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A decade of unprecedented growth
China's impact on the semiconductor industry 2014 update

Technology Institute

PwC's 10th annual in-depth report on China's semiconductor industry

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Welcome

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Ten years ago when we published our first report on China's impact on the semiconductor industry, we were responding to our clients' concerns that China's growing semiconductor production would cause over-capacity in the global market. At that time, it was estimated that Chinese semiconductor companies represented less than 6% of established semiconductor companies and that they contributed less than 0.2% of worldwide semiconductor revenues. But great growth was projected.

China did not disappoint in terms of growth. However, it wasn't its production of semiconductors that skyrocketed, but rather its consumption. Today, China accounts for more than half of the global semiconductor consumption and its growth rate exceeds the global industry growth rate year after year. Driven by strong global demand for smartphones and tablets—the lion's share of which are produced in China—and the growing momentum towards networked things (the "Internet of Things"), this strong growth in semiconductor consumption should continue in the coming years.

It's important to note, however, that while the growth of semiconductor production in China has fallen short of earlier expectations, it is still impressive and today represents 12% of the worldwide industry. But the production/consumption gap continues to grow despite the Chinese government's efforts to contain it via incentives and investments. This gap represents an unparalleled market opportunity for Chinese and multinational companies alike.

Going forward, it is clear China will continue to expand its role in the semiconductor industry beyond leadership in consumption. The next ten years are likely to witness an accelerated growth in semiconductor manufacturing and a new breed of semiconductor companies competing for leadership in the global industry.

Ten years is a long time, particularly in the rapidly changing technology industry and many factors go into an industry's growth rate and prospects. For this reason, over the years we've expanded our report to include an analysis of semiconductor patents and IPO trends, both of which indicate a steadily maturing market.

Like previous editions, this year's report looks at year-over-year growth in key areas. But interspersed throughout are ten-year comparisons that help readers see how far the industry has come over the past decade.

I'd like to take a moment to recognize the efforts of Clements (Ed) Pausa, key architect of this report. For ten years now he has dedicated a significant portion of his year researching and writing these annual reports, traveling back and forth to China to meet with industry leaders and executives. His decades of experience in the semiconductor industry have brought immeasurable depth and value to this series and we appreciate his dedication.

In summary, the past ten years have seen China's semiconductor industry transform itself from an emerging industry into a significant global player whose impact and growth will no doubt continue. If you would like to talk about how China's semiconductor industry is impacting your business, or how you can take advantage of its market potential, please contact me or any of the technology industry leaders listed at the back of this report.

Sincerely,

Raman

Ten-year perspective

The dramatic growth of China's integrated circuit (IC) design industry over the past ten years has resulted in a noticeable increase in industry awareness of China's semiconductor companies. Between 2003 and 2013 China's IC design sector revenues grew from US$541mn to US$13,150mn, a twenty-four times increase.

In 2003, the Gartner Dataquest Semiconductor Industry Worldwide Annual Market Share Database only included 11 Chinese companies out of a total of 200 worldwide semiconductor companies and the aggregate reported revenue of those 11 companies represented just 0.14% of total worldwide revenue. That would indicate that in 2003 the industry's perception was that less than 6% of the established semiconductor companies were from China and they contributed less than two-tenths percent of worldwide semiconductor revenues.

Ten years later the same Gartner Worldwide Semiconductor Market Share Database for 2013 included 32 Chinese companies out of a total of 288 worldwide semiconductor companies and the aggregate reported 2013 revenue of those 32 companies represented 1.9% of total worldwide revenue. Over the past ten years the industry has increased its awareness to recognize that more than 11% of the established semiconductor companies are now from China and that they contribute almost 2% of worldwide semiconductor revenues.

Not one of the five largest Chinese semiconductor companies included in the Gartner 2013 Worldwide Database—Spreadtrum, HiSilicon, RDA, Sanan, and Galaxycore—were included in the 2003 database, while ten of the eleven Chinese companies in the 2003 database continued to be included in the 2013 database. Only Beijing Huahong has disappeared from view.

