Chips and Change: How Crisis Reshapes the Semiconductor Industry (MIT Press)

Clair Brown, Greg Linden
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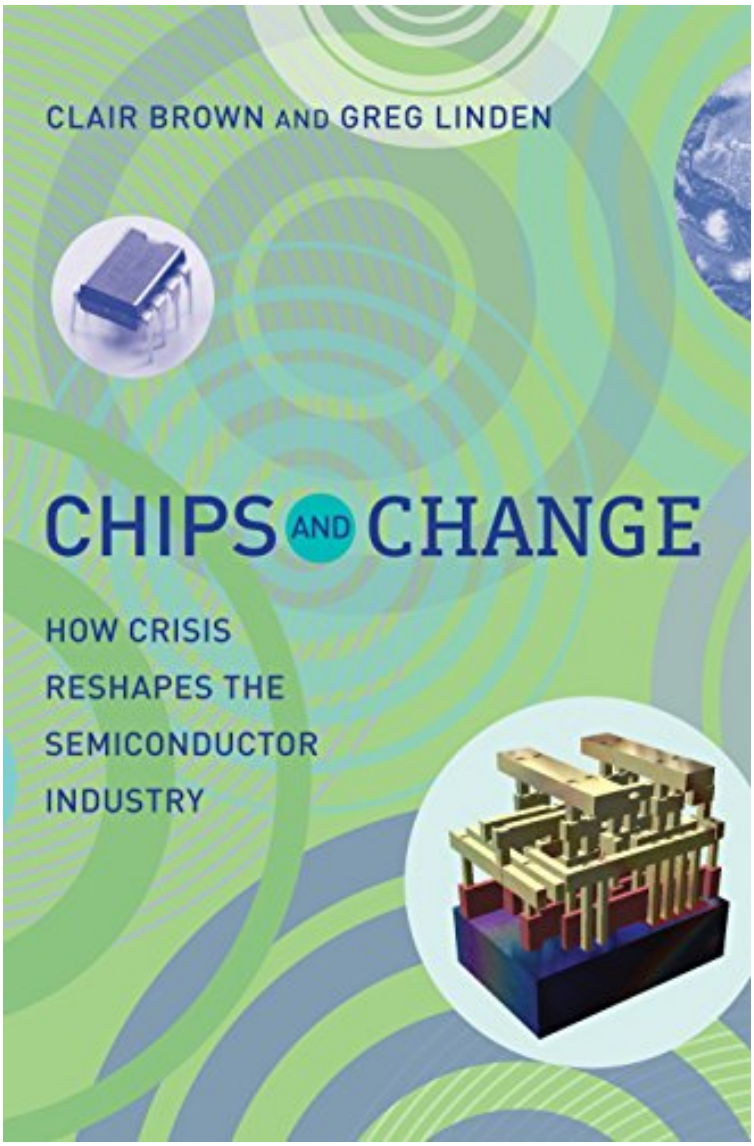

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Clair Brown, Greg Linden : Chips and Change: How Crisis Reshapes the Semiconductor Industry (MIT Press) before purchasing it in order to gage whether or not it would be worth my time, and all praised Chips and Change: How Crisis Reshapes the Semiconductor Industry (MIT Press):

1 of 1 people found the following review helpful. A good introduction to the competitive dynamics of the industryBy A. MenonChips and Change is an overview of the semiconductor industry and how it has evolved over the last 60 years. It starts by discussing the 8 intertwined crises that the industry is facing and has faced. It is a good introduction

