Combined AI and Data solutions for AUTOMATION

Challenge 4.1

Automated energy management for parts production

4 Combined AI and Data solutions for AUTOMATION

4.1 Automated energy management for parts production

Challenge and Context: The challenge is to derive a prototype of a shopfloor module for integration and smart energy management of the energy-intensive production equipment. Automated and energy-aware management of the production processes can have a significant positive impact on energy-intensive production industries. One of the approaches for overall energy optimization is to monitor and proactively manage production machines' states according to the production plan. Optimized timings of the special machine modes, such as start-up, shut-down and stand-by, will reduce the unwanted high-power idle times of the machines. Such automated machine control should, on the one hand, ensure that machines are prepared and ready for the execution of the production schedule, and on the other hand, it should minimize the overall energy consumption needed for transitions of machines from idle or stand-by modes to operating modes.

Use Case and Expected Solution: Predictability of the energy consumption profile is needed to optimize modes of machine operation. Energy consumption prediction models for production processes exist and are used in practice, but they are manually developed and tailored for specific production processes, considering particular energy consumers. Manual design of such models requires expert knowledge of process and energy modeling, is time-consuming and expensive, and limits transferability between different processes and reusability. A partner has technology blocks available at TRL 4 and a low-TRL playground for automatic determination of the relationship between energy consumption time profile and production plans, based on AI and machine learning methods using historical data about production plans and related energy consumption profiles. This automatic learning capability enables wide usage of the method across different production processes. The data-based approach also allows modeling the effects of external conditions (temperature, weather, season, etc.).

The expected solution should enable the industrial partner of the consortium to automate control over energy intensive operation machines. Optimized control over the operation states of the machines (e.g., pre-heat, standby, off-mode) should be in accordance with the actual production plan, while minimizing the overall energy consumption. The industrial consortium partner is currently enabling energy monitoring of all key infrastructure equipment for aluminum casting and automotive parts production. As the next step, this partner aims to implement an automated machine management tool for the plant's infrastructure. The aluminum casting production consists of a number of machines that are high energy consumers. In addition, varying preparatory start-up times are required to reach nominal operational conditions. Currently, there is no unified and vendor neutral approach for centralized monitoring and management of machines. Consequently, it happens that particular machines stay switched on and consume electric energy in periods when production is not running, which can be during night periods or pause periods. This leads to electric energy waste, increased costs and increased pollution due to excess electric energy consumption. The expected solution should automatically monitor and manage machines' states according to the central production time plan. This includes automatic startups and automatic shutdown or entering various standby modes.

Specifications for Use Case: The consortium partner will guide and mentor SMEs to use existing building blocks for automated energy management of production processes and further develop and implement these technologies in real production environments of use-case owners. For the partner use case, automated energy management of their production plant demonstrated at TRL 7 will enable them to automate control over high energy consumption assets according to the production, leading to minimization of energy related costs, while not affecting the execution of the planned production activities.

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

- Develop a smart energy management strategy and algorithm based on the energy consumption models of the machine modes
- Develop a module/system for monitoring and management of high energy intensive machines
- Demonstration of the prototype on the industrial setup

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Key Performance Indicators:

- Accuracy of predicted energy consumption for the observed production operation (% accuracy of energy consumption forecasts).
- Reduction of daily energy consumption per produced part, for the controlled machine/operation (% reduction in energy consumption per part).
- Production schedule adherence, indicating how closely production adheres to the planned schedule for the controlled production operation (operation delay time).

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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