

A Roadmap to Productivity

Intelligent networked manufacturing can make demand-driven production a reality

By Malcolm Wheatley

Despite a pace of innovation in computing and software systems that offers new capabilities to manufacturers on a nearly daily basis, a simple fact remains: A company's investment in enterprise, supply chain, and plant-floor applications will not deliver promised benefits if the underlying network is not up to the job.

That is unfortunate because these applications address real challenges that all companies—and especially midsize ones, typically those with 2000 or fewer employees—face in today's global marketplace.

Midsize manufacturers are just as burdened as the largest companies with rising commodity and energy costs, yet given excess capacity and overseas competition that exert downward pressure on price and profit, they have little chance to pass those costs on to customers. Squeezed by ever-shorter product lifecycles, midsize manufacturers also must respond with agility in a marketplace that calls for mass customization.

In response, a central tendency in manufacturing today is the movement toward demand-driven supply networks—a development wholly dependent upon having enterprise-system transparency into changing demand signals, inventory levels, and production scenarios.

Achieving transparency places unprecedented pressures on the network because the hunger of the enterprise system for information introduces the need for following capabilities:

- *Bidirectional communication* between the plant floor and the business enterprise for real-time production management

- *Communication among plants* as the means to brand and performance management

- *Communication with suppliers and customers* so as to recognize demand and respond in real time

In short, computers today are more often communication devices than calculators—and it is the network that makes the needed connections possible.

The challenge facing the network is clear: as data-intensive solutions, such as business intelligence and unified communications, come to the fore; as users make greater use of voice and video; and as services-oriented architecture becomes the rule, the role of the network in transforming manufacturing will become more crucial.

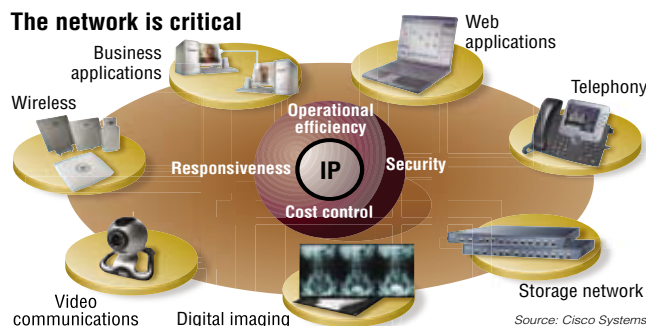
For manufacturers, network challenges are especially acute given the special nature of data on plant floors. Determinism and millisecond response rates are the norm, and the sheer amount of generated data can overwhelm even the most generously provisioned network.

Special Needs of Manufacturing

Plant data is too valuable to lock away, yet too many corporate computing networks have grown in an ad hoc fashion. Besides raising security issues, the result is less-than-optimal performance and higher-than-necessary maintenance expense.

Cisco Systems® is the worldwide leader in networking for the Internet. Founded in 1984, Cisco® engineers have been leaders in the development of Internet Protocol (IP)-based networking technologies. Today, with more than 47,000 employees worldwide, this tradition of innovation continues with products and solutions in core development areas of routing and switching, as well as in advanced technologies such as IP communications, wireless LAN, application networking services, storage area networking, security, and video systems.

Cisco has a roadmap that guides managers in stages to a more sophisticated approach to networks. Termed the *Manufacturing Smart Business Roadmap*, its intention, explains Edzard Overbeek, vice president of commercial markets for Cisco in Europe, is to shift the focus away from technologies and terminology, and emphasize how intelligent networked manufacturing alleviates midsize manufacturers' specific pain points.



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As the world's leading networking provider, Cisco Systems offers this guide to manufacturers in their quest to become demand-driven. The roadmap is built on a foundation of *business connectivity*, supplemented by a suite of capabilities aimed at *business efficiency*, with the intention of working toward a conceptual endpoint termed *business optimization*.