The initial 2004 edition of the *EE Times'* "Silicon Strategies' 60 Emerging Start-ups" only included a single partial Chinese semiconductor company, Memsic Inc. (Norwood Mass. and Wuxi, China), a 1999 spin-off from Analog Devices Inc. with a wholly owned subsidiary (Memsic Semiconductor Ltd.) located in Wuxi, China. This *EE Times'* list was their editors' selection of the 60 emerging semiconductor start-up companies to watch worldwide that were developing breakthrough technologies and products. Ten years later, the latest—version 15.1—of that *EE Times'* "Silicon 60: Hot Start-ups to Watch" now includes four Chinese semiconductor companies. They are: Alwinner Technology Co., Ltd. (Zhuhai, China); Brite Semiconductor (Shanghai) Corp. (Shanghai, China); Gpixel Inc. (Changchun, China) and Senodia Technologies Co., Ltd. Over the last ten years there have been ten Chinese companies out of the total of more than 340 companies that have appeared on the *EE Times*' Silicon 60 list of emerging technology companies since it first appeared in April 2004.

In summary, the dramatic growth of China's IC design industry over the past ten years has resulted in a noticeable increase in industry awareness of China's semiconductor companies. The worldwide industry recognizes that more than 11% of the established semiconductor companies are now from China and that they contribute almost 2% of worldwide semiconductor revenues. The latest—version 15.1—of that *EE Times'* "Silicon 60: Hot Start-ups to Watch" now includes four Chinese semiconductor companies.

Executive summary

China's semiconductor consumption growth continued to far exceed worldwide semiconductor market growth for a third consecutive year in 2013. While the worldwide semiconductor market increased 4.8% in 2013, China's semiconductor consumption market grew by 10.1% in 2013 to reach a new record of 55.6% of the global market.

China's semiconductor consumption market also continued to grow many times faster than the worldwide market as a result of two driving factors—the continuing transfer of worldwide electronic equipment production to China and the above-average semiconductor content of that equipment. Most industry analysts predict that the trend of an increasing share of electronic equipment production in China will moderate but continue over the next several years and China's share of worldwide semiconductor consumption to increase by a further 4%.

The major global semiconductor companies continue to dominate the Chinese market. There have only been fourteen different companies among the top ten suppliers over the past eleven years (since our initial report). Seven of these companies have been among the top ten suppliers to China every year from 2003 through 2013: Intel, Samsung, TI, Toshiba, SK Hynix, ST and Freescale. However, for the first time in our ten years of reporting it is quite likely that at least one of the largest Chinese semiconductor companies will be among the top 20 suppliers to the Chinese semiconductor market in 2014.

China's reported semiconductor industry growth continued in 2013 to exceed both China's semiconductor consumption growth and the worldwide semiconductor market growth. China's semiconductor industry has grown at an equal or greater rate than its semiconductor market consumption for eight of the past ten years. From 2003 through 2013, China's semiconductor industry has achieved a ten-year compounded annual growth rate (CAGR) of 23.0%. During this same ten-year period China's semiconductor consumption achieved a 19.4% CAGR and the worldwide semiconductor market a 6.3% CAGR (all measured in US dollars).

A conservative comparison indicates that China's semiconductor industry accounted for slightly more than 12% of the worldwide semiconductor industry in 2013, up from 11.6% in 2012. Looking forward, the Chinese authorities currently forecast that China's semiconductor industry revenues will grow to reach US$86bn by 2016 and would then represent almost 15% of the worldwide semiconductor industry.

