Using Real-Time AI Methods to Automatically Process Customer Order Flow

Introduction

Things used to be simple. You made a limited range of products which you made to stock. Then you fulfilled customer orders from your warehouse as they arrived by Fax or directly from your sales people. Production was planned months in advance, using an MRP or ERP system, based on sales forecasts.

Now, customer orders can come from a wide variety of sources, including Amazon and your own E-Commerce website. They can also come from your distributors and resellers, who may require you to drop ship products, as well as other more traditional sales channels. These orders flow in continuously, often for semi-custom products with a wide-variety of options.

Customers expect their orders delivered in a few days and not a few weeks or months, as a result of the "Amazon Effect". Also, money is now expensive. As a result, many manufacturers and distributors are forced to make-to-order, on a just-in-time basis, with Lean inventory management

Having people handle this customer order flow is becoming increasingly problematic due to the amount of time required to plan and schedule the needed purchasing, manufacturing, and warehouse operations, as well as the importance of preventing mistakes and of adapting plans and schedules when problems arise.

In this white paper, the author describes how a real-time intelligent agent architecture can be used to process the incoming customer order-flow automatically.

What is a Real-Time AI System?

A Real-Time AI system:

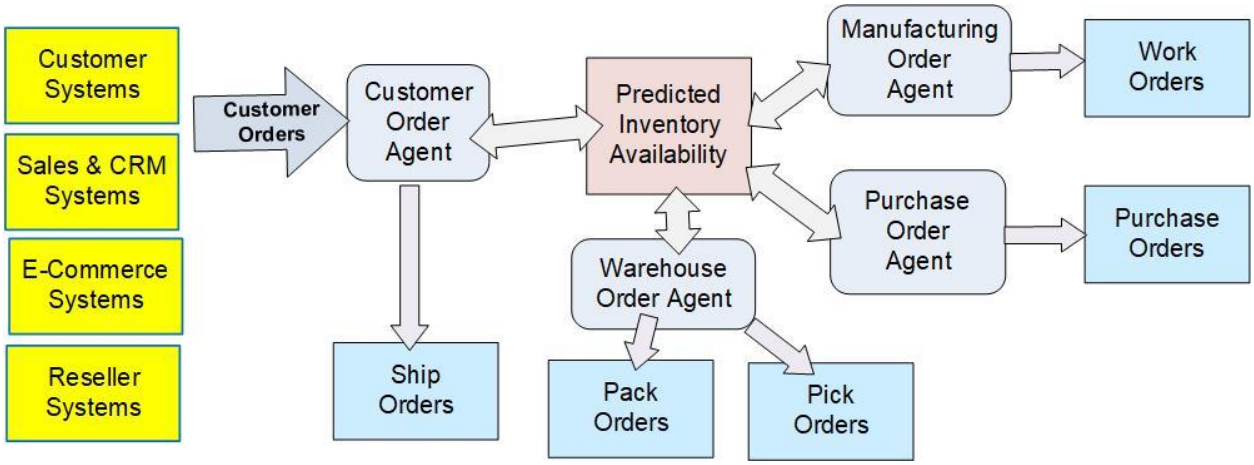
1. Receives and analyzes data from one or more sources in real-time
2. Contains algorithms that decide what to do with the result of the analysis.
3. Communicates the results of the analysis to other systems or people.

In doing this, a real-time AI system makes decisions that would normally be performed by people. These decisions may be used to automatically carry out activities, as in a robotic system, or to advise people, in near real-time, that they need to make decisions, and to provide them with the information they need to make those decisions.

In an intelligent-agent based real-time AI system, intelligent agents run in parallel to monitor sources of data for newly arriving data. Each agent then converts this data into actionable information, which is communicated to other agents, systems or people.

These agents contain decision rules plus some algorithms, where appropriate, to support the decision-making rules. Communications with other agents, systems, or people is then provided by the framework within which the agents run.

An Agent Based Model for Processing Customer Orders



In this model:

1. Orders flow from a variety of sources to a Customer Order Agent which converts the wide variety of incoming customer orders, into uniform ship orders, which are for a set of items to be shipped on a specific day to specific customer or distribution center.

2. The ship order line items then place a demand for products, at a future date, in a Predicted Available Inventory database. This may cause the predicted inventory for some of these products to go negative at a future date.

3. A Manufacturing Order Agent monitors the predicted inventory and may create Work Orders to make the needed products. The act of creating these work orders, creates a demand for the needed raw or intermediate materials at a future time in the predicted inventory database, which may drive the predicted availability of these materials negative in future.

4. Another Manufacturing Order Agent may monitor the predicted availability of intermediate materials and generate further work orders to convert raw materials into intermediate materials.

