Combined AI and Data solutions for DECISION SUPPORT

Challenge 3.1
Digital Twin-Enabled Smart Production Process Planning Tool

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3.1 Digital Twin-Enabled Smart Production Process Planning Tool

Challenge and Context: Production planning in manufacturing is still mainly driven by manual inputs and spreadsheet-based tools, resulting in fragmented workflows, low planning agility, and a high risk of reactive decision-making. This legacy approach makes it difficult to anticipate demand fluctuations, optimize resource allocation, or align production capacity with customer needs. One critical shortfall is the underutilization of historical customer demand data, such as order volumes, frequency, and variability across part numbers and time. Without a systematic analysis of this data, manufacturers struggle to identify recurring demand patterns, classify demand profiles, or tailor planning strategies accordingly. This challenge proposes the development of a Digital Twin-enabled production planning tool that harnesses historical customer demand data to simulate, evaluate, and refine planning strategies. The tool will integrate AI-based optimization algorithms alongside ABC/XYZ approach to entwine market segmentation strategies with product demand forecasting based on demand volume and volatility. These insights can inform planning priorities, buffer strategies, and resource allocation rules. By learning from past order behaviors, the tool will enable manufacturers to anticipate future demand scenarios, build resilient plans, and reduce inefficiencies across the production system.

Use Case and Expected Solution: An aluminum part automotive manufacturing company seeks to optimize its operational planning by leveraging structured historical customer demand and production data. The company aims to overcome typical industry challenges such as inefficient resource utilization, demand volatility, unbalanced workloads, and reactive planning processes. This requires a solution that uses historical demand patterns and future demands to build more robust, flexible, and data-driven planning strategies. To support this, we offer realistic, near-industrial low-level playgrounds such as the MOVE platform, and Smart and Agile Assembly Lab, where planning concepts, models, and tools can be developed, tested, and validated in a controlled yet complex manufacturing environment.

The tool developed through this challenge will analyze customer demand trends over time to uncover patterns and enable the grouping and classification of customers based on their demand characteristics. By examining past planning and production outcomes, the tool will identify inefficiencies and missed optimization opportunities. It will integrate AI-based planning algorithms to support data-driven decisionmaking. In addition, the tool will apply classification methods (e.g., ABC/XYZ) to tailor planning strategies according to demand data. Planners will be able to run scenario-based simulations using historical data and future demand, allowing them to proactively evaluate, compare, and refine planning alternatives before implementation.

Specifications for Use Case: This platform will provide a smart planning tool to optimize and support planning decisions before execution, reducing reliance on reactive adjustments, and improving overall resource utilization and performance. Two consortium partners will support SMEs in defining the Digital Twin-enabled smart production process planning tool, providing both AI expertise and industry insights. This will advance Digital Twin decision support developments.

The selected third party is expected to contribute with the following:

- Customer demand analysis and classification modules.
- Identification of planning inefficiencies using historical data.
- AI-powered simulation capabilities to assess and compare planning alternatives.

Key Performance Indicators:

- Planning Accuracy Improvement (%)
- Demand Forecasting Classification Accuracy (%)
- Reduction in Manual Planning Adjustments (%)
- Replanning Frequency (per week/month)
- Reduction in overproduction or stockouts (%)
- Increase in OEE (%)

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To be noted, the list of KPIs provided in this section is not exhaustive but rather indicative. Additional KPIs will be studied and can be integrated to ensure quality outcomes.

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