

WHITE PAPER

Responding to Volatility in the Semiconductor Supply Chain

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INTRODUCTION

A Light at the End of the Tunnel

The outlook for the high-tech industry is improving, and expectations for the semiconductor segment are rising as well. With the semiconductor book-to-bill ratio on the rise, others in the semiconductor industry are starting to feel more optimistic about its short-term outlook. For the first time in two-and-a-half years, semiconductor executives are starting to feel that the worst may be behind the industry.

"We've gone through some of the worst, wrenching downturns in the history of the semiconductor industry in the last two to three years," comments the CIO of a global semiconductor manufacturer.

"We experienced some of the most euphoric highs during the years of 2000/2001; and we also experienced some of the lowest lows. But I think from a semiconductor industry standpoint we've stabilized and turned a corner."

However, semiconductor companies have not yet declared victory. Demand continues to be a concern and will be until semiconductor companies see a steady stream of demand in their pipeline. During these turbulent times, IT has proven itself to be an ally of the semiconductor industry. IT has enabled semiconductor companies to create greater efficiencies in their organizations as a result of streamlining and creating a more agile supply chain.

At the heart of supply chain management initiatives are the series of applications that synchronize demand and supply, manage inventory, ensure service-level commitments, and provide greater visibility into the manufacturing operations. This white paper explores the power of supply chain applications in the semiconductor industry. It examines the pressing supply chain issues faced by semiconductor companies and how they are using IT applications to address these business issues. The paper presents a case study of a cutting-edge semiconductor manufacturer that has deployed a suite of supply chain management applications and profiles Oracle, a supplier of IT solutions to the semiconductor industry.

Cost-Cutting Reigns Among Fabs

A recent IDC survey of executives at semiconductor manufacturing organizations revealed that manufacturers are grappling with several similar business challenges. Reducing the costs of manufacturing and improving the effectiveness of sales and marketing are the top business objectives for semiconductor manufacturers, according to the survey. However, managing inventory and predicting demand also play important roles that should not be overlooked. As Figure 1 shows, these objectives received ratings of 3.8 and 3.0, respectively.

FIGURE 1

Semiconductor Manufacturers' Business Objectives

Q. Please rate how important the business objective will be to your company's strategic priorities:



n = 10

Source: IDC, 2003

Not surprisingly, the economic downturn of the past two-and-a-half years has led semiconductor companies to focus on reducing manufacturing costs. This focus continues to drive the use of foundries that are located in regions with lower labor costs.

Reduction of manufacturing costs has also resulted in a tightening of operations, particularly those activities associated with the supply chain and manufacturing processes. Many semiconductor executives would agree that their business is now leaner and more efficient as a result of the past 30 months.

"Everyone has become smarter, and the whole supply chain is being managed. I don't think you're ever going to go back away from that," comments one high-tech executive.

However, as we all know, tackling the semiconductor supply chain is no simple task. Optimizing this supply chain comes with its own set of business challenges, including:

- Improving predictability and velocity of demand signals
- Leveraging demand variability and improving customer service levels
- Implementing die-bank strategies for maximizing supply chain responsiveness
- Sustaining lead-time reduction while reducing inventory
- Integrating shop floor execution for global visibility
- Achieving accurate supply and demand picture

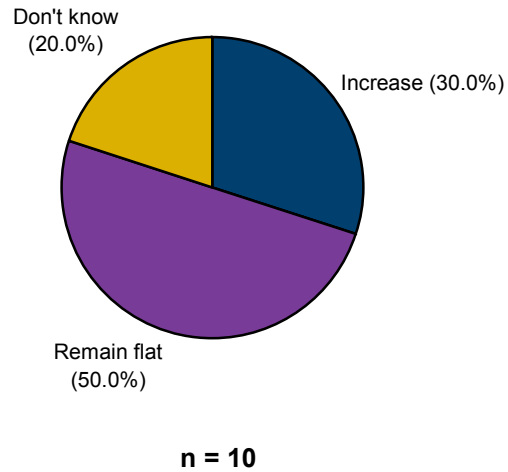
IT Proves Itself to Be an Important Tool

Semiconductor companies that have focused on streamlining their supply chain have found IT to be an important tool in their efforts of the past two-and-a-half years. IDC doesn't expect this situation to change. As the high-tech sector picks up, IDC expects semiconductor companies will continue to invest in IT, particularly as it relates to the supply chain. Almost one-third of the semiconductor manufacturers surveyed by IDC expect their IT spending to increase in 2004 (see Figure 2).

