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Manufacturing



Mastering complexity in global manufacturing.

Powering profits and growth through value chain synchronization

A Deloitte Research Global Manufacturing Study

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Executive summary

Manufacturers seeking to exploit global markets, supply chain, and engineering opportunities are hitting an invisible but nonetheless debilitating wall: mounting complexity across the value chain. And it is bound to get worse as manufacturers continue to globalize and accelerate new product introductions to spur growth. As a result, the task of coordinating product engineering, sourcing, manufacturing, logistics, and marketing and sales activities that are more and more scattered around the world and supporting an increasing number of new products is growing ever more difficult.¹

While most companies struggle to put the pieces together, a small group of manufacturers have excelled amid the complexity. These “complexity masters,” as we call them, are being rewarded handsomely. Their superior ability to

synchronize their value chains – including customer, product, and supply chain-related strategies and operations – and to leverage their strengths in collaboration, flexibility, visibility, and technology – has helped them generate profit margins up to 73 percent greater than those of other manufacturers (Figure 1). And they outperform the rest in revenue increases, market share growth, and shareholder returns.

These are some of the groundbreaking findings from our extensive survey of nearly 600 manufacturers across North America and Europe – from US\$50 million operations to multibillion-dollar global giants. With the survey data, supported by case studies of leading companies around the world, we explore the phenomenon of dispersed global value chains and complexity: how it is eroding the capabilities and financial

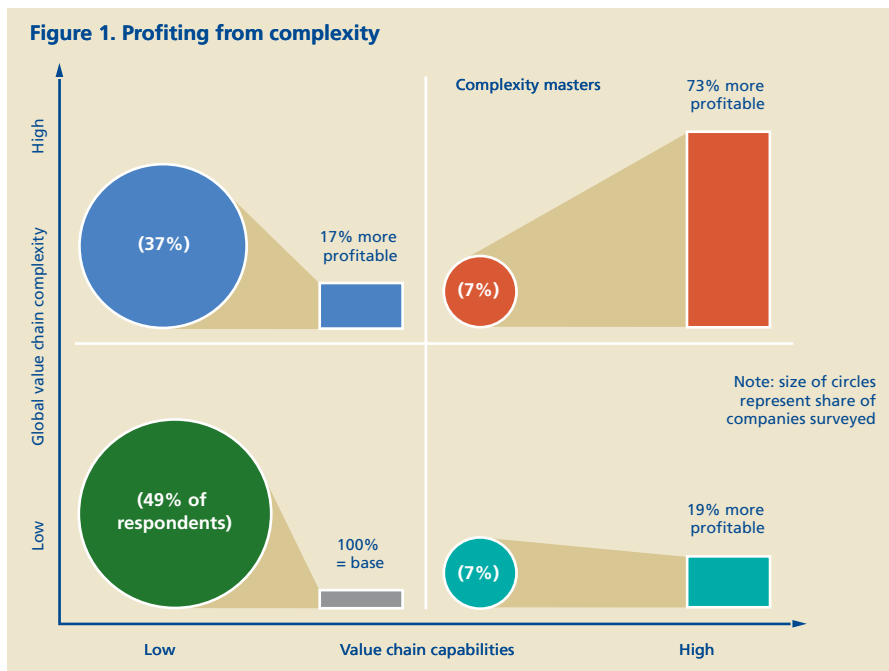
performance of manufacturers large and small; how manufacturers are dealing with the complexities; and the business practices that drive performance.²

The trends of complexity in global manufacturing

In Chapter I, our analysis begins by documenting how the value chains of manufacturers are being dispersed around the globe.³ We show that most of the nearly 600 manufacturers responding to our survey now view the entire world as their market and as a place to sell, source, manufacture, and engineer their goods. More than 80 percent sell outside their home regions, and the majority (53 percent) has shifted production to lower-cost regions such as China, Mexico, and Central and Eastern Europe. Additionally, about three out of five outsource pieces of engineering (59 percent) and manufacturing (62 percent).

Why are manufacturers shifting their activities to other locales? The drivers of this development include immense margin and cost pressures from increasingly large customers (such as mega-retailers and original equipment manufacturers); the mandate to cut engineering costs because of the increase in new products in many manufacturing sectors; and the need to “pull” the supply chain behind new market entries into emerging economies like China.

Coordinating the pieces of the value chain will become only more challenging over the next three years as product development continues to accelerate. New products introduced within the last three years will generate 29 percent of total revenue in 2003, up from 21 percent in 1998. By 2006, manufacturers expect the number to reach 35 percent. Given that R&D spending is expected to rise only slightly, from 4.0 percent of revenue in 2003 to a projected 4.3 percent in 2006, generating higher revenue from new products requires more introductions and/or more hits and fewer losers. To accomplish this, manufacturers over the last three years have cut their product development cycles an average of 12 percent to 16 months. By 2006, they plan to shorten cycle times to 13 months.



¹ For our earlier study on this topic, see Deloitte, *The Challenge of Complexity in Global Manufacturing: Critical Trends in Supply Chain Management* (London and New York: Deloitte, 2003).

² For the last two decades, we have conducted extensive research on global manufacturing – including industries such as aerospace and defense, automotive, consumer products, high technology/telecommunications equipment, life sciences, process/chemicals, and general manufacturing. Nearly 4,000 executives from leading manufacturing companies around the world have participated in the research since its inception in the mid-1980s, making it one of the most comprehensive and in-depth studies ever conducted around global manufacturing strategies, operations, and business performance. See, e.g., Deloitte Research, *Vision in Manufacturing: Global Report* (New York: Deloitte, 1998).

³ By “value chain,” we not only include the supply chain operations of planning, sourcing, manufacturing, and logistics but also the product development activities including R&D, innovation, product design, engineering, and transition, and the customer-related activities of marketing, sales, and service.

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Yet in the face of mounting complexity, many manufacturers’ responses seem counterproductive, creating the following paradoxes:⁴

- **The optimization paradox: Optimizing on a local rather than a global level.** Despite the potential of big savings and profit gains from designing value chains from a global or holistic point of view, most manufacturers are sub-optimizing by focusing on the local level – improving a production process or transportation route, for example.
- **The customer collaboration paradox: Rather than collaborating with customers, keeping interactions with customers at an arm’s length.** Despite the demonstrated benefits of working closely with key customers to drive sales, improve product innovation, and better match supply with demand, few manufacturers are collaborating closely with their key customer accounts.
- **The innovation paradox: Failing to prepare the supply chain for accelerating innovation.** While manufacturers say launching new products and services is the **No. 1** driver of revenue growth, they also say that supporting product innovation and improving time to market are among their **least important** supply chain priorities.

- **The flexibility paradox: Making it difficult to build flexible supply chains by dispersing manufacturing, logistics, and engineering to distant regions.**

While some efforts to globalize the value chain can improve responsiveness in certain markets through proximity, many companies experience overall longer lead times and increased difficulty in matching demand and supply.

- **The risk paradox: Raising the risk of quality and other potential failures.** Nearly every study participant says that maintaining high levels of quality is critical – their No. 1 value chain priority. But outsourcing or shifting critical elements of the value chain such as manufacturing, engineering, and sourcing to low-cost locales can raise their risk profile.

Such paradoxical behavior appears to come at a cost. More than a third (38 percent) of the respondents report slim operating margins of less than 5 percent or have lost money over the last year. About a third have not met their goals over the previous year for return to shareholders, market share growth, profitability, and return on capital/assets.

How complexity masters outpace the pack

To understand how some larger manufacturers (of those with more than US\$200 million in revenue) are managing complexity better than others, we analyzed the survey respondents along two dimensions: the degree to which their value chain operations were dispersed around the world (a measure of complexity), and the capabilities of those value chains (measured by such key capabilities as product innovation, time to market, product quality, and customer service levels). (See Chapters II and III.)

Manufacturers with highly complex global networks but strong value chain capabilities represented a distinct minority of all respondents (only 7 percent). These “complexity masters” are far more profitable than other companies surveyed.⁵ They are an average of 46 percent **more profitable** than manufacturers with comparatively weaker value chain capabilities operating in highly complex environments. In fact, complexity masters’ profit margins are **73 percent** greater than those with weaker value chain capabilities and less complex environments (Figure 1).

What are the secrets behind the successes of complexity masters? For one thing, they are further ahead in synchronizing key activities both **within** and **across** their customer, product, and supply chain operations and building the capabilities needed to sustain those advantages. In particular, our analysis revealed the following lessons from the complexity masters:

1. Compared to most other companies surveyed, complexity masters have developed superior capabilities **within**:
 - **Customer**-related operations – building stronger sales, marketing, and service processes, supported by more extensive investments in customer collaboration and customer relationship management (CRM) systems.
 - **Product**-related operations – improving engineering and R&D capabilities through better process integration, further supported by investments in product data/lifecycle management (PDM/PLM) systems.

⁴ For further details on these paradoxes of complexity, see Chapter I and Deloitte, **The Challenge of Complexity in Global Manufacturing: Critical Trends in Supply Chain Management** (New York and London: Deloitte, 2003).

⁵ In this study, we use the terms “manufacturer,” “business unit,” “company,” etc., interchangeably. The focus of the survey research is on the relevant business unit level at which manufacturing strategies are defined and operations are managed. See Appendix for more details on the methodology and respondent profile.

- **Supply chain**-related operations – developing sourcing, manufacturing, and distribution capabilities through more comprehensive performance improvement initiatives in areas such as quality management, quick-changeover techniques, lean manufacturing, and continuous improvement programs, among others – all supported by more extensive investments in technologies such as advanced planning and scheduling (APS), warehouse management, and transportation systems.
2. More importantly, complexity masters synchronize across customer, product, and supply chain strategies and operations – moving from sub-optimization to create what we call a “profit cycle.” Managers from each of the three areas work together year-round to design and develop strategies, products, manufacturing processes, marketing and sales campaigns, and customer service programs – all with the goal of creating growth and maximizing profitability throughout the cycle. For example, complexity masters are far more likely to factor quality and manufacturing process considerations into the product development process and work with customers on new product designs. Through such moves, these companies treat their product lifecycles more like “profit cycles” – a series of coordinated activities meant to squeeze the greatest profit from each product or product line.
3. Underlying complexity masters’ ability to synchronize customer, product, and supply chain operations is excellence exceeding that of most other companies studied in four areas:
- **Collaboration** with customers and suppliers to design and develop manufacturing processes, logistics networks, and new products that can be updated rapidly and inexpensively.
 - **Flexibility** through more extensive use of common parts and product platforms in product design, flexible capacity to quickly shift manufacturing loads, and the ability to rapidly change production volumes and product mix.
 - **Visibility** of customer, product, and supply chain operations, including product and customer profitability, manufacturing cost, and overall asset returns. They achieve this through collaboration, cross-functional integration, and technology.
 - **Technology** implementation across customer, product, and supply chain operations, including CRM, PDM/PLM, APS, and other technologies to help drive collaboration, visibility, and flexibility.
4. While complexity masters are far superior to other manufacturers in many key areas, in others they are no better. Thus, their capabilities in these areas are essentially “qualifiers” – necessary to compete but often insufficient to gain an edge. They include outsourcing of manufacturing, distribution, and logistics functions; workforce reduction; quality certification; product rationalization; the use of supplier scorecards; and enterprise resource planning (ERP) systems.
- The lessons of complexity masters on how to drive profits and growth not only apply to large companies. Our analysis of small and medium-size manufacturers (below US\$200 million in revenue), suggests that they, too, can learn from the masters. Most of them struggle in developing value chain capabilities, going global, and improving business performance. As they search for a profitable growth path, applying the lessons of complexity masters can get them on their way.
- The new mandate for mastering value chain complexity**
- The need to adopt the perspective and practices of complexity masters is becoming clear. Most manufacturers struggle to coordinate the pieces of their fragmented global value chains. Given the trend of increasingly dispersing pieces of their value chains to lower-cost regions and the accelerating number of new products they will have to manage in the coming years, their businesses will become even more complex. They will have to move quickly to better synchronize their customer, product, and supply chain operations, or be overwhelmed by complexity and left behind. As our research shows, those that master these complexities enjoy greater competitive advantage, improved operating profits, and higher shareholder value.
- While it may sound like a simple concept, it is something very few companies are able to achieve. Learning from complexity masters is valuable for manufacturers everywhere – from small, fast-growing business units to multi-divisional global operations – as they continue their quest for growth and profitability.

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The rising complexity of global manufacturing

Manufacturers feasting on new global markets and lower-cost manufacturing and sourcing opportunities in recent years have encountered an unpleasant side effect: mounting value chain complexity and lackluster business performance. Going global – with their own operations or via outsourcing to business partners – is no longer an option for many manufacturers that are trying to seize new markets or reduce manufacturing costs. Yet, the additional costs, operational problems, and quality risks from spreading pieces of once-tightly knit value chains around the world threaten to erase much of the gain.

Our study of the practices of North American and Western European manufacturers shows where companies are locating value chain activities around the globe, the drivers of such dispersion, the complexities they pose to a well-functioning business, and how manufacturers are coping.

This section of the report examines the trend of value chain dispersion – its causes and impacts. Here we discuss how the pressures of pursuing new markets, accelerating product innovation, and reducing supply chain costs are forcing manufacturers to source, manufacture, distribute, and sell throughout the world. We explore how manufacturers have been trying to manage the enormous value chain complexity generated by such dispersion and other factors. Then we discuss the financial toll that value chain complexity has taken, and why it is likely to get worse.

Globalizing the value chain

Our data show that manufacturers both big and small are spreading their operations across the globe. Most North American and Western European survey respondents – from global giants to regional and national companies – already operate on a global scale, with distribution, sales, and marketing operations around the world. More than 80 percent have marketing and sales operations outside their home regions. (See sidebar: “Looking at the world as one market,” page 5.) Of course, this has been the case for years for manufacturing giants that populate the Fortune 500 and FTSE 500 lists.

But it is now also true for much smaller organizations. Virtually all manufacturers experience global complexities in some or many parts of their value chains.

Like marketing, sourcing components or material outside the home market is the rule rather than the exception. More than 80 percent of the manufacturers surveyed either purchase or plan to purchase during the next three years components or material produced in other countries. (See sidebar: “Sourcing from low-cost locations,” page 7.) As with sourcing materials, manufacturing finished goods outside one’s home market is commonplace: more than half the respondents (56 percent) make their products elsewhere. (See sidebar: “The flight of factories to low-cost locales,” page 6.)

With the steady migration of factory jobs out of North America and Western Europe to lower-cost production facilities in Asia, Mexico, and Central Europe, these numbers are not surprising. But what may be surprising is this: nearly half the manufacturers (48 percent) surveyed now **engineer** products outside their home region. Thus, not only are the jobs of factory workers at risk, so are those of the professionals who design and engineer the products those workers once made.

Looking at the world as one market

Manufacturers are not abandoning their home markets. However, it is surprising how relatively few North American (63 percent) and Western European (49 percent) businesses plan to expand their sales at home. Their plans to pursue foreign markets are remarkable. The majority of the North American manufacturers surveyed today sell their products in Europe (Western, Central, and Eastern), South America, and Mexico (Figure 2). About half (52 percent) have sales outposts in China.

