



*ADVANCED ESD IP AND THE 45NM SUPPLY CHAIN*

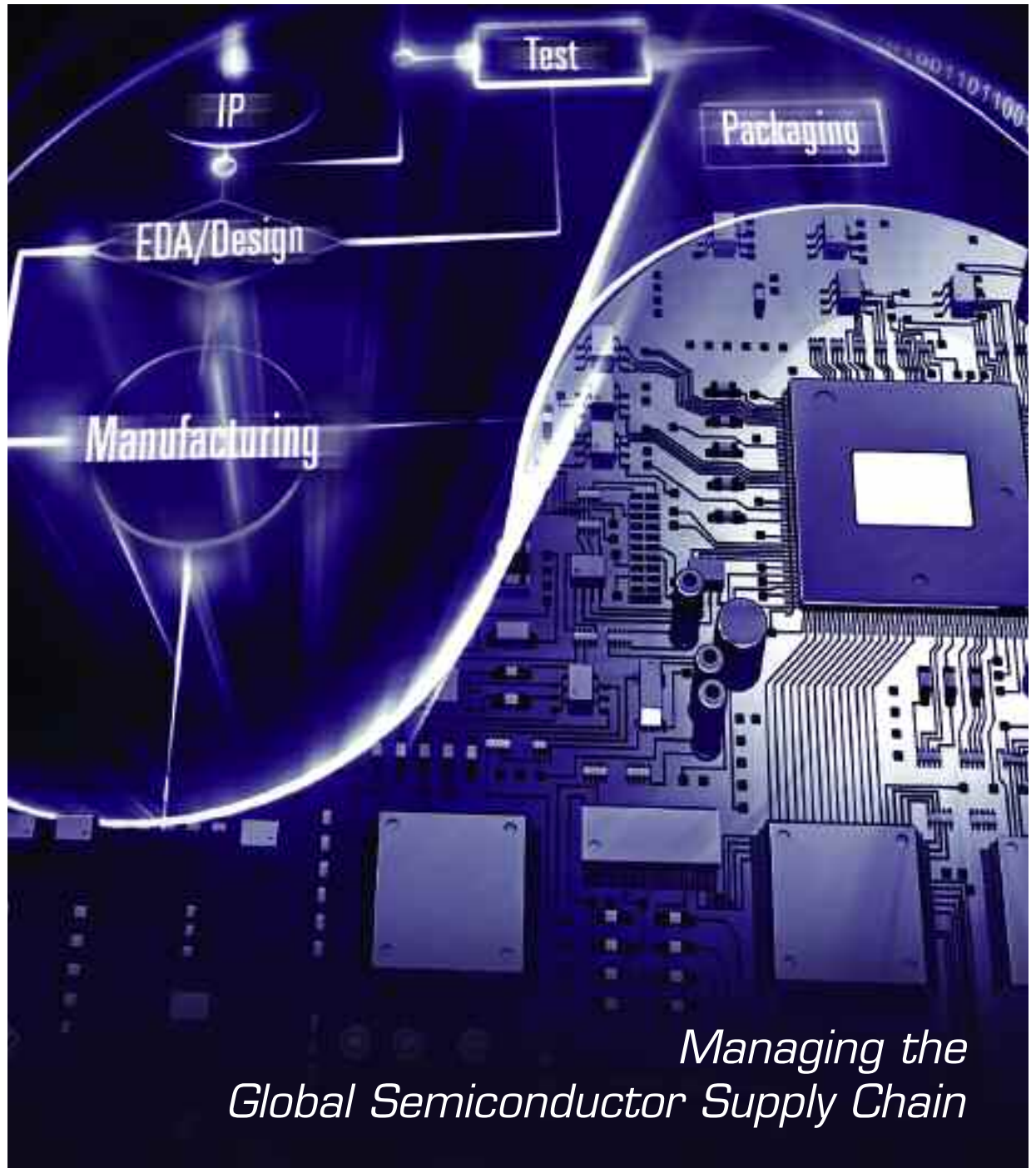
*SCALING SUPPLY CHAIN OPERATIONS FOR GROWTH AND PROFITABILITY*

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SEPTEMBER



*Managing the  
Global Semiconductor Supply Chain*

# CONTRACT MANUFACTURING: TRUSTED PARTNERSHIPS AND COLLABORATION KEY TO SUCCESS

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The semiconductor industry has always been focused on process technology, design and manufacturing tools for its advancement. Until recently, managing the supply chain was not very critical to maintaining a company's competitive edge. This could be attributed to a number of factors such as innovation as it is a company's core competency, dedicated and captive manufacturing facilities, fewer product, small package sizes, more demand than supply, and the industry being in allocation mode for a long period of time.

