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Manufacturing Optimization for Flex Systems

Manufacturing

Overview

MCM (Machine Centers Manufacturing) produces integrated manufacturing solutions according to the principles of Industry 4.0 for customers around the world. Their flexible systems are designed to evolve with production needs and operate with a high level of autonomy. To improve plant design and operation, MCM's software division, MCE, worked with Engineering

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customers make more informed decisions and optimize business performance using digital twin technologies.

Together, MCM and Engineering developed an FMS (flexible manufacturing systems) simulator for manufacturing optimization. Simulation and digital twin experts at Engineering tailor-made an FMS-specific simulation modeling library based on the systems knowledge of experts at MCM.

Problem: Flexible manufacturing system design

Modern machining shop floors require production systems that can be adapted to meet production problems as they occur. For technical reasons, most shop floor processes are automated, and, for economic reasons, the flow of materials and resources should also be automated to allow for long periods of unattended operation. The resulting systems are highly complex and would benefit from better forecasting and analytics.

MCM has also found that when designing such complex systems for successful tender, precise dimensioning is necessary to win the bidding process. Further design challenges arise when trying to predict system behavior or plan reconfigurations. And, without knowing system behavior well, it is difficult to define machine control policies.

A performance evaluation tool would help MCM address the challenges associated with FMS plant design. They wanted a tool to help support several activities:

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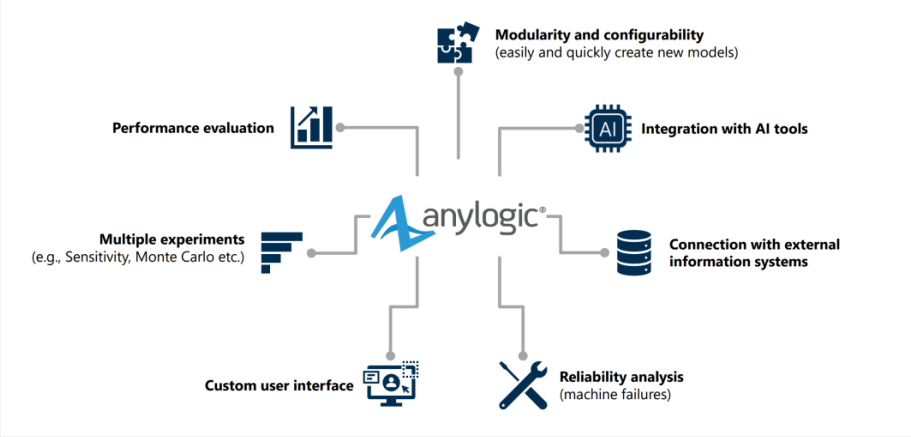
Solution: Manufacturing performance evaluation tool

At a high level, the simulation specialists at Engineering fulfilled MCM's requirements for an FMS Performance Evaluation tool by leveraging the capabilities of AnyLogic simulation modeling. The flexibility of the simulation tool, its connectivity, and its extensibility, made it ideal for meeting MCM's needs.



AnyLogic-centric solution.

To aid plant design and configuration, Engineering developed an FMS-specific library in conjunction with the plant specialists at MCM. The library was made from a collection of reusable agent and Java classes related to FMS applications such as production units, machines, pallet and tool racks, shuttles, etc.

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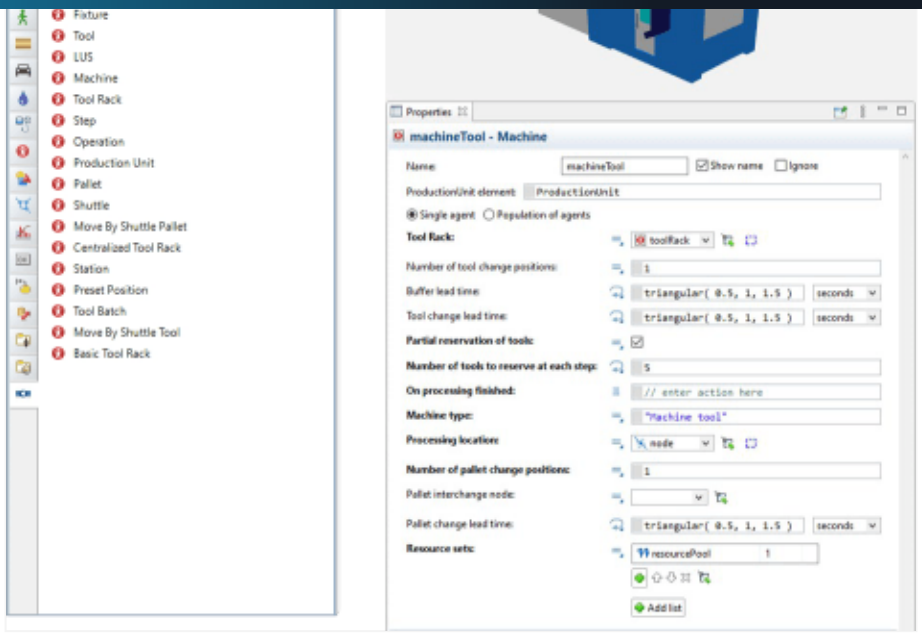
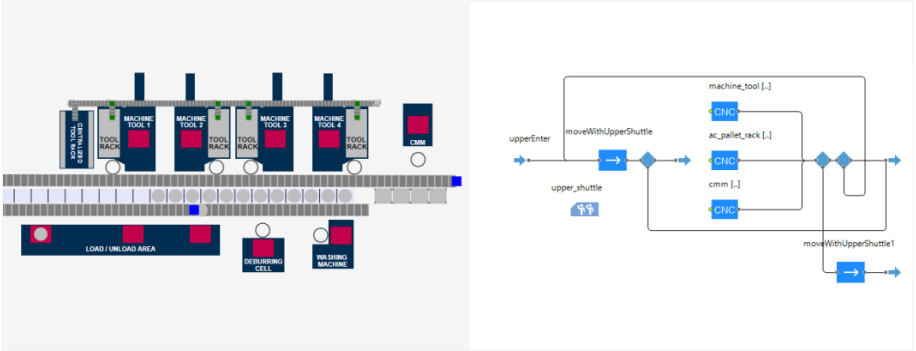