"The roadmap answers customers' questions, such as 'How can Cisco help me? What is the impact on the wider business and supply chain? What benefits am I likely to receive? And what do I need to invest in from a technology point of view?'" Overbeek explains: "What midsize manufacturers want to know first is our capabilities, not a list of our specific solutions and products."

Business Connectivity

Manufacturers requiring business connectivity typically lack good information for business decision making—information that is accurate, up-to-the-minute, and delivered cost-effectively and securely.

To establish good connectivity, a foundation should be created for current and future integration needs. This foundation includes Ethernet in the factory and the means for automated collaboration within a distributed manufacturing environment, while meeting requirements associated with a burdensome regulatory and security environment. When needed connectivity

is established, an aggregation of information from varied enterprise sources becomes available for use by decision makers.

When global tobacco products giant BAT acquired state-owned ETI in 2003, BAT Italia became Italy's second-largest tobacco company. But it also inherited ETI's aging communications infrastructure, which relied on 1700 routers to send production data to the company's headquarters over individual ISDN lines.

"The quality of all these connections was poor, and they weren't as stable and secure as we would have liked," recalls Duccio Rosselli, IT delivery technology architect, BAT Italia.

BAT needed a secure foundation that improved its business processes, Rosselli explains, while also achieving needed data integration in support of real-time decision making. "We needed to increase security on the links to have the flexibility to accommodate new applications and features on the network, and have scalable and easily managed solutions," he says.

Specifically, BAT Italia required a solution that offered the following:

- Industrial Ethernet to connect the plant floor to corporate operations;
- Wide-area networking to improve site-to-site communication
- Switching and routing that established a scalable infrastructure

Recognize the challenges, uses, and benefits of plant networks

As manufacturers become more demand-driven, their need to respond with agility to changing demand signals creates an appetite for near-real-time visibility into current production parameters: inventories, work in process, capacity constraints, and work-order status.

The challenges associated with better visibility begin on plant floors, where a cacophony of proprietary systems is found. Yet few companies commit to a single automation vendor for all their needs. Manufacturers instead confront the challenge of translating multiple proprietary outputs into a language and context understandable to the enterprise system.

Field-device management and proprietary-device communications represent the first layer of concern. Over time, these devices have gained intelligence for diagnostics, programming, and the ability to communicate in peer-to-peer networks. However, numerous fieldbus communications protocols remain—some of them proprietary, including HART, Modbus, PROFIBUS, and DeviceNet.

The second layer, above the device level, is programmable controllers (PLC) and supervisory control—or SCADA—workstations. Here too is valuable data for use in production and financial systems, again marred by multiple communications protocols.

Midway between devices and controllers and the enterprise busi-

ness system is the manufacturing execution (MES) and manufacturing intelligence layer. MES is a functional software layer concerned with detailed production management, whereas manufacturing intelligence systems aggregate data from disparate systems to allow analysis and decision support. Plant data historians also are found at this layer.

Overseeing all, enterprise resources planning (ERP) systems often reach down onto plant floors, either as a substitute for execution systems or in conjunction with them, to transmit orders to the plant floor or to track results.

A Changing Vista

Today, fresh developments are reshaping this landscape, offering hope to manufacturers struggling to reconcile concerns over cost, complexity, and security with the goal of becoming demand-driven.

"Even dominant vendors now recognize that the quest for perfect interoperability will result only from cooperative efforts around standards," says David Humphrey, senior automation analyst at Dedham, Massachusetts-based ARC Advisory Group.

