIGHT)

For outdoor measurement, we use different setups, mainly to manage sunlight or to measure some optical properties like dust in PV panels, heliostats, albedo, etc. For that, field reflectometers with a range of 330-2500 nm are used. In addition, different software is used for optical modelling, hyperspectral image analysis and chemometrics.

Playground for Predictive Maintenance

Goals and use cases

Timely scheduling of maintenance or decommissioning of large infrastructures is challenging as we explained in our G.A. Failure in detection of failures or wrong predictions produces unwanted downtime and costs.

This playground will address the problem of having online information about the health status of the overhead power line and other energy assets. For this, the final goal is to use different types of cameras that can provide different kinds of information: specifically, RGB, thermal and hyperspectral camera. Each camera provides different types of information that can be useful for ELES, for optimizing the AI based predictive tool they have.

From the several issues that ELES must manage during O&M activities, some issues have been discussed, and they are presented as user cases:

Case 1. Vegetation Recognition and assessing of its health state, in Transmission Line Corridors

- **Objective:** Monitoring the growth of different types of vegetation that have different growth rates. Online monitoring will make it easier to predict when intervention will be necessary. Also, health of vegetation is important because healthy vegetation poses significantly less risk to the infrastructure compared to diseased or damaged specimens.
- **Methodology**: Aforementioned cameras will be used in laboratory framework making images of different types of vegetation, selected by ELES. Then chemometric analysis will be done, and correlation between different types of images of the same sample. Then, according to the results and all the information that ELES needs for optimal O&M of transmission line corridors, a camera will be selected.
- The SME selected after the **open call** will be requested for develop with ELES and LEITAT the image capture in the field, the analysis and a predictive model about vegetation.

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Case 2 Assessing Infrastructure Condition

- **Objective:** Determining the condition of infrastructure according to the capabilities offered using imagery. Discussions indicate that it is possible to detect the amount of biofilm and dirt on insulation, identify corrosion, detect overheating, and more.
- **Methodology**: The methodology used here is similar to the previous use case. However, depending on which characterization is prioritized different combinations of cameras and optomechanical systems will be used. Then, depending on the results and the required information that ELES need for optimal O&M of energy assets, a camera and its optomechanical system will be selected.
- **Open call**. SME will be requested to develop with ELES and LEITAT the image capture in field, the analysis and a predictive model about selected issues in energy assets.

This low TRL playground will address the project ambition A1b, i.e. 2D/3D image analysis for large Energy Infrastructure predictive maintenance.

Tools and environments available

- **RGB camera,**
- **visible hyperspectral camera**
- **near infrared hyperspectral camera**
- **thermal camera**

3.2 High-TRL Playgrounds

The high-TRL playgrounds in AID4SME serve as real-world testing and validation environments where SMEs can implement and demonstrate their AI and data-driven solutions at TRL 6 to 7. These playgrounds are built around large-scale industrial challenges provided by the consortium's industry partners from the whitegoods, automotive, energy, and battery recycling sectors. These high-TRL playgrounds include pilot and full-scale production lines and are key to validating the practical impact of the developed AI solutions.

3.2.1 ARC playgrounds

As an industrial partner, ARC plays a significant role in high-TRL playgrounds, focusing on the implementation and validation of advanced technological solutions. The ARC playgrounds aim to serve as test environments for the real-world application and scalability assessment of the project's innovative solutions while also presenting key use cases that showcase ARC's contributions to the project. These use cases demonstrate innovative approaches to enhancing production efficiency, sustainability, and quality control across different stages of refrigerator manufacturing, from extrusion processes to refurbishment and part recovery. By leveraging advanced tools and AI-based solutions, the project aims to address major industrial challenges and contribute to the development of smarter, more sustainable manufacturing systems.

The playgrounds (use cases) offered by ARC are as follows:

1. **AI-Supported Fully Automated and Sustainable Extruder Production**
2. **More Flexible and Faster Mold Adjustment Operations in Refrigerator Production (Polyurethane Injection)**
3. **Collaborative Installation of Gaskets on Refrigerator Doors**
4. **Determining The Remaining Life of Parts and Optimize Their Refurbishment Processes.**

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- ***Use Case 1: AI-Supported Fully Automated and Sustainable Extruder Production***

Refrigerator doors and internal bodies are produced by using sheet extruder machines. A sheet extruder machine feeds plastic granules into a heated barrel with a rotating screw. The molten plastic is pushed through a flat die to form a continuous sheet. After exiting the die, the material is cooled and moves along the sheet line to produce the final product. Corona treatment, edge trimming, and length cutting processes are performed along the sheet line. Finally, the stacking unit palletizes the produced sheets.

Many integrated systems operate simultaneously in plastic sheet production. Real-time quality control and process control supported by AI of the current system can provide more efficient and sustainable production. In addition, with AI integration, the recycling material rate used for sheet production can be increased to the maximum value for production. Efficient production can be achieved with real-time quality and material control.

<u>Requirements</u>

1. ***AI-Supported Material Management:*** With AI-supported systems, raw material and recycled material mixing ratios can be optimized to increase production efficiency. The chemical composition of recycled materials can be continuously monitored with FTIR/NIR analysis systems, and production parameters can be dynamically adjusted according to this data. Thus, the recycled material ratio in layered extruder sheet production can be maximized to meet quality and performance requirements.
2. ***AI-Based Process Control:*** Optimization of production parameters such as extruder screw speed, temperature, gear pump speed, die settings, edge trimming, and cooling conditions through AI-supported algorithms. Real-time analysis of the production process enables dynamic adjustments to minimize energy consumption.
3. ***AI-Powered Image Processing and Quality Control:*** AI-based systems can enable continuous monitoring of critical quality parameters such as thickness distribution, surface defects (scratches, black spots, gloss, e.g.), and edge smoothness. Detected defects during production can either be automatically corrected or immediately reported to the operator.
4. ***Sustainability and Greener Future:*** Optimizing recycling rates and reducing scrap through AI-based control helps minimize energy consumption.