Asked about their selling plans for the next three years, between 40 percent and 54 percent of North American manufacturers plan to enter or expand their presence in Mexico, China, South America, and European markets. North American manufacturers target China more than any other growth market. Some 54 percent expect to enter or expand sales there.

The globalization plans of Western European manufacturers are similarly ambitious. Today, more than two-thirds sell to other parts of Europe, and a little more than half to North America (Figure 3). South America, China, and other Southeast Asian countries are other favorite markets. But the markets that Western European manufacturers target more frequently than others are closer to home: Eastern and Central Europe (59 percent and 52 percent, respectively). China comes in a distant third (41 percent).

Figure 2. Markets: top destinations for North American manufacturers

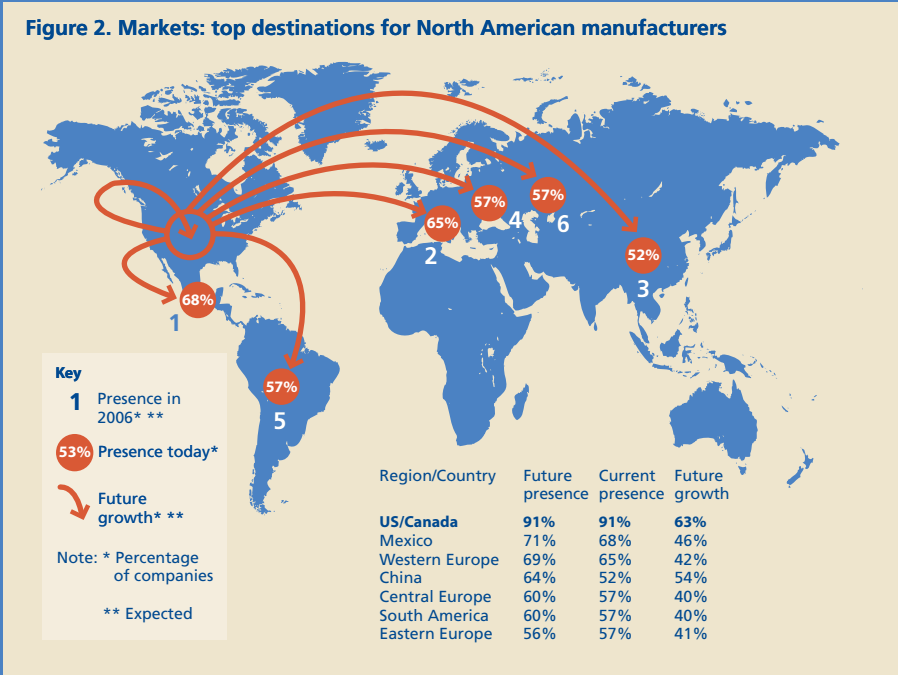
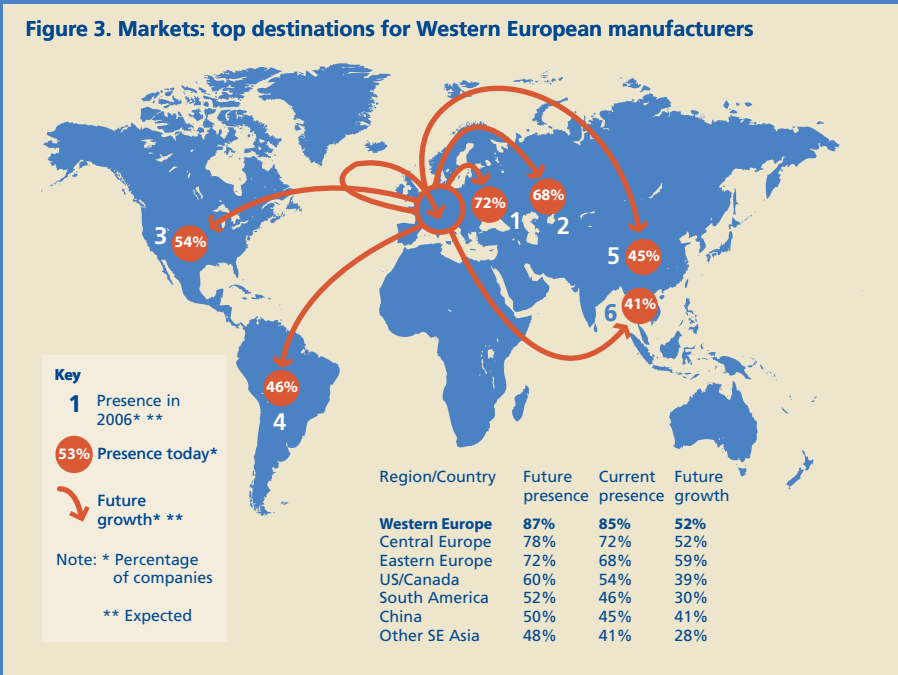


Figure 3. Markets: top destinations for Western European manufacturers



The flight of factories to low-cost locales

While factories in North America and Western Europe are not likely to disappear, the shift of manufacturing to lower-cost regions continues unabated. A large majority of North American (85 percent) and Western European companies (69 percent) plan to maintain or expand manufacturing in their home regions. However, about one-third or more also make goods elsewhere. For North American companies, today that “elsewhere” is usually Mexico (42 percent), Western Europe (39 percent), and China (37 percent). (See Figure 4.)

For Western European-based manufacturers, it is most commonly Central (38 percent) or Eastern Europe (35 percent), followed by China (32 percent) and North America (30 percent).⁶ (See Figure 5.)

But where will the new factories of the next three years be built or expanded? China is the place of choice. Some 37 percent of North American and 31 percent of Western European manufacturers say they will locate or expand factories in that country. For North American manufacturers, Mexico is a distant second (23 percent); for Western European companies, Eastern Europe is close behind (27 percent).

Figure 4. Manufacturing: top destinations for North American manufacturers

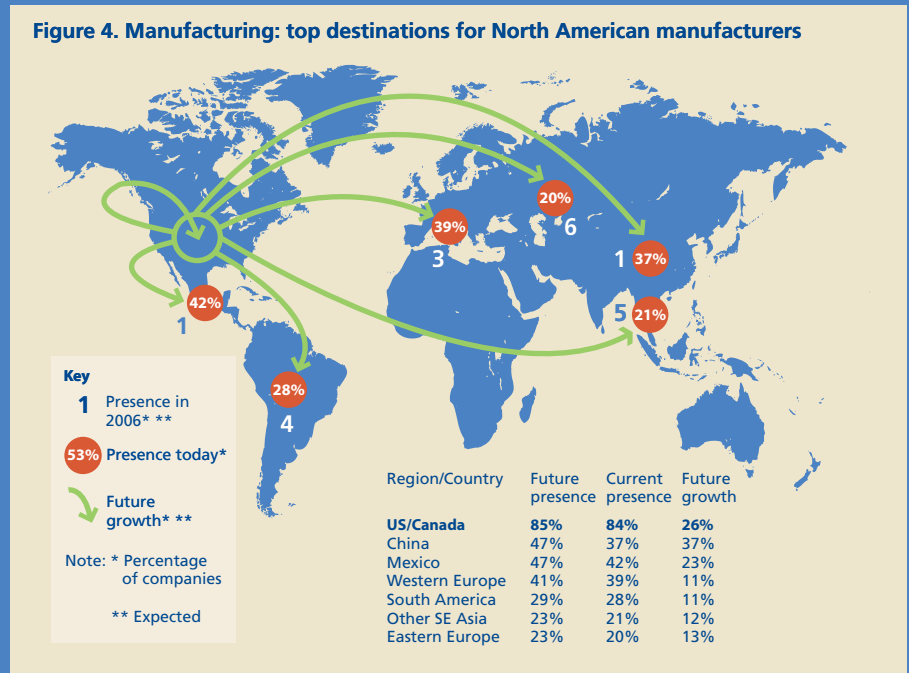
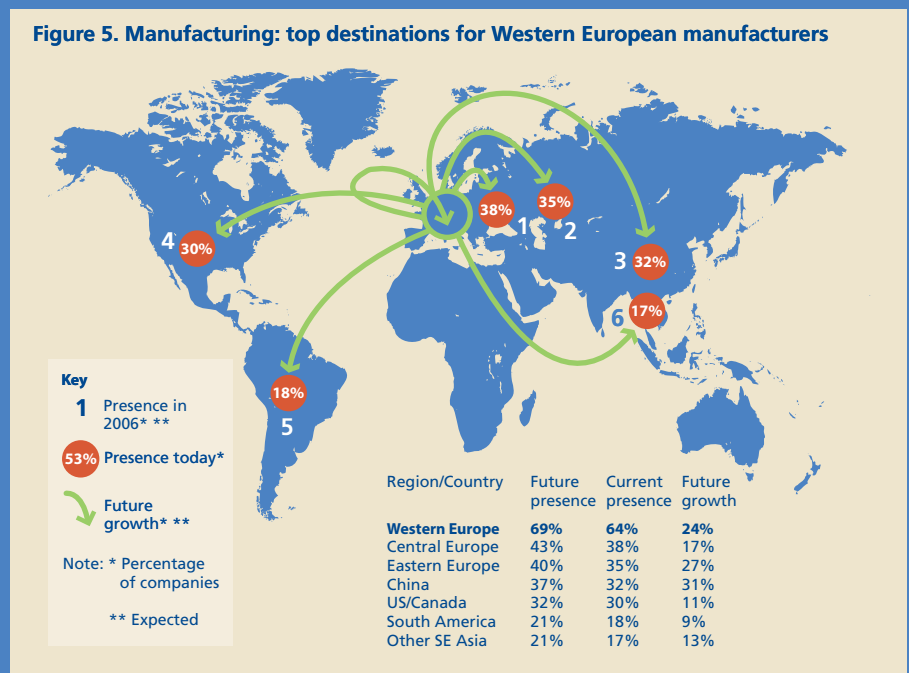


Figure 5. Manufacturing: top destinations for Western European manufacturers



⁶ For example, in a recent survey of manufacturing companies in the Netherlands, 30 percent plan to move a substantial part of their production capacity toward low-wage countries. See Deloitte, *Made in Holland II* (Amsterdam: Deloitte, 2003).

Sourcing from low-cost locations

For manufacturers in North America and Western Europe, low-cost suppliers located in areas such as Central and Eastern Europe and China play a big role today. They will play an even larger role in the next three years.

Currently, 59 percent of North American manufacturers source components or material from China. Mexico (49 percent) and Western Europe itself (44 percent) are other primary sources of supply (Figure 6). However, over the next three years, North American manufacturers will turn more and more to China for components and material. Some 58 percent will either start or expand their sourcing from Chinese companies; no other foreign country or region is even close (Mexico was next at 24 percent). Only about a quarter (26 percent) of the North American companies surveyed plan to expand sourcing operations in their home region.

Western European-based manufacturers today look to companies in Central (55 percent) and Eastern Europe (51 percent) more than any other regions for material or components. China (40 percent) and North America (37 percent) follow next (Figure 7).

Over the next three years, Western European manufacturers will most frequently source from China (41 percent) and Eastern Europe (36 percent); only 19 percent plan to increase their sourcing in their home region.

Figure 6. Sourcing: top destinations for North American manufacturers

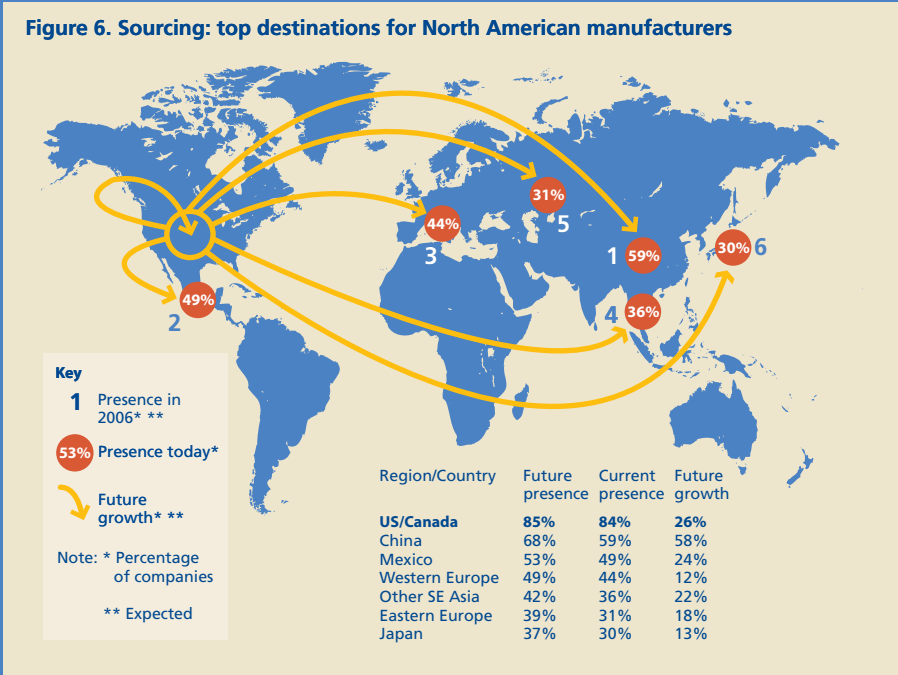
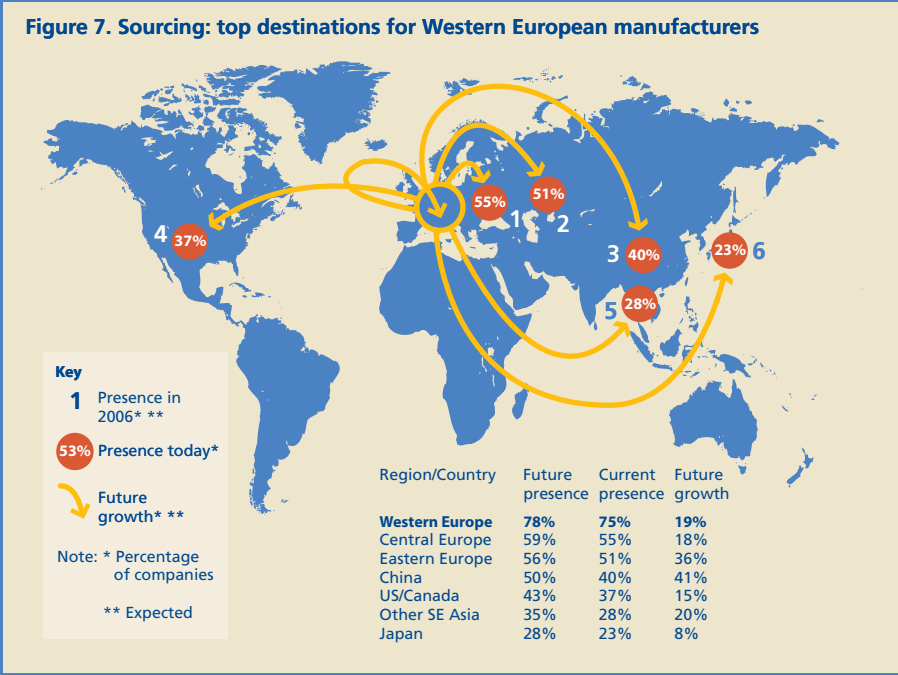


Figure 7. Sourcing: top destinations for Western European manufacturers



Moving the crown jewels of engineering

Factory jobs are not the only ones shifting out of North America and Western Europe. Professional positions in product engineering are at risk as well. Nearly a quarter (22 percent) of North American producers already have engineering operations in China (Figure 8). Another 14 percent plan to establish or expand operations there by 2006. From 8 percent to 14 percent plan to locate or expand product engineering in India, Central and Eastern Europe, Southeast Asia, and Central America over the next three years.

