Real-Time AI – Will It Revolutionize Industrial Operations Management?

Introduction

Real-time AI algorithms are not new. They helped put man on the moon and today are used in self-driving cars, ships missile defense systems, and even robot vacuum cleaners. What is new is their increasing application to assist operations managers to efficiently run their industrial operations with fewer support staff.

These real-time AI applications differ in their decision making from regenerative AI applications, such as Chat GPT, which are currently being hyped in the media.

Real-time AI applications analyze and act on new data as it arrives, in near real-time, from multiple sources, without human intervention. Regenerative AI systems, by contrast, answer questions posed by people by searching the contents of a large database or the Internet.

By analyzing the incoming flow of data, usually from multiple sources, real-time AI systems can:

- Take autonomous actions by sending orders to other systems that will carry these out.

- Provide decision support to people by providing them with the timely information they need, typically through the systems they routinely use.

- Providing warnings and alerts to people when there are situations which they need to pay attention to, typically in the form of text or Email messages.

In this white paper, the authors look at operations management applications and the challenges involved. They also describe an intelligent-agent based architecture which has been successfully deployed in a number of these applications.

Finally, the authors address the question as to whether real-time AI will revolutionize industrial operations management and replace ERP systems in this role.

Operations Management Applications

Real-Time AI based systems are used to solve real-time operations tracking, scheduling, and management problems in manufacturing, distribution, and service organizations.

Typical applications include:

1. Automatically processing customer orders into actionable purchase, receiving, manufacturing, picking, packing, shipping and installation orders.

2. Automatically planning and scheduling operations in real-time to make sure that customer orders get shipped, delivered and installed on time.

3. Tracking the flow of customer orders and materials through multiple manufacturing, distribution, and installation sites.

4. Automatically providing people throughout an organization with the real-time operations management information they need to do their jobs efficiently.

5. Automatically exchanging information with supply-chain trading partners for operational coordination and materials traceability.

6. Warning people when they are about to make an operational mistake.

7. Automatically alerting managers when situations arise that they need to pay attention to.

Real-Time AI technology has been applied by KnarrTek to solve operations management problems in a variety of manufacturing and industrial distribution applications, as well as in FDA regulated food and pharmaceutical applications. In each case, this has resulted in more efficient management of operations within these industrial organizations with fewer people.

Challenges

While real-time AI has already found its use in operations management in many large multi-national organizations, the true challenge lies in bring this technology to assist the 60,000 or so mid-sized manufacturing plants and the hundreds of thousands of smaller industrial distributors and service organizations in the USA.

These organizations typically have limited financial and IT resources while at the same time have great difficulty recruiting enough skilled people at an affordable cost.

The approach taken by KnarrTek is to use a software platform (MilramX) which typically provides over 90% of all the software code needed for such an application, working "out-of-the-box". This software platform provides capabilities for the easy customization of the code in terms of expert-systems rules or Python code, which can be performed by business analysts who have limited programming skills.

This enables a typical system to be deployed in a few weeks or months with a return on investment through labor savings taking only a few months.

Systems Architecture
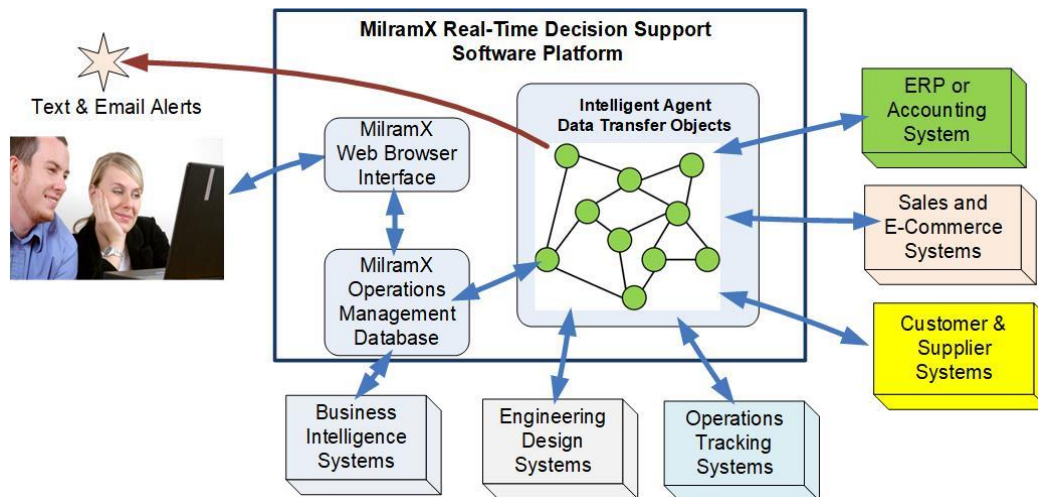
The traditional way of writing operations management decision support applications, such as ERP systems, is as a single large program. The issues with this approach, in real-time operations management applications, are:

1. Many things happen continuously at multiple locations within an industrial enterprise. By the time a single application has finished sequentially analyzing one situation, many other events may have occurred. As a result, many decisions do not get made, or people do not get the information they need, until it is too late.