<u>Challenges</u>

1. ***AI-Supported Material Management:*** Ensuring consistent quality can be challenging due to the variable nature of recycled materials. At the same time, maximizing recycled material while maintaining the required mechanical and aesthetic properties can be difficult. Also, recycled material may need to be cleaned of dust and contamination. Finally, integrating AI into existing systems is the most challenging requirement.

2. ***AI-Based Process Control:*** Effective implementation of AI-based process control requires data collection, model training, and continuous learning mechanisms. The accuracy of data received from sensors plays a critical role in ensuring reliable system performance. Furthermore, integration with existing automation and control systems can be difficult.

3. ***AI-Powered Image Processing and Quality Control:*** For effective AI-powered image processing and quality control, data collection and continuous learning can be critical. Ensuring real-time and highly accurate detection of quality issues and adjusting the line according to this information can be complex. Additionally, integration of AI systems into the production line can be difficult.

4. ***Sustainability and Greener Future:*** Optimizing recycling rates while reducing scrap is challenging due to the inconsistent quality and variable composition of recycled materials. At the same time, minimizing

energy consumption through AI-supported systems requires accurate, real-time data and integration with existing processes can be difficult.

Note: In addition to these challenges, improvements in extruder machines may also be required, including calendar rolls, cooling systems, dosage control, and other process optimizations.

- ***Use Case 2: More Flexible and Faster Mold Adjustment Operations in Refrigerator Production (PU Injection)***

Business context:

During this operation, following a mould change, operators perform trial-and-error checks on key characteristics, such as diagonal dimensions, polyurethane overflow, cabinet dents, and polyurethane voids. These inspections rely heavily on the operators' implicit knowledge and require fine-tuning of the mould machinery before the start of full-scale production. This iterative adjustment process results in an average downtime of approximately 60 minutes. When evaluating the total downtime associated with model transitions in the factory, mould adjustment prior to serial production emerges as the primary bottleneck.

FIGURE 18: REFRIGERATOR PRODUCTION LINE AT ARC

The first trial production is made with the new mold. After the trial production, the polyurethane overflow control of the refrigerator, void control on the cabinet, and dent control on the body are performed and the diagonal dimensions are checked by mold operators. According to all these controls, mold adjustment is made again based on the implicit knowledge of the mold operators. Here, different methods such as stretching the mold, shrinking, and adding plastic cores are used. After iterative trials, mass production starts with the refrigerator body that comes out of the mold at the desired level. These iterative steps cause downtime.

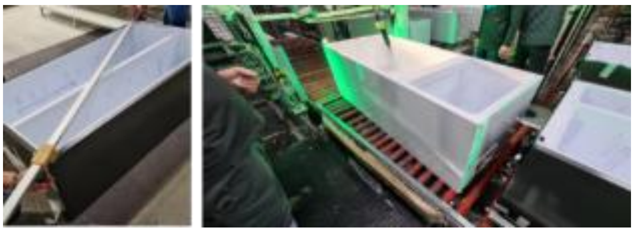

FIGURE 19: MOLD PRODUCTION PROCESS

Current Situation:

In the current process, two operators visually inspect certain points and perform necessary operations at the end of the line. The decision on cabinet quality is made by the operators, but no predefined gauges or tolerances are used, making the process prone to errors. If the cabinets meet quality standards, they are sent to the next stations for further processing. If not, they are moved to a separate conveyor for inspection and repair.

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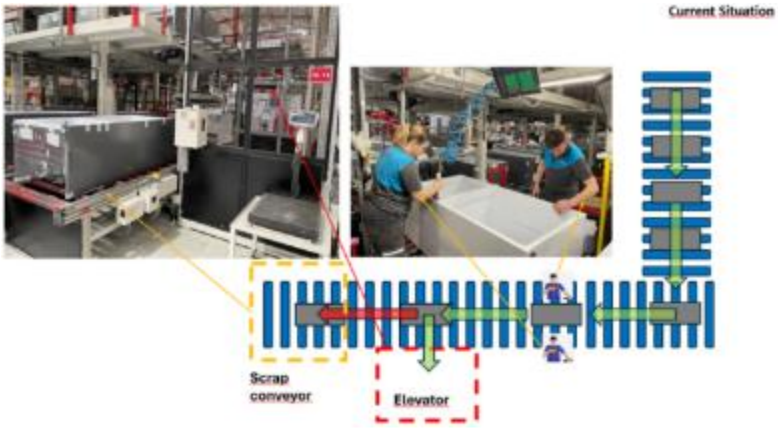

FIGURE 20: OVERVIEW OF THE CURRENT SITUATION

Proposed Solution:

We aim to implement a control point managed by sensors and cameras. As cabinets reach this point, the cameras and sensors will inspect all predefined parameters. The results will be displayed on a screen, and all data will be recorded in a database.