The past decade has witnessed a major change in the characteristics of the semiconductor supply chain. The industry experienced supply-and-demand equilibrium, which oscillated every three to four years. The high capital costs required to start and operate a manufacturing facility, combined with the reduction in average selling prices, made it a challenging environment to operate in. In the mid 1980s, one saw a large number of entrepreneurs who had great ideas, but not enough resources to establish a company with manufacturing facilities, so they instead set-up design houses. This one movement was a major contributor to the development of the fabless industry.

The emergence of fabless manufacturing made the supply chain model complex because a product underwent manufacturing in multiple companies across the globe. This model came with longer lead times and lead time variability. The industry also saw product proliferation occur, resulting in a large product mix. In addition, the product lifecycle was getting increasingly shorter, and the pressure to introduce new products to the market every four to six months was getting higher.

One can see the supply chain challenges facing semiconductor companies are vast and varied – from demand accuracies, to supply commits and variability, to managing yield and cycle time variability. This article will focus on the complexities associated with the fabless model and its characteristics; different issues and solutions; and lessons learned from other industries and their relevance to the semiconductor industry.

## CHARACTERISTICS OF A FABLESS SEMICONDUCTOR COMPANY

A fabless semiconductor company owns the intellectual property (IP) of a chip design, but outsources the manufacturing of its chips to another company. The number of manufacturing processes contracted out to other companies varies from company to company. This is a dynamic environment, and more and more integrated device manufacturers (IDMs), such as Intel, Texas Instruments (TI), Siemens, Samsung and others, are outsourcing some of their manufacturing to contract manufacturers. Hence, for the purpose of this article, "fabless semiconductor company" and "semiconductor company" are used interchangeably.

A fabless semiconductor company can outsource all its front-end manufacturing, including wafer fabrication, bump, probe/sort and all

other operations that take place prior to product being brought to the die bank. A fabless company can also outsource all its back-end processes, including assembly/packaging, testing, scan and pack, and drop shipping of product to customers. A pure fabless company outsources all the processes mentioned above. Generally, a fabless company may have a very small facility in-house for initial product development or testing. But once a product is in the volume production stage, it is all outsourced.

## CHALLENGES OF CONTRACT MANUFACTURING

The fabless manufacturing model has had its benefits and challenges. It allowed a number of small companies to start operations without having to heavily invest in manufacturing facilities. The entry barrier was lowered from an investment standpoint. It also allowed companies to have flexible capacity, which is critical, especially when demand is fluctuating. With manufacturing concentrated in a few companies, the cost benefit arising from economics of scale was achievable for these smaller fabless companies.

On the other hand, with manufacturing outsourced, fabless companies had to manage the material flow and the information flow to ensure the supply chain was smooth and effective. With multi-layer information flow, information distortion came into play and caused challenges. This also introduced latency in reaction time to an event, which caused higher disruption in the supply chain flow. Any disruption at one stage caused a ripple effect throughout the supply chain, creating higher nervousness in the system. All these issues faced by fabless companies urged them to sit back and seriously take a look at their demand management, supply management and partner collaboration business processes.

## A CORRELATION TO THE AUTO INDUSTRY

The issues associated with contract manufacturing are fairly new to the fabless industry, but not new to the manufacturing world. One need not look too far to see how other industries have resolved these issues.

The auto industry is one such industry where one can draw a number of parallels to the semiconductor industry and see how the industry resolved its issues with contract manufacturing (or more commonly known as subcontracting in the auto industry). However, the auto industry does have some characteristics that differ from the semiconductor industry: (1) The auto industry is not as extreme when it comes to outsourcing manufacturing; (2) the number of components it subcontracts is quite higher; (3) it is not as multi-tiered (one subcontract manufacturer shipping the material to the next subcontract manufacturer for further processing without sending the material back to the company that owns the material); (4) component suppliers in the auto industry are generally around the companies subcontracting; and (5) a company that subcontracts components most of the time has

higher negotiating power with a subcontractor. In spite of these differences, semiconductor companies can leverage the lessons learned by the auto industry and apply them to their own business.

Before World War II, auto manufacturers manufactured most components themselves. However, around the 1940s, the auto industry had to utilize contract manufacturing for higher volumes of components due to the general industrial climate during that time. Along this journey came all the issues one can see in the semiconductor industry today: varying capacity, a poor demand forecast, mistrust between subcontractor and company, quality issues, non-reliable supplies, miscommunication, etc. But by the late 1950s, the auto industry had learned from its mistakes and had mastered the contract manufacturing model. There were two main approaches to managing subcontracted operations at this time: (1) the exit relationship model, which was followed by most U.S. companies, and (2) the voice relationship model, which was followed by most Japanese companies. In the exit relationship model, a company looked for a new subcontractor if the previous subcontractor did not work out. In the voice relationship model, a company worked with the subcontractor to help them improve and resolve issues in a cooperative manner. Even though both models worked well during this time, in the long run, the voice relationship model brought larger benefits to companies.

