THE NEW ECONOMICS OF SEMICONDUCTOR MANUFACTURING

The Toyota Production System has been applied to chip making. The electronics industry may never be the same

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ILLUSTRATIONS BY STUART BRADFORD

THE SEMICONDUCTOR industry is undergoing a sea change. It's being split into haves and have-nots, and it has become much more difficult for everyone to make a profit. Never have so many smart people worked so hard for so little money.

Walk into a multibillion-dollar chip-fabrication plant—a fab—and you may very well get the impression that the industry is headed for a spectacular meltdown. One of the first things you'll see is a bay the size of two basketball courts packed with equipment for projecting a lithographic design onto wafers. Nearby, you'll find a towering bin, called a stocker, filled with wafers waiting to be processed by this equipment. The wafers are worth from US $10 million to $100 million—all of it idle inventory.

Why? To amortize the $5 billion investment in a fab over a five-year schedule costs more than $3 million a day. Conventional wisdom holds that to generate that much money you must keep all the equipment running all the time, even if that means creating large unused queues of wafers. What's more, to justify that scale, you have to produce a semiconductor product in volumes of at least 5000 to 10 000 wafers per month.

More than anything else, Moore's Law has been responsible for the gigantic costs. It takes huge amounts of capital to support the incessant cycles of investment and obsolescence that keep Moore's Law on the march. That rapid cycling explains why a company's shining jewels can turn into white elephants in just five years.

Although industry giants like Intel and Samsung work on a vast scale and can therefore make these huge investments work for them, smaller companies (and even some sovereign states) can no longer afford to play the game. A massive restructuring in the industry is forcing them to consolidate or outsource production in order to gain sufficient scale to compete.

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