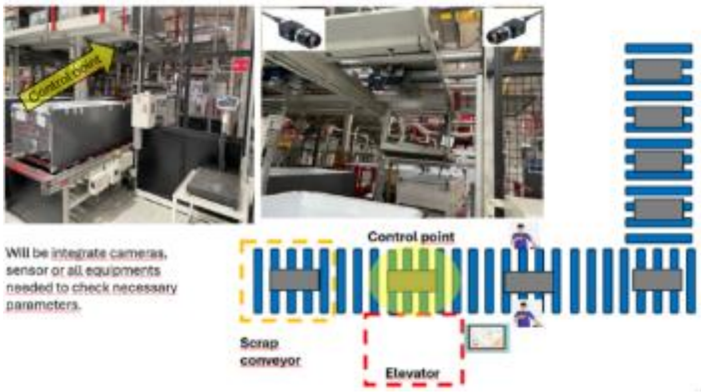

FIGURE 21: OVERVIEW OF THE PROPOSED SOLUTION

Control points and specs:

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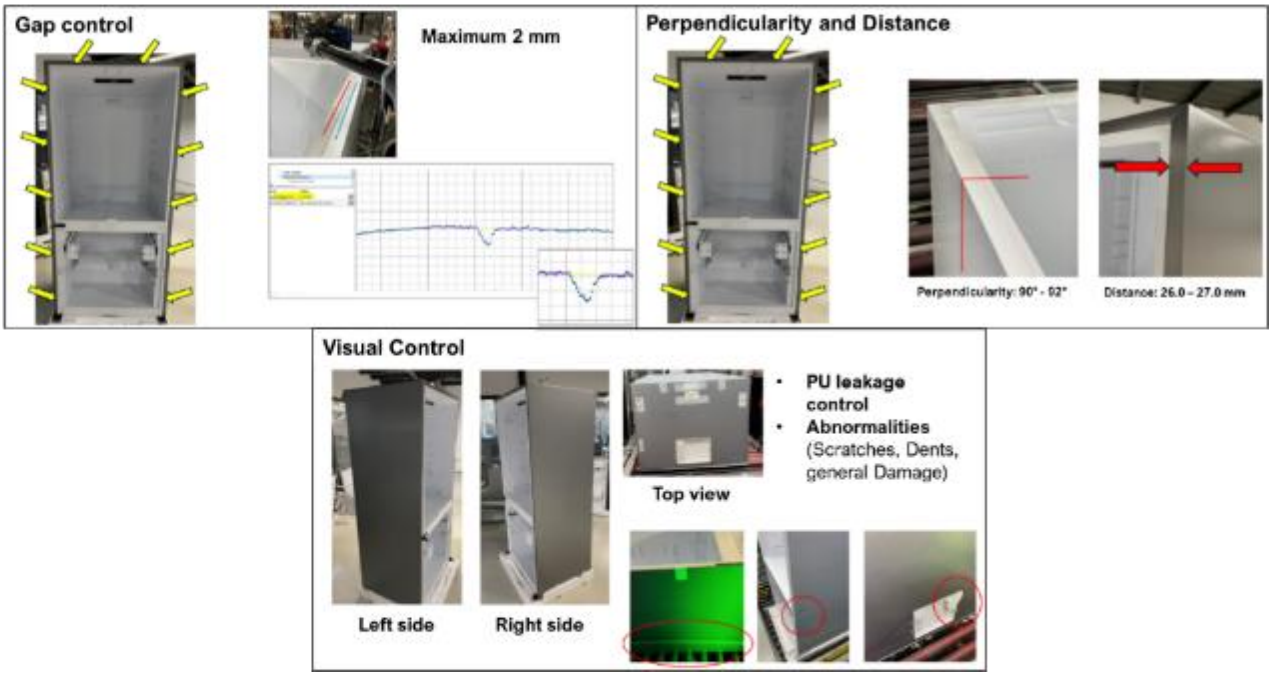

FIGURE 22: CONTROL POINTS AND SPECIFICATIONS OF THE CHECKS AND MEASUREMENTS PERFORMED BY THE OPERATOR

Required Technology Provider Profile includes:

- Laser 3D Scanning
- Digital Twin Expert
- AI Expert

By implementing these technologies, the project aims to achieve significant improvements in manufacturing efficiency. Specifically, reconfiguration costs are expected to be reduced by **50%,** while production capacity will increase by **3%**. Additionally, time-to-market will be shortened by **10%**, and the number of delayed deliveries will decrease by **5%.**

Furthermore, achieving a **first-time-right** rate of **95%** will play a crucial role in minimizing waste and enhancing overall production quality.

- ***Use Case 3: Collaborative Installation of Gaskets on Refrigerator Doors***

On the present status, gasket assembly process on door carried out by operators manually. At the same time two different products are being produced at Factory 6 Double Door Production line with two drums. There are also ergonomic issues caused by the manual gasket assembling process. With human-robot collaborative production improvement, there will be a 50 % reduction in manual processes. We also expect to reduce work related injuries significantly with this project.

In addition, quality problems (dislocation of the gasket, scratches on the metal door due to the manual processes, etc.) will also be addressed in this project.

FIGURE 23: COMPARISON OF CURRENT PROCESS AND PROPOSED SOLUTION

- ***Use Case 4: Determining the remaining life of parts and optimizing their refurbishment processes***

Approximately 75,000 refrigerators are collected annually, primarily due to return rights and warranty claims. Despite significant potential for high-value recovery through refurbishment or component reuse, most of these units are sent directly to the return center without further evaluation. Currently, only around 10% of the collected refrigerators undergo inspection to assess their suitability for refurbishing or component recovery. This limited capacity at ARC is primarily due to the manual nature of the decision-making process, which relies entirely on the subjective judgment of operators. As a result, although nearly 75,000 refrigerators are collected each year, only about 7,000 can be inspected, leading to substantial economic losses and environmental impact.

AI-Supported Fully Automated and Sustainable Refurbishment and part recovery Methods Requirements:

Sorting with digital methods:

- When the returned product arrives at the return center, it is categorized by the system algorithm. Then, according to historical field information of the product, the system decided whether to refurbish, recover spare parts or scrap the product.