The subcontracting model made leaps and bounds in the auto industry between 1960 and 1980. The issues of poor quality and timeliness of supplies were solved by having company quality assurance personnel and planners placed at subcontractor locations. Soon this became a certification process, which required higher collaboration with subcontractors throughout the manufacturing process. From there, the auto industry introduced self-certification, whereby a subcontractor gets its process and quality certified periodically. Self-certification was possible with higher trust and collaboration between the company and the subcontractor. And today, businesses have a process whereby companies communicate electronically for just-in-time (JIT) deliveries, and subcontractors supply components directly to the assembly line of the company, demonstrating a very high level of trust, collaboration, commitment and partnership. This was also aided by technology to manage these processes with enterprise resource planning (ERP) systems, collaboration systems and communication networks.

## SUCCESS FACTORS FOR CONTRACT MANUFACTURING

Irrespective of their level of contract manufacturing, semiconductor companies have a hard time trusting their partners. A large majority would still like to monitor, operate and manage supply chain execution in a manner as if the manufacturing facilities were in-house. To manage these complex business processes, companies invest heavily in people and technology. This requires companies to collaborate on a real-time basis.

### **A Partnership Built on Trust**

The voice relationship model of the auto industry is very relevant in today's semiconductor industry. Companies can work on building their relationship and trust by sharing information, working as partners and having an understanding of and respect for the challenges faced by each company. In today's industry, most companies are trying to monitor and control every stage of manufacturing. In many cases, this happens after the fact since there is a delay in receiving information from the subcontractor. This process is followed mainly because companies do not want to give up their control and do not trust their partners to do as instructed.

Today, semiconductor companies already share their most important asset with contract manufacturers, the design of their chips, so why not share additional information and place trust in them executing the supply chain in the same way. IC designs are protected by IP laws, but trust can be built in other aspects of the business too,

resulting in a simplified process. If the auto industry can do it with hundreds of subcontractors and manage thousands of components, semiconductor companies can easily manage the 20 to 40 contract manufacturers they deal with on a regular basis.

### **Collaborate for Supply Chain Agility**

The sharing of information both ways goes a long way in building trust and ensuring a company has the right information to make an appropriate decision. Irrespective of the level of control and monitoring companies follow, collaborating helps to ensure both parties are looking at the same information and that there are no barriers to information flow. Companies can collaborate on demand forecasts, supply commits and execution throughout manufacturing operations.

Various levels of collaboration exist within the semiconductor industry. The most common form of collaboration is one-way communication between the contract manufacturer and the semiconductor company. It is more like receiving a snapshot picture once a day rather than receiving one in real time. Moreover, most of the time, collaboration is limited to supply chain execution operations only. Most sophisticated companies do collaborate on all business processes: demand collaboration, supply commit collaboration, work-in-process (WIP) information, shipment information, invoices and payments. Business-to-business (B2B) collaboration results in effective information flow. Similar to the auto industry's Covisint and other private collaboration consortiums, which established standards for various business processes, the RosettaNet consortium established B2B standards for most business processes in the semiconductor and high-tech industries. For companies that feel B2B collaboration is too sophisticated and requires much effort, there are alternate real-time collaboration solutions through service providers. These service providers have worked with most of the big contract manufacturers and have established a mechanism to extract relevant data needed for collaboration. Therefore, companies that work with these collaborative data providers will not have to worry about establishing B2B connection with each of their contract manufacturers.

With real-time collaboration, both parties have a complete picture of the supply chain which helps them make correct decisions, minimize information flow latency, avoid miscommunication and build trust between partners.

## THE ROAD AHEAD

It is just a matter of time before one can see the true JIT environment of semiconductor chips being delivered to original equipment manufacturing (OEM) or electronic manufacturing service (EMS) assembly lines, and a semiconductor company having multiple manufacturing partners whose relationships are built on trust. At the same time, technology and architectural changes, such as service-oriented architecture (SOA), are going to make collaboration tools easier to work with. New business process management (BPM) initiatives, which drive processes across organizations, will also help semiconductor companies avoid duplicating the transaction monitoring and control process, removing non-value added process steps and simplifying the information flow to manage the supply chain in the most efficient and effective way. ■

### **About the Author**

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