

# Next-Generation Manufacturing A Connected Approach

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Following is the introductory essay from the upcoming Connected Series book, *Connected Manufacturing*, available this fall from the Cisco Systems® Internet Business Solutions Group.

### The Case for Connectivity

**While global manufacturers have for years used technology to increase productivity and improve customer service, today they face unprecedented challenges. Tectonic shifts in the global economy have created important new competitors—and huge new markets in emerging countries. Plus, user demands for wider and more tailored products are forcing manufacturers to innovate faster and develop greater intimacy with end customers.**

At the same time, technology has also advanced. Manufacturers now have large-scale databases, integrated enterprise resource planning software, radio frequency identification devices, and broadband Internet—to name a few—to tackle these challenges.

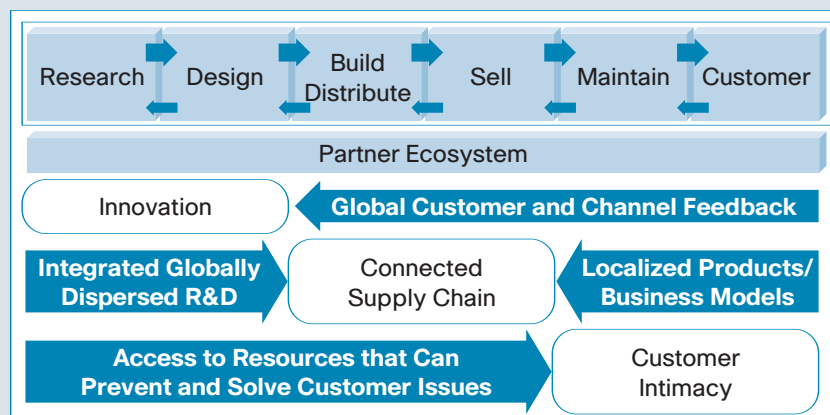
We find specific examples from around the world. Boeing invests in Moscow engineering facilities to develop the 787 Dreamliner. Emerson Electric Co. designs and manufactures core product modules in China and then customizes them locally. Kia Motors America moves manufacturing from “low-cost” Korea to cheaper facilities in Slovakia. CEMEX S.A. de C.V. integrates tracking and fleet management technologies to meet customer cement delivery requirements within 20 minutes.

These examples demonstrate a shift to next-generation manufacturing. They show, as we see in Figure 1, how manufacturers are emphasizing bidirectional information-sharing through the global manufacturing value chain—from research and development (R&D) to the customer and back; from suppliers to plants to sales-channel partners, and conversely.

Source: *Bidirectional Flow of Information in Next-Generation Manufacturing Ecosystem*. (Cisco Systems, Inc., 2005)