The overall performance of China's IC industry (the sum of IC design, IC wafer manufacturing and IC packaging and testing) continued to be the major contributor to China's overall

semiconductor industry growth in 2013. IC industry revenues increased by 19% to more than US$40bn in 2013. Two sectors of China's IC industry reported double-digit growth in 2013. China's IC design sector grew by 33% in 2013 to a new record US$13.2bn and the IC packaging and testing sector grew by almost 19% to a record US$18bn. However, because of the fire at the Hynix Wuxi wafer fab facility and a slower-than-expected ramp up of Intel's Fab 68, the growth of China's IC wafer manufacturing sector slowed to just 4.3% in 2013 and did not reach US$10bn as had been expected. China's IC industry achieved an overall self-sufficiency ratio of about 27% (ratio of production versus consumption values) in 2013, which is a further increase from the 25% reported for 2012 and noticeably higher than the 20% average for the previous nine years since 2003.

In 2013 China's O-S-D (optoelectronics-sensor-discrete) consumption market grew 11.3% to reach a new peak of US$31.7bn. For the second consecutive year this increase was much greater than the worldwide O-S-D market increase of 1% and China's share of that market grew to 54% in 2013 (from 49% in 2012). China's consumption represented almost 80% of the worldwide discrete market; 48% of the worldwide sensor market but only 38% of the worldwide optoelectronics market. China's reported O-S-D industry achieved self-sufficiency for the fourth consecutive year in 2013, with an overall self-sufficiency ratio of about 110%, while the value of China's O-S-D exports exceeded the value of O-S-D imports for the fourth year in a row.

China's IC consumption/production gap increased again in 2013 to a new record annual high despite the various government plans and efforts to contain it. This gap is the yearly difference between IC consumption and IC industry revenues. During the ten-year span of our reports on China's semiconductor industry, this gap has grown from US$20.8bn in 2003 to US$108.2bn in 2013, increasing every year except 2009. The China Semiconductor Industry Association (CSIA) 2014 report forecasts a further widening of China's IC consumption/production gap to US$130bn despite the Chinese government's plans and efforts to contain it. It is our belief that this gap is behind many of the Chinese government's ongoing initiatives to increase indigenous IC production.

Integrated circuit (IC) design continues to be the fastest growing segment of China's semiconductor industry. During the ten years from 2003 through 2013 China's IC design (fabless) industry has grown at a 37.6% CAGR from US$541mn to over US$13bn. IC design contributed more than 37% to China's semiconductor industry revenue growth in 2013 and was responsible for about 29% of China's semiconductor industry revenue. During the last ten years China's IC design industry has grown from representing just 0.4% of the worldwide IC market and 2.5% of the worldwide fabless IC industry in 2003 to representing almost 5% of the worldwide IC market and 17% of the worldwide fabless IC industry in 2013.

Packaging assembly and test remains the largest of China's semiconductor manufacturing activities when measured in terms of value added, production revenue, employees and manufacturing floor space. This impact is often missed because it is allocated between two separate industry sectors: the IC packaging and testing and the O-S-D sectors. The composite weighted average of China's 2013 SPA&T production is now estimated to be about 58% of worldwide, up from a revised 52% in 2012.

The Chinese government has been offering incentives to promote the

development of the semiconductor industry for more than a decade. However China's IC consumption continues to greatly exceed IC production and more than 90% of its consumption still relies on imported ICs. Chinese government stakeholders have been reconsidering the risks posed by the country's heavy reliance on others for semiconductor components and capabilities. In June of 2014 the Chinese central authorities announced new "Guidelines to Promote National IC Industry Development", otherwise known as "New Document 4", unveiling a program to promote the IC industry by setting up a state-level lending group and special national and regional investment funds.

The "Guidelines" include the establishment of a National Industry Investment Fund of RMB 120bn (US$19.5bn) to be invested between 2014 and 2017 to support the development of IC and related industries and to promote industrial restructuring and upgrading. The National Industry Investment Fund was set up at the end of September 2014 and is expected to start official operation by the end of 2014.

In addition, the "Guidelines" provided for the establishment of several regional local government and private equity investment funds for a total of an additional RMB 600bn (US$97.5bn). Beijing had already established an IC Industry Equity Investment Fund of RMB 30bn (US$4.9bn) in June of 2013 and other provinces and cities, including Anhui, Shanghai, Shandong, Tianjin, Wuhan and Shenzhen, are following the Beijing model and establishing local funds to support the IC industry.