FIGURE 2

Changes to Semiconductor Manufacturers' IT Budget in 2004

Q. *Do you expect your IT budget to increase, decrease, or stay the same from calendar year 2003 to 2004?*



Source: IDC, 2003

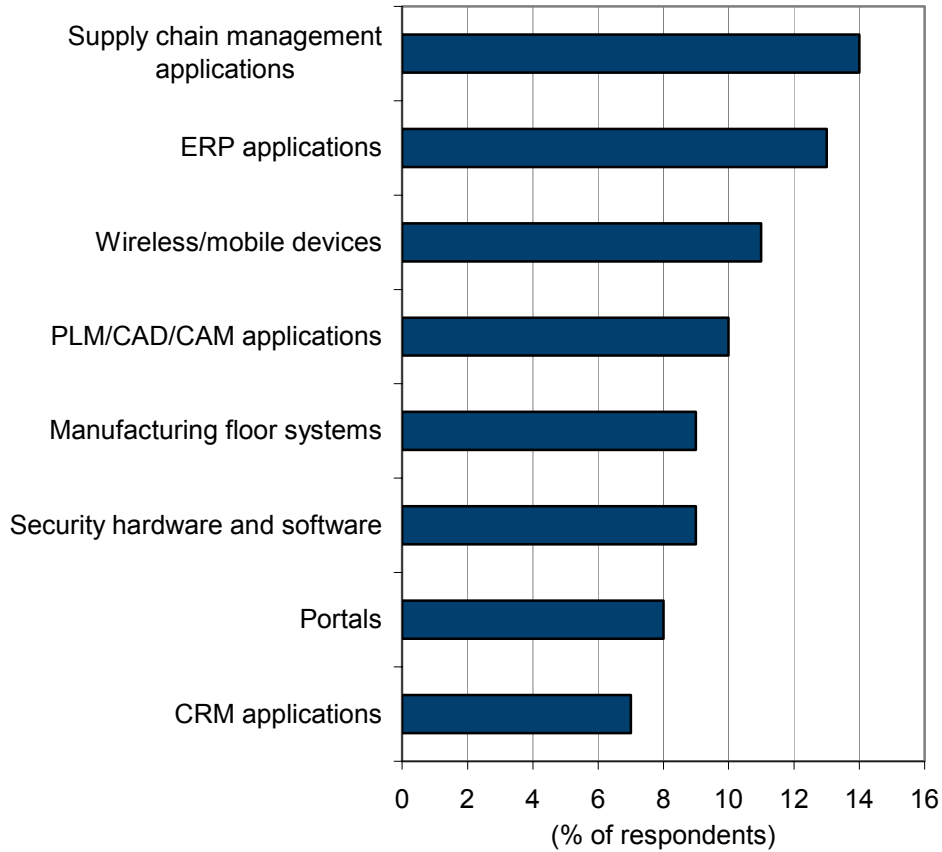
During the 2002–2007 period, IDC expects high-tech manufacturers to increase their IT spending at a compound annual growth rate (CAGR) of 7.1%.

What key IT investments are high-tech manufacturers making? Most of the investment dollars center around supply chain management and enterprise resource planning (ERP) applications, which top the list of technologies in which high-tech manufacturers are planning to further invest during the next 12 months (see Figure 3).

FIGURE 3

Future Plans to Use Technology at High-Tech Manufacturers

Q. Please tell me if your organization has plans to use the following technologies in the next 12 months:



n = 100

Source: IDC, 2003

PROFILE OF A SUPPLY CHAIN SOLUTION VENDOR SERVING THE SEMICONDUCTOR INDUSTRY: ORACLE

A multitude of vendors provide supply chain management applications to the high-tech industry. Oracle is no exception. The vendor has placed a significant focus on the high-tech manufacturing industry. IDC estimates that Oracle generated approximately \$326.6 million in revenue (or 7.2% of its revenue) from the U.S. high-tech industry in 2002. As a result, Oracle is one of the 10 largest IT vendors in the U.S. high-tech industry.

The company's mission in the high-tech industry is "to continue to define and develop business solutions and processes which unlock true value for its customers in the EMS, semiconductor, configured electronic systems, and consumer electronics segments of the high-tech industry." To achieve this mission, Oracle pursues customers that are innovative, leading high-tech manufacturers. This work exposes Oracle to cutting-edge requirements, which it uses to build functionality back into its products. For example, Oracle works with more than 75 semiconductor manufacturing customers. Of these companies, 66% have been named leading fabless semiconductor companies.

