Artificial Intelligence in Manufacture

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Why Adopt Artificial intelligence

- Many mid-sized Manufacturers, such as those making Mechanical and Electrical Components / Products, Paints, Cosmetics, Coatings, Food and Beverages, and Others, are facing Increasing Demands from their Customers for Small, Customized Batches of Product Delivered Rapidly, often with only a few days to turn around the order.

Why Adopt Artificial intelligence - 2

- This is in Contrast to Their Previous Operations, which Created Large Volumes of Standard Products with Production Runs Measured in Weeks or Months

- Here "Large" is a Relative Term: Micro / Small / Medium

- Aim is to Reduce Idle Time of Machines and Labour to near ZERO

Why Adopt Artificial intelligence -3

- Aim is to Increase Product Range within a **Domain**

- Aim is to Maximise Product Range and Minimize Overheads

- Aim is to have the Order Book Full by Diversifying Your Product Range

Helps in Decision Making

- Integration of Design and Manufacturing Processes can be Achieved through Knowledge Based System

- The Knowledge Based Systems are complex Rule Based Systems that Help in Solving Problems that are Solved by Experts

- The Knowledge Based System is NOT a Generic "Inference Engine" or "Reasoning Engine"

Helps in Decision Making -2

- The Knowledge based Engine is fine tuned to a Domain or more specifically to a Product

- Knowledge Based System pertaining to a Specific Domain collects the Data about the Problems faced in the Previous History of Design and Manufacturing of the Specific Domain

- Compare the Results, the Historical Data regarding Material Usage and Process Selection Parameters and the Current Design Guidelines

Helps in Decision Making -3

- Rules must be compiled and coded in the most appropriate format
- The Data represents the Domain Technical Knowledge
- New Knowledge Based System, also called Expert System, could be created simply by adding new knowledge applicable to another domain.
- The Resulting Domain Independent / Specific Interprets are called Shells

Helps in Decision Making -4

- Expert systems are usually written Primarily as Rule Based Systems, a Forward Chaining or Backward Chaining Inference Strategy is used to Proceed from the Known Data to the Desired Solutions

- The success of the Knowledge Based System is dependent upon its functionality within the design environment

Helps in Decision Making -5

- This complexity can be handled by the use of Real-Time Manufacturing Execution Systems (MES) in combination with Real-Time Manufacturing Operations Management (MOM) Systems to track and manage their operations.

- The use of real-time artificial intelligence (AI) methods can dramatically simplify and lower the cost of deploying these real-time MES and MOM systems, making them affordable and usable by small and mid-sized process manufacturing organizations.

Helps in Decision Making -6

- Automating the tracking, planning and scheduling of manufacturing operations using a MES combined with a real-time MOM system has many operational benefits including:
  - ➢ Giving real-time manufacturing visibility of the status of production, inventory and customer orders
  - ➢ Preventing operational mistakes
  - ➢ Eliminating unnecessary overhead labour costs
  - ➢ Helping to prevent late shipment of customer orders
  - ➢ Enabling "lean" management of inventory
  - ➢ Automatically collecting materials' traceability data
  - ➢ Increasing sales by offering reliable delivery of semi-custom products within short delivery times

Embedding AI in MES / MOM / ERP

- Some of the ways that AI makes these systems easier to use include:
  - Minimizing data capture time by only capturing the minimum data needed. The AI system presents the user with a form and only a minimum number of data entry boxes. The system then adjusts the form as data is entered based on rules embedded in the system.
  - Preventing mistakes. As each data item is entered, the data is checked by rules and algorithms, and the user is warned immediately if he or she is about to make a data entry or operational mistake to allow for corrective action, just like a self-driving car does. This minimizes training time.

Embedding AI in MES / MOM / ERP -2

➢ Enabling managers, supervisors and customer support personnel to keep track of what is going on in real time. The data captured are interpreted by the built-in rules and algorithms as a real-time manufacturing status of inventory, jobs, customer orders, people and machines that can be seen anywhere and anytime there is an internet connection. This data can be shared with internal employees as well as selectively shared online with customers and vendors. This dramatically reduces the amount of time everyone spends trying to make sure customer orders get shipped on time and to answer those "What is the status of my order?" telephone inquiries.

Embedding AI in MES / MOM / ERP - 3

➢ Intelligently exchanging information with systems used by other departments. There is no need for operations managers to have access to all the data used by accounting, human resources or sales. But selective data exchange, controlled by a set of rules specific to each organization, can enable managers, supervisors and customer support employees to do their jobs much more efficiently.

➢ Automatically scheduling jobs through a production facility based on rules and parameters set by the production manager. This eliminates the need for managers to continually answer those "What do I work on next?" questions. Instead, the AI-based algorithms make the myriad of routine real-time manufacturing scheduling decisions that are needed in a modern manufacturing plant. However, managers can always adjust the schedule when needed to account for special circumstances.

Embedding AI in MES / MOM / ERP - 4

➢Assisting managers in deciding what jobs to schedule and what materials to order. An AI-based system is able to predict when inventory shortages will occur in response to a continual inflow of new customer orders. The AI-based system can then alert managers when these problems are about to occur and assist them in analyzing the data to make smart decisions

Embedding AI in MES / MOM / ERP - 5

➢ Alerting managers when problems are about to occur. The AI-based rules and algorithms continuously scan the data collected by the operations tracking system, as well as data imported from other systems, to find situations that may be problematic. This may be as simple as a job step taking too long to complete or a prediction that a customer order will not be shipped on time. The system is then able to send alerts to managers in the form of email messages or text messages sent to their mobile phones so they can take immediate action. This saves them from "walking the floor," being "glued to a computer monitor" or pouring over reports to try to determine when something is about to go wrong or why some thing has gone wrong

Open Source ERP - OFBiz of Apache Foundation

- It is possible to build the AI Layer / interface with the Open Source ERP of Apache Foundation, "OFBiz"

- CAD Group of National Informatics Centre has Integrated Apache OFBiz with CollabCAD, an Open Source CAD / CAM / FEA / CAE Solution

Artificial Intelligence in Manufacture

This will Result in Revolutionizing Manufacturing Environment on the Lines of Industry 4.0 or IoT

AI in Manufacture

Leads to

JUST IN TIME Manufacture

Artificial Intelligence in Manufacture

Thank You