Refurbishment:

- Creating rule sets to determine the scope of product refurbishment.
- Hygiene monitoring with infrared cameras and sensors
- Performance testing with thermal camera
- Electrical safety testing by robotic process
- Visual inspection with image process

Spare part recovery functional inspection:

- Determining the life cycle of parts and optimizing their recovery processes.
- Traceability.

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3.2.2 LTH playgrounds

LTH Castings is one of Europe's leading high-pressure die-casting companies with deep roots in innovation and a 75-year foundry tradition. Its facilities in Slovenia, located in key sites such as Škofja Loka, Trata, and Ljubljana are designed not only for high-quality production but also as advanced pilot environments. In these sites, live production lines are complemented by integrated data platforms and smart manufacturing systems. This environment now serves as a test bed for AI applications and data-driven digital transformation projects.

Advanced Production Environment

- **Die-Casting and Machining**: The Slovenian sites house state-of-the-art high-pressure die-casting machines along with extensive CNC machining centers. These allow for the production of precision aluminum components required by leading automotive brands.
- **Integrated Toolshop and R&D Space**: Significant investment has been made to provide a fully automated and digitally supported environment. This tool shop not only supports the in-house production of specialized die-casting tools, trimming devices, and clamping systems but also serves as an innovation hub featuring modern equipment like 3D-metal printers and high-precision scanning systems.

Digitalization and Data Integration Infrastructure

- **EDGE AI Testing Playground**: A dedicated production environment has been set up to test and validate EDGE AI solutions. This includes experiments in optical quality control using AI image analysis that supports immediate, real-time decision making in production.
- **Real-Time Data Collection**: Production machines are equipped with sensors for electricity consumption, production metrics, and quality indicators. Real-time data is gathered into an InfluxDB environment, which forms the backbone of smart energy management pilots.
- **Cloud Integration and Advanced Analytics**: The facility offers seamless integration with the Azure Cloud Hub. Data collected on the shop floor is pushed to the cloud for further processing and analysis. This supports advanced analytics and enables the creation of digital twins that power smart production process planning.

Business Intelligence and Visualization

- **Power BI Readiness**: A Data Warehouse (DWH-ready) environment is available, facilitating the aggregation of production and sensor data. This setup empowers detailed real-time reporting via tools like Power BI, which is essential for monitoring operational KPIs and driving data-driven decision-making.
- **Comprehensive Dashboarding**: Custom dashboards are being developed to visualize machine performance, quality control, and energy consumption. This visualization plays a crucial role in pilots for automated energy management and digital work instructions.

Smart Workflows and Operator Training

- **Digital Work Instructions and Skill Capturing**: Through the deployment of the rewo.io platform, the facilities enable digital work instructions. This solution not only standardizes procedures on the shop floor but also captures operator skills and knowledge. Training modules and smart visual guidelines help in reducing onboarding time and ensuring continuous employee upskilling.
- **Pilot Projects for Production Planning**: Two live production projects serve as a test bed for digital twin–enabled smart production process planning tools. These pilots aim to enhance process planning, monitor production flows, and continuously improve operational efficiency.

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AID4SME

AI and Data-Driven Use-Cases

The unique "playground" characteristics of the facility empower the development and refinement of several AI/data-driven use-cases:

1. **Digital Twin Enabled Smart Production Process Planning Tool**: By merging real-time sensor data with high-fidelity simulation environments, a digital replica of the production process is developed. This helps optimize process parameters, foresee potential disruptions, and ensure resource-efficient planning.
2. **Automated Warehouse and Internal Logistics Management**: Integration of IoT sensors and AI analytics allows dynamic tracking and automation of warehouse operations and internal logistics, boosting efficiency and reducing delays.
3. **Automated Energy Management for Parts Production**: Real-time energy monitoring combined with AI-based optimization techniques enables the facility to manage consumption patterns. This leads to significant gains in energy efficiency, directly supporting the company's CO2 neutral and "Zero Waste" initiatives.
4. **Automated Machine Selection for Parts Production**: AI-driven decision support systems evaluate production variables and machine capabilities in real time to assign the optimum machine for each job. This maximizes production throughput while maintaining high quality.
5. **Digital Work Instructions and Operator Skill Capturing**: Enhanced by video and interactive interfaces, digital work instructions reduce errors and inconsistencies. Moreover, continuous training modules ensure that operators stay updated with new techniques and improve over time.

3.2.3 VKR playgrounds

Verkor is a battery cell manufacturer located in France. VKR's Gigafactory, still under construction is located in Dunkirk, and Verkor Innovation Center (VIC) is located in Grenoble, where VKR playgrounds will be located. This innovation center offers a laboratory line and a pilot line, which are both fully digitalized.

FIGURE 24: VERKOR INNOVATION CENTER (VIC) IN GRENOBLE

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Verkor pilot line was commissioned in mid-2023. It spans over 12 000m² with a dry room area of 4 000m². Verkor workforce on this pilot line is around 170 FTEs, producing a capacity of 150 MWh/y of battery cells, equivalent to 5-10 car battery pack per day. This pilot line is fully digitalized, with a digital backbone architecture allowing us to connect the different process steps together for traceability, performance checks, power consumption monitoring and so on.

This facility will allow us to test Edge AI solutions. Since a dedicated production environment has been set up with optical monitoring of some process steps, to have close-loop machine control and almost real-time decision making processes.

Moreover, monitoring of the energy consumption of production machines is done to feed our smart power management system.