FIGURE 1

### Next-Generation Manufacturing

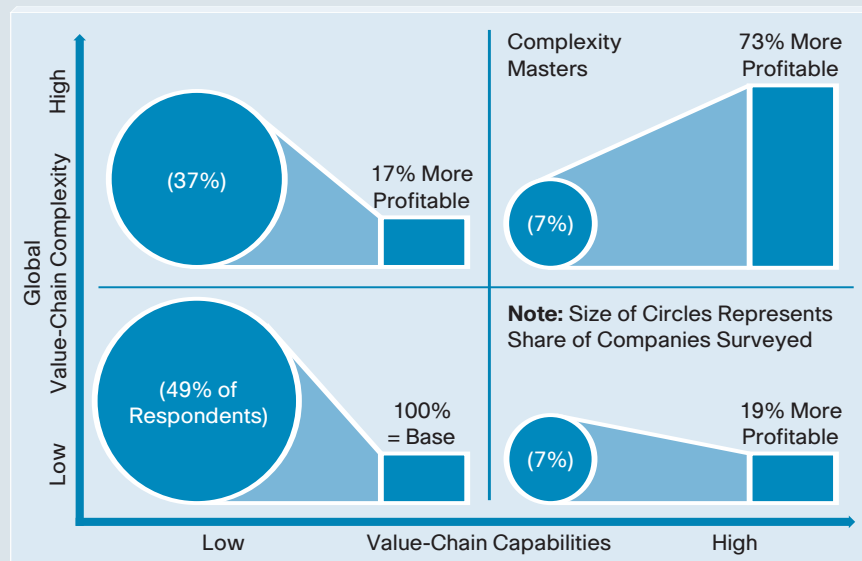


While Figure 1 shows that goods flow from left to right, information moves in both directions and across traditional functions and organizations. Each value chain includes multiple partners and customers, with information flowing between these different parties and across country and regional boundaries. In order to invest effectively in new products, the left side of the chain, where raw innovation occurs, is tightly connected to the right side of the chain, where customer interactions take place. The supply chain is, by definition, global and applies to all functions, not only to capital-intensive ones.

Moreover, research indicates that early adopters of these principles are benefiting financially and separating themselves from competitors. In fact, superior profitability can be enjoyed by creating value chains on a worldwide scale and mastering the complexities of global sourcing, manufacturing, and sales. Most manufacturing companies, however, have yet to establish the processes and methodologies that support a truly effective global business, as we see in Figure 2.

FIGURE 2

### Profiting from Global Value-Chain Capabilities



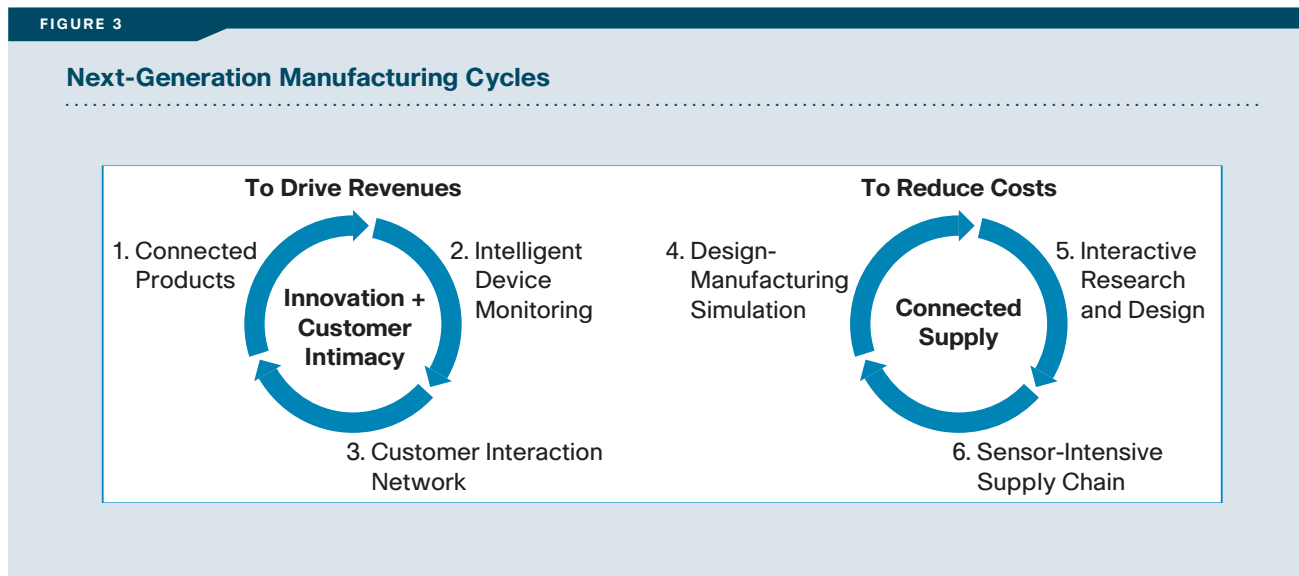
Source: *Complexity Masters Are More than Three Times More Profitable than Runner-Ups.* (Deloitte, 2003; published with permission)

Working with leading companies in high technology and industrial goods, the Cisco® Internet Business Solutions Group (IBSG) has developed a framework to describe the approach these first movers are taking. It consists of three building blocks:

- **Customer intimacy** allows organizations to differentiate the customer experience in order to cross-sell, up-sell, and maximize loyalty.
- **Innovation** in new product development requires integration of inputs from multiple sources, including customers, suppliers, original equipment manufacturers, and in-house R&D.