In addition to working with leading high-tech manufacturers, Oracle stays attuned to changing industry requirements through a series of mechanisms, including:

- ☒ **High-Tech Customer/Partner Advisory Board (CAB).** Through its annual customer and field advisory board, Oracle uses information gleaned from customers and partners to define functional inputs for future releases.
- ☒ **Partnership with the Fabless Semiconductor Association**
- ☒ **Critical Account Program.** Oracle provides development-assisted implementation to select accounts.
- ☒ **Center of Excellence Program.** Development works closely with the business and IT executives of industry-leading companies to build solutions for leading-edge business practices.

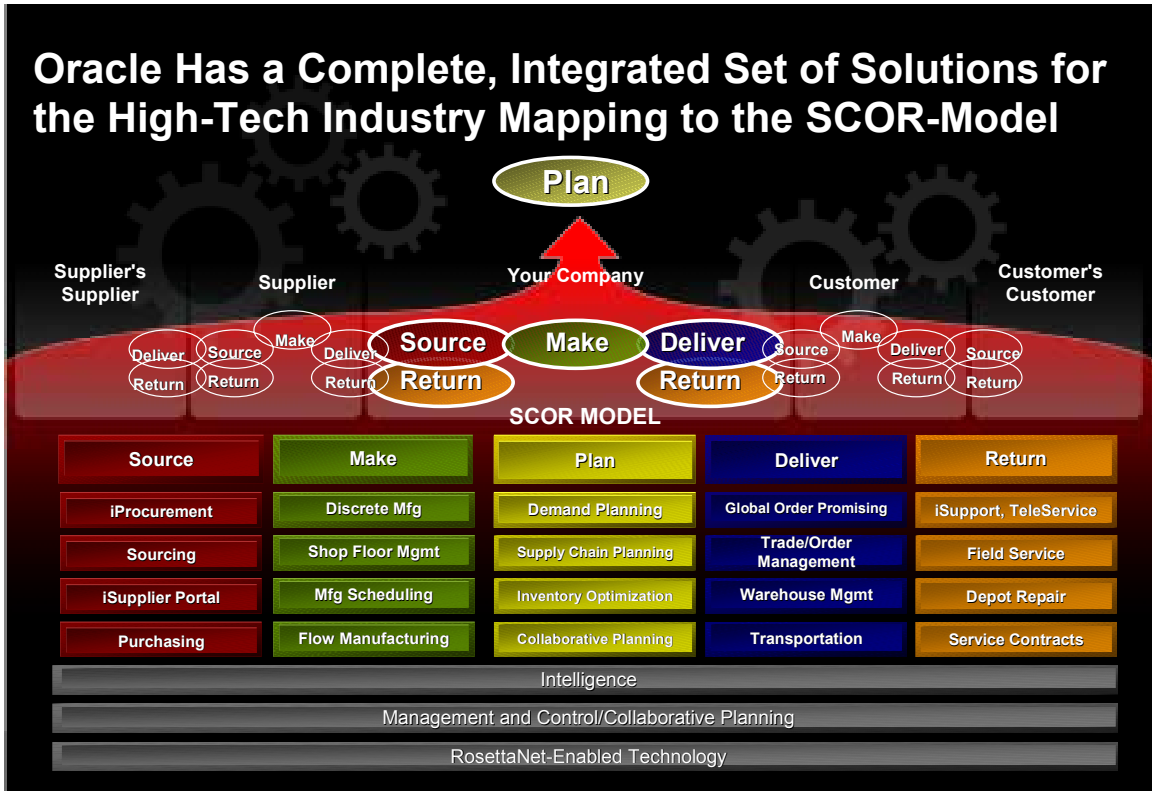
Solutions for the High-Tech Industry

With its E-Business 11i.9 suite of applications Oracle is able to bring an end-to-end offering of applications to semiconductor manufacturing organizations. The application suite includes financials, human resources, manufacturing, sales and marketing, order management, procurement, product life cycle management, and service and supply chain planning and execution. The latest version of the supply chain modules includes 772 new features, of which 70% are expected to benefit high-tech customers. Some of the key features include outsourcing and multi-tier CTO (configure to order), serial tracking and genealogy, semiconductor detailed scheduling along with key enhancements in demand planning, collaborative planning, and shop floor management. With RosettaNet support built into the middleware and its applications, Oracle's manufacturing applications can integrate the business processes of customers' suppliers and partners.