Local analysts predict that by the end of 2015 the total equity funds established by China's central and local governments for the semiconductor industry will exceed RMB 200bn (US$32.5bn). If successful, these new guidelines and investment funds could significantly alter the composition of China's semiconductor industry over the next decade.

Another consequence of Chinese government stakeholders reconsidering the risks posed by the country's heavy reliance on others for semiconductor components and capabilities appears to be a negative change in the working environment

for foreign firms and the increasing sensitivity of their relationship with the Chinese government.

During the last three years, China's IC industry has reported a 24.2% US dollar CAGR and it seems reasonably probable that it will follow or exceed our last (2011) aggressive scenario through 2015 and achieve the MIIT revenue goals of 330bn RMB (US$54bn), with IC design reaching 70bn RMB (US$11.4bn). During 2013, more than US$9bn of additional fixed-asset investments were made in China's IC industry to bring the total for the last three years to almost US$20 bn. This increase in investment rate clearly supports the aggressive scenario requirements.

Greater China's consumption and production of semiconductors continued to grow much faster than the worldwide semiconductor market to reach new record levels during 2013. Measured in US dollars, Greater China, which includes China, Hong Kong and Taiwan, accounted for more than 62% of the worldwide semiconductor consumption market in 2013, while it produced more than a quarter of worldwide industry revenues. Greater Chinese companies have grown to dominate worldwide semiconductor outsourced manufacturing. Greater China companies, accounting for US$29bn, 81%, of total worldwide 2013 foundry revenues and for US$12bn or 48% of total worldwide 2013 SATS revenue.

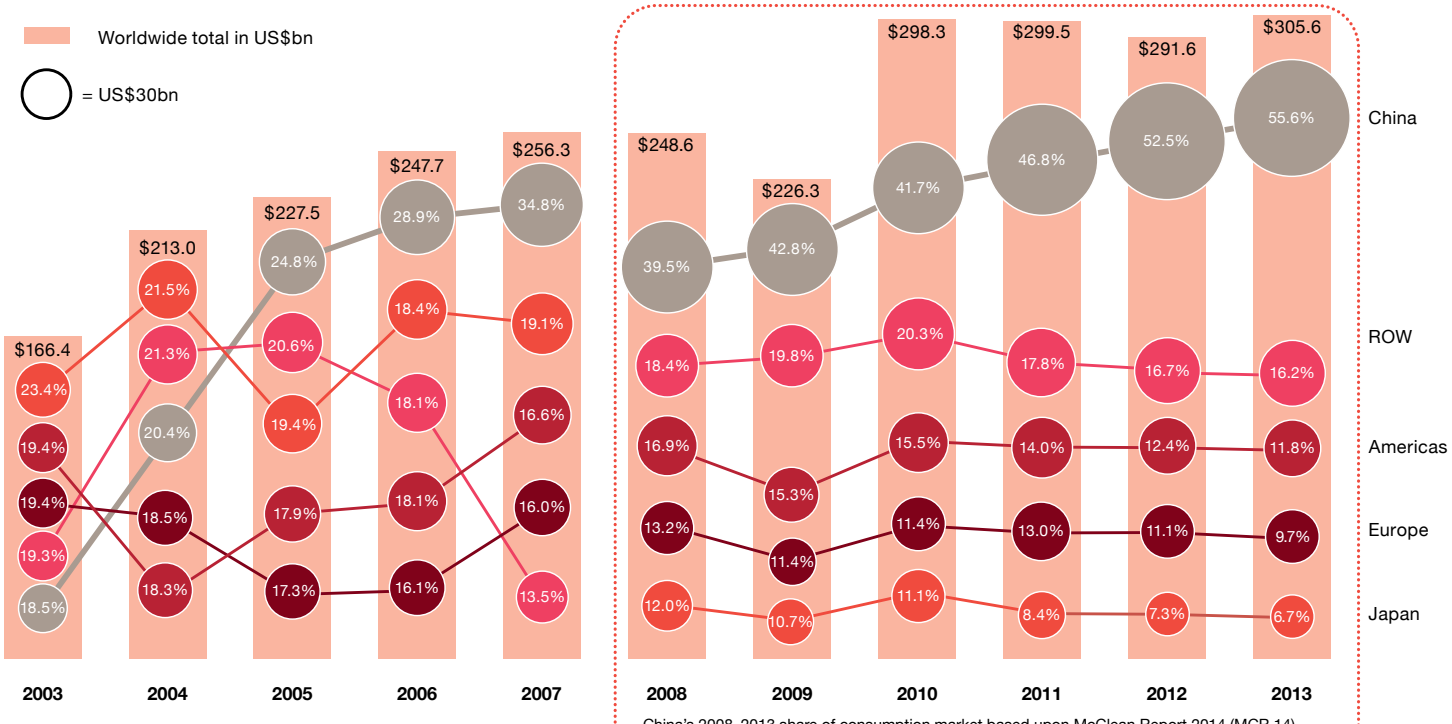
In summary, China's consumption and production of semiconductors continued to grow much faster than the worldwide semiconductor market to reach new record levels during 2013. However, China's IC consumption/production gap (the difference between IC consumption and IC industry revenues) increased again in 2013 to a new record, motivating the Chinese government's to provide additional new incentives to increase indigenous IC production.