Automation vendors, for example—at both the device and supervisory control layer—are moving to Industrial Ethernet to save

Cisco Manufacturing Smart Business Roadmap

Business optimization		Realizing marketplace leadership	
Pain point	Business imperative	Business solution	
Lack of optimal asset and resource utilization limiting margin expansion	Creating sustainable competitive advantages	Unique platform adaptable to evolving business requirements	
Business efficiency		Integrated supply chain	
Pain point	Business imperative	Business solution	
Lack of collaboration and communication impacting productivity and competitiveness	Extending visibility and control through the value chain for real-time flexibility	Expanded foundation for secure collaboration and communication	
Business connectivity		Connected Manufacturing	
Pain point	Business imperative	Business solution	
Lack of good information for business decision-making	Business and production environment integration for better visibility and control	A secure foundation for business integration and communication	

Source: Cisco Systems

The purpose of the road map is to demonstrate how intelligent networked manufacturing is integral to demand-driven manufacturing.

- Wireless for flexibility and ease of deployment.

The Cisco capabilities that BAT Italia adopted included Cisco router technology, complete with hardware encryption acceleration; IP Security VPN; firewall protection; in-line intrusion prevention; Network Admission Control; and URL filtering embedded, augmented by IP telephony and unified messaging.

Most Cisco capabilities reside within single physical units, adds Rosselli, rather than spread over different devices. "This setup reduced operating costs and technical complexity because the functionality is integrated with one device, which makes overall network management easier," he says.

For manufacturers struggling to aggregate informa-

tion from disparate systems that lack common standards and wanting to enhance real-time decision making, meet regulatory requirements, and increase flexibility, establishing connectivity is the place to start.

money and increase visibility and flexibility.

"Ethernet has changed," adds Mark Wylie, industry solutions manager at Cisco. "It is realistic to see it replacing fieldbus protocols: quality of service parameters ensure that data gets to the destination. A new generation of Ethernet switches guarantees critical data gets to its destination within the expected timeframe. The prospect is of a single network, stretching right across the plant floor."

Equally important, a new generation of networking standards is restating the art of the possible both on the plant floor and for communication between the plant floor and the enterprise.

ISA-95, for example, is an international standard that defines the terminology and models used in the integration of business systems at the enterprise level with control-level applications at the automation layer.

OPC Unified Architecture (OPC-UA), on the other hand, from the OPC Foundation, aims to merge existing OPC specifications and update them in light of recent technology advances, including Web Services.

"Standards such as ISA-95 and OPC-UA remove barriers to communication by creating an environment of perfect interoperability between otherwise dissimilar applications," says Humphrey. "The result is lower integration costs, easier maintenance, improved information sharing and—most important—more profitable business performance in a highly competitive world."

ERP and Supply Chain

As the network on the plant floor has changed, so too has the broader enterprise and supply chain network—and the business environment in which it operates.

ERP systems have matured to allow a single instance to be deployed across plants and facilities. Planning and scheduling functionality has improved, and can be integrated with just-in-time modalities, creating the flexibility needed to optimize production—vital if the goal of being demand-driven is to be met.

Globalization also affects the business environment. As business functions—including manufacturing—are outsourced to those who can cost-effectively perform them, the vertically oriented, single-entity supply chain becomes fragmented. Companies struggle with the complexities of accessing their own control systems. The prospect tomorrow is that they must access their suppliers' control systems.

Finally, with RFID and two-dimensional bar codes on plant floors and in warehouses, intelligent devices can automatically parse this data into useful information—dispensing with the need for middleware to act as an interpretation and transformation layer—and make it available to the enterprise and supply chain.

In each case, the network provides scalable, cost-effective, and secure connectivity. "In the classic world of IT, security of data is paramount, with network availability less so; but to a manufacturer, it is the availability of the network that is paramount—and it must be achieved without compromising security," says Wylie. "It is a change of emphasis, but an important one." ■

Integrating Supply Chains

Manufacturers that want to move beyond simple connectivity to business efficiency will feel operations pains characterized by a lack of collaboration and visibility within the supply chain. The goal is to extend the previous “foundation” stage so as to forge efficient shared business processes, especially for better forecasting, demand management, and inventory control. Another important area, particularly for outsourced manufacturing, is sharing product design information.