Lastly the data is stored in an Azure Cloud hub to allow refining and analytics. This data will ultimately lead to a digital twin of the factory processes and building to allow smart power management.

Verkor use case will allow the development and refinement of various data-driven use cases:

- **Intelligent production planning using a Digital Twin:** Integrating real-time sensor data with comprehensive simulation tools produces a virtual model of the production process. This model will help to fine-tune process parameters, anticipate potential pitfalls, and efficiently plan operations while minimizing resources used.
- **Cell Quality monitoring**: Through vision AI coupled with process monitoring, we will allow automated quality control of the produced cells, to improve cell output and reduce the scrap rate.

3.2.4 ELES playgrounds

ELES, the Slovenian grid operator, plays a key role in the project by providing a high-TRL playground for testing and demonstrating the Digital Twin-based decision support tool. ELES's involvement includes:

- Defining Real-World Challenges – ELES identifies practical challenges related to grid balancing, local energy systems (microgrids), connection between microgrid and public grid and energy storage optimization, which will guide the tool's development.
- Testing and Validation at Higher TRLs – While JSI provides a lower-TRL Digital Twin environment for initial development (TRL 4), ELES enables the testing and demonstration of the tool at TRL 6/7 in a real-world energy system.
- Optimizing Microgrid Sizing and Operation – The decision support tool will help ELES optimally size and control smaller parts of the energy system that includes charging of EV, reducing costs related to energy production, storage (CAPEX), and renewable energy wastage.
- Industry Collaboration and Scalability – ELES not only acts as a testbed but also helps define additional challenges where SMEs and other industry players can apply the technology to broader grid operations.

In summary, ELES provides a real-world testing environment, validates the technology at a higher readiness level, and ensures that the solution is applicable for large-scale grid operations.

LOGI contributes essential hardware and firmware components. LOGI's Omnipower motherboard is designed for data acquisition, processing, and implementing the control algorithm that underpins the digital twin. It also supports real-time data sharing via USB, BLE, and WiFi for Over-The-Air (OTA) updates and cloud processing and 5G connectivity can be included when needed. This advanced technological backbone ensures that the Digital Twin model remains current, accurate, and capable of supporting both optimization and predictive maintenance tasks.

Further enhancing the ecosystem, ELES will also be cooperating with the Josef Stefan Institute (JSI). The JSI playground focuses on energy component scaling and energy management by providing its own digital

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twin of the energy system environment. In this setting, prototype optimization algorithms are developed and tested, specifically aimed at scaling energy system components. This collaborative aspect is expected to expedite the transition of the technology from lower TRL stages (as provided by partners like JSI and JSI's initial development environment) to demonstrate at higher readiness levels in actual operational contexts.

ELES real-world testing

Selection of Testing Sites in Slovenia

ELES will provide several operational sites that are already equipped with:

- Production units (e.g., solar panels)
- Energy storage systems
- EV charging stations (charging patterns)
- Consumption
- Measurement infrastructure (historical and real-time data collection)

These sites effectively function as microgrids, allowing testing under realistic operational conditions. Some grid components might be simulated.

Data Collection and Integration into the Digital Twin

- Historical data analysis: The sites already have a history of production and consumption data. This data will be used to train and validate the Digital Twin model, ensuring it accurately represents real-world behaviour.
- Real-time data feed: The tool will integrate live measurements from smart meters (or simulated data sets), allowing dynamic updates.
- EV charging impact assessment: The system will track the effect of EV charging on local grid stability, peak demand, and storage utilization.

Digital Twin Simulation & Optimization

- Energy balancing and forecasting: The Digital Twin will predict power production, consumption and power peaks, optimizing energy flows to reduce costs and increase efficiency. As well the energy/power available to provide system services will also be taken into account.
- Storage optimization: The tool will test optimal charge/discharge strategies to minimize losses.
- Grid stability assessment: The model will evaluate how microgrid self-sufficiency and resilience can be improved by adjusting load profiles, generation patterns, and storage strategies.
- EV charging scheduling: The system will simulate different EV charging scenarios (e.g., peak vs. off-peak charging) to reduce strain on the grid.

Real-World Implementation & Testing

- Controlled experiments: Once validated in a simulated environment, real-world (or simulated) tests will be conducted at the sites.
- Automated decision support: The Digital Twin will provide real-time recommendations for energy management, which will be implemented and monitored for impact.
- Adaptive learning: The tool will continuously refine its models based on real-world feedback, improving decision accuracy over time.

Evaluation and Final Validation

- Comparison of simulated vs. actual outcomes (e.g., cost savings, energy efficiency improvements).
- Assessment of scalability – determining how the approach can be applied to larger grid operations.
- Reporting and feedback loop – refining the tool based on operator experiences and collected performance metrics.

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Key Features of the Decision Support Tool

Real-Time Data Integration & Monitoring

- Connects to ELES (or other) sites, collecting real-time production, consumption, and storage data.
- Integrates EV charging station activity to assess grid impact.
- Provides a dashboard for visualization of key parameters.

Predictive Analytics & Forecasting

- Uses historical data to forecast energy demand and production
- Uses data to forecast OPEX and CAPEX
- Predicts battery usage patterns to optimize charging/discharging cycles.
- Simulates grid stability under different load scenarios.

Optimization Algorithms for Energy Management

- Minimizes costs by optimizing energy flows between production, storage, and consumption.
- Reduces peak demand by dynamically adjusting EV charging schedules.
- Enhances grid stability by recommending adjustments to local energy use.

Scenario Analysis & Decision Support

- Allows grid operators to simulate different energy management strategies.
- Evaluates the impact of policy changes, market conditions, and new infrastructure investments.
- Provides recommendations on grid upgrades based on real-world data.