Section 1: Market and industry overview

China's semiconductor market

China's consumption growth continued to far exceed worldwide semiconductor market growth for a third consecutive year in 2013. While the worldwide semiconductor market increased 4.8% in 2013, China's semiconductor consumption market grew by 10.1% in 2013 to reach a new record of 55.6% of the global market. Although much of this exceptional growth continued to be the result of China's dominant position in the production of smartphones and media tablets, almost three percentage points of this increase was the result of China's continuing revaluation of the renminbi (RMB). Measured in local (RMB) currency, China's semiconductor consumption market grew by 7.3% in 2013. That 7.3% local currency growth, which was very close

Figure 1: Worldwide semiconductor consumption market by region, 2003–2013
(Total worldwide in US$bn)



Source: Semiconductor Industry Association (SIA), McClean Report 2014 (MCR 14), Gartner Dataquest (GDQ), CCID Consulting (CCID)

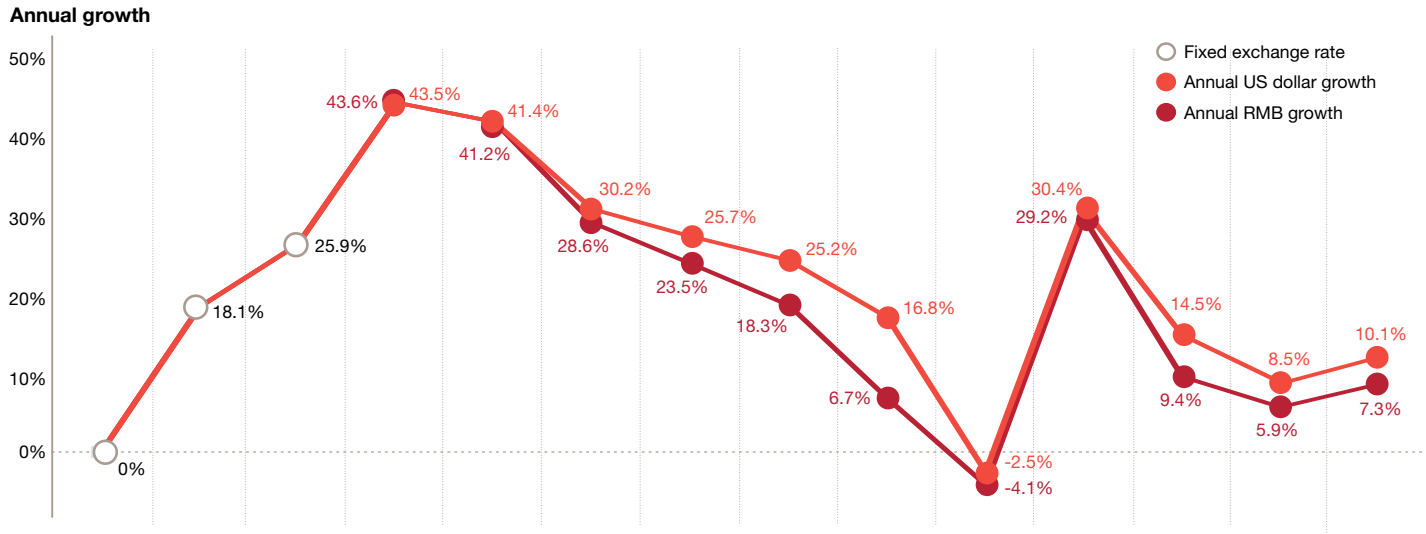
China's 2008–2013 share of consumption market based upon McClean Report 2014 (MCR 14) market history.