- **Connected supply** embraces all company and relevant partner functions around the world, improving the flow of information to improve decision making and accelerate processes.

As Figure 3 illustrates, customer intimacy and innovation provide a platform to enhance revenues, while connected supply is aimed at cost reduction. While many organizations excel at individual pieces of this framework, truly successful, next-generation manufacturers link all three components to create a sustainable, competitive advantage. In fact, the essays in this book feature several companies that have developed such an overarching vision and painstakingly assembled the pieces needed to make it work.



Source: *Integrated Value Cycles Improve Profitability*. (Cisco Systems, Inc., 2005)

## Driving Revenues by Combining Customer Intimacy and Innovation

As consumers demand more choice and flexibility, manufacturers need to understand their needs and requirements. In other words, they must achieve and sustain customer intimacy. Interactions with customers can be enriched by streamlining self-service and feedback processes, by training and developing customer-facing employees, and by taking advantage of the kinds of interactive technologies Cisco has deployed in its own sales and service operations. More sophisticated products, in fact, can be engineered to include new connectivity capabilities, which give valuable information on usage patterns and customer life-cycle events.

While information-capture and analysis are critical to developing customer intimacy, they are not enough. This information must then be translated into product and service innovation. Research by The Boston Consulting Group<sup>1</sup> shows that emphasis on R&D spending, as measured by R&D spend divided by total revenues, does not correlate with financial success. This makes sense if

<sup>1</sup> *Peak Performance in Innovation—Rules for Success for R&D Management in the Manufacturing Industry*, Boston Consulting Group, 2003.

we consider that effective and efficient innovation is also a function of how it occurs. Organizational or geographical silos make it difficult for companies to focus on innovation and tend to prevent cross-pollination of ideas.

Rather, innovation needs to develop organically from multiple sources within the extended global value chain. Ideally, all of the potential sources of innovation—customers, suppliers, original equipment manufacturers (OEMs), and in-house R&D—need to be embraced, because each one uses, or contributes to, the manufactured goods and will have a perspective on how they can be improved. Emerson, for example, has outsourced a number of noncustomer-facing manufacturing activities to focus on its core strengths. It uses a lower-cost Chinese team to design a new generation of products, build them in China, and ship them to configuration centers around the world for customization according to local requirements.

Leading manufacturers have already put this combination of innovation and customer intimacy into action, using three approaches:

- **Connected products.** Seamlessly connecting basic products to services opens a vast range of possibilities for manufacturers. The Apple iPod together with iTunes pioneered this approach to create a legal, cost-effective, easy-to-use, one-stop environment for end users. As a result, Apple enjoyed 85 percent market share in the music data download market and, with a “halo effect,” increased Apple computer sales by 26 percent. In fact, Apple is evolving into the platform of choice for Web-based personal content management. Companies that capitalize on this kind of product differentiation can expect to command a price premium of up to 15 percent, based on IBSG analysis.
- **Customer Interaction Network.** In an effort to improve the customer experience at every touch point, leading manufacturers are deploying Customer Interaction Networks to enable life-cycle support across a complex array of services, delivered by OEMs and channel partners. Cisco, for example, has harnessed technologies such as IP-based communications to migrate all of its call centers into a virtual contact center. The new network will give customers a unified experience across all channels over which they choose to communicate—the Web, telephone, e-mail, or in person—and across each kind of interaction, from sales to customer service. The results of the project dramatically affect the bottom line. In addition to enhancing the customer experience, Cisco created significant savings through productivity benefits while decreasing average talk time by more than 30 percent.
- **Intelligent Device Management (IDM).** The remote management of products has evolved from basic monitoring to sophisticated performance management and information analysis, using intelligent devices attached to products at customer sites. The technology allows typical manufacturing companies to monitor its devices, track operating parameters, perform expert diagnostics, and provide proactive maintenance and support. All of this results in improved reliability and serviceability of products, benefiting both the company and its customers. For the typical manufacturing company, IDM has created opportunities for new, value-added services that have helped improve service revenue.

