From source to drain:
Fixing the supply chain

Supply-chain excellence has proved elusive for semiconductor players, but a handful of initiatives can yield significant improvement.

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Connecting the terms "semiconductor," "supply chain," and "excellence" requires courage. Asking a customer of a semiconductor company about its supplier's delivery performance can be a genuinely emotional experience. Of course, this must be put into the context of 2008 to 2010, one of the worst inventory-depletion/demand-surge cycles in economic history. Current microcontroller woes in the automotive industry, following the tragic events in Japan in March 2011, must also be taken into account. Even if we normalize for such events, however, customers' views are generally pretty bleak.

One might say that customers judge the semiconductor industry too harshly. High capital intensity, coupled with long cycle times and a position far down the value chain, make semiconductors a classic case study for supply-chain problems ranging from "pig cycles" to "bullwhip effects." These are tough problems to solve.

In fact, customers are a little sharper-eyed than one might assume. Supply-chain performance levels within the industry vary significantly even within the same applications. Over the last three years, we have built a benchmark database containing 9 of the top 20 semiconductor players. Key metrics like "on-time delivery to customer request date" vary by almost 40 percentage points, while others such as "forecast accuracy on product-family mix, three months out" can vary from levels near

30 percent—equivalent to a random walk—to levels above 90 percent achieved by serious consumer-electronics original-equipment manufacturers (OEMs) and original-design manufacturers (ODMs).

But no single player displays excellence across the board. Some have clearly excelled in bringing down supply-chain costs and inventory. Others have focused on improving service levels. Yet few have found the ideal balance between the two. Hence, we conclude that there is significant upside opportunity for all players in the industry.

We turn first to the value we see in excellent supply chains. To capture this value, we describe commonly observed issues and tried and tested improvement levers to get the fundamentals right. We conclude with our beliefs about the characteristics of truly differentiated semiconductor supply chains in the future.

Value in excellence

The business case for supply-chain excellence is strikingly simple: Exhibit 1 contrasts the customer experience between a low- and a high-performing semiconductor player. Based on insights from our own work on five large semiconductor supply-chain transformations in the last five years, we believe revenue upside is the most underestimated impact of supply-chain improvement. In our experience, the revenue impact from a significant improvement in supply-chain performance can amount to an increase of 5 to 10 percent. In addition, we typically identify reductions of at least 15 percent, and in some cases as much as 30 percent, in inventory and working capital.

Exhibit 1

Taking a semiconductor customer's perspective illustrates the value that high-performing supply chains can add.

Poor semiconductor supply-chain experience (real example)

- You wait 1 week for a response to your order
- Your supplier tells you he cannot meet your requested delivery date for more than half of your orders
- For more than a third of your orders, your supplier misses his promised delivery date; very often he fails to tell you up front
- You have no option for urgent orders; instead, many products you need are out of stock

Where would you buy?

Best-in-class semiconductor supply-chain experience (real example)

- You get a confirmation of your order within 24 hours and are able to track its progress
- Your supplier manages to fulfill your request in 9 out of 10 cases; he even offers differentiated service levels depending on the criticality of your supply
- Your supplier almost never lets you down; in the rare instance when he misses a shipment, he notifies you as soon as possible and discusses mitigation options
- For an extra charge, you are able to place rush orders or get other value-adding services

While excellence in the supply chain has major cash and cost advantages, additional market opportunity is key

A successful transformation also reduces the day-to-day firefighting and tedious manual interventions we encounter in many semiconductor organizations. This does not generally have an enormous impact on cost efficiency, but it is a significant operational improvement, freeing up management time for other things.

Moreover, the business case for supply-chain excellence will become increasingly important. To date, capturing the next wave of innovation and technology advancement promises much more upside than investing in a state-of-the-art supply chain. Our hypothesis is that this will change: as an ever-increasing share of the industry and its products moves away from leading-edge technology, this will allow for innovation in business operations as well.

If successful, a high-performing supply chain can be a competitive weapon: flexible, agile, and reliable.