The forecast for Western European engineering professionals may be worse. Some 14 percent of companies based there plan to enter or expand their engineering operations in China (Figure 9). A similar percentage will do so in North America and Eastern and Central Europe (13 percent and 14 percent, respectively).

Figure 8. Engineering: top destinations for North American manufacturers

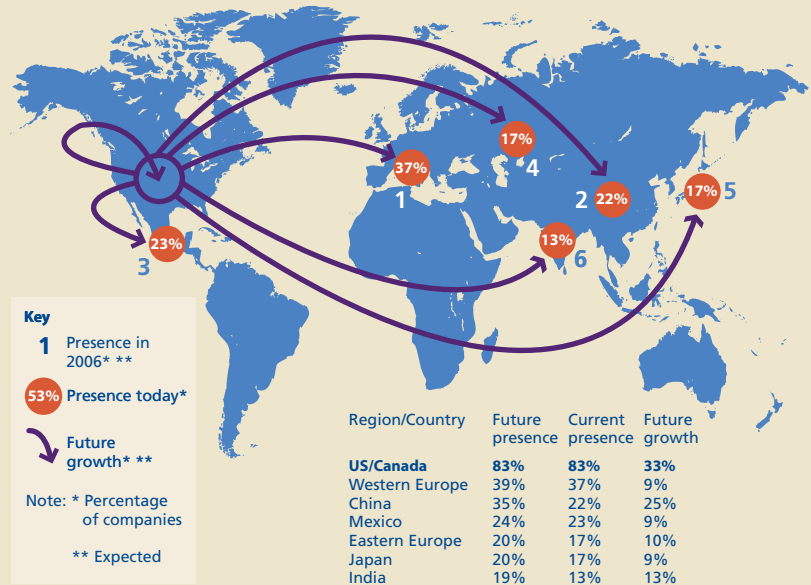
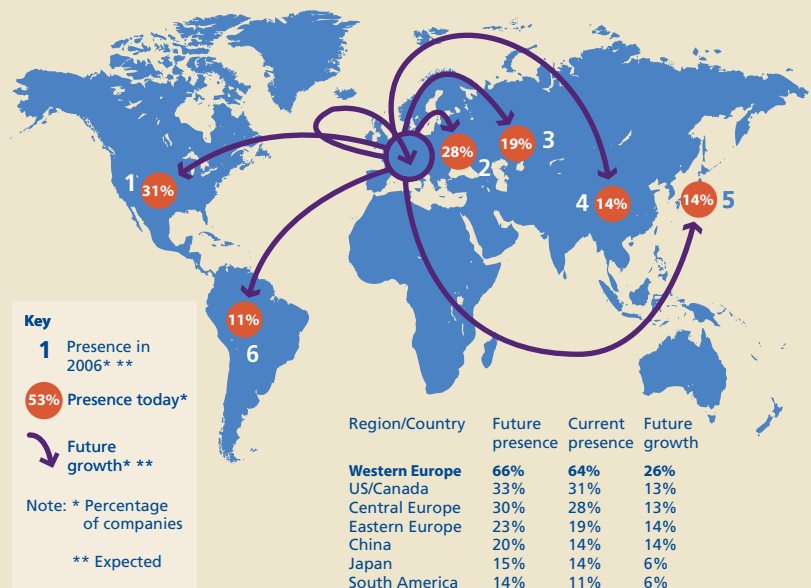


Figure 9. Engineering: top destinations for Western European manufacturers



The drivers of global value chain dispersion

Whether it involves marketing, sourcing, manufacturing, or engineering, why are so many manufacturers increasing the global presence of their value chain operations? The pressures are coming from three main areas: customer demands for lower cost; the pursuit of markets around the world; and innovation (Figure 10).

Customer-induced cost pressures are probably the biggest force. Consolidation of buying power in retailing and other industries, easier access for customers to alternative sources of supply around the globe, and low inflation (and in some cases **deflation**) have been squeezing manufacturers in a vice grip. They **must**

reduce costs to stay profitable, and many cost reduction opportunities can be found across the value chain.

Thus, the trend to build products in lower-cost regions is rampant, with no signs that cost reduction efforts and factory closures in North America and Europe will diminish soon (Figure 11). More than half the manufacturers surveyed (53 percent) have already moved production to lower-cost locales and about three out of five have outsourced some or more of their manufacturing, distribution, logistics, and engineering functions (Figure 12).

Even the “crown jewels” of manufacturing – a company’s product engineering capabilities – can increasingly be found outside of home markets. (See sidebar:

“Moving the crown jewels of engineering,” page 8.)

But reducing costs is not the only reason why manufacturers move value chains overseas. With stagnant markets at home, the drive for revenue growth is another lure. To supply new markets such as China and India, many manufacturers must bring their sourcing, manufacturing, and distribution operations with them. China is not merely a great place to produce low-cost furniture, cars, and apparel for the rest of the world. Chinese consumers – nearly 1.3 billion of them – represent an enormous potential market.⁷

The pressure to locate value chain operations in new markets extends to key suppliers as well. Thus, even companies without global ambitions may be forced to expand their operations geographically to preserve critical customer relationships.

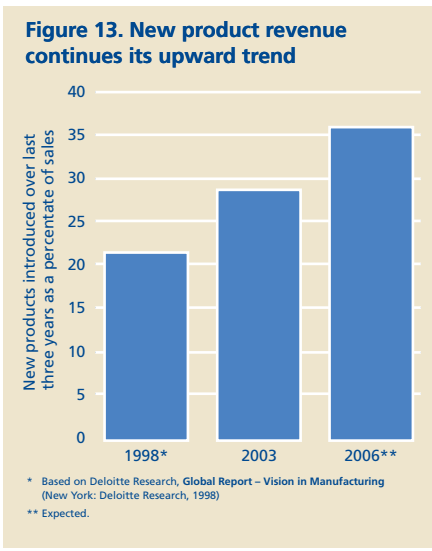
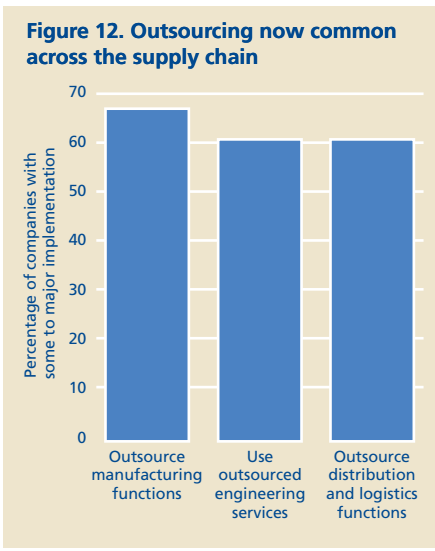
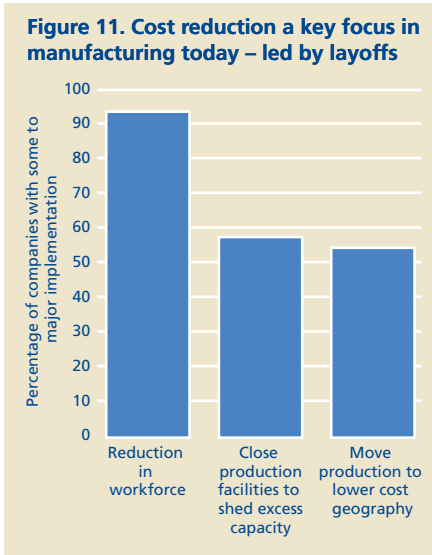
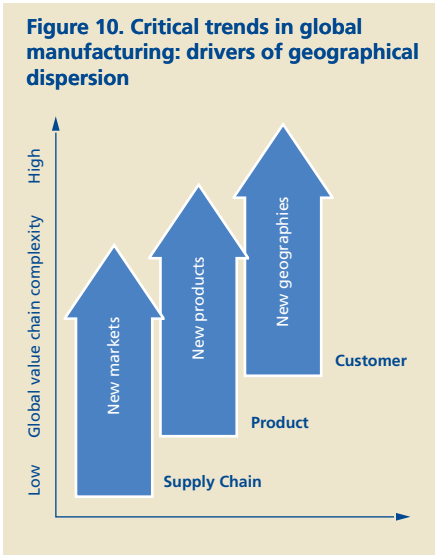
Accelerating innovation is also dispersing the pieces of the value chain.

Manufacturers’ destinies more than ever depend on introducing new products, faster and better. Our survey respondents are unequivocal on this point. They rate product innovation the No. 1 driver of revenue growth. In fact, by 2006 they expect 35 percent of their revenue to come from new products introduced during the three preceding years (Figure 13). That is an astonishing number compared with 1998, when the figure was 21 percent.⁸

The high cost of R&D is forcing manufacturers to enlarge their global presence and extend their supply networks. Pharmaceutical, automotive, high-tech, and other companies increasingly find it difficult to recover product development expenses unless they sell their goods globally. As digital technology increasingly transforms other products and raises their R&D costs, many more industries will have to follow their path.

The impact of dispersion: mounting complexity

Managing value chain activities that are scattered across the globe takes a tremendous amount of coordination, especially if plant managers, shop floor workers, draftsmen, product engineers, and component manufacturing personnel are no longer on a manufacturer’s payroll. Take the examples of Caterpillar and Nokia. Caterpillar, the US\$20 billion construction and mining equipment manufacturer, has 114 plants, 70 parts distribution centers, and 4,000 independent dealers scattered around the world.



⁷ For more information on manufacturing in China, see, e.g. Deloitte Research, *The World’s Factory: China Enters the 21st Century* (New York: Deloitte Research, 2003).
⁸ See Deloitte Research, *Global Report: Vision in Manufacturing* (New York: Deloitte Research, 1998). For more on innovation, see also Deloitte Research, *Creating Unique Customer Experiences: The Next Stage of New Product Development* (New York: Deloitte Research, 2001).

Finnish telecommunications-equipment manufacturer, Nokia, has factories in eight countries (Finland, China, Hungary, Germany, Mexico, the U.S., Brazil, and South Korea), and R&D centers in 14 others. Its suppliers are everywhere. And its mobile phones appear in retailers in every major market. Coordinating value chains like these requires technology and infrastructure far beyond phone calls and faxes.

Now add another variable to the equation: accelerating innovation. The task of coordinating such activities grows exponentially when more new products are pumped through the supply chain. Product lifecycles are shrinking for everything from cars and mobile phones to handbags and TV sets as markets are going from “mass” to “niche.” In the automotive field, for example, there used to be just a half dozen sport utility vehicle (SUV) models on the market. Today there are more than 60 as automakers try to target new customer segments with the right vehicles. That forces manufacturers to reduce the time they take to develop new products. In fact, survey respondents’ average product development time today (16 months, from product concept to launch) is 12 percent less than it was in 2000. By 2006, these respondents expect it to have shrunk by another 18 percent (Figure 14).

All this means that more market studies, product development, and supply chain cost analyses must be conducted; more products designed and engineered; more suppliers lined up and certified; more manufacturing processes designed; and more logistics networks cobbled together. It also means that more meetings must be held among marketing, sales, product development,

manufacturing, logistics, customers, and suppliers; that more initiatives be coordinated; and more rollouts managed.

The consequence of fast-growing value chain dispersion and accelerating innovation is **complexity**. It is an explosive concoction. Such complexity is blowing to pieces the iron-grip control supply chain managers used to have in coordinating their operations. The task of managing and coordinating the activities of engineers and product development, factories, logistics operations, marketing, and sales people around the world – to creating a profitable growth path – becomes geometrically more difficult (Figure 15).

Coping with complexity: manufacturers’ paradoxical responses

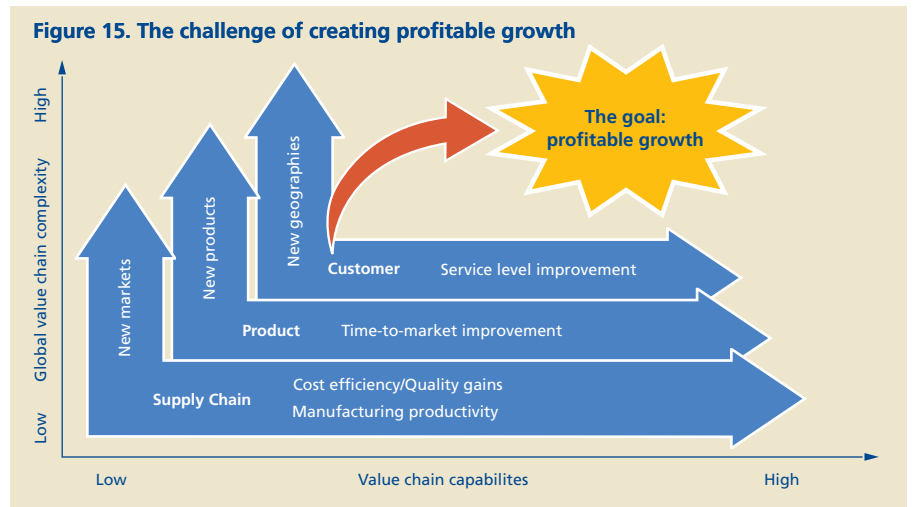
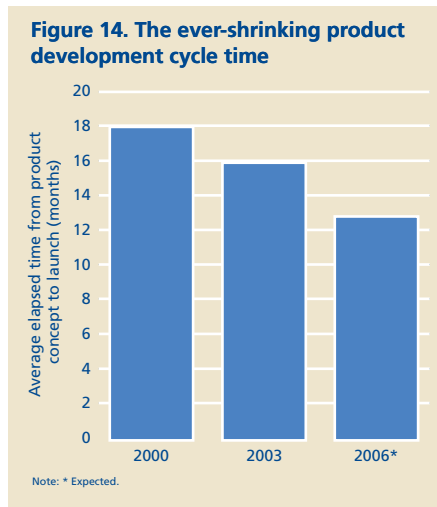
Manufacturers are not sitting still only to allow complexity to overrun them. For example, our data show that most are aggressively cutting costs. Quality remains their highest value chain priority despite impressive quality gains across every segment of manufacturing.

But after looking deeply at initiatives to improve their value chains, we found significant evidence that many moves may be counterproductive. In fact, we were struck by the following five paradoxes:

- **The optimization paradox.** Despite potentially large economies of scale resulting from designing supply chains from a global perspective, most manufacturers sub-optimize by focusing on the local level. After spreading supply chain assets around the world, most manufacturers are streamlining operations through piecemeal moves such as focused

quality improvement initiatives, quick-changeover production, and warehouse optimization. Each of these moves may be beneficial in and of themselves; however, they may divert focus and critical resources and not address the most critical issues of optimizing end-to-end value chain performance. In many cases, these types of initiatives simply move the challenge to another part of the business. In assessing their own capabilities, manufacturers say their greatest area of competitive **disadvantage** is their supply chain cost structure. However, improving the structure of the entire supply chain network ranks at the bottom of performance improvement programs (Figure 16), making it the area manufacturers are least likely to address. Only about half the companies surveyed (51 percent) have made at least some effort to optimize their supply chain network structure. A large majority (91 percent) of the ones that have done so, however, report medium to very high benefits.