Chicago-based Corrugated Supply converts paper into corrugated sheets that its customers then finish and assemble into boxes. To meet demands for shorter lead times and faster turnaround on orders, the company needed to streamline systems, reduce waste, and lower costs. “We needed to offer our customers greater visibility into the system,” says David Pung, director of information systems at Corrugated Supply. Specifically, the company required an overall solution that embraced these requirements:

- Maximum network reliability and uptime to support a 24-hour business model
- The ability to manage network devices from a common interface to ensure consistency across the plant
- Integration with Websites, and support for customized extranets for supply chain and purchasing systems
- A single-source provider for core routing and switching, wireless networking, and IP communications

Corrugated Supply deployed Cisco capabilities that not only deliver real-time visibility and flexibility—interfacing with every piece of machinery in the plant via a wireless network—but also provides a link to the company’s Website. In addition, Cisco supports the customized extranets to Corrugated Supply’s customers, sending them real-time shipping notifications and alerts to prepare production machines.

Since implementing the system, notes Pung, Corrugated Supply has cut overall paper waste in half, doubled order volume, and enabled just-in-time manufacturing. Today, 85 percent of company’s orders arrive online.

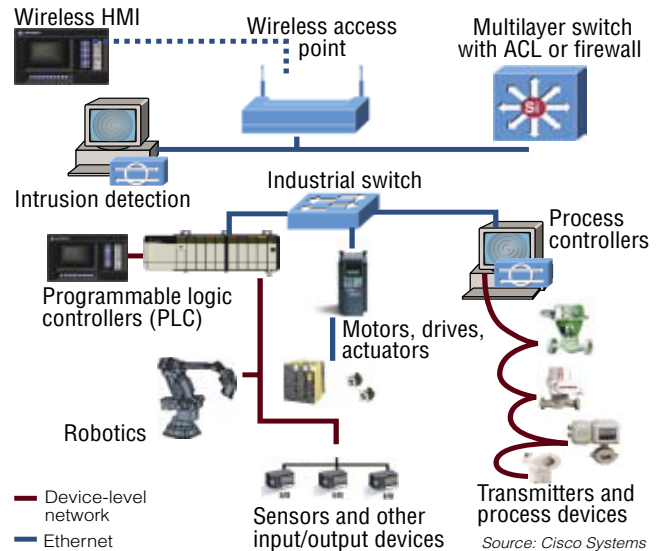
If there is a need to extend visibility beyond the enterprise and into the supply chain—to foster collaboration and reduce inventories through better logistics and supplier performance management—then it is time to build on the foundation with virtual private networks, unified communications, and a wireless infrastructure.

Customer Focus

Manufacturers wanting to go beyond business efficiency toward business optimization, will have experienced problems that revolve around maximizing asset use and supply chain flexibility. Overbeek says optimization is essentially customer-facing and calls for a communication platform that connects customers to the design, development, and production of goods and services, while simultaneously improving after-sales and

Ethernet to the factory

Production network



With industrial Ethernet, the need for disparate fieldbus networks is eliminated, allowing a single network—even on the plant floor.

relationship-management capabilities.

“Through better asset utilization and demand responsiveness, manufacturers can maximize operating and profit margins by means of integrated business processes,” he says. “The result is true visibility across the entire enterprise and its supply chain—from design to delivery, and after-sales.”

This optimized visibility generates quantifiable benefits in the form of greater resource use, marked product differentiation, and a sustainable competitive advantage.

Cisco Intelligent Networked Manufacturing solutions enable real-time collaboration by lending complete data visibility and flexibility throughout the entire manufacturing value chain—from product development through manufacturing, sales, and service management.

A roadmap is used to get where you want to go. Cisco’s roadmap highlights the capabilities manufacturers must employ to connect with the enterprise, work efficiently with suppliers, and optimize customer relationships. But the capabilities are not mutually exclusive—many manufacturers look to improve in several areas at once. As with any good map, there is more than one way to get where you want to go. Most important is having a good technology partner that is looking at the same “map” you are. ■

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