Why excellence is difficult to achieve

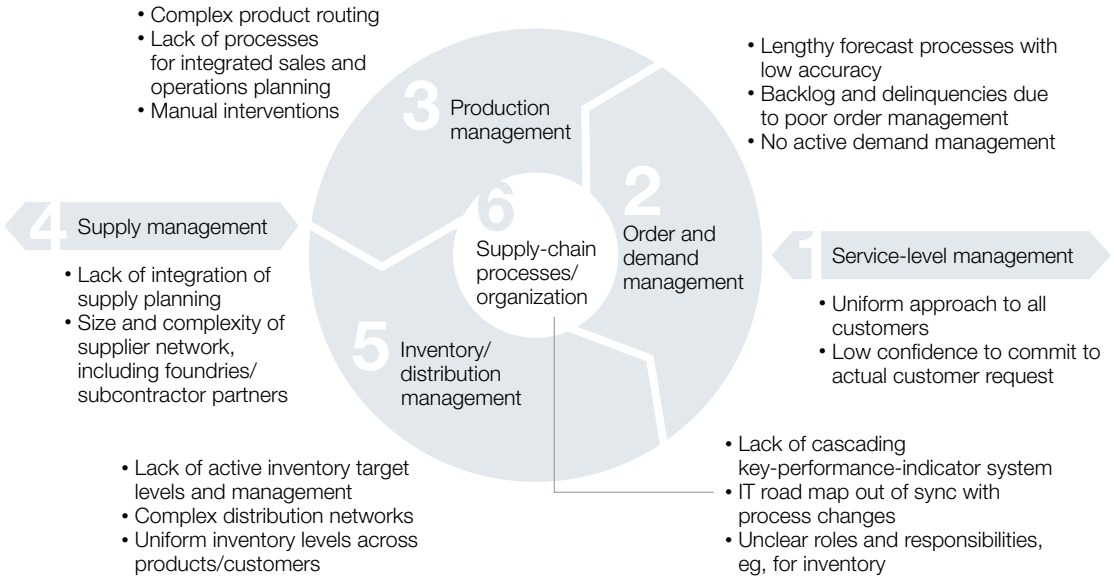
When we analyze supply chains, we do so starting from service-level management, moving to supply management, then to distribution- and inventory-management processes (Exhibit 2). We look at both physical and digital data flows, effectively "stapling ourselves to orders" as they pass through the various systems and from team to team. This complements our quantitative and qualitative benchmarking.

In our recent work, we found that several issues were widespread in the semiconductor industry. The following are some of the most frequent and important issues to address:

Exhibit 2

Many semiconductor companies experience similar issues along the supply chain.

Six links on the supply chain and associated issues



Some of the most important issues in the semiconductor industry include insufficient segmentation of the supply chain, low ability to manage demand, and low forecast accuracy

- Little to no segmentation of the supply chain: all customers, orders, and products are treated equally
- Low ability to manage demand actively, particularly in times of allocation
- Low forecast accuracy due to a lack of collaboration with the customer, inefficient processes, and misaligned incentives
- Insufficient engagement from senior managers and executives, as well as a lack of true decision making related to customer trade-offs; for example, given a constrained supply, should a company sell to Customer X or Customer Y in sales and operations planning (S&OP)
- Complex routing in the production process
- Poor rules about product life-cycle management, leading to aging or obsolete inventories
- Lack of integrated key performance indicators (KPIs) supported by a robust IT infrastructure that enables data visibility and efficient processes (for example, order management)

Some case examples provide more detail on forecasting accuracy: at one client, the forecast process for a quarter finished in the second month of the quarter. What is worse, by the time the forecasting process was complete, the initial inputs were no longer valid. In another case, a client forced its sales team to forecast a detailed product mix four quarters out. A third penalized its sales force for any deviation of forecast from sales targets, leading to end-of-quarter panics as these artificial forecasts had to be supported by frenzied sales activity and discounts. Needless to say, a vicious cycle of mistrust developed in these organizations between production and sales, the former making sure that inventory levels rose to match potential last-minute surprises from the latter.

A lack of integrated KPIs, the final issue on the list, has been a point of contention for our clients. Most of them have upgraded their IT systems by now, introducing complex planning and supply/demand matching tools from i2, SAP, or other vendors and integrating them with complex enterprise-resource-planning systems. Many clients have yet to see a return on what are often significant investments. Sometimes, however, the reasons for that low return are obvious: we frequently find IT systems redesigned with legacy processes, crippling the systems right from the beginning.

Making things better

All too often, actions to improve the supply-chain situation are focused on only one area at a time

(for example, fixing forecasting without addressing S&OP). However, given the interdependencies inherent in a supply chain, we recommend an integrated approach to supply-chain transformation. A highly visible cross-functional "war room," in which all information is available and a cross-functional team makes decisions, has proved to be an effective instrument of change. The war room allows for both quick wins and fast reactions if improvements are not developing as projected. It is therefore particularly effective in crisis settings with tight customer allocations or short supplies. It continues to be useful even when the crisis has passed: we have found that many of our clients have maintained the physical location to leverage the convening power and clarity a war room can bring.

Beyond the war room itself, we typically recommend putting in place three to five targeted initiatives to drive change. Here are three examples.

One client started a *forecasting-improvement initiative*. The core insight for the company was that the timing, the frequency, and the granularity of its forecasts were not tied to its decision needs. For example, nine months before delivery, the client had to decide on front-end foundry capacities. Three months before delivery, it had to decide on the product mix to build (that is, how many of which product)—a much more granular level of decision making. The foundry-capacity decision was quarterly; the production plan, weekly. The first required high-level assumptions on the number and technology of wafers needed, and the latter required details on product mix.