- **The customer collaboration paradox.** With customer needs – and new products to fill those needs – changing faster than ever, manufacturers must be far closer to their best customers and faster to react appropriately. Thus, we expected to find extensive collaboration between manufacturers and their key customers, from the very highest levels (e.g., strategic planning and forecasting) down to the lowest operational details (e.g., transportation planning and inventory management). However, this appears not to be the case. Most companies are more



focused on collaborating with suppliers and investing only modest efforts in customer collaboration. Only about half the companies surveyed have medium-to-major implementation of key customer collaboration initiatives in place across strategic planning, forecasting and demand planning, marketing and promotion planning, production planning, inventory management and replenishment, transportation planning, cost reduction, and quality improvement. Yet of those who do this, nearly nine out of ten (87 percent) on average report medium-to-very high benefits from such initiatives.

- The innovation paradox.** Despite recognizing the links between revenue growth and product innovation, most respondents indicate their supply chains are not ready for the increasing pace of new product introductions. They rank product innovation and time-to-market as their least important supply chain priorities. The lack of concern about improving product innovation and product lifecycle management emerges in other data. Fewer than a third (31 percent) do not use common parts, sub-assemblies, and product platforms. Fifty-seven percent have no formal product lifecycle program methodology. And some 73 percent do not use product lifecycle management software.
- The flexibility paradox.** In general, the companies surveyed say flexibility is a key priority. However, as a whole, some may be increasingly more inflexible in the pursuit of direct product cost reductions. Despite the need to change their supply

chains quickly to incorporate more new products, relocating operations can make them less flexible as a whole. While opening a new plant close to an emerging market can create flexibility by proximity, the opposite can be true as well. In pursuit of unit cost savings, moving a plant away from a primary market can lengthen lead times and reduce responsiveness. Supply chain flexibility means having the capabilities to quickly and efficiently match supply with rapid changes in demand. This is crucial in industries where product demand fluctuates greatly and lifecycles are difficult to predict.

- The risk paradox.** Almost all survey respondents (96 percent) say their product quality capabilities are equal or superior to those of their primary competitors. In addition, they rank product quality as their top supply chain priority. Most have one or more quality programs (such as quality certifications like ISO9000, statistical process control, Six Sigma, and TQM) under way. In fact, four of the top 12 supply chain initiatives are quality programs. Nevertheless, a number of noticeable trends are raising the risk profile of survey respondents. Sourcing from low-cost locations (risk: the potential erosion of quality and reliability achievements); moving production to low-cost venues (risk: the introduction of planning complexity, cultural, language, and regulatory barriers); outsourcing production and engineering (risk: loss of, or reduced control of core processes and product quality, as well as the possible loss of innovation capability and

“In general, the companies surveyed say flexibility is a key priority. However, as a whole, some may be increasingly more inflexible in the pursuit of direct product cost reductions.”

Figure 16. Despite the potential of optimizing from a global point of view, competitive advantage from optimizing the supply chain cost structure is at bottom of list

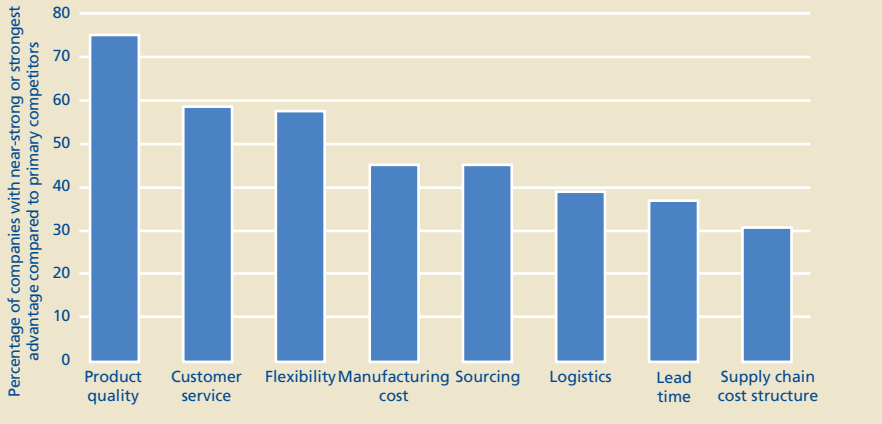
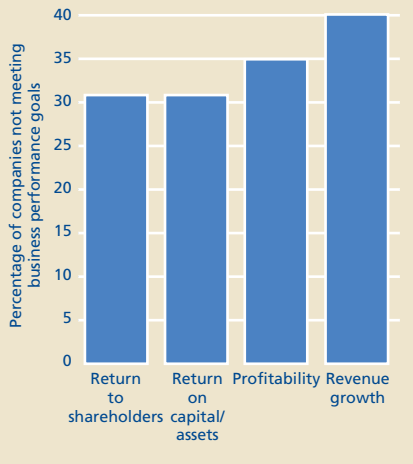


Figure 17. The challenge of complexity: diminished returns



intellectual property); and serving new markets (risk: excessive product proliferation and new service requirements). The costs of failure can be great.⁹ These increased risks are forcing manufacturers to devote significant resources to protect their hard-won quality achievements.

The financial cost of complexity

The economic environment in recent years has hit manufacturers especially hard. Their responses to cost-cutting pressures, consolidation through mergers and acquisitions, and the pursuit of new markets have extended supply chains and added layers of complexity. All this creates new costs. More than a third (38 percent) of the nearly 600 respondents have slim operating margins of less than 5 percent or are losing money. In the last year, 33 percent failed to achieve their goals for return on

capital/assets; 36 percent missed their goals for return to shareholders; and 35 percent fell short of their profitability targets. Some 40 percent did not achieve their revenue goals (Figure 17). These numbers are in line with our other recent global research, which found that more than half of the 1,000 largest manufacturers in the world (51 percent) generated profits that did not meet their cost of capital. In effect, they were destroying shareholder value.¹⁰

Complexity can erode manufacturers' operational performance. That, in turn, diminishes their financial performance. Yet our study found a small number of manufacturers that are managing increasing value chain complexity effectively, and profiting handsomely by doing so. As we discuss in the following chapters, these companies take a very different approach to managing their value chains.

⁹ A study by Vinod Singhal from Georgia Institute of Technology, and Kevin Hendricks from the University of Western Ontario in 2000 found that when companies announce supply chain problems, their stocks lose an average 8.62 percent (or an average US\$120 million per company) 90 days afterwards.

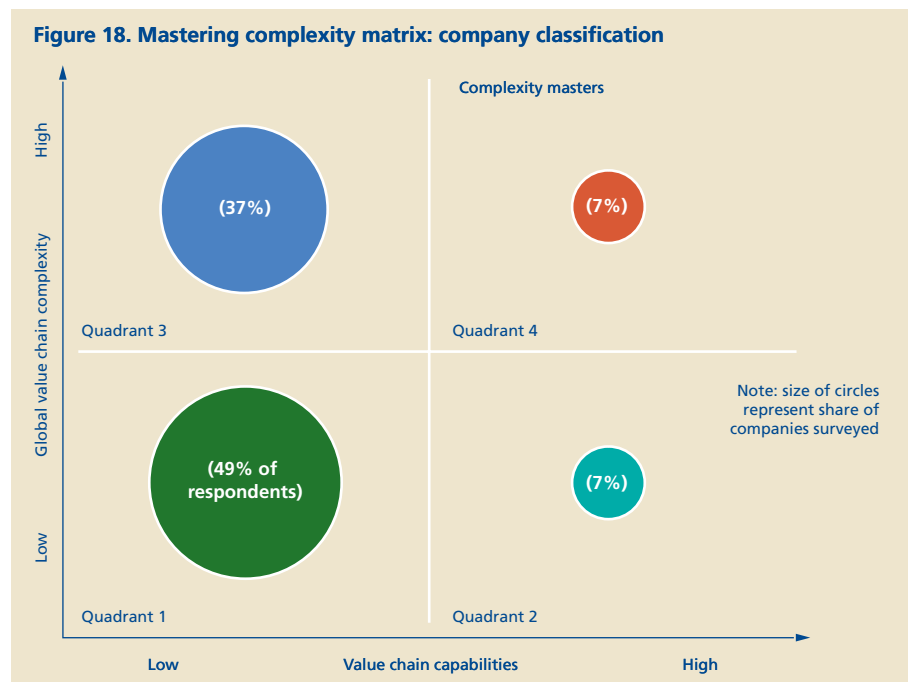
¹⁰ Deloitte Research, *Global Manufacturing 100* (New York: Deloitte Research, 2002).

Mastering complexity: synchronizing the value chain

Before exploring the winning practices for managing highly complex global value chains, we wanted to first answer a more fundamental question: is the investment in improving capabilities in complex environments worth it? If, in fact, product innovation, supply, and marketing/sales operations can degrade as the value chain becomes more complex, how much does it affect the bottom line?

To explore the success factors of managing value chains with greater geographic dispersion and complexity, we focused on the “global value chain complexity” of manufacturers – a measure of the degree to which they have dispersed their value chain globally.¹¹ To sharpen the inquiry, we focused most of our analysis on larger companies in our sample – the 315 companies or business units with revenues ranging from US\$200 million to tens of billions. Generally speaking, we find that the larger the manufacturer, the more geographically dispersed its value chain will be and the more complex it is to manage.¹² (For details on the small and medium-size companies below US\$200 million in revenues, please see sidebar “Smaller manufacturers, too, can profit from mastering complexity” on page 14.)

We also examined the value chain capabilities of manufacturers – measured by their capabilities relative to their primary



competitors in ten key areas. With this in mind, we analyzed the relationship between global value chain complexity and value chain capabilities by grouping respondents into four categories, described below (Figure 18). (For more details, see sidebar: “Discovering the masters of complexity,” page 15.)

- **Quadrant 1:** Manufacturers with low global value chain complexity and moderate-to-low value chain capabilities (this group represented 49 percent of the respondents).
- **Quadrant 2:** Manufacturers with low global value chain complexity and high value chain capabilities (7 percent).
- **Quadrant 3:** Manufacturers with high global value chain complexity and moderate-to-low value chain capabilities (37 percent).
- **Quadrant 4:** Manufacturers with high global value chain complexity and high value chain capabilities (7 percent).

¹¹As mentioned earlier, by “value chain,” we not only include the supply chain operations of sourcing, manufacturing, and logistics but also the product development activities of R&D, product design and engineering, and the customer-related activities of marketing, sales, and service.

¹²Of course, the degree to which a company geographically disperses the pieces of its value chain is not the only driver of complexity. We discuss other drivers in this study, including the accelerating pace of product innovation. However, we believe “dispersion” and its impact – making it harder for managers in different functions to coordinate their actions – is a significant driver of complexity, and helps us separate companies with “high” complexity from those with “low” complexity.

Smaller manufacturers, too, can profit from mastering complexity

The complexity masters show that larger organizations (with revenue of US\$200 million and above) can effectively manage the many pieces of their far-flung value chains. But what about small and midsized companies – ones with US\$200 million and less in revenue? Is life simpler for them?

Apparently not. Analysis of the more than 200 companies in our study that fall below US\$200 million in sales shows that even they are not immune to value chain complexity. In fact, about 20 percent experience complexity as we define it. A much larger percentage will experience it as part of their near-term growth plans.

Classified in our four quadrants that juxtapose value chain complexity with value chain capabilities, here is how our small to medium-size enterprise (SME) survey respondents fared.

- **Quadrant 1.** Nearly 68 percent have low global value chain complexity and mediocre-to-poor value chain capabilities.
- **Quadrant 2.** 12 percent have strong value chain capabilities but low global value chain complexity.
- **Quadrant 3.** About 17 percent have high global value chain complexity but average-to-poor value chain capabilities.

- **Quadrant 4.** Less than 4 percent have both high value chain complexity and high value chain capabilities. (This is not surprising given the small size and limited global reach of these companies.)

While SME Quadrant 2 and Quadrant 4 companies have made some strides in separating themselves from the competition through better value chain capabilities, overall business performance is not as strong as it is in similarly positioned companies above US\$200 million in revenues. SME Quadrant 4 companies exceed other SME companies in profitability (37 percent higher than manufacturers in Quadrant 1), but not on all other business performance metrics. Quadrant 2 companies struggle to generate returns on better value chain capabilities. Their profit level is about 3 percent below that of Quadrant 1 companies, and they barely distinguish themselves in other business performance metrics such as capital/asset and shareholder returns.

Those in Quadrant 3, hurt by higher complexity and weak value chain capabilities, have profit margins 16 percent less than companies in Quadrant 1, where nearly 68 percent of the total respondents reside. Quadrant 3 companies also report the lowest scores across key business performance metrics, including revenue

growth, shareholder return, capital/asset returns, market share growth, customer satisfaction, and customer loyalty/retention.

Clearly, as the experiences of Quadrant 3 companies point out, SMEs trying to globalize their value chains **without** the required capabilities for managing them set themselves up for trouble. At the same time, the performance of manufacturers in Quadrant 2 suggests that building great value chain capabilities on a small canvas has limited impact.

So what should SME companies with global ambitions do? Learn from the big-company complexity masters. Following their lead is likely to provide a surer footing for global value chain expansion as SMEs continue to grow. Finding a path to profitable growth is of concern to all executives and it will become increasingly difficult to ignore the lessons from complexity masters.

