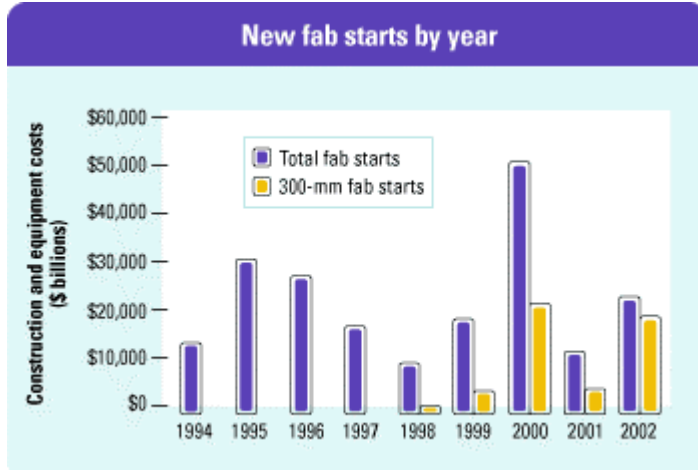


Has The Downturn Robbed 300 mm Of Its Rightful Glory?



Here's an article on the state of 300mm technology that appears in this month's *CleanRooms* magazine by IDC director of technology Michael O'Halloran (PDX).

300-mm fab construction was down in 2001, but business bounced back in 2002.

<ALIGN=CENTERSource: Strategic Marketing Associates (Santa Cruz, California)

The move to 300 mm has been the catalyst for new contamination control technologies, pushing automation, software and advanced process controls toward new capabilities while forcing totally new thinking in fab design. Where can we expect 300-mm technology to be once the chip market emerges from the latest market downturn? We've asked IDC's (Industrial Design and Construction; Portland, Ore.) chief technologist, Michael O'Halloran, to share his insight on the future of 300 mm and where it just might take chip making and ultimately affect contamination control.

You could say that 300-mm technology, like the fabled cat, has nine lives.

At the beginning, during the 1990s, the much-anticipated debut of 300-mm technology was repeatedly delayed. Equipment manufacturers moved mountains to create a new generation of processing tools that set a new standard for size, complexity, performance and cost. To accommodate those new tools, new fabs had to be built and existing facilities had to be upgraded to complete the technology's launch cycle. This led to the inevitable struggle faced by fab technologists to de-bug 300 mm's processing challenges.

And as if these technological hurdles weren't enough, the industry was hit with one of its many slump cycles just as 300 mm was going through its birthing pains. The downturn of the late 1990s sapped the industry of the economic horsepower to carry the 300 mm marathon to the finish line.

The consensus among analysts seems to be that recovery has commenced in the electronics industry, however feeble that recovery may feel.

The recovery technically began back in January 2002, and then relapsed into a state of tepid recuperation. In addition, analysts concur that the industry's growth rates going forward aren't likely to match the dynamic double-digit annual gains that prevailed in the 1990s.

That's the bad news.

Blue skies ahead?

The good news includes the statistic that every previous industry recovery has experienced capital expenditure growth spikes of more than 40 percent. That precedent doesn't guarantee that the next upturn will be charged with the same degree of robustness, of course.

However, the electronic industry's tendency to dramatically reverse its fate portends a likelihood that this maturing industry is, as one industry observer recently put it, "like a teenager with at least one more good party left in him."

In the meantime, the question remains: Has this latest electronics downturn—the most severe in history—robbed 300 mm's "better mousetrap" of its rightful time of glory in the industry's hall of fame?

That's not likely, when you consider how the industry historically gestates, launches and leverages its new technology phases. Shifts to larger wafer size standards have typically run in 10-year cycles.

Remember, 200-mm manufacturing enjoyed a decade-long domination during the 1990s. The ferment of 300 mm began to generate discussion and research in the mid-1990s, but the technology wasn't able to fully engage until half a decade later for the reasons I've described.

While 300 mm's travails slowed the pace of the technology's implementation, it did nothing to erode the inherent superiority of the 300-mm model.

The financial sacrifice can be worth it for those who can afford to step up to this new industry standard. 300-mm manufacturers can earn nearly twice the revenue from a 300-mm wafer than competitors offering 200-mm product. Because the technology allows manufacturers to command premium prices for their products, it's expected that as we go forward, most new fabs will be built for 300-mm production or future 300-mm capability. Indeed, about 80 percent of new fab starts are 300-mm operations. The impact of 300 mm's more efficient economics on semiconductor inventories and prices is but a fraction of what it will be as more of the new 300-mm fabs go into production. However, it will take the next few years for the full impact of the technology's influence to register in the marketplace in the form of price reductions and market trends.

Already, 300 mm's efficiency is seen as a driver in the explosion of the foundry side of the business. Foundry capacity is expected to double between 1999 and 2003, and it's been growing more than 19 percent per year since the late 1990s. Major manufacturers that may never have thought of going into the foundry business now find it prudent to do so. Their marketing strategies have shifted when faced with the surplus capacity that 300 mm can suddenly deliver.

After 300 mm has run its course, the next technology tide will probably wash in wafers measuring 450 mm in diameter. The 450-mm era may take longer than 10 years to arrive this time, however. The staggering increase in costs for semiconductor fabs and tools are moving into a surreal realm that may make the industry's next technology leap financially impossible without active government participation.

We've already seen former rivals in the private sector join forces in the kind of creative collaborations necessary to fund fabs costing more than \$2 billion. But what will fabs cost 10 years from now? Alliances among even the industry's most powerful private leaders may not be enough to underwrite that next major technological leap.

It's a rule of survival in any industry; those who miss the window of opportunity to implement the latest technology may find themselves too far behind the technology curve to remain competitive against companies that do choose to upgrade their capability.