Regional share of worldwide consumption market is based upon Gartner "Semiconductor Forecast Database, Worldwide, 2012–2018 1Q14" and prior with adjustments for dislocated purchases.

to what Chinese officials had forecast at the start of the year, far exceeded all other regions and may be understated since most of the semiconductors consumed in China were sourced from multinational suppliers and priced in dollars, euros or yen.

It has been ten years since our first report on China's impact on the semiconductor industry. During the first of those years China moved rapidly from being the smallest of the regional semiconductor consumption markets in 2003, with 18.5% share, to the largest by 2005, with 24.8% share. Since then, China has expanded its semiconductor consumption market leadership position and increased its market share every year but one (2010). During four of those years (2004, 2005, 2006 and 2010) China's semiconductor consumption grew by commanding the majority of worldwide market growth. During the other six years, including the past three, China's semiconductor consumption has grown at the expense of decreases in other regions. During the past ten years China's semiconductor consumption has grown at a 19.2% compounded annual growth rate (CAGR), while total worldwide consumption has only grown at a 6.3% CAGR. The net result is that while the worldwide semiconductor market as reported by WSTS has grown by US$139.2bn from 2003 to 2013, China's semiconductor consumption as reported by the China Semiconductor Industry Association (CSIA) has grown by US$150bn and 2013 was the second year that China consumed more than half of all the worldwide semiconductor market.

Figure 2: China's semiconductor market growth, 2000–2013



Market value

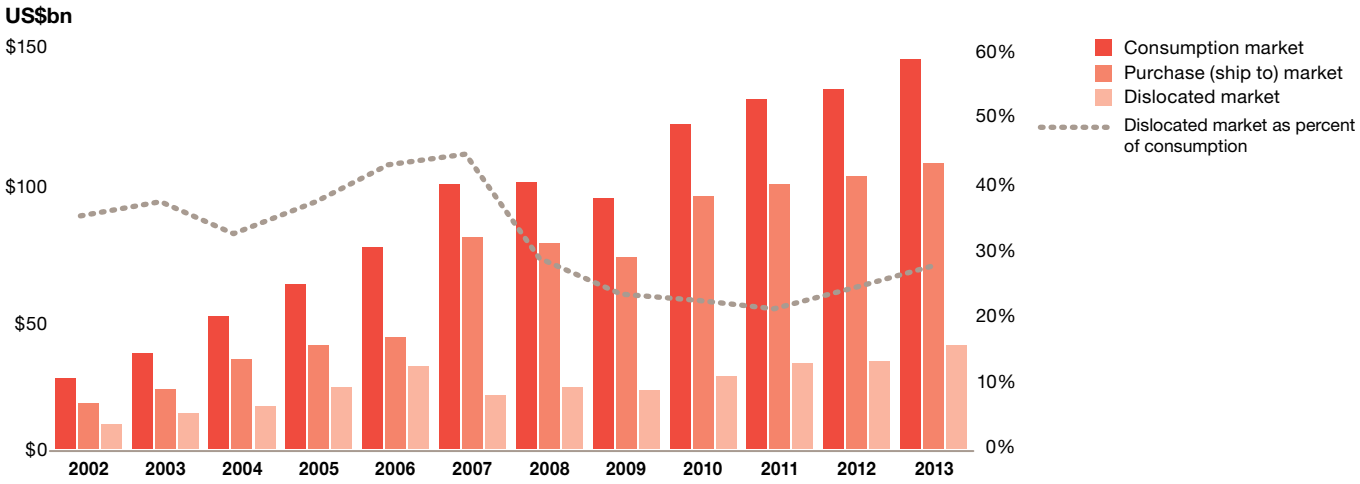
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
US$bn	14.4	17.0	21.4	30.7	43.4	56.5	71.0	88.9	103.8	101.2	132.0	151.2	164.1	180.8
RMBbn	119.5	141.1	177.6	255.1	360.0	463.0	571.7	676.1	721.5	691.6	893.4	977.5	1,035.6	1,111.7