FMS Library palette and an example component.

Using the FMS-specific library alongside the standard AnyLogic libraries allowed MCM engineers to rapidly prototype FMS facility designs. In testing, they could quickly layout a shop floor using the new library and combine it with regular AnyLogic functionality to develop facility-specific algorithms, such as a plant-dependent control policy.



Machine tooling layout and model logic

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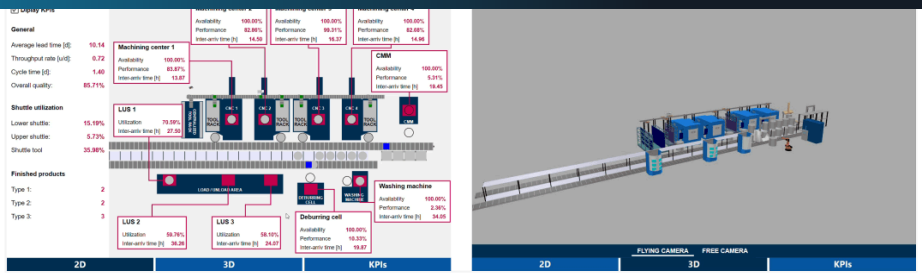

Custom user interface showing data outputs and FMS layout rendering.

Results:

With the FMS Simulator, MCM and Engineering achieved what they set out to do and more.

The system allows modelers to quickly provide high-level simulations during the preliminary stages of selling a plant and give end customers a preview of how the real-life solution will be.

A powerful capability of the FMS Simulator is that it allows the introduction of complex control policies. The blocks in the FMS library were designed so that it is possible to easily detail the main system management algorithms. There exists, within the tool, the capability to reproduce the algorithms governing each production cell. This capability makes it possible to create digital twins for monitoring the real-time status of a plant and carry out virtual commissionings for testing purposes.

Sensitivity analysis for different echelons and parameters indicates a future direction for increasing overall supply chain performance. Different behavioral parameters show diverse influences on the backlog level towards Tier-2 suppliers, hence, the chip shortage

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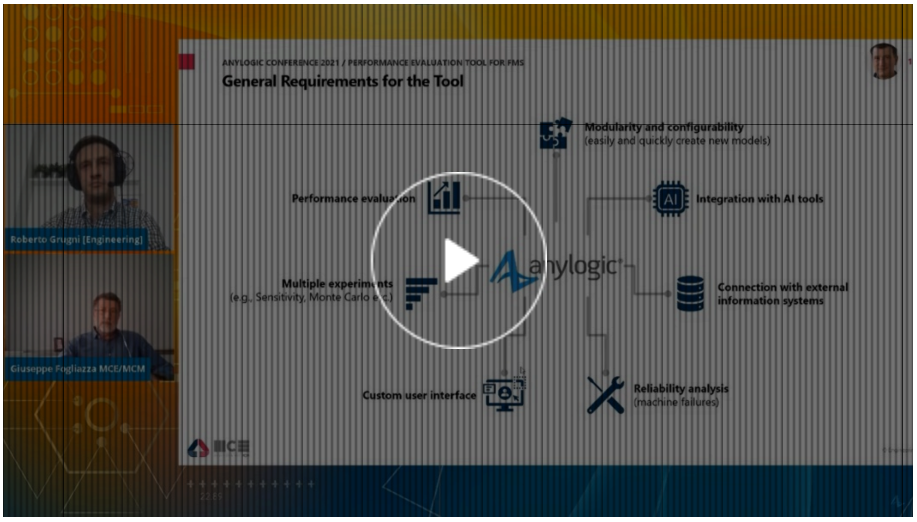
Grugni and MCE director Giuseppe Fogliazza in their joint presentation at the AnyLogic Conference 2021:



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