5. A Purchase Order Agent will typically monitor the predicted availability of raw materials and create Purchase Orders to order more raw materials.

6. Finally, a Warehouse Order Agent will monitor the Ship Orders, as well as the predicted availability of materials for Shipment and generate Picking and Packing orders for the shipping department.

This model, as presented here, is somewhat simplistic and, in practice, becomes significantly more complex; but the principles stay the same.

The purchase, work, pick, pack and ship orders can be directly issued to people but, in general are issued to an operations tracking system such as BellHawk, which performs several important functions:

1. Tracking status of inventory, purchase, work, picking, packing and shipping orders, including materials received and shipped as well as materials scrapped.
2. Tracking predicted available inventory in real-time as materials are received, consumed, produced, and shipped.
3. Converting orders into actions to be carried out by people and then performing short term scheduling of these actions.

Computing Predicted Inventory Availability

An inventory tracking system like BellHawk tracks its predicted available inventory in its predicted inventory table. This table contains future credits and debits to the inventory based on Purchase Orders (POs), Ship Orders (SOs) for customers and Work Order (WOs) for making finished products and their components. This enables the future availability of inventory, on each day, to be computed based on the current physical inventory for an item, plus the credits minus the debits in the predicted available inventory table.

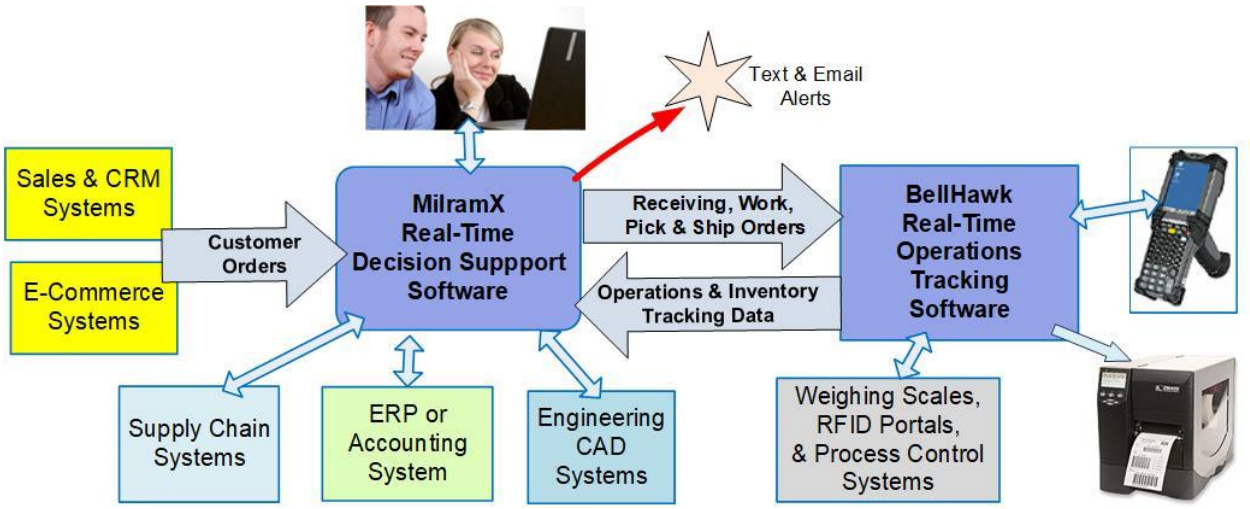
When a WO record is created, a future credit is added to the predicted inventory table with the quantity and expected date for the parts to be produced by the WO.

When each corresponding WO step record is created, a future debit is added to the predicted inventory table with the quantity of parts to be consumed and the expected run date for the step.

When parts are recorded out of the final WO step, these are added to the quantity to physical inventory. This causes the quantity in the predicted inventory table for that WO item to be adjusted downwards to reflect the reduced remaining quantity to be made. This reduction is, of course, offset by the increase in physical inventory by the manufactured material so the net amount of available inventory stays constant across the “material out of work order step” event.

When materials are consumed on a WO, these are added to the quantity already consumed in the traveler step items table. This causes the debit quantity in the predicted inventory table for each WO step part to be adjusted downwards to reflect the reduced remaining quantity to be consumed.

Interaction between Decision Support and Operations Tracking System



A real-Time AI-based decision support system, such as MilramX, is typically paired with an operations tracking system, such as BellHawk, which uses technologies such as barcode and RFID tag scanning to track operations in industrial manufacturing plants and warehouses, as well as at construction sites.

Purchase Orders generated by MilramX are typically sent to an ERP or accounting system, as purchase requisitions, which can be adjusted by purchasing managers, as appropriate. At the same time, Receiving Orders are sent to BellHawk, to be used by the receiving department to facilitate the receipt of materials.