Discovering the masters of complexity

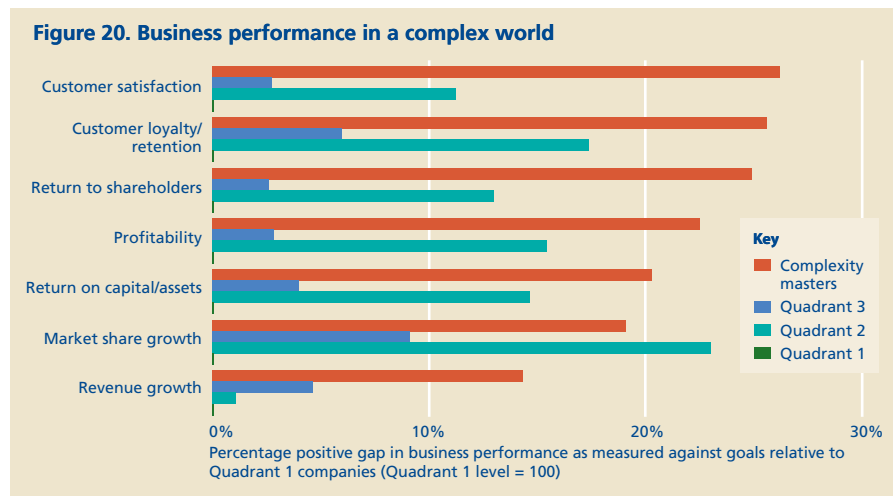
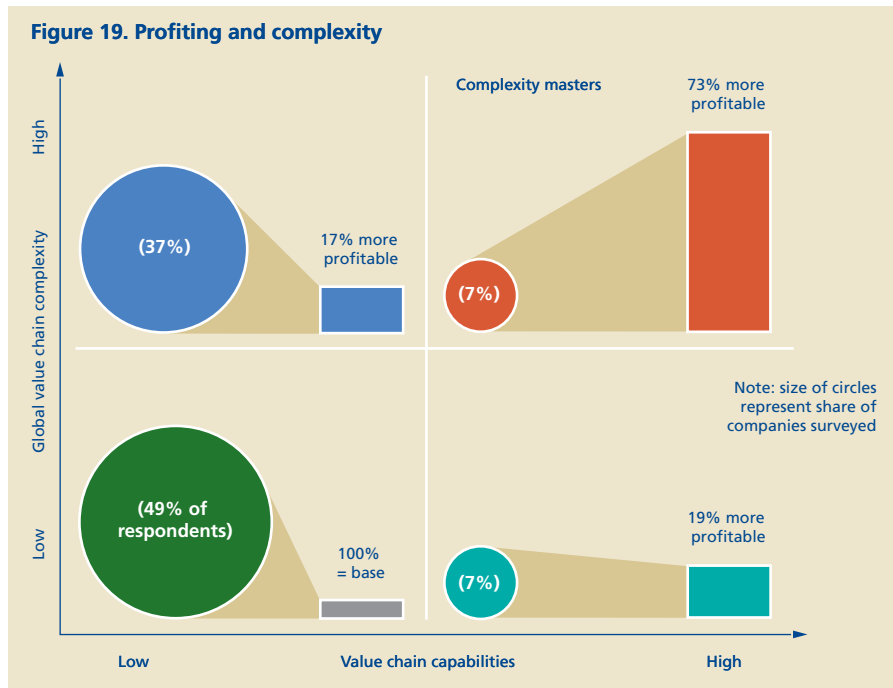
To determine the practices of manufacturers that manage complexity well, we focused on a subset of the total survey population: the 300+ survey respondents with annual revenue of at least US\$200 million. Our rationale for looking at these companies was this: they are far more likely to deal with global value chain complexity. The higher the revenue, the greater the likelihood they have more products, operate more plants, manage more distribution centers, and sell into more markets around the world. The results of these companies will be of interest to smaller manufacturers that have similar global ambitions.

As with the original sample of nearly 600 respondents, this smaller group is made up of companies and business units of larger entities in a wide range of industries, including aerospace and defense, automotive, consumer products, high technology and telecommunications equipment, life sciences, process/chemicals, and general manufacturing. One-third (33 percent) had sales of US\$1 billion or more. We then divided the survey population by two dimensions (Figure 18).

- Degree of global value chain complexity** based on the geographic diffusion (low or high) of four value chain functions: sourcing, manufacturing, engineering, and marketing/sales operations across 13 geographic regions. We created a global value chain complexity index, giving companies scores from 1 to 52. A manufacturer's complexity score depended on the extent to which it scattered the four value chain activities across 13 geographies (Australia/New Zealand, China, India, Japan, Korea, Other Southeast Asia, Western Europe, Central Europe, Eastern Europe, Africa, United States/Canada, Mexico/Central America, and South America).
- Level of value chain capabilities.** This axis gauges the relative competitiveness of each surveyed company on ten dimensions of value chain capabilities. We created a universal measure by taking a composite score of each respondent's ratings in ten areas: product innovation, time to market, sourcing effectiveness, product quality, manufacturing flexibility, manufacturing productivity and cost-effectiveness, manufacturing lead time, logistics effectiveness, customer service, and supply chain cost structure. Manufacturers scored themselves against primary competitors on a 5-point scale, on which 1 equals "significant disadvantage," 3 is "equal capability," and 5 is "strong advantage." Based on the ten metrics and the 5-point scale, we created a value chain capability index in which a company could achieve an aggregate score between 10 and 50.

By grouping survey respondents along the two axes, four groups result.

- Quadrant 1.** Companies with low global value chain complexity (scoring below 20 on the global complexity index) and low-to-medium value chain capabilities (scoring below 40 on the value chain capability index). These manufacturers comprise nearly half (49 percent) of the base.
- Quadrant 2.** Companies with low global value chain complexity (scoring below 20 on the complexity index) but high value chain capabilities (scoring 40 and above on the value chain capabilities index – on average exceeding the capabilities of their primary competitors across our ten metrics). Only 7 percent of the respondents fell into this category.
- Quadrant 3.** Companies with high complexity (scoring 20 and above on the complexity index) but low-to-medium capabilities (scoring below 40 on the operational performance index). This group accounted for about 37 percent of all companies.
- Quadrant 4.** Companies with high complexity (scoring 20 and above on the complexity index) and high capabilities (scoring 40 and above on the value chain capabilities index). We refer to this group as the "complexity masters." Constituting just 7 percent of the sample, they indeed are a select group.



Managing complexity: the new mandate

To assess the value from effectively managing value chain complexity, we compared the financial performance of manufacturers in each quadrant – focusing in particular on those in Quadrant 4, the “complexity masters.” Overall, the data suggest that having strong value chain capabilities in both low- and high-complexity environments is critical to financial success. In less complex environments, businesses with strong value chain capabilities (those in

Quadrant 2) on average are 19 percent more profitable than companies with weaker value chain capabilities in Quadrant 1 (profit margins of 7.5 percent vs. 6.3 percent). Similarly, in high-complexity environments, manufacturers with strong value chain capabilities are 48 percent more profitable than those with weaker value chain capabilities (average margin of 11 percent vs. 7.4 percent). (See Figure 19.)

Financially speaking, complexity masters run circles around manufacturers with

weaker value chain capabilities – even those with less complex businesses. Profit margins of complexity masters are on average 73 percent higher (11 percent vs. 6.3 percent) than those of Quadrant 1 companies. And they outperform in several other business performance yardsticks. Thus, “big and complex” **can** be far more profitable than “small and simple.”¹³

In asking respondents whether they missed, met, or exceeded certain business performance goals, we found that companies in Quadrants 2 and 4 led the pack in shareholder returns, profitability, market share growth, revenue increases, and return on capital assets, as well as in customer satisfaction and customer loyalty/retention (Figure 20).

For manufacturers with high complexity, value chain capabilities appear to have a significant impact on business performance. Complexity masters greatly outperformed Quadrant 3 companies on every measure of financial performance. Similarly, in simpler environments, Quadrant 2 companies outpace Quadrant 1 companies on all financial metrics. Inarguably, manufacturers whose supply chains have conquered the complexities of global fragmentation and accelerating innovation outperform their peers financially.

Mastering complexity: synchronizing customer, product, and supply chain operations

Knowing that manufacturers with highly complex value chains and strong value chain capabilities perform better than other companies, we then took our inquiry the next step: what capabilities did the complexity masters have that the others did not? What enables them to keep product innovation high, time to market short, product quality supreme, manufacturing productivity strong, and total supply chain cost structure lean in the face of significant complexity? And how did they create those capabilities?

To answer these questions, we examined the strategies, operational practices, technologies, and other factors behind their superior capabilities. We looked at the data to understand such issues as how they manage their supply chains, products, and customers. Which initiatives – process improvement, quality, demand planning,

¹³ For further analysis on business performance in global manufacturing, see Deloitte Research, *Global Manufacturing 100* (New York: Deloitte Research, 2002); Deloitte Research, *Performance Amid Uncertainty in Global Manufacturing: Competing Today and Positioning for Tomorrow* (New York: Deloitte Research, 2002). For further information on our research on supply chain management and the impact on business performance in various industry segments, see e.g. Deloitte Research, *Profiting from Continuing Differentiation in the Global Chemicals Industry* (New York: Deloitte Research, 2003); Deloitte Research, *Competing on Collaborative Customer Solutions: Differentiation in High Tech Digital Loyalty Networks* (New York: Deloitte Research, 2002); Deloitte Research, *Automotive Digital Loyalty Networks: Driving Shareholder Value Through Customer Loyalty and Network Efficiency* (New York: Deloitte Research, 2001); and Deloitte Research, *Digital Loyalty Networks: e-Differentiated Supply Chain and Customer Management* (New York: Deloitte Research, 2000).

lean manufacturing, and so on – are most important? What are the key technologies they are using? Which factors differentiate performance and which are mainly qualifiers – necessary to compete, but insufficient to gain an edge on competitors?

After looking at volumes of data on the practices of manufacturers in all four quadrants, our overriding conclusion is this: complexity masters are much better than other manufacturers at managing, coordinating, and synchronizing **within** and **across** three areas: **customers, products,** and **supply chains** (Figure 21). At the same time, they are building the necessary underlying capabilities of collaboration, flexibility, visibility, and technology.

Managing within

Complexity masters have made major improvements in key processes. Their value chain advantages begin with cross-functional business process excellence and integration within three areas:

- The marketing, sales, and service process (“customer-related” operations).
- The planning, sourcing, manufacturing, and distribution process (“supply chain-related” operations).
- The product innovation, engineering, and development process (“product-related” operations).

The data suggests complexity masters have reengineered these three distinct core

business processes for dramatic improvements in efficiency and effectiveness. First, they have launched more extensive initiatives to boost the performance of these business processes than have companies in the other three quadrants (Figure 22).

In customer-related operations, they are much more aggressive in improving sales, marketing, and customer service. In product-related operations, they are ahead in improving engineering and R&D. And, in the area of supply chain, they lead in implementing performance improvement initiatives in sourcing, distribution, and manufacturing. What is more, these initiatives yield significant business benefits (Figure 23).

Second, complexity masters make wider use of, and generate greater benefits from, technologies that integrate activities in each business process: customer relationship management systems (CRM) to link marketing, sales, and service; product lifecycle management (PLM) and product data management (PDM) software to tie together the steps of product development; and warehouse and transportation optimization systems in the supply chain. (See Figure 31 further below.)

In their customer-related operations, the masters had better access to customer information than did Quadrant 3 companies on such measures as customer service levels, customer retention rates, and customer/channel profitability. Similarly, complexity masters outshone Quadrant 3

companies in capabilities for effectively developing new products and managing their lifecycles. And, they are much more likely to have product profitability information. The supply chain is another arena in which the complexity masters stand out. They are more advanced and better than Quadrant 3 companies at optimizing the entire supply chain network. Not surprisingly, most complexity masters (83 percent) have a single executive in charge of end-to-end supply chain strategy. Overall, about two out of five companies had no such leader in place.

Complexity masters are also far more likely to use and benefit from techniques and initiatives around quick-changeover manufacturing, lean manufacturing, total productive maintenance (TPM), focused

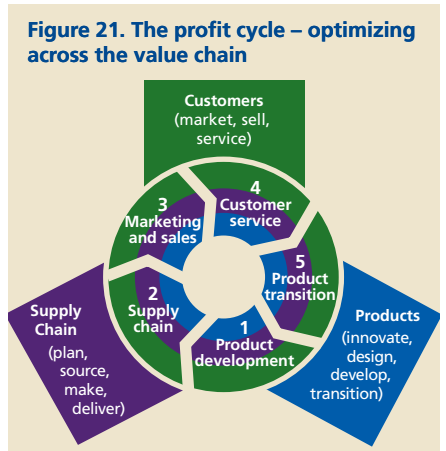


Figure 21. The profit cycle – optimizing across the value chain

Figure 22. Building a foundation for mastering complexity: key areas of performance improvement initiatives within customer, product or supply chain operations

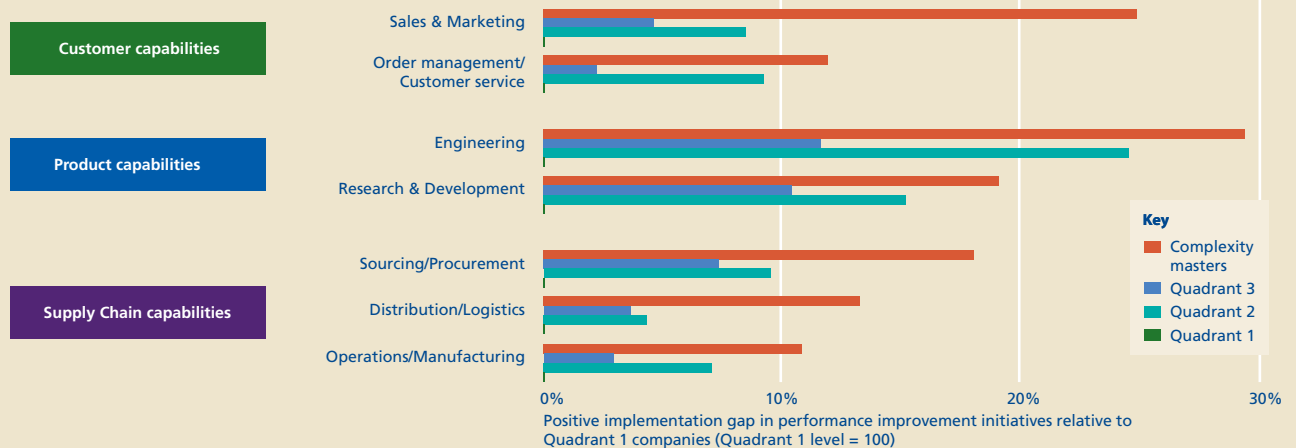


Figure 23. Complexity masters benefit from customer, product and supply chain performance improvement initiatives

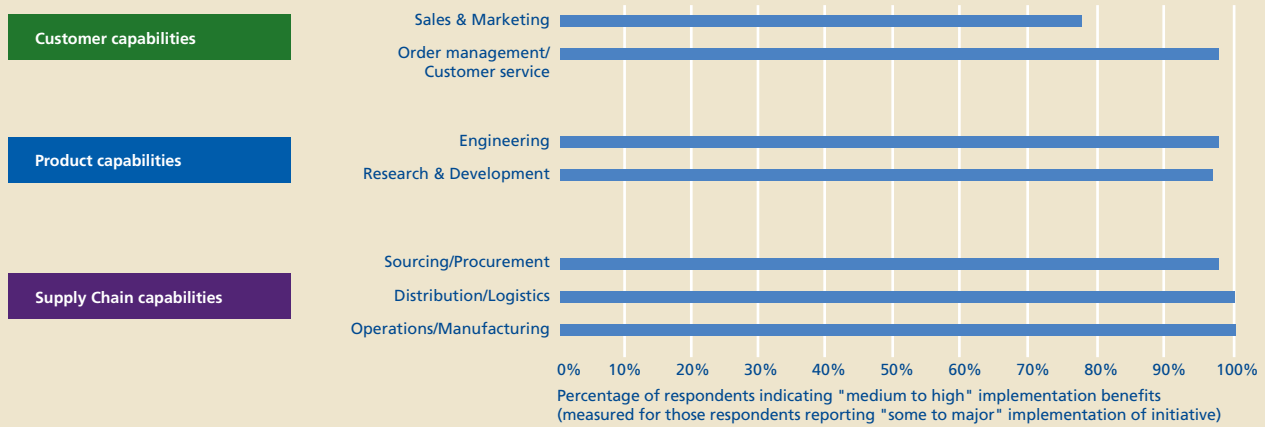
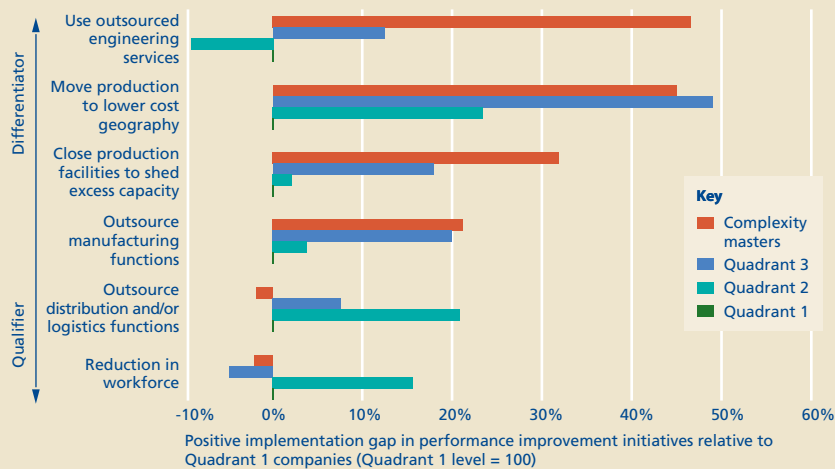


Figure 24. Cost reduction initiatives



factory production systems, and continuous improvement programs. They bolster their quality programs, moving beyond passive certifications to more rigorous initiatives such as Total Quality Management (TQM), Six Sigma, and Statistical Process Control (SPC). (See Sidebar: "Why and how complexity masters take quality to the next level.")