Final Deliverables of the Support Tool:

Fully Functional Digital Twin Software

- A software tool capable of real-time monitoring, forecasting, and optimization.
- Accessible via web-based interface or API for integration with existing systems.

Deployment & Testing Report

- Validation results from ELES test (simulation) sites demonstrating tool accuracy and effectiveness.
- Performance comparison before and after tool implementation.

Scalability & Business Case Analysis

- Technical blueprint for scaling to more microgrids or grid-wide deployment.
- Cost-benefit analysis for potential investors and stakeholders.

The real-world testing at ELES sites in Slovenia will allow the Digital Twin-based decision support tool to be validated under actual grid conditions. By leveraging historical and real-time data, the system will be fine-tuned for real-world deployment, optimizing microgrid performance, energy storage utilization, and EV charging impact.

The primary deliverable of the project is the Digital Twin-based decision support tool, which will be developed by an SME. This tool will serve as an advanced analytics and optimization platform for managing microgrid operations, EV charging, and energy storage.

The Digital Twin-based decision support tool is the core innovation of the project, developed by an SME, and is the main deliverable. It will enable data-driven, optimized management of microgrid operations, EV charging, and storage, leading to cost reductions, better grid stability, and increased efficiency.

Predictive maintenance

ELES is collaborating with LEITAT and LOGI to implement an AI-driven predictive maintenance solution aimed at enhancing the management of its infrastructure, particularly the KER2 facility. This initiative utilizes

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advanced 2D and 3D imagery analysis to assess the condition of critical assets, enabling ELES to anticipate equipment failures and schedule maintenance proactively. By integrating real-time data from sensors with historical maintenance records, the system employs machine learning algorithms to detect patterns indicative of potential issues, thereby reducing downtime and maintenance costs. LOGI contributes by providing the necessary hardware and firmware to support AI-based image analysis, while LEITAT offers expertise in developing and deploying predictive maintenance technologies.

4 Events and Network of the CoP

To ensure visibility of the AID4SME CoP as well as engagement, and knowledge-sharing, the project partners have identified a range of strategic events that align with the project's core pillars AI, digital transformation, and sustainable innovation. These events across Europe offer key opportunities to connect with stakeholders (e.g. drivers in AI, technology peer groups), promote project outcomes, and reinforce the value of the CoP among SMEs, academic partners, and policymakers.

Four dedicated partners, **Green eDIH** in Romania, **Latvian Technological Center (LTC)** in Latvia, **ISQ** in Portugal as well as **EWF**, are supporting to increase the visibility and outreach of the CoP across their respective regions. Through participation in national and regional events, and thematic forums, they actively promote the CoP.

- **Green eDIH**, as a representative digital innovation hub in Romania and member of the AID4SME consortium, has selected several events based on their relevance to the green and digital transition of SMEs. These include *Green Energy Expo & Romenvirotec*, *ICREE*, *ICAIAL*, *Big Data Week Bucharest*, and *Bucharest Tech Week*. Each of these events provides a valuable platform to engage with Romanian SMEs, research institutions, public authorities, and sustainability professionals core stakeholders of the CoP.
- **LTC**, as an active member of the innovation ecosystem in Latvia, partner of **Enterprise Europe Network** and **EIT Manufacturing**, as well as project partner of the AID4SME consortium, has identified several strategically relevant events in Latvia and Lithuania for the second half of 2025. These events align closely with the goals of the CoP.
- In Portugal, **ISQ** plays a key role in bridging applied research with industry needs, particularly in the areas of digital transformation and sustainability. Although no formal CoP-related events have been scheduled at this stage, ISQ maintains a strong presence in sectoral and thematic forums, where it regularly shares insights and results from its broad portfolio of research and innovation initiatives. ISQ's dedicated R&D unit is currently involved in approximately 45 active projects across four core areas: **Materials and Technologies, Intelligent and Digital Systems, Training and Qualifications, and Low Carbon and Resource Efficiency**—many of which align closely with the thematic focus of AID4SME.
- **EWF** will present the AID4SME project during its six bi-annual General Assemblies throughout the project's duration, engaging in its network of 28 European member countries and 2 Observer Members to promote knowledge exchange and foster collaboration within the welding and manufacturing community.

4.1 Events in Europe

At the European level, events such as the *Sustainable AI Conference* (Germany), *Energy Tech Summit* (Spain), and *GITEX Europe* offer access to a wider ecosystem of innovation stakeholders and a broader technological perspective. These conferences are highly relevant for the AID4SME CoP as they bring together leading voices in AI, energy transition, green innovation, and emerging tech markets.

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While Green eDIH may not be present at all European events, other AID4SME partners located in Germany, Spain, and other host countries are well positioned to attend and represent the Community of Practice. These partners will share insights from the project, explore synergies with other initiatives, and promote the CoP to an international audience of potential members, solution providers, and multipliers. This collaborative and distributed event engagement strategy enhances the CoP's outreach, strengthening its European dimension and facilitating cross-border partnerships aligned with the Green Deal and Digital Europe objectives.

Sustainable AI Conference 2025 [2]

Date: September 16–18, 2025

Location: Bonn, Germany

Overview: Organized by the Bonn Sustainable AI Lab and the Institute for Science and Ethics, this conference focuses on shaping sustainable AI and its future implications.

Participation Statistics: Expected to attract a diverse group of researchers, practitioners, and policymakers interested in the ethical and sustainable development of AI.

Key Takeaways:

- Discussions on the ethical considerations of AI development.
- Exploration of AI's role in promoting sustainability.
- Opportunities to engage with leading experts in sustainable AI practices.