In response to Receiving, Work, Pick, Pack and Ship orders sent to BellHawk, MilramX receives back operational and inventory status, including updates to the predicted available inventory, tracked by MilramX.

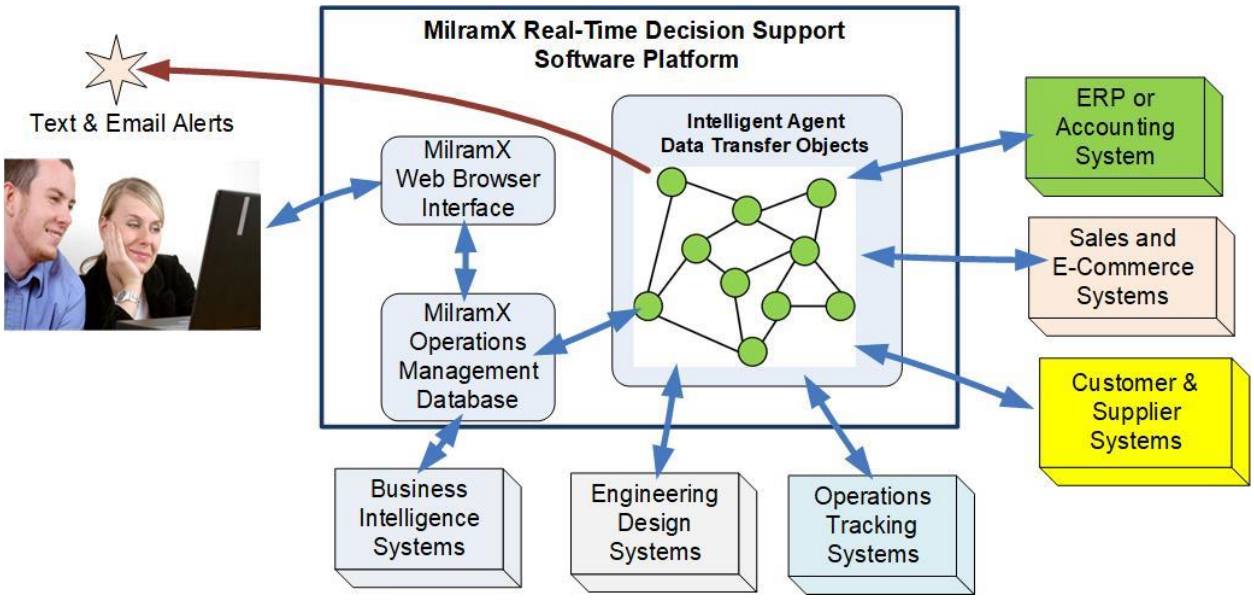
One complexity that BellHawk takes care of is that different customers many require different labels on products and their packaging. BellHawk uses a rules-based engine to automatically generate the correct labels for each customer and product, thus helping prevent potential mistakes. These are dynamically integrated into the appropriate work, packing and ship orders as appropriate.

BellHawk can also send information along with the work orders. This may be drawings and/or numerical control data for machines or production lines or other process data. Usually these are derived from interaction with engineering or process management systems.

As part of their monitoring function, MilramX agents can send text or Email alert messages. For example, to alert a purchasing manager that materials need to be ordered or to a production manager that critical materials have arrived, so that an important job can now be started.

MilramX can also exchange information with supplier and customer systems used by supply-chain trading partners. This includes purchase orders and advanced shipment notices as well as materials traceability data.

Intelligent Code Agents



A software platform like MilramX can support many code agents running in parallel. These agents are typically programmed in Python, with typically over 90% of the code needed automatically generated on demand, or provided pre-generated, by the MilramX framework. This enables rapid and cost-effective deployment of these agents.

In a typical MilramX application the agents maintain an operations management database, which is used by the agents as a common repository of their knowledge. This database can then be used to provide decision support through a web-browser interface or used as the basis of further business intelligence using third party software tools.

An intelligent agent framework like MilramX is designed for 24x7 operation on multi-core processors with agents being added or updated dynamically without taking the order processing system down. MilramX can also sustain operations when one or more of its data sources goes off-line for a time.

Commentary

Use of real-time AI methods can enable automation of many of the aspects of managing customer orders through a variety of manufacturing and industrial distribution organizations, including dynamically assigning work or other orders across multiple sites.

This can considerably reduce the number of people required to process an incoming customer order flow, as well as eliminating mistakes that people often make.

Such systems do not replace ERP systems but instead augment them so as to enable efficient operations management in a make-to-order, just-in-time, lean inventory enterprise.

Authors

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