In nearly all areas, complexity masters (followed by Quadrant 2 companies) have more extensive performance improvement initiatives in place (Figure 25).

Do these efforts pay off? Absolutely. Of the complexity masters that are far into performance improvement initiatives (i.e., those that report "some" to "major" implementation), the vast majority (from about 70 percent to 100 percent) have received "moderate to very high" benefits.

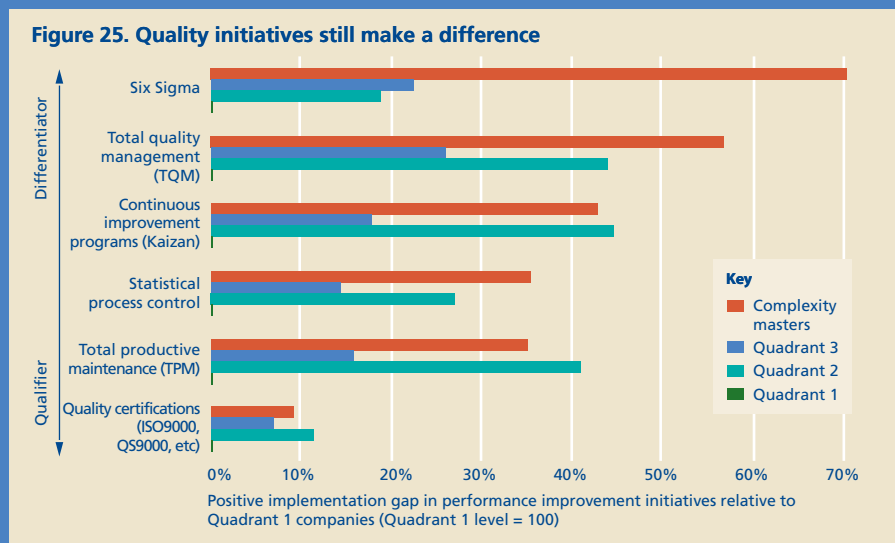
While complexity masters are far superior to other manufacturers in many key areas, in others they are no better. Thus, their capabilities in these areas are essentially "qualifiers" – necessary to compete but often insufficient to gain an edge. They include outsourcing of manufacturing, distribution, and logistics functions; workforce reduction; quality certification; product rationalization; the use of supplier scorecards; and enterprise resource planning (ERP) systems. (See e.g. Figure 24.)

Complexity masters build their superior value chain capabilities with a solid foundation – process excellence in customer-, product-, and supply chain-related operations. Their practices and technologies integrate marketing activities with sales and customer service activities; product innovation with design and development; and sourcing with manufacturing and distribution.

Why and how complexity masters take quality to the next level

The global dispersion of a manufacturer's value chain ratchets up complexity, which in turn can exponentially increase risk problems – of defective components, faulty products, and inconsistent distribution and customer service levels, to name a few. While an astounding 96 percent of companies surveyed overall believe that their product quality capabilities are better than those of their primary competitors, the detailed picture tells a very different story.

Complexity masters are much more likely to embrace rigorous quality programs, from Six Sigma and TQM to Kaizen and statistical process control. That is in stark contrast to Quadrant 3 companies – manufacturers with high global complexity but with low-to-medium value chain capabilities. These companies trail the complexity masters significantly in all quality improvement techniques but quality certification programs such as ISO9000 and QS9000 (Figure 25).



Synchronizing across

The complexity masters are the kinds of companies that over the last decade were leaders in using operational improvement techniques like reengineering, TQM, and Six Sigma to achieve cross-functional integration of specific business processes. However, such process superiority does not fully explain their dominance. In fact, additional survey data point to an even more important factor: **their ability to synchronize customer, product, and supply chain processes during crucial moments in the lifecycles of their products.** This is about synchronizing not just within but also across the processes.

The phrase “synchronizing across” refers to complexity masters’ exceptional ability to go beyond the boundaries of the three business processes, orchestrating activities across all three during key moments of the product cycle – effectively creating a “profit cycle” in which the overall business performance is the goal rather than the sub-optimization in customer, product, or supply chain operations (Figure 26). Instead of operating largely independently, managers from all three areas work together from the outset to design and institute products, manufacturing processes, marketing campaigns, and customer service programs with one overarching goal: maximizing the

profitability of the company’s product and service offerings.

This, in turn, forces managers to think about such things as:

- Designing products that can be updated rapidly and efficiently to keep them marketable but without always having to create a whole new line from scratch.
- Developing manufacturing and supply chain processes that likewise can be enhanced rapidly and inexpensively to accommodate new products and features or new customers.
- Collaborating with customers and suppliers to better define product and component requirements.

This is not just about **cross-functional** synchronization of a single business process, such as marketing or new product development. It is about the **cross-process** synchronization of the three major business operations. It is strategy and process excellence taken to a whole new plane. If cross-process synchronization is truly what separates the complexity masters from the pack, why is it so important? Look at what can go wrong when companies do not coordinate these processes. For example,



Figure 26. Managing the profit cycle

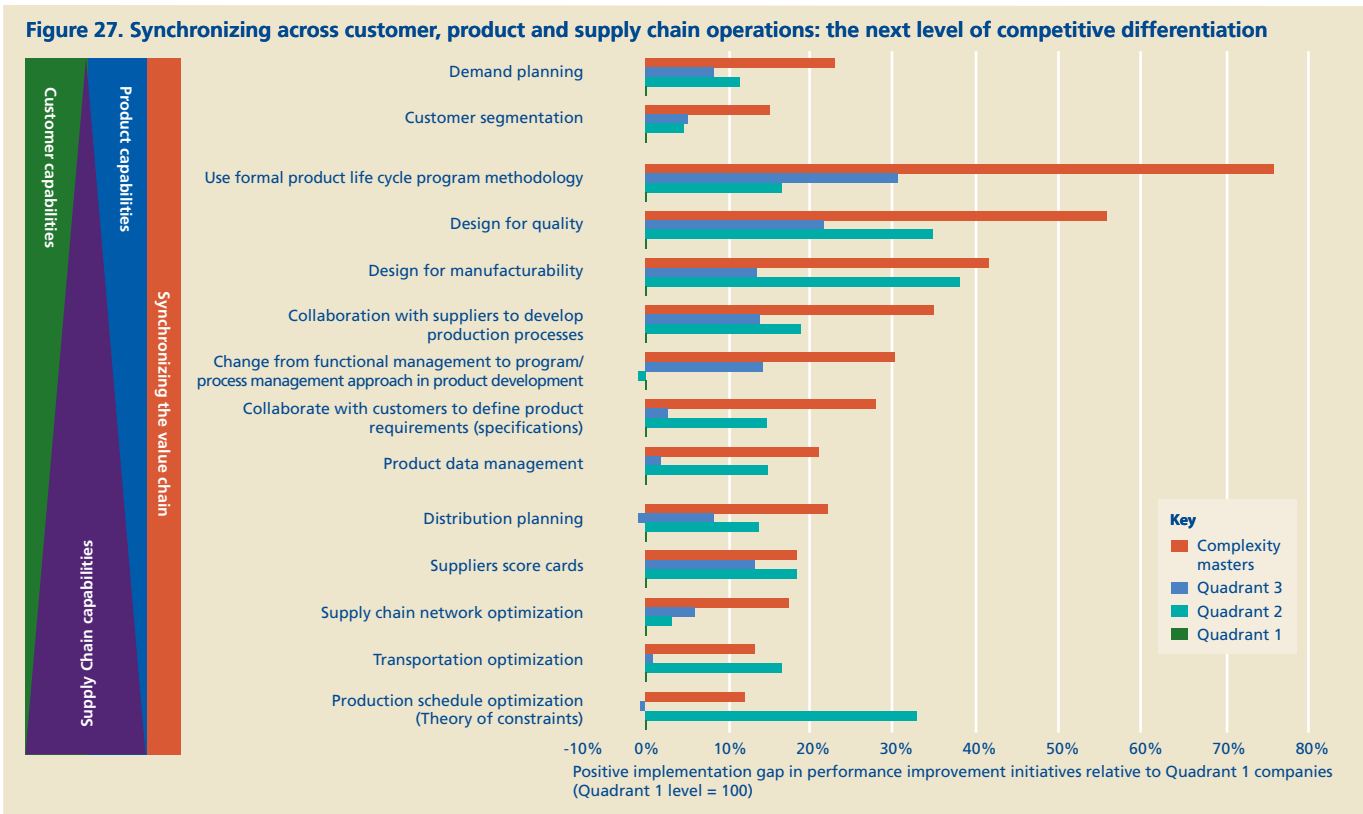
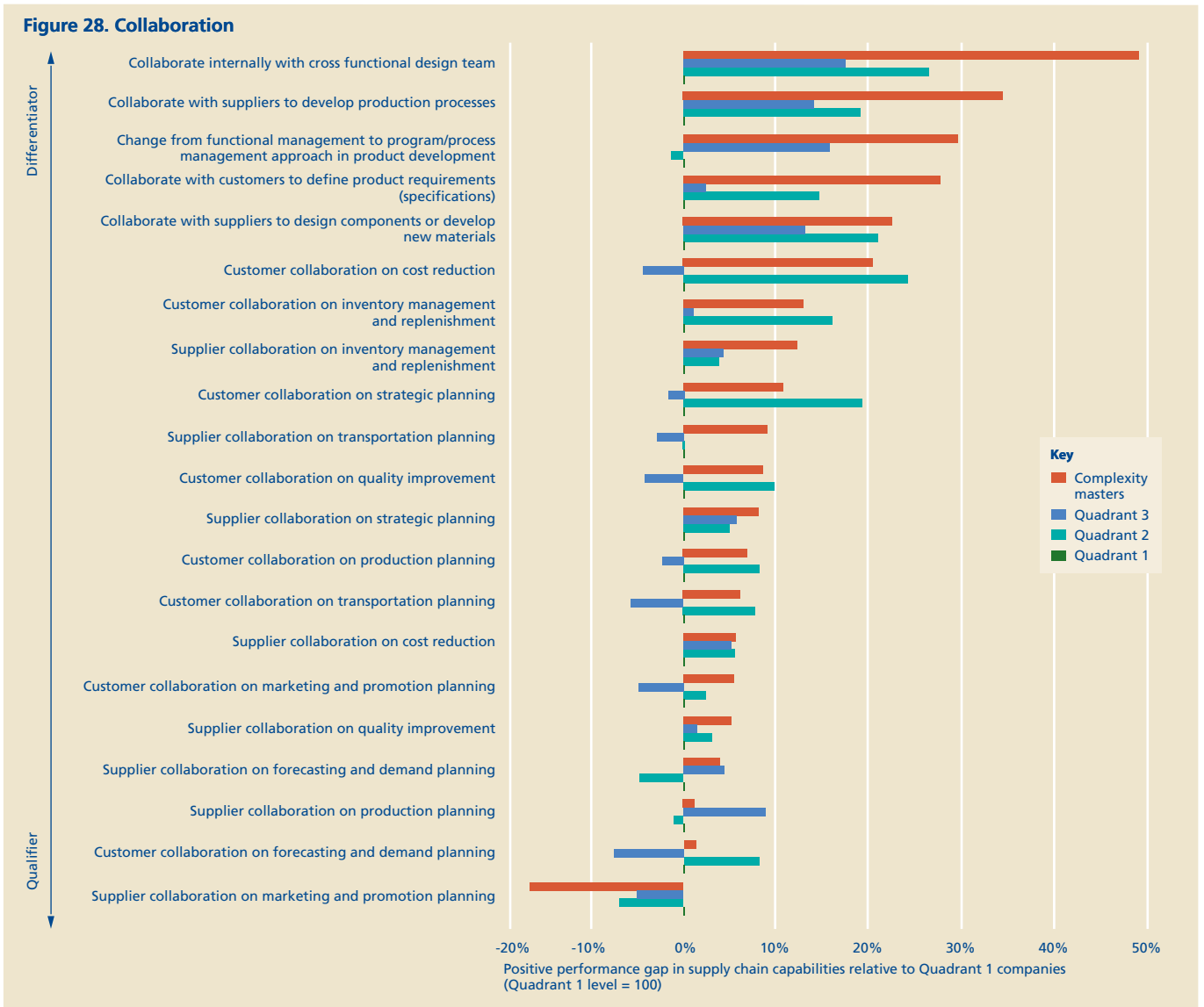


Figure 28. Collaboration



in the rush to meet tight engineering schedules, design engineers do not include supply chain planners and manufacturing engineers in design reviews, fearing their feedback will only slow them down. Sales and marketing managers push for product features that will broaden their market without understanding the trade-offs in engineering and manufacturing costs. Such conflicting objectives and lack of collaboration between functions produce sub-optimal decisions. As can be seen in Figure 27, complexity masters, and Quadrant 2 companies, appear to be less prone to such miscues. They are far better at orchestrating customer, product, and supply chain processes than most other manufacturers.