Oracle provides a broad set of integrated applications specifically for the high-tech industry that map to the Supply-Chain Operations Reference-model (SCOR) (see Figure 4). This paper does not go into detail about every module; rather, it highlights some of the key components of Oracle's supply chain management solution.

FIGURE 4

Oracle's Supply Chain Solutions for the High-Tech Industry
Map to the SCOR-Model



Source: Oracle, 2003

Supply Chain Management Solution

Most relevant to semiconductor companies is Oracle's supply chain management solution. The supply chain planning solution can support all types of high-tech manufacturing business models — from completely manufactured in-house operations to completely outsourced manufacturing operations. The solution provides manufacturers with real-time access to information and supports manufacturing inside the four walls of the company or extended to contract manufacturers or logistic partners. Key components of Oracle's supply chain management solution for the semiconductor industry include Oracle Shop Floor Management and Oracle Advanced Planning solutions.

Oracle Advanced Planning

This set of modules is designed to address end-to-end planning across procurement, manufacturing, fulfillment, service, marketing, and logistics enterprise processes. It enables semiconductor companies to leverage demand variability, plan holistically, and implement die-bank strategies for maximizing supply chain responsiveness to even unforeseen demand. Key components of the Advanced Planning solution include:

- ☒ **Demand Planning.** Helps to achieve an accurate consensus forecast by bringing together marketing, sales, manufacturing, customer, and supplier information and supports an enterprisewide sales and operation planning process with multidimensional OLAP analysis (e.g., product, channel, geography, and time).
- ☒ **Inventory Optimization.** Determines the most effective inventory postponement strategy while taking into account demand, supply and lead-time uncertainty, and customer service levels.
- ☒ **Supply Chain and Manufacturing Planning.** Reduces supply chain planning cycle time through holistic database-centric planning. Collaborative capabilities help to provide a clearer picture of the impact of customer and supplier forecasts, schedules, and constraints.
- ☒ **Global Order Promising.** Helps manufacturers to promise orders more accurately by taking into account material availability, manufacturing capacity, supplier capacity, and transportation capacity.
- ☒ **Manufacturing Scheduling.** Helps to drive plant and shop floor efficiencies by improving asset utilization through support for complex scheduling methods such as sequence dependent setups, batch resourcing, and network routings with a highly interactive scheduling user interface.
- ☒ **Collaborative Planning.** Provides demand and supply collaboration with customers, contract manufacturers, and suppliers, and therefore complete supply chain visibility, by simultaneously sharing forecasts and order commit information across multiple enterprises. Includes support for key processes such as waterfall analysis, vendor managed inventory (VMI), and liability analysis.
- ☒ **Supply Chain Intelligence.** Decision-making tool to help drive continuous improvement in supply chain. Can define a series of parameters upon which to be notified. For example, can track key performance indicators compared to plan, set up business performance targets, and notify decision makers of exceptions.

Oracle Shop Floor Management Solution

Originally built for the semiconductor industry, this solution has more than 75 customers today. With this solution, semiconductor companies can track customer orders all the way down to the shop floor. It also allows seamless integration of ERP system with third-party MES systems, eliminating multiple points of integration. Key features include the ability to:

- ☒ Manage complex shop floor lot transactions
- ☒ Model and track operation yield-related cost for products
- ☒ Identify and proactively respond to quality issues
- ☒ Provide end-to-end genealogy of products
- ☒ Provide full traceability across the entire semiconductor supply chain

Table 1 shows how Oracle's supply chain management solution helps semiconductor companies address many of their key business and technology challenges.

TABLE 1	
How Oracle's Supply Chain Management Solution Addresses Challenges of Semiconductor Manufacturers	
Challenge	Oracle's Solution
Improving predictability and velocity of demand signals	Solutions that enable demand collaboration and improve forecast accuracy by enabling ubiquitous information sharing among foundries, assembly and test facilities, OEMs, contract manufacturers — Demand Planning, Collaborative Planning
Leveraging demand variability and improving customer service levels	Solutions that leverage demand variability to precisely determine the levels of inventory investment required to meet your customer service objectives at the lowest possible cost — Demand Planning, Inventory Optimization
Implementing die-bank strategies for maximizing supply chain responsiveness	Solutions that determine how far forward in the semiconductor supply chain to hold inventories and still maintain customer service levels; that sustain lead-time reduction while reducing inventory — Inventory Optimization, Supply Chain and Manufacturing Planning, Collaborative Planning
Tracking, visibility and genealogy for the global shop floor	Solutions that help manage dynamic routings, track complex shop floor lot transactions, provide end-to-end genealogy of products, and model and track operation yield-related cost for products. Provides real-time shop floor visibility for IDMs, fabless companies, fabs and assembly and test houses — Shop Floor Management
Achieving accurate supply and demand picture	Solutions that generate a single, holistic supply chain plan that provides long-range aggregate planning across foundries, test and assembly houses, contract manufacturers, and OEMs as well as short-term detailed scheduling — Advanced Planning (Suite)