## Controlling Costs Through Connected Supply

The cost containment part of the next-generation manufacturing framework focuses on the supply cycle. Unlike traditional approaches to supply-chain optimization, which concentrate on processes related to component and product manufacturing and delivery, connected supply includes all core company functions, across all geographies. Fundamentally, it is about improving the flow of information among all stakeholders, while providing real-time visibility into the information they need to perform their roles.

Such globalization does not require so much rigid standardization of functions or business processes as it does a precise definition of how partners should interact—and which information needs to be exchanged to ensure that best practices are implemented around the world. By doing so, it allows for faster, more inclusive decision making. It speeds up manufacturing and supply processes, without losing the specific advantages of different regions across which the supply chain might be spread.

A number of leading organizations have embarked on initiatives to deliver connected supply benefits, using technology to improve design, collaborate on R&D and engineering, and manage their supply chains.

- **Simulated manufacturing environments.** To drive global adoption of design and manufacturing processes, leading players are creating simulated manufacturing environments that enable rapid propagation of best practices and real-time collaboration. Nissan, for example, uses laser technologies to scan an existing factory floor, creating an electronic blueprint that can then be optimized, using simulation tools, and quickly replicated. By creating factory layouts and flows following the same set of rules, the time and cost required to design and build new factories can be reduced significantly. Boeing also uses integrated, computer-aided design tools to simulate how its 787 aircraft will be assembled, operated, and serviced long before the aircraft is built. As a result, Nissan expects to reduce development costs by up to 40 percent, improve fuel efficiency by up to 10 percent, and create an aircraft that is much easier to maintain.
- **Interactive R&D: global, virtualized engineering.** Boeing is teaming up with more than 20 major partners to produce its next-generation 787 aircraft. Two-thirds of the 787 will be designed and produced by Boeing's partners, who are geographically distributed across four continents and 10 time zones. To do this, Boeing built a global collaboration design environment using a vast IT network that enables distributed teams to interact as if they were sitting in the same room. For instance, engineers can exchange design information, 3-D models, and reusable parts with real-time voice and video communications across a secure network. Instead of working on multiple, duplicate, and often unsynchronized data, engineers use a single, shared database, ensuring that designs will work together. Using this interactive R&D environment, Boeing has committed to accelerating its time to market by 25 percent to 30 percent, while lowering development costs by more than 20 percent. For the 787 aircraft, this represents more than US\$1 billion in savings.

- **Sensor-intensive supply chain.** As they become more and more reliant on contract manufacturers and third-party logistics firms, manufacturers are finding it increasingly difficult to manage complex, global supply chains. Recent studies suggest that 3 percent to 4 percent of sales, and up to 25 percent of operating costs, are lost because of supply-chain inefficiencies. To counter this problem, leading manufacturers are deploying a variety of sensors to gather location, temperature, tampering, shock, and other information across the supply chain, allowing them to react faster and better to challenges. For example, CEMEX, Mexico's leading cement manufacturer, faced high transportation costs and spoilage as customers repeatedly changed their orders and delivery schedules. Using global positioning system (GPS) sensors mounted on cement trucks and linked to a central control center, CEMEX can now dynamically reroute trucks based on up-to-the-minute information about changing customer requirements. As a result, CEMEX reduced delivery time from three hours to 20 minutes, cut the number of delivery trucks by 35 percent, trimmed operating costs by US\$100 million, and improved on-time delivery.