Companies that make the investment find that a 300-mm factory can produce chips and generate profits at prices that will put a 200-mm factory into red ink.

Despite its painful birth and baptism by recession's fire, 300 mm is a cat that's still packing plenty of lives as its growing power only begins to define the latest of this exciting industry's many overhauls.

Michael O'Halloran is chief technologist for IDC (Industrial Design & Construction; Portland, Ore.) and a frequent contributor to CleanRooms magazine.

300-mm fabs listed in order of operational start date

Company, ownership or collaboration	300-mm fab site	Country	Construction or 300 mm started	Operations started or planned start date	300-mm cleanroom size (ft ²)	Maximum* 300-mm water capacity (wafers/month)	Beginning products, initial or current technology (node/nm)
Semiconductor 300, Infineon	Esslingen	Germany	1999	1999	Rig: 1na	1,500	Memory, 140 nm
Intel	Folsom, Or. (Fab C10, FPI)	USA	2H1993	2001 (1C)	125,000 (66,300)	8,000	Microprocessors, 60 nm
Toshiba Technology, Hitachi	Fuchiraka, Itabaki (Fab 1)	Japan	2000	2001 (1C)	258,000	40,000	Foundry, 180 nm
United Microelectronics (UMC) Samsung	Tainan (Fab 12A) Hsinchu (Line 11 Fab 11)	Taiwan Korea	2H1993 10/2001	2001 (2C) 2001 (3C)	258,000 Rig: 1na	40,000 5,000	Foundry, 130 nm Memory, 150 nm
Infineon Technologies	Esslingen	Germany	202003	2001 (4C)	150,000	20,000	Memory, 140 nm
Micron	Folsom, Idaho (FRC)	USA	1H2001	2001 (4C)	Rig: 1na	2,000	Memory, 100 nm
ProMOS, Mosel Vitelic—Infineon JV	Hsin-Chu, (Vopule in existing fab)	Taiwan	2000	2001 (4C)	125,000	30,000	Memory, 140 nm
Sony Semiconductor	Kumatori, Kyoto	Japan	4Q2001	2001 (4C)	215,000	12,000	CCD sensors on standard FETs on 300-mm quartz
Taiwan Semiconductor Manufacturing (TSMC)	Tainan (Fab 12, Phase 1)	Taiwan	2000	2001 (4C)	247,500	25,000	Foundry, 130 nm
Philips Semiconductor and STMicroelectronics, JV	Croissy-lez-Paris (Fab 2)	France	202003	2002 (2C)	Rig: 1na	2,000	CMOS development, 90 nm
IBM	East Fishkill, N.Y.	USA	4Q2003	2002 (3C)	138,000	15,000	Logic, 130 nm
Texas Instruments	Coulter, Texas (DVC63)	USA	4Q1993	2002 (3C)	150,000	35,000	DSF, 120 nm
Intel	Folsom, Idaho (Fab 24/11A)	USA	10/2001	2002 (4C)	125,000	30,000	Microprocessors, 130 nm
Elpida Memory, NEC—Hitachi JV	Irigahira	Japan	10/2001	2003 (1C)	150,500	20,000	Memory, 130 nm
Taiwan Semiconductor Manufacturing (TSMC)	Hsin-Chu (Fab 14, Phase 1)	Taiwan	2000	2003 (1C)	275,250	30,000	Foundry, 130 nm
UMC, UMC-Infineon-EDB Investment JV	Fosfin (Wafer Fab Park (twin modules))	Singapore	202001	2003 (2C)	218,000	40,000	Foundry, 130 nm
Nanya Technology, JV with Infineon	Taipei	Taiwan	3Q2002	2003 (2+)	150,000	20,000	Memory, 90 nm
Powerchip Semiconductor	Hsinchu (No. 2)	Taiwan	4Q2001	2003 (1+)	125,000	15,000	Foundry, 130 nm
Chartered Semiconductor Manufacturing	Singapore (Fab 7)	Singapore	1Q2003	2003 (3C)	170,000	25,000	Foundry, 130 nm
Intel	Folsom (Fab 24)	USA	2Q2001	2003 (4C)	150,000	30,000	Microprocessors, 90 nm
Dongbu Electronics	Gyeonggi (Fab 2)	S. Korea	2H2003	2004 (2+)	150,000	30,000	Foundry, 90 nm
AU Pie. Ltd., UMC-AMD JV	Fosfin Wafer Fab Park	Singapore	2002	2005 (3C)	200,000	40,000	Foundry, 90 nm
Infineon Technologies, formerly White Oak Semiconductor	Fitchburg, Va.	USA	2000	Shelton	125,000	30,000	Memory, 40 nm

*Current production capacity is proprietary information.

Other announced plans (listed alphabetically):

- 1st Silicon is considering a 300-mm fab
- AMC plans to build 300-mm fab by 2004
- China's government has plans for five 300-mm fabs by 2005
- Intel's 300-mm Fab 22 in Chesham, Ark. will transition to 300 nm in the future.
- Mitsubishi plans to build a 300-mm fab in Kashi, Prefecture, Japan for operation by 2004.
- Micron has no current plans to build 300-mm fab, targeting 90 percent outsourcing instead.
- ProMOS has further expansion plans for its 300-mm fab

- Toshiba will renew 300-mm fab plans at the end of 2002.
- TSMC has broken ground for its Fab 14, Phase 2, but contract base is TBD. 347,500 m² cleanroom, 25,000 wafers/month.
- UMC has started construction of Fab 14, Phase 2, but operations are TBD. 214,250 m² cleanroom, 30,000 wafers/month.
- PS'1 for Don Pador at TSMC, "will 300-mm equipment and materials transferred to Fab 12 - which is now exclusively a 130-nm wafer fab"