The approach the initiative team took was to work backward from the decision meeting, specifying granularity and timing of forecasts. The next question was how and where to get the necessary information in a speedy manner, thereby reducing the latency period between the original input and the decision. By assessing the existing processes in this way, the client arrived at a list of simple rules on improving forecast accuracies (Exhibit 3). The team realized, for example, that only 20 percent of parts were driving 80 percent of the

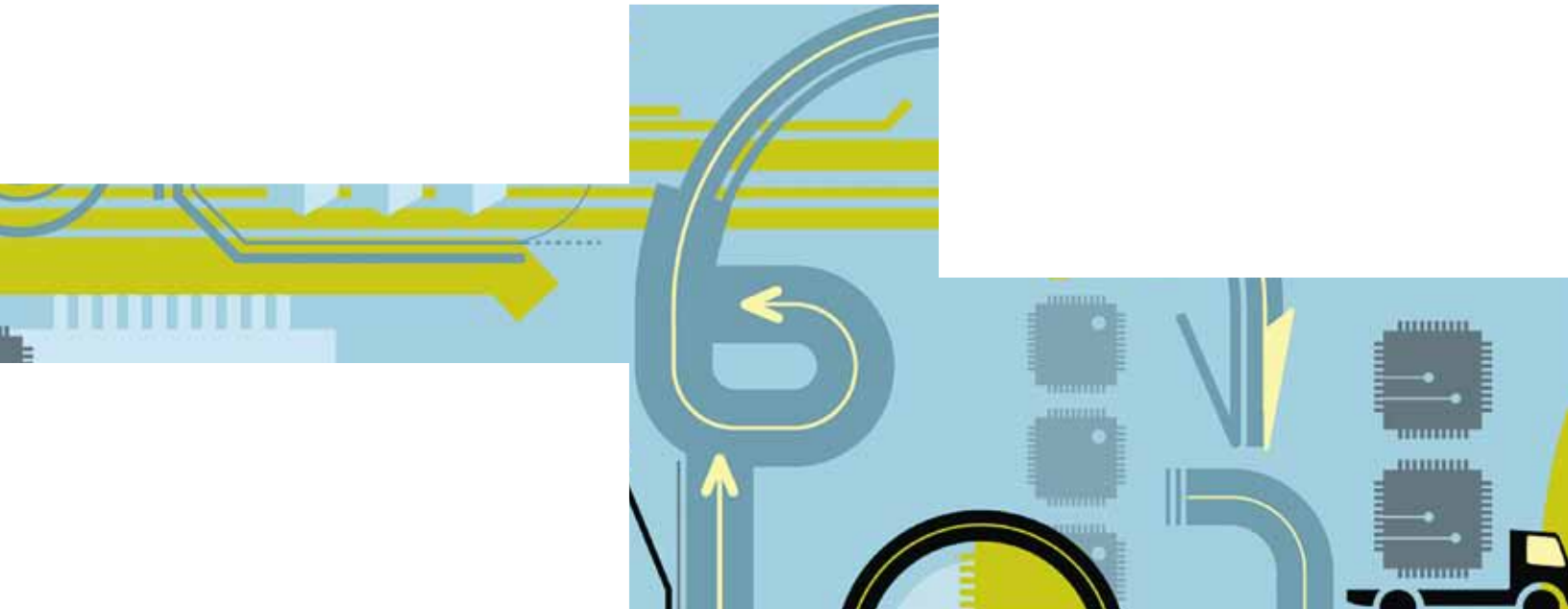
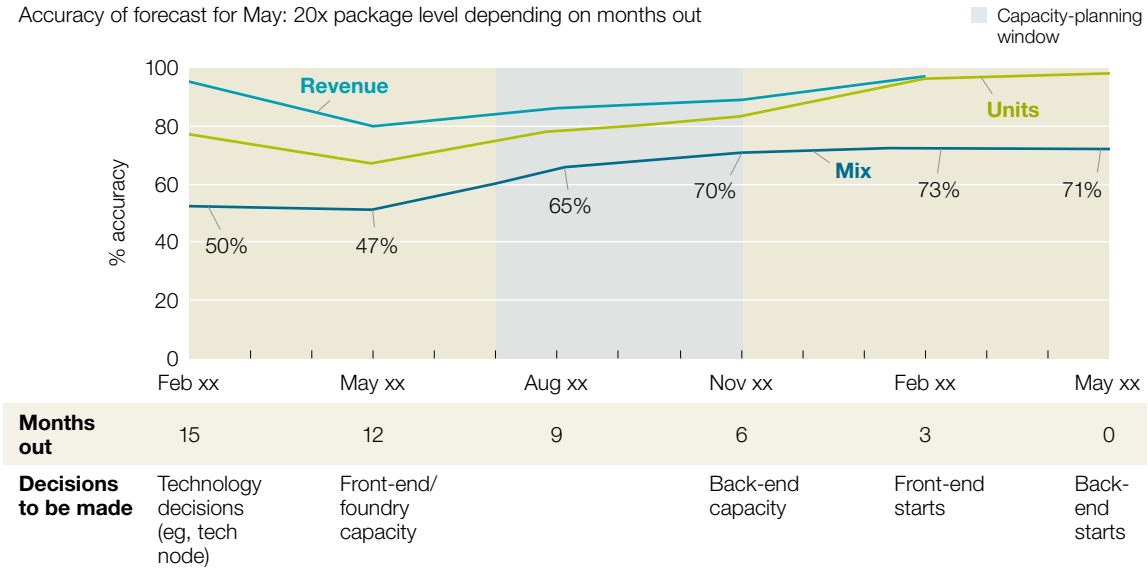


