Evolving automation systems drive advances in manufacturing

Manufacturing environments are rapidly evolving due to global competition and changing customer requirements. To maintain competitiveness, intelligent software control programmes are required to operate at faster speeds; information integration becomes imperative in achieving timely and accurate data retrieval to support critical business decisions. Paul McRoberts, Industry Solutions Manager-Initiatives, South Pacific Region, Rockwell Automation discusses the importance of intelligent software for increasing productivity in manufacturing plants.

The notion of intelligent software has existed for a long time, but a paradigm shift is occurring in how critical and complex automation systems are designed, configured, and controlled. To achieve 'artificial intelligence or self healing' would be the ultimate goal; a system where the intelligence of machines is such that traits like reasoning, knowledge, planning, learning, communication, and perception provide machines with the ability to move and manipulate objects to improve commercial outcomes. While intelligent software still has a long way to go to achieve this, increasing embedded computing in distributed intelligent devices provides improved system operation.

Combining sophisticated software and distributed smart devices produce 'intelligent software'. These agents often include features such as embedded diagnostics, communications, calibration and control activities that are typically performed in a programmable logic controller (PLC) or other distributed control system. By having the ability to respond to changes in conditions such as unexpected component failure, environment changes, workload changes or system operating objectives, these agents provide superior and reliable performance. Intelligent software devices that can evolve to overcome challenges and self-heal to prevent downtime are being actively developed. This technology has proven to be widely adaptable to a range of complex systems and industrial applications.

Intelligent and integrated manufacturing

The success of a company's manufacturing capabilities is often measured by their ability to respond to market changes. Traditionally, the production management system used by manufacturers was based on Enterprise Resource Planning (ERP) applications. In this model, a set of separate software applications are used for different parts of planning, scheduling, and execution processes. Significant limitations are entailed with this approach resulting in disconnected planning and execution processes. The move towards an intelligent and integrated environment will bring the flexibility and efficiency needed by manufacturing systems.

The integration of a manufacturing system allows functional areas such as design, analysis, planning, purchasing, cost accounting, inventory control and distribution to be linked, providing valuable information about the status of a particular plant. EtherNet/IP remains the industrial network of choice for many manufacturing plants, providing an integrated system with the agility and flexibility that is essential for competitive manufacturing in today's global market.

Autonomous Control Systems

Intelligent software has the potential to create an automated control system that can be applied to a diverse range of industries. There are generally several components to be incorporated into an autonomous control system including variable frequency drives, intelligent software and networked motor condition monitoring devices. Typically, these systems integrate drives, intelligent relays, motor control centres, sensors and other monitoring devices on a common data-driven Ethernet/IP communications network. This provides precise motor control intelligence as part of a strategic maintenance program.

Technology has allowed for significant advances in generating high level, advanced control software. By increasing productivity on the plant level, the software does not affect the day to day running of the machines eliminating the need for complicated maintenance requirements. These intelligent software applications are aiming to be generic, self-healing type systems for companies that want to take their technology to the next level.

Autonomous control systems must perform well despite significant uncertainties in the plant and the environment for extended periods of time. They must be able to compensate for system failures without external intervention. If a variable on a machine is changed, autonomous control allows the machine to automatically re-configure so that there is no misalignment. The higher the degree of automation, the more critical is the integrity of the data used to control the machines.

Intelligent software and overall equipment effectiveness

Recent advances in integrated manufacturing intelligence systems have expanded the performance

capabilities of overall equipment effectiveness measurements. OEE is established by determining overall capacity and planned production time compared with loss due to downtime, performance or quality limitations. Business enterprise systems are required to collect, organise and report data detailing information about potential inefficiencies in a manufacturing plant. Addressing these deficiencies with integrated manufacturing intelligence systems has expanded the performance capabilities of OEE measurement.

Intelligent manufacturing software allows information to be digitally captured in real-time simplifying interpretation. The challenge for software developers is to overcome the limitations associated with manufacturing plants having to sort through millions of data points to determine how best to interpret the findings. Intelligent software systems need to be adaptable to analyse individual parameters for varying applications.

Integrated safety and motion control

Manufacturing plants are increasingly realising the importance of integrating safety controls to help minimise worker injuries and increase overall cost savings. The safe control of motion has many benefits including efficient maintenance of an application without disrupting power supply to machinery, safe speed control and safe control of potentially hazardous movement. Efficient translation of data to produce an action, or exact motion to help maximise safety, continues to be the backbone of intelligent software advancement.

Control of intelligent agents that can interact with actuators and sensors provides the ability to address motion control in large, complex manufacturing systems. Relying on a single, central controller has significant limitations because damage to that controller or to the communication infrastructure used can result in a loss of controllability. Safety hazards are inevitable when motion control is compromised. A distributed, survivable and adaptable architecture can be achieved by distributing the intelligence of the system among multiple controllers. Embedding standalone or multiple intelligent agents inside the controllers, results in an advanced level of motion control.

Distributed Control Agents (DCA) interact with intelligent agents in a manufacturing system to achieve a functional outcome. The use of agents in automation allows for the design of more flexible and smarter control architectures. By leveraging an agent communication layer (ACL) on top of communication networks such as EtherNet/IP, a manufacturing system is able to achieve coordination of dissimilar systems. Intelligent agents possess the capability to detect equipment failures and to isolate failures from propagating allowing for increased safety and productivity and reduced downtime in a manufacturing plant.

Energy Efficient Solutions

Energy management is a complex but important factor in optimising production processes in manufacturing plants. Globally, manufacturers are putting systems in place to reduce water, air, gas, electricity and steam consumption—resources widely required by processing plants. Recent advances in intelligent motor control, incorporating variable speed drives, intelligent software and networked motor condition monitoring devices allows for a measureable impact on energy use and operational efficiency. Intelligent software can offer significant energy savings by improving process diagnosis, stability and consistency in operations and by improving the control response to operating changes.

Manufacturers can use energy consumption data to identify variables in energy costs across all equipment on the plant floor collectively and also with individual machines. Energy management can be applied to machine design practices by improving efficiency of equipment components such as motors and drives or by attaching monitoring devices to assist with data collection. By collecting accurate energy consumption data, manufacturers can modify the OEE calculation to include energy efficiency, allowing them to achieve higher profitability while reducing greenhouse emissions.

Intelligent software leads manufacturing into the future

Manufacturing environments are rapidly changing as a result of increased global competition and changing customer needs. Advances in intelligent software technology continue to provide manufacturing enterprises with the capabilities and flexibility to deal with these changes. By coordinating and integrating production activities within a manufacturing enterprise, intelligent agents provide increased productivity and profitability.

Intelligent agents are increasingly able to incorporate logic and collaborative reasoning parameters to detect faulty components, process problems and inefficiencies in a manufacturing plant. By eliminating the need for centralised control, autonomous intelligent agents display the capabilities for predictive reconfiguration of production processes, thereby reducing downtime and increasing productivity.

With the manufacturing environment constantly evolving—the ultimate goal is to develop adaptive, self-healing systems that can react to their environment and modify their behaviour accordingly to maximise production efficiencies. AT