Energy Tech Summit 2025 [3]

Date: Dates to be announced

Location: Bilbao, Spain

Overview: Recognized as a leading climate tech event in Europe, the summit brings together investors, entrepreneurs, and government leaders to discuss advancements in energy technology and sustainability.

Participation Statistics: Anticipated to host numerous global energy and climate tech stakeholders, including startups, investors, and policymakers.

Key Takeaways:

- Insights into the latest trends in energy technology and sustainability.
- Networking with key players in the energy and climate tech sectors.
- Opportunities to explore partnerships and investment prospects in green technology.

GITEX EUROPE 2025 [4]

Date: May 21–23, 2025

Location: Location to be confirmed

Overview: GITEX Europe is set to be one of Europe's largest tech events, focusing on various technological advancements, including AI and green technology.

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Participation Statistics: Expected to attract a vast number of technology experts, innovators, and industry leaders from across Europe and beyond.

Key Takeaways:

- Exposure to cutting-edge technologies in AI and sustainability.
- Opportunities for collaboration with tech innovators and startups.
- Insight into the future landscape of technology and its impact on sustainability.

4.2 Events in Romania

Green eDIH intends to actively participate in the Romanian events, leveraging them to disseminate information about AID4SME and foster direct dialogue with stakeholders. By presenting the CoP's objectives and benefits, Green eDIH aims to recruit new members, raise awareness among Romanian SMEs about funding and support opportunities through the project, and facilitate knowledge exchange regarding AI-driven and data-powered innovation for sustainability. These face-to-face opportunities will also serve to collect feedback and understand local needs, ensuring the CoP remains demand-driven and context-sensitive.

Green Energy Expo & Romenvirotec 2025 [5]

Date: April 9–11, 2025

Location: Bucharest, Romania

Overview: this annual expo is dedicated to renewable energy and environmental protection, serving as a platform for technology and service providers in the green energy and environmental sectors to showcase their innovations.

Participation Statistics: typically attracts numerous exhibitors and visitors from the renewable energy and environmental sectors, including industry professionals, policymakers, and academics.

Key Takeaways:

- Exposure to the latest advancements in renewable energy technologies.
- Networking opportunities with industry leaders and potential collaborators.
- Insights into environmental protection strategies and sustainable practices.

International Conference on Renewable Energy and Environment (ICREE) 2025 [6]

Date: May 17–18, 2025

Location: Bucharest, Romania

Overview: organized by the World Academy of Science, Engineering, and Technology, ICREE 2025 aims to bring together leading academic scientists, researchers, and research scholars to exchange and share their experiences and research results on all aspects of Renewable Energy and Environment. The conference will cover topics such as wind energy applications, hydropower applications, and photovoltaic technology.

Participation Statistics: while specific numbers for the 2025 conference are not yet available, similar conferences typically attract several hundred participants, including academics, industry professionals, and students.

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Key Takeaways:

- Insights into the latest research and developments in renewable energy and environmental sustainability.
- Discussions on integrating green technologies into sustainable practices.
- Opportunities for networking with professionals and experts in related fields.

International Conference on Artificial Intelligence Applications in Law (ICAIAL) 2025 [6]

Date: May 17–18, 2025

Location: Bucharest, Romania

Overview: organized by the World Academy of Science, Engineering, and Technology, ICAIAL 2025 aims to bring together leading academic scientists, researchers, and research scholars to exchange and share their experiences and research results on all aspects of AI Applications in Law. The conference will cover topics such as AI in legal practice, computational models of legal knowledge, and the ethical implications of AI in law.

Participation Statistics: while specific numbers for the 2025 conference are not yet available, similar conferences typically attract several hundred participants, including academics, industry professionals, and students.

Key Takeaways:

- Insights into the latest research and developments in AI applications within the legal sector.
- Discussions on integrating AI into legal practices and frameworks.
- Opportunities for networking with professionals and experts in related fields.

Big Data Week Bucharest 2025 [7]

Date: This is an annual event, the date for 2025 is not announced.

Location: Novotel Hotel, Bucharest, Romania

Overview: Big Data Week Bucharest 2024 was a two-day event focusing on delivering practical knowledge in big data and AI. The conference features a main stage for key topics and targeted workshops aimed at deeper technical learning and skill-building. 2025 edition is not yet announced.

The event is organized by one of Green eDIH's members, which significantly enhances opportunities for direct outreach, collaboration, and visibility for the AID4SME Community of Practice.

Participation Statistics: Big Data Week Bucharest typically attracts between 100 and 300 participants, including data professionals, AI experts, business leaders, and technology enthusiasts, making it a valuable event for engaging with a concentrated and knowledgeable community in the fields of big data and AI.

Key Takeaways:

- Insights into current trends and strategies in big data and AI.
- Opportunities for hands-on learning through interactive workshops.
- Networking with industry leaders and peers

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Bucharest Tech Week 2025: Celebrating Technological Innovation [8]

Date: June 16–20, 2025

Location: Bucharest, Romania

Overview: Bucharest Tech Week is Romania's largest technology festival, bringing together over 30,000 participants across seven days of events. The festival includes five days of Business Summits, featuring international experts discussing topics such as sustainable technology, AI, human resources, software architecture, and Java development. The week concludes with a Tech Expo, showcasing the latest technological innovations for the public.

Participation Statistics: the 2025 edition is expected to attract over 1,500 business professionals during the Business Summits and more than 25,000 technology enthusiasts during the Tech Expo.

Key Takeaways:

- Insight into integrating AI into various business practices.
- Exposure to the latest technological innovations and solutions.
- Networking opportunities with industry experts and professionals.