Note: Market reporting has changed since 2003 with sensors and optical semiconductors included as part of the optoelectronics-sensors-discrete (O-S-D) segment which along with integrated curcuits make up the total semiconductor market

Source: CCID, CSIA

China's reported semiconductor consumption market is greater than most market analysts' Chinese market share reports because a significant portion of the semiconductor devices consumed in China continue to be purchased outside of China. This "dislocated purchasing" occurs because some customers—due to supply chain considerations such as control of key inventory items, intellectual property protection and/or toll processing business models—will buy semiconductor devices outside of China and transship them to China for use and consumption. Since 2008 we have been identifying this "dislocated purchasing" for the Chinese consumption market by a comparison of consumption to purchasing TAM (total available market). Using the most recently revised measure of purchasing TAM, we have found that this "dislocated purchasing" declined noticeably during 2008 and 2009, remained relatively constant at just over 24% of consumption for the following three years before increasing to 28% in 2013. In 2013 the largest share of this "dislocated purchasing" occurred in Taiwan, Korea, the Americas and Singapore. Japan's share of this "dislocated purchasing" has declined significantly since 2011.

Figure 3: Analysis of China/Hong Kong consumption versus purchasing TAM semiconductor market history



Source: CSIA, Ministry of Industry and Information Technology (MIIT), Gartner

Table 1: China's production and worldwide share of main electronic products, 2008–2013

	Production in 1000s						% CAGR	Worldwide market share %					
	2008	2009	2010	2011	2012	2013		2008	2009	2010	2011	2012	2013
Main products													
Mobile phone	559,640	619,520	998,000	1,133,000	1,181,540	1,456,610	20.1%	44.7%	49.9%	62.7%	63.8%	67.7%	80.6%
Computer/PC	136,666	182,150	246,000	320,000	354,110	336,610	19.8%	47.0%	60.9%	73.4%	74.0%	70.8%	62.8%
Color TV	90,331	98,990	118,000	122,000	128,230	127,760	7.2%	43.9%	48.3%	47.8%	48.6%	53.8%	56.7%
Digital camera	81,883	80,260	90,000	82,900					62.3%	64.9%			
SPB exchange					28,280	31,160	10.2%						