Source: IDC, 2003

IDC OPINION

Oracle has put quite a bit of emphasis on the semiconductor industry because it sees the fabless semiconductor as the source of much innovation. By staying in touch with the leading-edge developments in the high-tech industry, Oracle is well positioned to drive innovation through the rest of the high-tech industry and even the manufacturing sector. Furthermore, the company's belief that it needs to maintain leadership across the high-tech sector in order to stay in touch with innovative manufacturing developments for the rest of its business helps ensure Oracle's commitment to this industry.

The supply chain management solution is rich with features. Key to continued success is educating customers about the benefits of these features and how they can be used. Oracle continues to drive improvements and support for innovative business practices by working closely with its customers. Now that Oracle has a strong supply chain footprint in the high-tech industry, its next challenge is to develop a comprehensive partner strategy and work on educating and converting systems integrator partners.

Oracle's depth in the high-tech industry helps to address industry-specific business processes, but as the company extends its presence in the automotive, aerospace and defense, and medical device industries, these cross-industry leanings are likely to benefit all industries.

CASE STUDY

Xilinx Reduces Inventory Costs with Advanced Supply Chain Planning

One major semiconductor manufacturer that is investing in supply chain applications is Xilinx. This case study illustrates the benefits that can be attained by supporting supply chain business processes with IT systems.

Anticipating Demand

With \$1.16 billion in sales, Xilinx of San Jose, California, leads one of the fastest-growing segments of the semiconductor industry: programmable logic devices. As a supplier of more than half the world demand for field programmable gate arrays (FPGA), Xilinx serves more than 7,500 customers.

On any given day, the company's customer base can be characterized as dynamic, which creates an air of uncertainty when running a manufacturing operation. In 2000, more than 70% of its business came from the telecommunications industry, which is characterized by last minute design modifications and rapidly changing standards.

Because of the unpredictability of the market in which Xilinx operates, the company was looking to improve its visibility into the supply chain in order to improve its commitment levels to customers. The economic events of 2000 heightened Xilinx's need to make changes to its supply chain. As the telecommunications industry contracted, Xilinx saw its revenue drop in half. Consequently, the company was forced to take a large inventory write-off as it adjusted to the new reality of its customers' demands.

At the heart of Xilinx's supply chain visibility challenges was that its business processes for wafer fabrication planning and execution acted independently. The IT systems that Xilinx was using to support the two business processes was homegrown and did not link the two sets of activities (planning and execution). Compounding the complexity of the situation is that Xilinx operates as a fabless semiconductor business. It outsources everything but the design, marketing, and support of its products. Therefore, providing an accurate forecast to its partners is critical to Xilinx's ability to meet its commitment levels to customers.

Because Xilinx's planning and execution business processes acted independently, the company did not have insight into its forecast when scheduling orders. The result, in some cases, was that the company scheduled orders but did not have enough material to fulfill them. This situation caused Xilinx to overcommit or undercommit.

An Advanced Supply Chain Planning Solution

Xilinx's solution was to tie together two major business processes and their associated systems. This approach would result in increased delivery while enabling better inventory management. In its pursuit of a planning software package that would support the integration of both business processes, Xilinx evaluated 13 packages and then narrowed its decision to three. The company provided data to each of the three finalists and had them develop a plan for execution. As a long-time Oracle Order Management customer, Xilinx evaluated Oracle during its selection process and ultimately selected Oracle's Advanced Supply Chain Planning (ASCP) module.

Xilinx was impressed by Oracle's understanding of the semiconductor business. "You could tell that Oracle was head and shoulders above the rest," says Chris Wire, Senior Director, Supply Chain. Xilinx had given Oracle a thorny data set that required an understanding of the semiconductor industry's unique inverted bill of materials and speed binning processes. Oracle showed that its people had expertise in the industry as it demonstrated its plan for Xilinx. The company also liked Oracle's plan to integrate the Supply Chain Planning module with its Oracle ERP system.