The four factors of synchronization

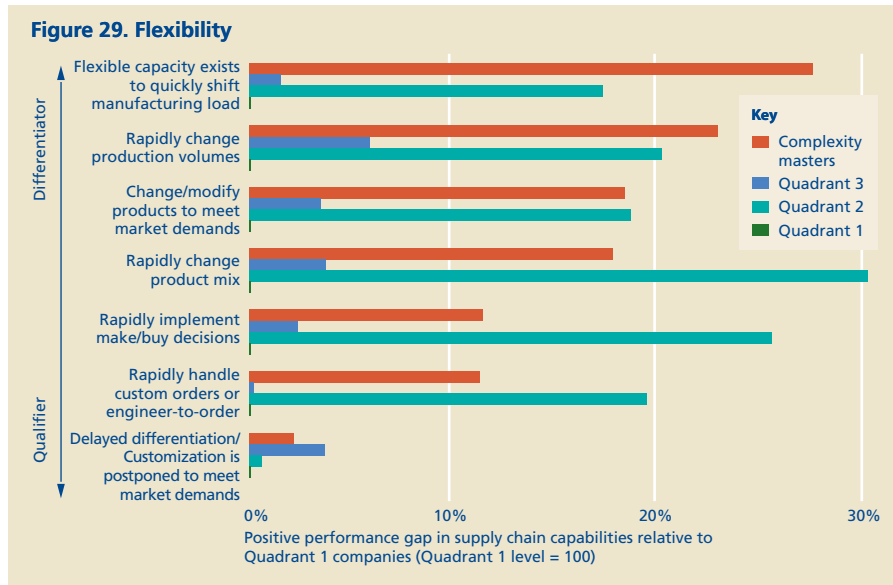
The ability to manage global value chain complexity in a profitable way comes down to two key factors: excellent customer-, product-, and supply chain-related business processes; and excellent synchronization across those processes. In the last decade, it has been well-documented how process improvement programs can achieve the former. But how do complexity masters achieve the latter?

We have identified four elements of synchronization: **collaboration**, **flexibility**, **visibility**, and **technology**. They enable a manufacturer to orchestrate and optimize the activities, decisions, and actions of employees in product development, demand-creation, and supply chain

processes scattered across the world (Figure 26). As such, they are important tools for managing the inevitable complexity that arises from an ever-more fragmented value chain.

We looked at practices and technologies in each of those areas – those that were prerequisites but did not differentiate complexity masters from the rest, and those that did. The differentiating factors are:

- **Collaboration.** This is about teamwork internally and externally (with customers and suppliers) in the areas of marketing/sales/service, sourcing/manufacturing/distribution, and innovation/engineering/product development (Figure 28). The complexity masters stand out from



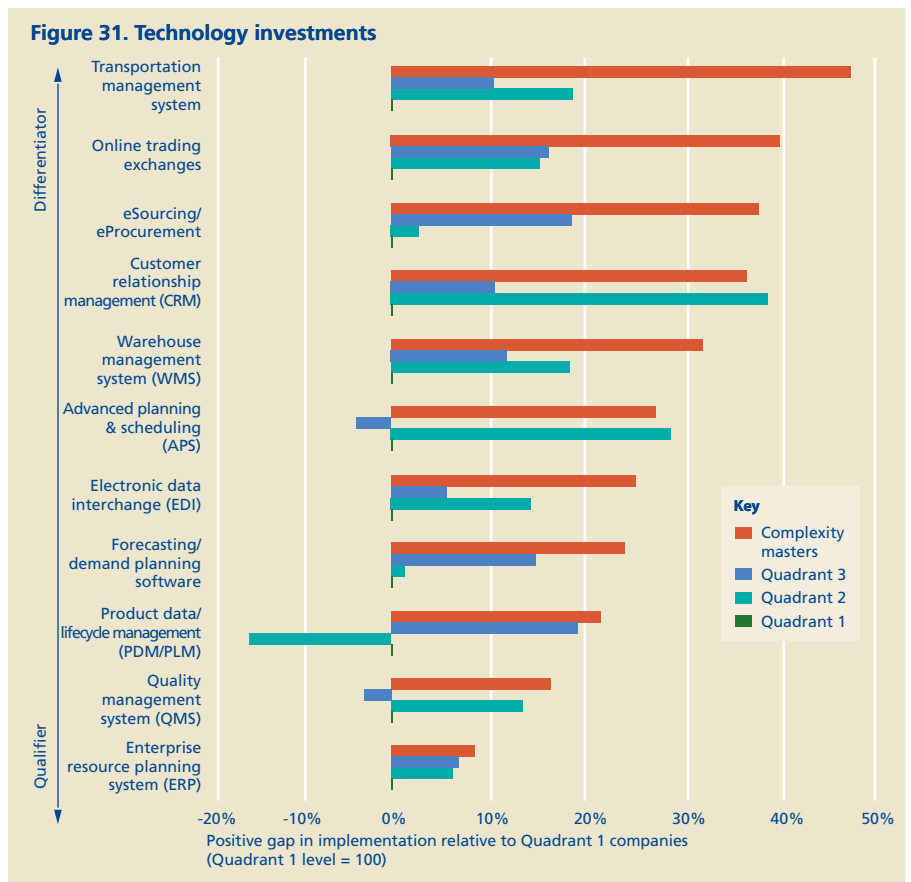
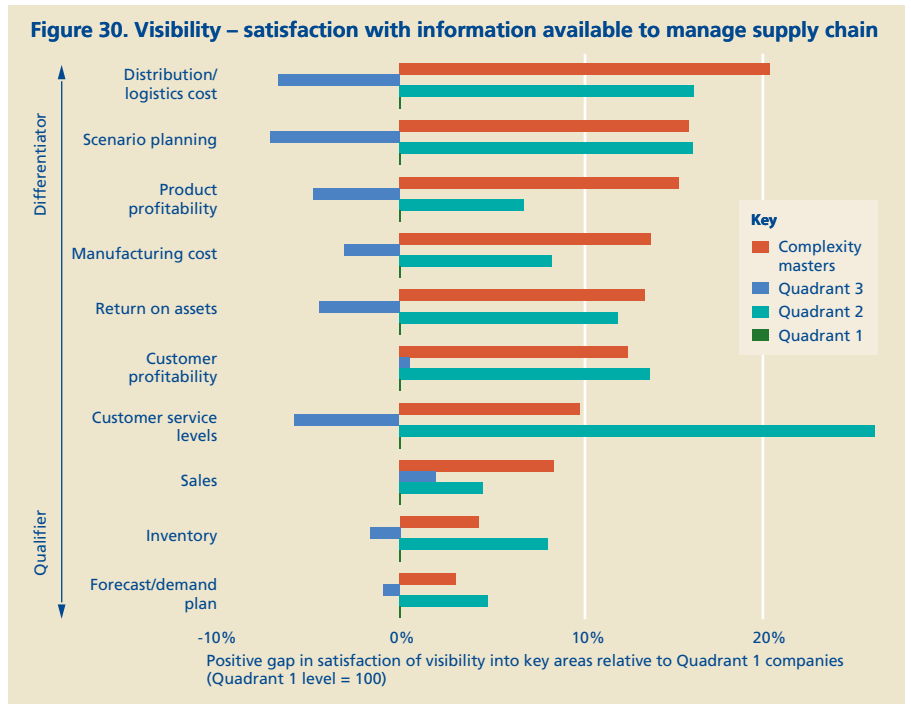
“Complexity masters report more flexible production capacity to change plant loading and greater ability to adjust product mix and volumes. Thus, they are not as vulnerable to forecast error or demand volatility, both of which are inevitable in the real-world marketplace.”

the rest with more cross-functional design teams and a higher degree of collaboration with suppliers to develop production processes and to design components or develop new materials. They also collaborate more closely with customers on strategic issues such as forecasting and demand planning, marketing and promotion planning, and strategic planning. This helps improve visibility and enables them to better match supply and demand on an ongoing basis. And, because they collaborate more extensively with key customers, they can see new product opportunities early. Not surprisingly, complexity masters report a significant advantage in this dimension. Complexity masters also collaborate internally more effectively than Quadrant 1 companies. For example, they have stronger commitments to cross-functional design teams, design for quality, and design for manufacturability techniques. Collaboration techniques that are necessary but do not differentiate complexity masters include working with suppliers on production planning, inventory management, and replenishment; and collaborating with customers and suppliers on forecasting and demand planning.

- **Flexibility.** Complexity masters' products and manufacturing processes can be altered more readily than those of other companies (Figure 29). They accomplish this by creating flexible capacity to quickly shift manufacturing utilization and rapidly change production volume; changing/modifying products to meet market demands; shifting product mix; and quickly implementing make/buy decisions. That makes it far easier for them to update their product lines and create new ones based on parts that have already been designed and engineered. Complexity masters report more flexible production capacity to change plant loading and greater ability to adjust product mix and volumes. Thus, they are not as vulnerable to forecast error or demand volatility, both of which are inevitable in the real-world marketplace.

- Visibility.** Complexity masters are able to build the right product mix, introduce their products at the right time, price them appropriately, manage inventory levels, and meet customer service goals because they have greater visibility into customer service levels, product costs, product profitability, and customer forecast data (Figure 30). They also have far better capabilities to execute through better collaboration across the enterprise to customers and suppliers. Overall, many companies simply do not seem to have the visibility they need to run their business better. Manufacturers in Quadrant 3 – those operating in a highly complex environment with average-to-poor value chain capabilities – clearly struggle to gain visibility into areas such as distribution/logistics cost and customer service levels.¹⁴

- Technology.** Not surprisingly, complexity masters also are far more likely to adopt leading technologies that can dramatically improve collaboration, visibility, and flexibility. These technologies include transportation management systems, online trading exchanges, e-procurement, CRM systems, warehouse management systems, APS systems, and forecasting/demand planning software (Figure 31). PDM/PLM software has reached the 50 percent mark in adoption for both Quadrant 4 and Quadrant 3 companies, whereas other companies lag far behind. Differentiation between complexity masters and Quadrant 3 companies in this respect may come less from the software licensing, but from the practices in using PDM/PLM software to improve innovation and product lifecycle management – areas in which complexity masters are ahead. Nevertheless, some technologies seem to be just “qualifiers.” ERP is a common foundation for virtually all manufacturers, regardless of size or quadrant. The technology has been adopted at least to some extent by 85 percent of all companies surveyed, and by 96 percent of the complexity masters. The gap in usage of quality management systems and EDI are also relatively small compared to other technologies, although complexity masters are furthest ahead in all of them.



¹⁴ On how radio-frequency identification (RFID) can revolutionize supply chain visibility, see Deloitte Research, *Move Over Barcodes: Consumer-Goods Firms Eye Radio Frequency ID* (New York: Deloitte Research, 2003).

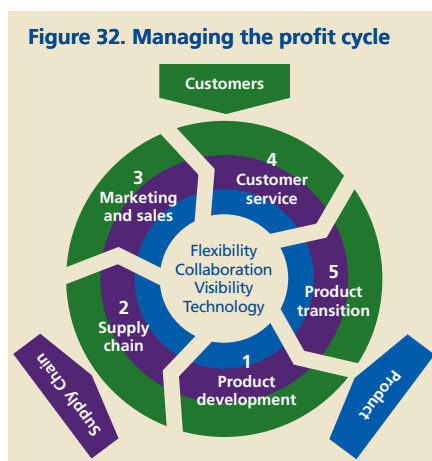
How it works: case studies in synchronizing the value chain

As we have seen, companies that fall into the complexity masters category do a far better job of coordinating customer, product, and supply chain operations. From the launch of a new product and throughout its entire lifecycle, information about customer needs and lifecycle profitability informs decisions on new product development, product features, pricing, and product transitions as well as decisions on changes to the underlying supply chain and customer management strategies and operations.

But where is such coordination most critical? When can synchronizing the work of customer, product, and supply chain activities really drive revenue and profits? How are management practices, capabilities, and technologies making a difference? Examining what can happen in the lifecycle of a product illuminates these issues.

Figure 32 depicts the stages of a product portfolio lifecycle from birth to death. It begins with product development; moves on to manufacturing and distribution; then moves to creating demand, selling, and servicing; and ends with retiring the products at the appropriate future moment with a transition to new products.

The goal of this process is not to maximize revenue at the expense of profitability (which might be the goal of marketing and sales), nor to increase share of revenue from new products (which could be R&D's target), nor to deliver rock-bottom costs (the supply chain manager's mantra). Instead, the goal is to maximize the total profit of the product portfolio over time. Thus, to give this process a name, we use a term neutral to R&D, marketing, and supply chain personnel: "the profit cycle."



Synchronization in product development

To master the complexities of accelerating innovation and fragmented operations, manufacturers often need to build product families that can be updated rapidly and inexpensively. To a large degree, that requires building flexibility into the product design. For discrete manufacturers, this means the ability to swap components in

and out without having to build a new product and manufacturing process from scratch. Of course, it also requires clear visibility into ever-fickle customer needs – advanced signals that the market is turning. This kind of visibility demands that manufacturers collaborate at high levels with retailers or other channel partners that sell their products.

For manufacturers in process industries, similar considerations are important. In specialty chemicals, for example, the ability to consolidate product information in an Internet-based knowledge repository improves customer, product development, and supply chain operations. This type of synchronization can pay huge dividends: better and cheaper customer service, and speedier, more effective product development and sales cycles.¹⁵

In the product development stage, building a flexible product and supply chain is critical. The experience of Motorola, for one, demonstrates this. Its Personal Communications Sector business unit (PCS) generates about 40 percent of the company's US\$26 billion in yearly revenue. PCS makes mobile phones, pagers, two-way radios, and other mobile telephony equipment. In recent years, Motorola had lost global market share to Nokia in the mobile phone sector. In 2002, Nokia's share was more than twice that of Motorola (36 percent of all units sold vs. 15 percent), a far cry from the days in the mid-1990s when Motorola owned 50 percent of the global handset market.¹⁶ In 2001 and 2002, the Schaumburg, Illinois-based company lost a total of US\$6 billion.

¹⁵ See Deloitte Research, *Profiting from Continuous Differentiation in the Global Chemicals Industry* (New York: Deloitte Research, 2003).

¹⁶ C. Whyte, "Motorola's Battle with Supply and Demand Chain Complexity," *iSource Business*, April/May 2003.

Over the last three years, PCS has been overhauling its supply chain. After evaluating the business unit's supply chain, the head of Motorola's worldwide supply chain declared a "war on complexity."¹⁷ Pressed by Nokia to compete on innovative features in cell phones, Motorola products had taken on untold complexity, with scores of products and hundreds of incompatible parts.

Having too many products to juggle and not enough commonality among them, Motorola was often late to market with mobile phones, pagers, and other mobile equipment. To correct the problem, Motorola devised an index that would measure each product's complexity for design, engineering, and manufacturing – factors such as part counts, test times, and use of industry standard parts. Each factor was weighted for its impact on key business drivers like responsiveness.

PCS's product development group began using more standard parts, reusable product platforms, and product postponement practices for both hardware and software.¹⁸ The C330 phone, for example, has 150 parts, compared with its predecessor's 400.¹⁹ PCS has reduced its number of telephony platforms from 100 to five in just two years. By the fourth quarter of 2002, the PCS unit had returned to profitability. In the first half of 2003, the unit was also solidly in the black.

The ability to keep up with shorter product lifecycles in an efficient way is one of the hallmarks of complexity masters. They do this by designing supply chains that can churn out new products faster, to more regions of the world, and keeping quality high.

Synchronization in the supply chain

Integrating customer, product, and supply chain activities to improve manufacturing and distribution can generate big returns for both simple and more complex manufacturers. Two very different companies demonstrate this vividly: sports car maker Porsche and pharmaceuticals giant GlaxoSmithKline.