2. You need a large amount of computing power to try to make the large singular application run fast enough to meet the needs of all the processes and people involved.

3. You need to shut down and recompile the decision support application every time there is a change to operating procedures or people's needs within the organization or additional information needs to be sent to trading partners. This can be problematic in many industrial applications where 24x7 operation is required.

By contrast, MilramX uses the paradigm of intelligent agents which are run as separate processes in parallel on affordable multi-core processors running the Windows operating system. In this way each intelligent agent process can monitor a one or more sources of data for changes and then make decisions, advise people, and/or communicate with other agents in near real-time.

The algorithms used by these agents may range from a simple set of rules to complex non-linear self-adaptive statistical correlators (Neural Networks). While these algorithms typically depend on standard libraries, it is important to recognize that the decisions made by each agent are typically unique to each specific organization and how it does business.

The solution adopted by MilramX to solve this problem is to make as much use as possible of third-party software libraries for performing mathematical and other real-time AI computations and then to use a Python script as the application specific "glue" to contain the decision support rules and other such computations.

The benefit of this is that the Python script can be dynamically linked to the intelligent agent process, as can the Dynamic Link Libraries (DLLs) that it uses. This enables the Python scripts to be dynamically updated while the overall real-time operations management decision support application is running 24x7.

MilramX also includes mechanisms for scheduling and monitoring the execution of the intelligent agents as well as providing mechanism to enable simplified access to different data sources. This is all with the goal of making it as quick and easy as possible for people with limited programming experience to create or update intelligent agents, and maintain the system as the organization and its markets expand.

Commentary
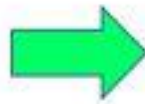
With the use of real-time AI, the goal of replacing stacks of reports about what went wrong yesterday with just the just-in-time information needed by each manager in is finally starting to be achieved. Such systems:

1. Put managers directly in touch with what is going on in their operations rather than requiring time-wasting coordination meeting with staff members.

2. Automate much of the routine decision-making leaving managers to focus on those special cases where their experience is really needed.

3. Require far fewer operations management support staff, with attendant cost savings and easier staff recruiting and retention problems.

4. Reduce delays in the manufacturing or distribution process.

5. Enable rapid and economical production and distribution of a wide variety of semi-custom products.

Will such systems bring about a revolution in industrial operations management? We believe that the answer is yes. But time will tell.

With increasing use of computer-controlled machine tools on the shop floor and automated robots in the warehouse, the number of people needed to make or distribute products for customer orders is rapidly decreasing.

At the same time, the number of people involved in managing these operations has seen a rapid increase. Now real-time AI systems provides the opportunity for mid-sized industrial organizations to significantly reduce the number of "overhead" people required, while being able

to quickly deliver customer orders, with fewer mistakes, thus increasing customer satisfaction and sales.

As we deploy an increasing number of these systems, we are getting smarter about how to structure these systems and their application so that they make the lives of everyone in the organization simpler and do not require hiring expensive IT or other staff to maintain these systems.

One final question we get asked is whether Real-Time AI systems will replace ERP systems. Our answer is a definitive NO. Both systems are required for a functional organization and need to work together.

ERP systems basically capture operational and financial history and may be used in long range materials and operations planning. Real-time AI systems, by contrast are concerned with short-term operations planning, real-time scheduling, monitoring, and alerting. Both are needed for effective operations management.

Many of our clients come to us because their ERP systems do not meet their needs. The answer, in almost every case, has been to implement real-time AI based add-ons to their ERP systems rather than buy a new ERP system. As a result, these clients were able to avoid the cost and disruption of implementing a new ERP system, which would not have solved their real-time operations management problems anyway.

Authors

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Dr. Peter Green serves as the Technical Director of KnarrTek Inc. Dr Green obtained his BSC (Hons) in Electrical Engineering and his Ph.D. Degrees in Electronics and Computer Science from Leeds University in England. Subsequently Dr. Green was a senior member of technical staff at Massachusetts Institute of Technology and a Professor of Computer Engineering at Worcester Polytechnic Institute.

Dr Green is a Systems Architect who is an expert in using real-time artificial intelligence methods to implement real-time Operations Tracking and Management systems for Industrial Organizations. He has led the implementation of over 100 such systems over the past decade. Dr Green also led the team which developed the BellHawk job and materials tracking software as well as the MilramX decision support and intelligent information integration software platform.

Eric Green

Eric Green serves as the Director of Support of KnarrTek Inc. Eric Green obtained is bachelor's degree from UMASS Dartmouth in Operations Management and Management Information Systems. Eric has been a part of 40 plus implementations of operations management systems over his 8 years of experience in this field. This includes receiving, production, inventory management, shipping, order management, as well as integrations with a number of ERP systems and a range of different manufacturing equipment.

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