In our experience, the sensor-intensive supply chain also changes the way a company sells. By improving visibility across the supply network, companies can quickly provide support centers with more accurate information, helping to increase customer satisfaction and loyalty while setting the stage for future sales. Even more important, the sensor-intensive supply chain helps to break down the boundaries between different product silos, organizations, and departments. Information about products and customers flows more easily, enabling more efficient cross-selling and faster reaction to customer preferences, which in turn translates into superior returns.

## **The Shifting Global Landscape Necessitates Next-Generation Manufacturing**

By adopting these strategies, manufacturers can take advantage of the large-scale market transition we see unfolding, driven in particular by low costs in emerging economies such as China and India. This landscape has supported rapid growth, which generates money for investment and increases the affluence of the domestic economy. The result is a virtuous cycle where investment leads to greater export capability and increases domestic consumption, which in turn fuels further growth.

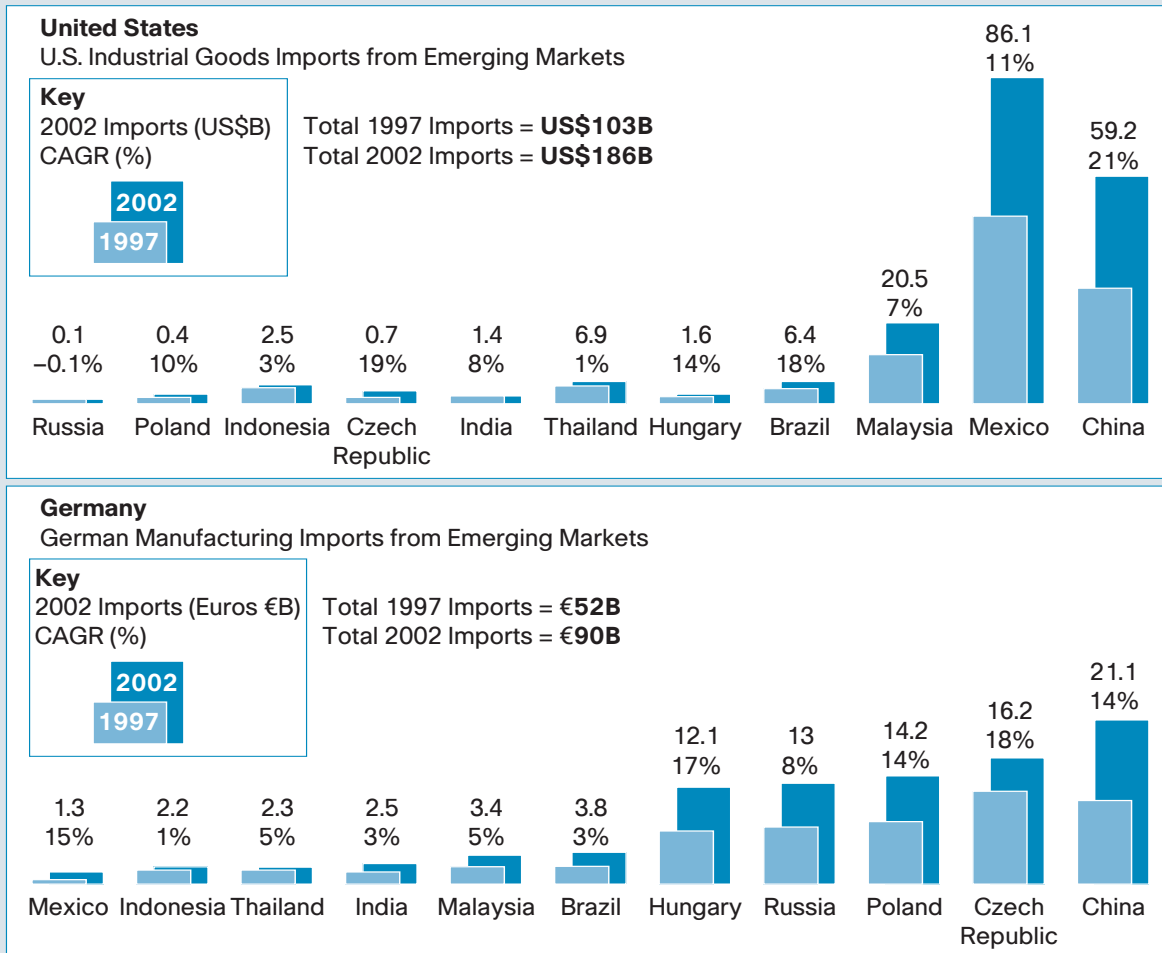
The magnitude of this shift is startling. Goldman Sachs suggests that by 2039, the economies of Brazil, Russia, India, and China—collectively known as the BRICs—could together be larger than those of the G6<sup>2</sup>