to the competitive dynamics of the industry, the microeconomics of the busineses and labour and the engineering evolution underpinning the dynamic landscape. The constant challenges the industry faces can be further highlighted from the fact that in just 3 years since the printing of this the Taiwanese DRAM producers and Elpida are all gone due to some of the crisis that were articulated in the book.Chips and Change is split into 8 chapters each of which is on a specific crisis that the authors think are especially relevant to the semiconductor industry. They start by discussing the loss of competitive advantage which is focused on how the US was the first innovator in semiconductor manufacturing followed by Japan then Korea then the foundry model of Taiwan and finally a potential new threat of China. They focus on subsidized capital being a short term tailwind to moving up the manufacturing curve but the long term challenges of the industry making subsidized capital not a sufficient criteria to maintain dominance (evidenced by Japan). The second crisis discusses the rising cost of fabrication, the incremental cost of a leading edge fab today is a huge multiple of what it was 20 years ago and given the lack of concentration of profits within the industry being able to fund the capex for leading fabs has become prohibatively risky (which helped catalyze the foundry business which has much better economies of scale). The authors discuss also the crisis of rising costs of chip design. Given the growing complexity of chip design and the limits of physics on current lithography technology chip design has gotten much more difficult and expensive and required greater collaboration between fabless and foundry. The book discusses the migration of demand from corporate which is performance based to consumer which is much more price elastic. This has made semiconductor manufacturing more niche product demand based with less dependable margins and further fuelled the need for the foundry model. Net net the authors discuss how semiconductor productivity growth has mainly fed to consumer price deflation rather than to any form of profitability. The authors discuss the limits of Moore's Law and how the capex intensity of transistor shrinkage is getting higher (which is basically crisis 2). They discuss the engineering advances which have taken us to current frontiers, like immersion and double patterning but also discuss EUV as a potential new frontier. The authors discuss the crisis of human capital, which is less of a crisis to be honest, though the authors note the US visa difficulties are a problem for retaining high quality talent. There are large new labour supplies from China/India for software and electrical engineers which the authors analyse, both from an impact on the wage bargaining of existing engineers to the impact on industry profitablity. The authors tackle the crisis of low returns and high risk in semiconductor manufacturing, this is definitely a recap of crisis 2/3 and 4- in particular the rising cost of desing, manufacturing and at the same time price squeezes. It reinforces the need for foundries/fabless model for the less oligopolistic business lines. Lastly the authors discuss New Global Competityion as a crisis, which is a modern day reflection of their crisis 1, which is the loss of competitive advantage. They discuss SMIC in China and the growth of semiconductor manufacturing within China.The growth of semiconductor manufacturing is in and of itself very interesting and this book is a good guide to its history. It shows revenue distribution through time mainly from 90s to this decade. They show the distributions of revenues in fabless and foundry partnerships and as well discuss long run ROA's of the various business models. Given difficulty in getting some data its not as though one is presented with continuous data series and a lot of the analysis was out of date when the book was published. I recommend this book for those interested in the industry and some of its economic issues. The crisis articulated and the cyclicality of demand led to a fair amount of consolidation in the industry post the publishing of the book which reflects favorably on the contents. I would think given the changes that have occured since the publishing, a new edition would warrant a slightly different take on the current challenges as the competitive landscape having consolidated is lending itself to focusing on margins rather than market share.1 of 1 people found the following review helpful. Timely and AccessibleBy Sean TannerBrown and Linden provide an insightful economic history of a turbulent industry that shapes much of our daily lives. Their primer on semiconductors was useful and concise. You will come away with a new respect for the toil, risk, and resilience that characterize the chip industry.10 of 10 people found the following review helpful. An Outstanding Study of Strategy and ChangeBy Loyd Eskildson"Chips and Change" provides an excellent overview of the rapidly changing strategic environment in the semiconductor industry, and some sense of where things are headed. Since the 1960s the semiconductor industry has been a driver of global economic growth and social change. Each country involved wants a large, viable semiconductor industry that provides good jobs. The authors use eight technical and managerial crises going back to the mid-1980s to examine the industry from an economic perspective, helping readers understand how global competitive advantage can be won and lost. None of the crises are permanently resolve, invariably rebuilding, often in a new guise (eg. fear of Japan re-emerges as fear of China).In the first crisis, Japanese chip producers raised their share of industry revenues above U.S. producers by the mid-1980s by improving their manufacturing technology thanks to government demanding technology transfers from IBM etc. wanting access to growing Japanese markets, and lower capital costs. Their government also subsidized RD, promoted cooperation between competitive groups, and protected Japanese markets. Japanese yields (70 - 80%) exceeded U.S. (50 - 60%), and reliability was also higher. American responses included Motorola's Six Sigma program to dramatically improve quality, U.C. Berkeley's establishing best-practice comparative performance benchmarks and the fall of "not-invented-here" attitudes in the industry, lowering the value of the dollar 51% vs. the yen, establishing a research consortium (SEMATECH) that helped chip-makers and suppliers work more closely together, and largely exiting the DRAM memory business due to overcapacity.Intel also