Exhibit 3

Forecast-accuracy measurements must be tied to critical operations decisions.



Questions:
What are the critical time horizons?
What granularity is needed?
Which cuts are needed?

overall forecast error. This made it possible for the team to focus its sales and marketing people on forecasting the products that truly made the difference. The team also uncovered islands of excellence within the organization: some accounts were operating at significantly better forecast-quality levels than other similar accounts, thereby allowing for the identification and dissemination of best practices. Finally, the client team also realized that tying sales-force incentives to forecast accuracy (for example, awarding compensation based on accuracy rather than size of order) had substantial impact.

Another client revised its inventory management by introducing a *new product segmentation*. It had learned from the diagnostic, which included a segmentation exercise, that slow-moving "C" products accounted for just 5 percent of revenues but made up 20 percent of inventory. The segmentation was conducted on two simple axes: customer lead time and an A-B-C classification of product contribution to gross margin. New inventory strategies were devised to create the following designations: "pull from finished goods," "pull from die bank" or "build to forecast," and "build to order" (for rare or long-lead-time products). Simulated implementation of these new strategies showed that the number of days of inventory would decline by 10. The simulated benefits were fully captured within two calendar quarters.

A third client learned about its poor order management through the diagnostic. As much as one-third of its orders were modified within the stated lead time. Processing orders took up to one week and customers were, in many cases, not notified about rescheduled deliveries because manual interventions compromised the reliability of information flow in the system.

One initiative developed was the use of *lean tools to clean up internal interfaces and processes* such as value-stream maps and operator-effectiveness analysis. The team also grouped customers into segments based on historical ordering lead times and levels of order churn. A targeted strategy tied to the behavior of a given customer segment was put in place. Those who did not adhere to the relevant strategy were educated and also faced penalties; for example, fees were introduced to reflect the costs in the client's supply chain that were a result of the client's behavior. Service levels were adopted, and for key customers, lead times were significantly reduced—thus decreasing the probability that a customer would change its mind.

Below are three commonalities of the previously discussed levers and initiatives:

1. They require very little investment. This is often the case, as existing IT and system capabilities frequently significantly exceed the real need for process improvement.

2. Despite the appearance of independence, each initiative really needs the others to be carried out as well if it is to deliver visible impact. As such, the design of a formal program requires a thorough understanding of the entire organization, including both its physical and information flows.

3. Supply-chain transformation is a true cross-functional change-management exercise and therefore needs both top-management attention and alignment across functions. The sheer scale and elaborateness of a modern semiconductor supply chain, with its multiple internal stakeholders and interfaces (for example, those among procurement, manufacturing, planning, product development, marketing, and even sales), require alignment of incentives across these functions.

Outlook: Toward excellence

A semiconductor company that improves its supply chain can certainly excel within the industry and deliver superior performance. At the same time, the improvements discussed so far will eventually become table stakes—necessary to remain a viable competitor but not enough to be truly differentiated. We encourage the industry to look beyond itself and harvest insights from supply-chain champions outside semiconductors. Players in other industries model a number of best practices:

- Aggressive reduction of cycle and transit times at all stages: front end, back end, and distribution

- Postponement of stock-keeping-unit differentiation (for example, delay the marking of otherwise finished goods until a customer order arrives, and only then stamp the chip with customer-specific information)

- Integrated planning and restocking systems between OEMs/ODMs and retailers

- Outsourcing of core supply-chain processes to specialist providers that are encouraged by clear service levels

- Truly differentiated customer-service levels with upgrade options for customers

By focusing on these strategies, a semiconductor company can create a truly differentiated competitive advantage. Furthermore, a company that regularly employs these approaches will become highly appealing to any customer that has had experience dealing with the ups and downs of the semiconductor industry. In this ever-maturing industry, this advantage could prove to be particularly valuable.

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