Data from the 2002 U.S. Census Bureau indicates that imports from low-cost countries<sup>3</sup> to the United States accounted for more than 20 percent of U.S. consumption of motor vehicles, electrical equipment, and household appliances, along with approximately 25 percent of computers and peripherals and almost 30 percent of general electrical equipment.

<sup>2</sup> *Dreaming with BRICs: The Path to 2050*, Dominic Wilson, Roopa Purushothaman, Global Economics Paper No. 99, GS Global Economics Website, 2003. G6 includes France, Germany, Italy, Japan, United Kingdom, and United States.

FIGURE 4

The Shifting Global Import/Export Landscape



Note: NAICS = North American Industry Classification System  
CAGR = Compound Annual Growth Rate

Source: U.S. Census Bureau; Statistical Office of Germany, 2003

The growth rates for imports from the BRIC economies, and countries that neighbor industrialized regions, are in the double digits. Neighboring economies include Mexico in relation to the United States; and Poland, Slovakia, the Czech Republic, and Hungary (known as the Visegrád-states) in relation to Europe. Even goods requiring more sophistication, such as aerospace parts or medical instruments, are increasingly imported from outside traditional industrialized nations.

As a result, we now see increased competition among emerging markets. For instance, car manufacturer Kia is building a plant in northern Slovakia, at which it plans to produce 200,000 cars per year for the European market beginning in late 2006. Kia will work with 10 of its key suppliers at this new production facility, and the cars will cost 15 percent less to produce than those made in formerly “low-cost” Korea.

Boeing already operates its largest foreign engineering center in Moscow, where 1,000 engineers work on commercial and integrated defense system projects. Some 300 Russian engineers are assigned to Boeing’s next-generation 787 Dreamliner, cooperating with their peers in the United States. Most U.S. high-technology firms are opening substantial R&D facilities in China.

But BRIC growth is driven not only by exports and outsourcing. Many underestimate the scale of domestic consumption. China ranks first in the world in market volume for refrigerators and air conditioning, second for energy, and fourth for chemicals and packaging.<sup>4</sup> According to Goldman Sachs, compared to domestic growth, the net exports of BRIC countries have been a relatively minor contributor to their overall growth. Many in so-called developed countries would be surprised to know that the rate of technology adoption inside the BRIC countries has, in many instances, surpassed that of the rest of the world. While the growth rate of global cross-border Internet traffic has slowed,<sup>5</sup> it continues to increase in these regions. In 2005, for example, interregional (between regions) traffic climbed 64 percent in Asia and 70 percent in Latin America, while intraregional (within region) traffic increased 102 percent in Asia and 336 percent in Latin America.<sup>6</sup>

No global manufacturer can afford to ignore these markets. A recent survey of large U.S.-based manufacturing multinationals shows that many plan to start or expand operations in emerging economies over the next three years—not only sales and marketing, but sourcing, R&D, engineering, and manufacturing (see Figure 5).