Let us start with Porsche. The German company is a relatively small auto manufacturer (4.8 billion euros in annual revenue) with a less complex supply chain than, say, GM or Toyota, which have manufacturing and engineering operations in markets around the world. In 2001, Porsche began extensive research to understand whether or not customers would be interested in a Porsche SUV, and if so, at what price, with what features – and could it be done without diluting the brand. It turned out 40 percent of Porsche owners also already owned an SUV, many of which were high-priced models sold by automakers such as Land Rover, BMW, and Mercedes. The research told Porsche that customers would pay a premium for a Porsche SUV, but only if it were built on the foundation of Porsche quality and performance.

Porsche had to design a supply chain strategy that would preserve its reputation for quality and performance but would reduce production costs significantly. This was especially important given that the company had to spend a half billion dollars in developing the SUV, which was to be called the Cayenne – priced from US\$50,000 to US\$100,000.²⁰ Porsche outsourced the manufacture of the chassis and nearly every other part but the engine to Volkswagen and other suppliers.

To preserve the brand's heritage and focus on performance and quality, Porsche built a new plant in Leipzig, Germany, for the assembly of the vehicle. The plant is one of Europe's leanest car factories, where just 300 workers can assemble 25,000 Cayennes annually. With the heavy reliance on outsourcing, the plant can break even on an operating basis by building just 5,000 SUVs a year – critical volume flexibility in a volatile global luxury sports vehicle market. By using in-depth customer research to design the product as well as the supply chain, Porsche has created a whole new platform for profitable growth.

Now let us look at GlaxoSmithKline. The company shows the power of introducing product development and customer-related thinking into the design of a global supply chain. In 1999, Glaxo began a four-year program to restructure its sprawling supply chain operations from a global, not local (meaning country- or product-based) view.²¹ Rising costs and complexity in its supply chain forced the global optimization program. Four years ago, the company appointed a senior executive to oversee the entire supply chain and its overhaul. At that time, Glaxo's plants largely produced for the countries or continents in which they were located.

Increasing product variations and manufacturing steps had raised Glaxo's supply chain complexity and costs enormously.²² But the supply chain overhaul has significantly reduced the number of plants, which now serve regions around the world, saving the company about US\$500 million a year. Glaxo's supply chain strategy is in part a function of its product development strategy – that is, not letting supply chain constraints or local optimization get in the way of quickly ramping up production of hot new drugs.

The company now dedicates plants to one of three areas, based on where a product is in its lifecycle: flexible plants that can ramp up quickly to make new products or products in their early growth stage; plants for producing large quantities of established drugs, whose volumes are more predictable; and plants dedicated to established pharmaceuticals, especially those for small markets.

The result: a highly flexible and cost-effective supply chain that helps Glaxo compete in a world of exploding innovation and product proliferation.

¹⁷ Ibid.

¹⁸ "Product postponement" refers to the ability to delay the differentiation or customization of a product until later in the supply chain process.

¹⁹ See also M. Tatge, "Recharged: You've heard it all before. But this time, Motorola really is back," *Forbes*, September 15, 2002.

²⁰ See C. Ritter, "Porsche to Offer Cheaper Version of Hot SUV," *Wall Street Journal*, August 28, 2003.

²¹ Deloitte Research, *The Strategic Impact of ERP in the Pharmaceutical Industry* (New York: Deloitte Research, 2001).

²² From a 2000 editorial by the then-head of Glaxo Wellcome's supply chain, Tim Tyson, in *World Pharmaceutical Developments* magazine. GlaxoSmithKline was formed on December 27, 2000, through the merger of Glaxo Wellcome and SmithKline Beecham.

Synchronization in marketing and sales

The products of complexity masters are more likely to have features and functions that truly matter to customers. These manufacturers possess superior insights into customer needs gained through initial and ongoing market research. But the masters also use their CRM systems to continually inform supply chain managers and product developers on features customers want or do not want after product launch. That boosts both initial and ongoing product profitability. It also boosts customer retention without bankrupting the company.

Before the launch of a new product, masters have a good idea about its total possible costs, not just the costs of development but also for those involved in building an extended supply chain and for marketing. Thus, they can better time new product introductions and avoid becoming the unprofitable pioneer. As we refer to it, they are “right to market” rather than always trying to be “first to market,” which can save them a fortune, minimize risk, and maximize profits.

As in product development and supply chain design, collaboration is critical in the marketing and sales part of the profit cycle. A good example of customer collaboration is the case of Samsung Electronics Co. The US\$25 billion South Korean consumer electronics company has risen quickly to become the No. 1 maker of big-screen TVs, the No. 3 maker of cell phones, and the No. 1 maker of LCD displays.

This is no accident. In many ways, it is a result of investments in product, supply chain, and customer operations and synchronization of key activities across these areas. For example, Samsung works closely with retailers such as Best Buy Co. to improve its order fulfillment record. After launching new products, Samsung uses customer information gathered on the sales floor – both quantitative and qualitative – to more accurately forecast demand and improve its order fulfillment rates.²³

To further increase retail sales, Samsung uses third-party “detailers” who visit stores like Best Buy and Circuit City that carry Samsung products. Detailers monitor stock levels, display conformance, and competitors’ products and pricing. After just three months, they identified compliance problems with retail promotions and improved product display. Quality problems are also identified quickly – and acted upon. The detailers transmit this information daily via the Internet to Samsung’s CRM system. That information, in turn, goes to Samsung’s product development, sales, and marketing communications professionals.²⁴

In addition to getting better at matching retail demand with supply on a daily basis, Samsung is collaborating with retailers much more closely on its future product plans. The chains want Samsung to discuss its future product plans not weeks or months before launch, but years in advance to better support those products.

For a company that has accelerated its product launches – in 2000 the firm secured 1,442 U.S. design patents, second only to Apple Computer²⁵ – hit products are more critical than ever. Detailers talk to customers about whether or not they are considering purchasing Samsung gear, and gather other qualitative information to uncover demands for new features and functions – even whole new products. That kind of information goes right to Samsung product developers, giving them a daily “ear” on the market.

The impact of these and other CRM and supply chain initiatives at Samsung is that sales to a key customer have doubled over a period of just two years, and costly sales and marketing investments have been more effective.

In the automotive industry, General Motors Corp.’s launch of the Chevrolet Celta compact car in Brazil provides another good example of the benefits of customer collaboration in marketing and sales.²⁶ In September 2000, the automaker went

live with an initiative that let customers buy the car through a website or kiosks located inside Brazilian Chevrolet dealerships. By receiving information on automobile specs directly from customers, the company’s Gravataí, Brazil, assembly plant can forecast production needs, cut inventory costs, reduce taxes, and more accurately predict profit margins.

To reduce manufacturing complexity, Celta buyers choose from a low number of configuration options – far fewer than those for North American models, whose configurations can number 20,000 or more. In addition, to improve manufacturing efficiency, the Celta is mass-produced to a pooled inventory that responds to demand from dealers and customers. Because vehicle orders are instantly transmitted to distribution, manufacturing, and procurement, Chevrolet can rapidly align production plans with demand to ensure that the right vehicles with the right options are available. In addition, accessorization of the vehicles beyond the standard factory options available from the factory has been postponed to the dealers to increase consumer choice at a low cost. This also allows dealers an additional revenue stream. First-year sales were a record for GM in Brazil; more than 81,100 Celtas, two-thirds of which were purchased via the website.

Synchronization in customer service

Caterpillar Inc., a US\$20 billion manufacturer, demonstrates the fruits of coordinating customer, product, and supply chain operations in after-sale service. The company makes construction and mining equipment, engines, and industrial gas turbines at 114 plants around the world. It distributes parts from 70 distribution centers worldwide. Its equipment and parts are sold and serviced through 4,000 independent dealer locations.

The dispersion of Caterpillar’s supply chain network around the globe creates

²³ From a speech by Samsung Electronics America Inc. Director of CRM Peter Goodnough and Deloitte’s Richard Carson at the joint Deloitte/Stanford Global Supply Chain Management Forum executive seminar, “Collaborative Supply Chain and Customer Management: Driving Shareholder Value through Management of the Extended Enterprise, November 14, 2002, at Stanford University.

²⁴ G. Conlon, “Customers Really Matter,” *Destination CRM*, August 1, 2002.

²⁵ From Goodnough and Carson’s Stanford presentation.

²⁶ From P. Koudal, H. Lee, et al., “General Motors: Building a Digital Loyalty Network Through Demand and Supply Chain Integration,” Stanford Case Study, Jan. 1, 2003. See also Deloitte Research and Stanford Global Supply Chain Management Forum, *Integrating Demand and Supply Chains in the Global Automotive Industry* (New York: Deloitte Research, 2003).

huge complexity. Caterpillar products are used in 197 countries covering 23 time zones. Many of its machines end up in remote locations: diamond mines in South Africa, the jungles of the Amazon, offshore oil drilling platforms, and the like. The company's parts inventory is vast; equipment can remain in use for decades, which means parts must be available for machines as old as 40 years or more. The vast majority of parts sell less than one per month. Equipment that is down for repair can cost customers millions in lost income. One of Caterpillar's key success factors is the quality of its equipment.

To be highly responsive to customers and yet keep costs in line, Caterpillar designs products with service in mind. That is, so they can be repaired quickly and economically, the company's machines reflect a lot of modular design.²⁷

Caterpillar has also designed its parts service supply chain from a global perspective. Parts manufacturing, the bulk of which flows through Caterpillar's hometown of Peoria, Illinois, is centralized, while parts warehouses are sprinkled around the world. Information systems give dealers tight linkages with parts facilities. Today, dealers can fulfill 95 percent of service parts orders. An elaborate information system that every dealer is hooked into and which identifies the parts in all dealer locations enables 99.8 percent of daily orders to be filled within 24 hours. Another example of Caterpillar's success in this area is that only 0.2 percent of the company's more than 500,000 service parts go on back order in any one year.

Caterpillar is leveraging its excellence in service parts distribution and logistics externally as well, serving over 40 global clients through the Cat Logistics business unit. And the company is not resting on its laurels. It has embarked on developing a next-generation technology platform for service parts management in partnership with Ford Motor Company and SAP AG.

Conclusion

Despite the turbulent economic times of recent years, virtually all manufacturers have been improving their value chains. They have taken many steps to reduce costs and find new revenues streams. They have sought new global markets for their products; new places to source, manufacture, and distribute them; and more new products to channel through their supply chains. And their aggressive plans for the future suggest that they are not putting these efforts on hold. However, these moves often generate a significant cost – one of rising complexity. The survey data and case studies show how value chain complexity is unavoidable for most manufacturers that want profits and growth.

But no matter how complex their value chains, this much is clear for most manufacturers: autonomous corporate initiatives of the last decade or more to optimize within product development, supply chain, and demand-generation areas will no longer be enough to compete effectively. The challenge for manufacturers the rest of this decade is a whole new one: continuing to optimize those three areas but, more importantly, synchronizing across them at key moments in the profit cycle – from product development and supply chain management, to marketing/sales, and customer service. This means aggressively adopting practices such as cross-functional and cross-organizational collaboration; building flexibility and rapid evolution into product designs and manufacturing processes; getting visibility and real-time data from other areas that can impact the cycle; and adopting technologies to enable the profit cycle.

Although the challenges of achieving such cross-functional and cross-organizational coordination are immense, the returns are impressive. And they are available not only to large, complex organizations, but also to manufacturers whose value chains operate in less-complex environments – that is, in fewer countries and with fewer products, customers, and supply chains to manage.

Following in the footsteps of the complexity masters is, of course, a tall order. But as globalization of manufacturing and innovation continue to accelerate, we believe it will no longer be an option but rather a requirement for survival and success.

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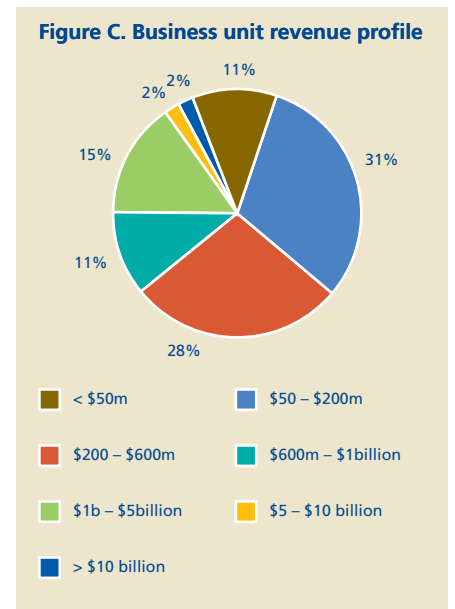
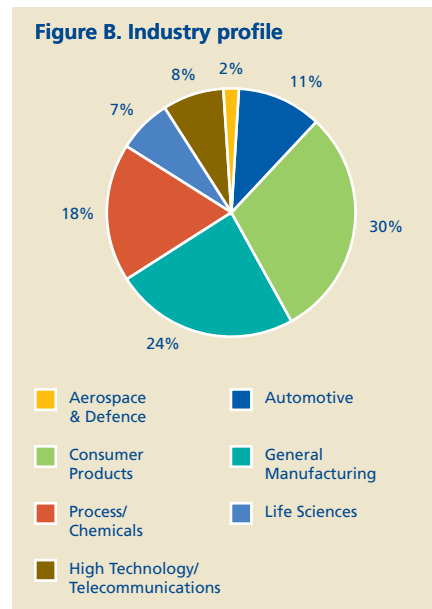
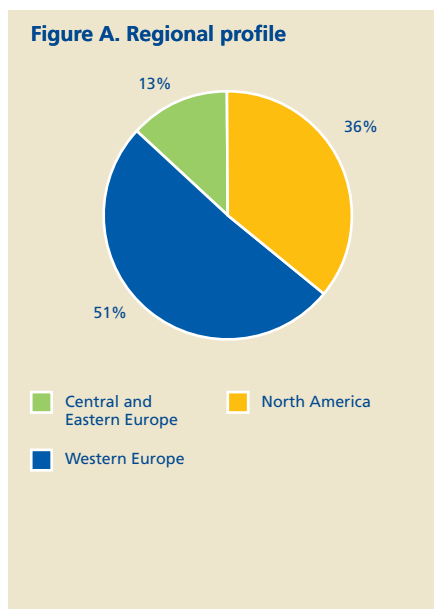
²⁷ For details, see the *Harvard Business Review* article by ex-Caterpillar Chairman Donald V. Fites, “Make Your Dealers Your Partners,” March-April 1996, pp. 84-95.

Appendix: survey methodology and respondent profile

Our research on global value chain complexity is based on a comprehensive, in-depth survey of nearly 600 executives in companies based in Western Europe (51 percent of total respondents), North America (36 percent), and Central and Eastern Europe (13 percent) (Figure A).²⁸

Industries represented in the study include aerospace and defense, automotive, consumer products, life sciences, process and chemicals, high technology and telecommunications, and general manufacturing (including metal fabrication, industrial machinery, and equipment) (Figure B).

Of all reporting entities, including both entire companies and business units of larger parent companies, about 40 percent have revenues between US\$200 million and US\$1 billion, and nearly 20 percent in excess of US\$1 billion (Figure C).



²⁸ Europe includes Austria, Belgium, Denmark, France, Germany, Italy, The Netherlands, Norway, United Kingdom, Sweden, Portugal, Spain (Western Europe), Bulgaria, Croatia, Czech Republic, Lithuania, Poland, Serbia, Slovakia, Slovenia (Central and Eastern Europe). North America includes Canada and the United States.

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