Approximately 10 people, including employees from both the supply chain and IT departments, worked on the project. In the beginning, Xilinx hired Oracle Consulting to work with them on establishing the plan. Throughout the project, Xilinx kept one Oracle consultant on staff. Xilinx broke the project into two phases that matched the two business processes that it sought to bring together. They are as follows:

- ☒ **Phase 1: Wafer fabrication planning process.** Xilinx implemented the Oracle ASCP module to assist with its long-range forecasting process, which involves Xilinx's subcontractors and produces demand forecasts that are used to replenish Xilinx's inventory. Xilinx completed the implementation of phase 1 in the first quarter of 2003. This phase took approximately a year to implement, which was an acceptable time frame for Xilinx. "We did a lot of modeling in the beginning," explains Wire. "The trick with the planning phase is how to set up the bill of materials."

- ☒ **Phase 2: Scheduling and execution.** This phase includes responding to orders, taking inventory out of the buffer, assembly, and testing. Xilinx expects to complete phase 2 by the first quarter of 2004.

"We have a good relationship with Oracle's Advanced Supply Chain Planning development team," says Wire. "They have been very responsive, oftentimes working weekends to solve our problems."

Reduced Inventory Costs and Better Customer Satisfaction

Xilinx's advanced supply chain planning project cost approximately \$2 million to implement, and it has already saved the company several millions of dollars in inventory, giving this project one of the highest ROIs in the company.

In addition to enabling Xilinx to better manage inventory, the advanced supply chain planning project has also help Xilinx to improve its customer satisfaction levels. Xilinx provides customers with guaranteed service levels about when they will receive their products. Before the project, Xilinx had a history of 92–95% performance to first commit. Since implementing the planning system, Xilinx has seen this number rise to more than 98%. This increase in commitments improves overall customer satisfaction.

Finally, by tying together the business processes and supporting IT systems, Xilinx now knows:

- ☒ How much raw material it has on hand
- ☒ How much capacity is available
- ☒ How long it will take to manufacture an item

Therefore, it knows what it can commit to.

CONCLUSION AND RECOMMENDATIONS

As the market matures and competition increases, semiconductor companies will continue to use information technology to gain efficiencies and establish a competitive differentiator. Customers will no longer pay for a semiconductor company's inefficiencies. They will demand top-notch customer service at a lower cost. If they cannot attain these attributes, they will move to the competition. As you plan your supply chain strategy, keep in mind the following:

- ☒ **Build in agility.** High-tech manufacturers live and breathe in a changing environment. They must adapt to survive. "We're constantly reinventing processes and reinventing ourselves to adapt," explains one high-tech executive. IT systems that are built to be adaptive will succeed in high-tech manufacturing environments — whether it is an agile supply chain, a shared services model, or an IT architecture that supports future expansion. As one high-tech manufacturing executive explains, "We want to gain the purchasing power and economies of scale of being a billion-dollar company while maintaining the agility and closeness to the market that you get by being 15–20 strategically distinct businesses."

- ☒ **Create a strong partnership between IT and line of business.** Our interviews with executives who have led successful supply chain projects revealed that such projects always had a tight partnership between the supply chain and IT executives. Remember, these are not IT projects. At the heart of the supply chain solution may be a set of applications, but these projects need to start with the business processes and then use IT as an enabler to streamline the flow of information.
- ☒ **Simplify your business and your business processes.** IT is a tool to help streamline the flow of information in the supply chain. Don't mistake IT for the solution itself. "If you think your IT systems will fix your problems, you will probably be disappointed," states Wire. "Start with the process and let the system be the enabler of the processes."
- ☒ **Bring in talent with both applications and industry knowledge.** When working with a technology vendor on your supply chain solution, be sure to find someone who can serve as a bridge between the business processes and the IT. Xilinx found it valuable to work with an Oracle consultant who understood both the software and the semiconductor end user well. This person was able to interpret Xilinx's needs back to Oracle.
- ☒ **Work with your IT vendor to build a partnership.** Work with your IT vendor to jointly lay out a road map of your business today and in several years. If your IT vendor understands your business plans, then it is in a better position to build these features in future releases.
- ☒ **Perform due diligence.** Financial stability, technical expertise, and the ability to integrate with legacy systems are top criteria for semiconductor companies when selecting an IT vendor, according to an IDC survey. As you evaluate potential IT vendors with which to work, be sure to look into these factors as well as the vendors' commitment to your industry.

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