



Combined AI and Data solutions for DECISION SUPPORT

Challenge 3.4

Automated warehouse and internal logistics management

3 Combined AI and Data solutions for DECISION SUPPORT

3.4 Automated warehouse and internal logistics management

Challenge and context

Manufacturing companies increasingly operate highly automated and complex production environments, in which internal logistics such as buffer warehouses management, pallet flows, automated forklifts operations, and the deployment of AMRs have a direct impact on production continuity, energy consumption, and overall operational efficiency. This is particularly relevant in metal-part production settings, where production rhythms can be variable, intermediate buffers are often constrained, and disturbances can rapidly propagate across the shop floor. Despite the increasing levels of automation in production equipment, the execution and coordination of internal logistics are still frequently governed by fixed rules, manually triggered actions, or dispatcher-based decision-making. As a result, logistics resources are often used sub-optimally, leading to inefficient fleet utilization, unnecessary transport movements, delayed machine supply, increased operator effort, and avoidable production interruptions. In such environments, the lack of real-time coordination between production needs and logistics execution becomes a major barrier to both efficiency and resilience. Typical inefficiencies include:

- delayed response to machine-originated transport requests;
- poor prioritization of urgent logistics tasks;
- unnecessary empty movements and excessive transport distances;
- low fleet utilization due to unbalanced task allocation;
- weak coordination between conventional forklifts and AMRs;
- reduced resilience under disturbances such as machine stoppages, variable cycle times, and temporary congestion.

Digital Twin based control and decision-support frameworks address these limitations by enabling a more integrated, event-driven, and adaptive approach to internal logistics management. By combining real-time machine signals, logistics state information, and operational context, such frameworks can support dynamic task generation, prioritization, fleet allocation, and routing decisions. This is especially relevant in industrial contexts characterized by heterogeneous equipment, variable demand patterns, and frequent disturbances. However, effective deployment remains challenging due to the complexity of the underlying decision architectures, the need to integrate smoothly with existing machines, forklifts, AMRs, and IT systems, and the requirement to ensure practical usability in real production environments. AID4SME is flexible to overcome these challenges for use case owners inside and outside the consortium. Inside the AID4SME consortium, LTH would like to develop a smart planning tool for their automated buffer warehouse and internal logistics system. This digital twin-based tool should enable them to optimise internal workflows for the automated transporting around 200 pallets on the shop floor.

Use case and expected solution

The expected outcome is a smart, dynamic, AI-optimized fleet management engine that uses machine-triggered inputs (KLICI s stroja) as operational events, dynamically assigns transport tasks, optimizes resource use within the agreed scope, and provides an operator-facing communication layer for forklift operators and AMRs. The solution requirements are as follows:

Data availability and event inputs

For challenge preparation and low-TRL research activities, partners will work with pre-provided historical data samples and clearly documented data schemas by LTH. These are expected to include data such as, where available:

- machine-triggered inputs;
- machine and line status signals;
- warehouse and buffer status;
- pallet and material flow data;
- forklift task logs and localisation data;
- AMR mission and execution data;
- operator interaction logs; and
- production planning and order context.

Live data ingestion, system integration, and validation against the industrial environment are led by the selected SME together with LTH in the higher-TRL playground. LTH will clarify which data are directly available, which are only available as historical samples, and which indicators would need to be derived by the SME. Data and developed solutions should be made available for non-commercial (research) purposes to consortium members beyond the project duration, and a dual-licensing approach allows consortium members, especially LTH, to use the solution after project completion.

Route and fleet management

The core decision-support logic should assign tasks to available resources on the basis of constraints such as fleet availability; capability constraints; expected travel time and execution time; route constraints. The primary objective is to develop and validate an internal route and fleet management solution that interprets machine-triggered logistics inputs and supports prioritization and task allocation across conventional forklifts and one AMR demonstrator (AMR to be provided by solution provider). The selected SME may combine optimisation methods, scheduling algorithms with AI-based approaches.

Operator and system communication

The solution should include an operator-facing dispatch and feedback interface through which tasks are communicated to operators. This may take the form of an operator terminal, mobile interface, dashboard, or another practical dispatching mechanism proposed by the SME together with LTH in the higher-TRL playground. The interface should support actions such as:

- task notification;
- task acknowledgement or acceptance;
- completion feedback;
- exception handling;
- reassignment of urgent machine-linked requests.

Specification for use case

The goal of this challenge is to move beyond static or reactive dispatching practices towards a data-driven solution of internal transport resources capable of improving responsiveness, reducing inefficiencies, and supporting more robust and sustainable production operations. The solution will be validated at TRL 6 in the LTH industrial environment through a pilot demonstration on the selected production line. The solution includes one AMR demonstrator provided by solution provider. Validation will assess technical feasibility, operational robustness, and measurable logistics improvement under realistic factory conditions. For external SME use cases, transferable results and deployment concepts will be evaluated up to TRL 7.

Expected solution

The primary objective is to develop and validate a solution enabling LTH to optimize efficiency, reduce logistics energy consumption, and production stops.

Key Performance Indicators

Key Performance Indicators (KPIs) should clearly demonstrate the relevance and impact of the proposed solution. They must address at least two of the following dimensions: resource optimisation, Green Deal

objectives, and social impact. All KPIs must be SMART (Specific, Measurable, Achievable, Relevant and Time-bound), ensuring they remain quantifiable throughout the project.