4.3 Events in Latvia

LTC intends to actively participate in the national and regional flagship events to promote the AID4SME initiative, increase awareness of CoP activities, and foster collaborative opportunities for Latvian and Baltic SMEs. The events serve as ideal platforms to present AID4SME's objectives, highlight funding and innovation support opportunities, and gather direct feedback from all stakeholders (businesses, academia, society, and public stakeholders ensuring the CoP remains both relevant and responsive to local needs.

Riga Food 2025 [9]

Date: September 4-6, 2025

Location: Riga, Latvia

Overview: The largest in the Baltics food industry fair "Riga Food" yearly outlines the trends of the food industry development, highlights novelties and presents a number of enterprises of regional importance. LTC is the main organizer of innovation stand for innovative companies.

Participation Statistics: Typically attracts ~ 400 exhibitors and more than 20000 visitors from different food sectors including technology developers and R&D institutions.

Key Takeaways: Exposure to food sector technology developers, R&D institutions as well as large-scale food processing companies. Networking opportunities with industry leaders and potential collaborators.

Riga Comm 2025 [10]

Date: October 9-10, 2025

Location: Riga, Latvia

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Overview: RIGA COMM is an annual IT and business event bringing together entrepreneurs from the service and manufacturing sectors, executives from public institutions and organizations, and professionals from various industries. LTC is the main organizer of innovation stand for innovative companies.

Participation Statistics: Hybrid type of event, there are 12 conferences on 6 stages, exhibition takes place in parallel with conferences. More than 2500 professionals. Special area is devoted for B2B meetings.

Key Takeaways: The event offers a unique opportunity to explore the latest digital solutions and technologies presented by service providers and product manufacturers from the Baltics and beyond. Attendees can consult with industry experts and discover the most suitable tools and innovations for their business or organization all in one place. Encourage modernisation of companies, organisations, state and municipal institutions for more effective operation. The content of the exhibition is suitable for entrepreneurs and executives of all fields.

TechIndustry 2025 [11]

Date: November 27-29, 2025

Location: Riga, Latvia

Overview: Tech Industry is the largest trade fair for mechanical engineering, metalworking, automation, electronics, and emerging technologies in the Baltics. The event showcases the latest innovations and technologies across a wide range of sectors, including metalworking and manufacturing, mechanical engineering, construction, automation, electronics, electrical engineering, automotive, road and bridge construction, shipbuilding, railway and aerospace industries, agriculture, and water and heating systems bringing them all together under one roof.

Participation Statistics: More than 250 participants from 18 countries. Around 10000 visitors from all Baltic countries.

Key Takeaways: Tech Industry stands as the region’s premier platform for showcasing innovations in metalworking, mechanical engineering, automation, and electronics. A standout feature is the ability to see real-time machine demos, robotics in action, and automated systems live, offering a practical look into Industry 4.0 trends. With seminars, workshops, and expert talks, participants gain insights into automation, digitalization, energy efficiency, and sustainability trends.

4.4 Events in Lithuania

Balttechnika 2025 [12]

Date: May 14-16, 2025

Location: Vilnius, Lithuania

Overview: Lithuania's premier engineering and technology exhibition. The event brought together leading professionals in mechanical engineering, industrial equipment, electronics, and innovation, serving as a central hub for showcasing advanced manufacturing solutions and fostering international collaboration.

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Participation Statistics: More then110 companies-exhibitors from Lithuania, Latvia, Estonia, Germany, and other countries. More then 4000 professional visitors. Special conference dedicated to Industry 4.0.

Key Takeaways: The "Making Industry 4.0 Real" conference addressed digital transformation, AI, cybersecurity, and sustainability, featuring insights from global industry leaders. The "Innovation Island" showcased cutting-edge Lithuanian technologies, emphasizing advancements in automotive and industrial sectors. The inaugural Automotive Forum facilitated discussions on autonomous driving, electric vehicles, and sustainable transportation, promoting cross-sector collaboration.

4.5 Informal Networking

As part of its standard practice, ISQ informally disseminates relevant project outcomes during national and transnational meetings, often in the context of other EU-funded or innovation-driven initiatives. These interactions frequently include stakeholders who are part of, or closely connected to, the AID4SME CoP—such as SMEs, public authorities, technology providers, and academic institutions. While these dissemination efforts are not formally branded under the CoP umbrella, they play an important role in maintaining project visibility, encouraging knowledge exchange, and fostering future synergies. This informal but strategic dissemination approach can be an important part of the project’s communication plan, while structured CoP-branded events in Portugal continue to be developed.

5 Recommendations for sustainability of the CoP

To ensure the long-term impact and viability of the AID4SME project, several sustainability pathways have been identified, focusing primarily on the continuation of its Community of Practice (CoP). These include integrating the CoP into existing innovation networks such as AI-on-Demand and EIT Manufacturing, enabling cross-project collaborations and institutional partnerships. Additionally, the transformation of project assets—such as training programs, AI validation platforms, and digital playgrounds—into modular, service-oriented offerings could generate ongoing value for SMEs and startups, while allowing the CoP to operate as a semi-commercial ecosystem supporting Europe’s green and digital transitions.

All project partners will actively contribute to these sustainability efforts by leveraging their collective expertise and lessons learned from previous projects and ongoing initiatives. This collaborative approach ensures that best practices are applied across all aspects of the CoP, from technical support to community engagement and policy alignment. Expanding educational outreach via subscription-based online courses and industry-tailored mentoring, combined with a structured community engagement plan, ensures continuous knowledge exchange and visibility. These strategies, complemented by regular impact tracking and success story dissemination, will solidify AID4SME's role as a catalyst for sustainable innovation among European SMEs

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