ended its "second-sourcing" agreements with other chip-makers, limiting competition, established the principal that the software embedded in the design (microcode) is copyrightable and began challenging threats to its intellectual property, sped up its product development cycle, and began branding its products. Motorola, IBM, and TI waited to exit the market until '97-'98, with only Micron remaining (cut its costs through design). Japan, in turn, lost its DRAM leadership to Korea's Samsung with its greater access to capital, and was further hindered by an overemphasis on quality while the market shifted from long-term mainframe uses to shorter-lived PCs and other consumer goods.Increasing wafer size and decreasing line-width (from two microns in 1980, to .035 micron in 2009 - human hairs are about 100 microns) led to rapidly rising fabrication plant costs - the second crisis reviewed. Costs to build a leading-edge fabrication plant rose from $200 million in 1983 to $5-7 billion by 2007. Costs of developing the process flow also rose - to $2.5 billion. Consolidation was an obvious response, as was the development of independent Asian contract manufacturers that produced chips for other firms. This, in turn, has led to concern over ultimately losing fabrication (and design) skills in the U.S.The third crisis was the inability to design chips that took advantage of the large number of circuits available through new fabrication plants. This was resolved through system-level integration onto a single chip, thus bringing faster operating speeds, lower power consumption, lower costs, the ability to be used in smaller consumer products, and improved reliability. At the same time, the required software (45% of design cost) rose to over 200 person-years for design and test. This led to the reliance on design automation and reusable code cores. Lowering the cost of design to meet consumer end-product requirements (the market moved from mainly PCs to also include cell-phones, etc.) also led to opening design centers in Asia (especially India), and 24-hour design work through passing the work back and forth between India and the U.S. over the Internet.Particularly interesting was the authors' pointing out that cost savings via Asian engineering are not as dramatic as appear - only 25-50% savings, vs. the 80-90% that would appear via salary comparisons. Engineers in China and India, and to a lesser extent Taiwan, are younger with less experience and often only two-year degrees. They also often don't get trained on automated chip design. On the other hand, based on Samsung's experience in taking only ten years to move up the DRAM memory technology chain beginning in 1981, the authors envision Asian engineer parity with the U.S. in 10+ years. Meanwhile, the number of U.S. chip engineers has stagnated/fallen, and may already have been overtaken by those in Asia.A related concern is that outsourcing leading-edge fabrication plants to Asia and Europe will lead to outsourcing chip design as well. The authors sort of go round in circles on this issue, eventually concluding that this negative outcome is likely.One final challenge: The authors see current consumer-product chips as over-designed - more functions than most users want. Thus, the next trend will be simplifying those chips for use by poorer populations.

For decades the semiconductor industry has been a driver of global economic growth and social change. Semiconductors, particularly the microchips essential to most electronic devices, have transformed computing, communications, entertainment, and industry. In Chips and Change, Clair Brown and Greg Linden trace the industry over more than twenty years through eight technical and competitive crises that forced it to adapt in order to continue its exponential rate of improved chip performance. The industry's changes have in turn shifted the basis on which firms hold or gain global competitive advantage.These eight interrelated crises do not have tidy beginnings and ends. Most, in fact, are still ongoing, often in altered form. The U.S. semiconductor industry's fear that it would be overtaken by Japan in the 1980s, for example, foreshadows current concerns over the new global competitors China and India. The intersecting crises of rising costs for both design and manufacturing are compounded by consumer pressure for lower prices. Other crises discussed in the book include the industry's steady march toward the limits of physics, the fierce competition that keeps its profits modest even as development costs soar, and the global search for engineering talent.Other high-tech industries face crises of their own, and the semiconductor industry has much to teach about how industries are transformed in response to such powerful forces as technological change, shifting product markets, and globalization. Chips and Change also offers insights into how chip firms have developed, defended, and, in some cases, lost global competitive advantage.