Many manufacturers are developing product segmentation strategies for these markets. Such segmentation, however, is not completely straightforward. Typical manufacturing companies are finding that buyers in developed economies are also showing interest in using products with reduced feature sets as an alternative to more expensive equipment whose advanced features many regard as superfluous.

<sup>3</sup> Sample consisting of 11 countries: Brazil, China, Czech Republic, Hungary, India, Indonesia, Malaysia, Mexico, Poland, Russia, and Thailand.

<sup>4</sup> The Boston Consulting Group China Database, 2004.

<sup>5</sup> Doubling approximately every two months in 2000, it took one year to double in 2003/2004. International Telecommunication Union, Strategy and Policy Newslog, October 7, 2005.

<sup>6</sup> International Telecommunication Union, Strategy and Policy Newslog, October 7, 2005.

FIGURE 5

### Expansion of U.S.-Based Multinational Manufacturers into Emerging Markets

	China	Mexico/ Central America	Europe (West, Central, East)	India
Marketing/Sales	56%	47%	40%	23%
Sourcing	57%	26%	14%	21%
Manufacturing	38%	25%	10%	12%
Engineering/R&D	26%	9%	10%	14%

<sup>7</sup>Survey of 226 U.S.-based manufacturing multinationals with combined revenues of around US\$500 billion, showing percentage of respondents planning to start or expand their operations in emerging economies over the next three years.

This latter trend underlines the need for careful market management and close monitoring of local customer requirements. As customers see an ever-widening selection of goods and services at competitive prices, and a larger variety of channels from which to purchase them, it becomes a buyer's market. No longer content to pay for mass-produced, generic goods, buyers are increasingly demanding more customized products, which leads to greater manufacturing complexity.

We see this now in the automotive sector. In 1982, the Mercedes Car Group produced nine models; over a decade later, in 1993, it offered just 10. By 2004, however, the number of choices had climbed to 25. Worldwide, the number of car models increased 47 percent from 1990 to 2003, and an additional 23 percent are expected through 2015.<sup>8</sup>

LG Electronics clearly demonstrated its understanding of customer needs with its F7100 Qiblah mobile phone, which is designed for, and marketed to, Muslim customers. Because photographs carry a cultural stigma in the Islamic world and prayer service is a cornerstone of Muslim religious practices, the F7100 does not have a built-in camera. Instead, it contains an embedded compass device that points to Mecca, and also features a prayer-time alarm.

## Putting the Building Blocks Together

In essence, the manufacturing sector must defy conventional economic wisdom by increasing customization while reducing prices. The most successful companies will do this by excelling in all three components of connected manufacturing: customer intimacy, innovation, and connected supply. They will master increased complexity and achieve the difficult balance between standardizing processes and products internationally, and responding flexibly to regional needs. They will reconfigure global supply chains constantly, in real time, and will avail themselves of the cost advantages and skilled talent pools in emerging economies.

<sup>7</sup> Source: *Growing the Global Corporation*, Deloitte Research Global Manufacturing Study, 2005.

<sup>8</sup> McKinsey RACE Automotive & Assembly Extranet Survey, 2004.

As you will read in the essays from this book, companies that embrace these principles are already reaping rewards in terms of improved profitability. The pioneers in this book are not simply looking for lower-cost sourcing—they're creating entirely new models. The smooth passage of information across the extended value chain allows them to use new customer approaches in both developed and emerging markets, and to innovate more rapidly and efficiently.

Now is the time for companies to embrace the core principles of next-generation manufacturing and use them to achieve a sustainable and competitive advantage. We hope these essays will provide inspiration and some insight into how this can be accomplished.

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#### MORE INFORMATION

The Cisco Internet Business Solutions Group (IBSG), the global strategic consulting arm of Cisco Systems, helps Global Fortune 500 companies and public organizations transform the way they do business—first designing innovative business processes and then by integrating advanced technologies into visionary roadmaps that improve customer experience and revenue growth.

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