Source: CSIA, Ministry of Industry and Information Technology (MIIT), Gartner

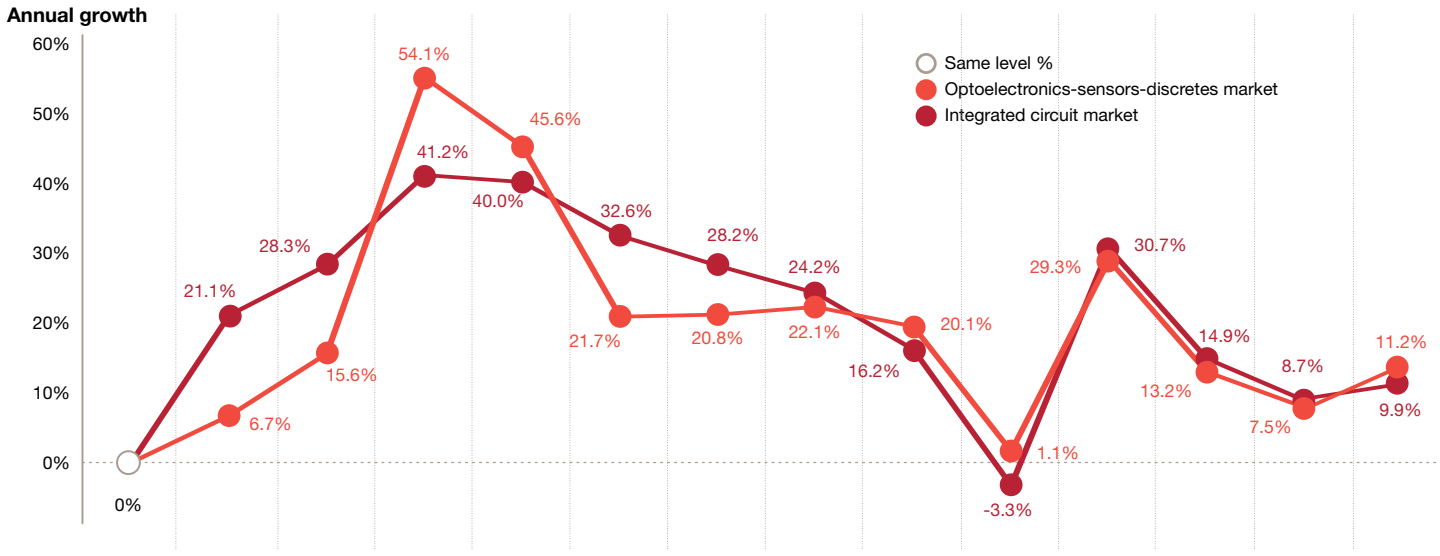
China's share of worldwide electronic equipment production increased by more than two percentage points to 35.1% in 2013.

China's semiconductor consumption market continues to grow many times faster than the worldwide market as a result of two driving factors—the continuing transfer of worldwide electronic equipment production to China and the above-average semiconductor content of that equipment. During 2013 electronic equipment production in China increased by US$45bn while it decreased by US$15bn, 1.5%, in the rest of the world. As a result, China's share of worldwide electronic equipment production increased by more than two percentage points to 35.1% in 2013. At the same time, the semiconductor content of China's electronic equipment production remained well above the 20% worldwide average at 34% in 2013.

Whether the Chinese semiconductor consumption market will continue to gain global market share will be primarily determined by the future transfer of electronic equipment production. Most industry analysts predict that the trend of an increasing share of electronic equipment production in China will moderate but continue over the next several years. According to Gartner, China's share of electronic equipment production is forecast to increase to more than 38% by 2017; the semiconductor content of that production to gradually increase to over 35%, while the worldwide average content increases to 25%; and China's share of worldwide semiconductor consumption to increase by a further 4%.

The integrated circuit (IC) consumption market in China increased 9.9% to US$149bn in 2013. This increase was realized while the worldwide IC only market increased 4.7%. As a consequence, China's IC consumption grew to represent almost 56% of worldwide consumption in 2013. During 2013 China's IC consumption increased by more than US$13bn while the worldwide market increased by US$12bn. This is the sixth time in the past seven years that

Figure 4: China's IC and O-S-D market growth, 2000–2013



Note: Market reporting has changed since 2003 and the definition O-S-D (Optoelectronics-Sensors-Discretes) market now includes sensors and optical semiconductors

Source: CCID, CSIA

China's IC consumption grew faster than the rest of the world's IC market and China's IC consumption grew at the expense of displacing IC markets in other regions. This confirms the resumption in the dynamics of China's impact on the industry, although China's rate of IC consumption market growth is gradually moving closer to the worldwide rate.

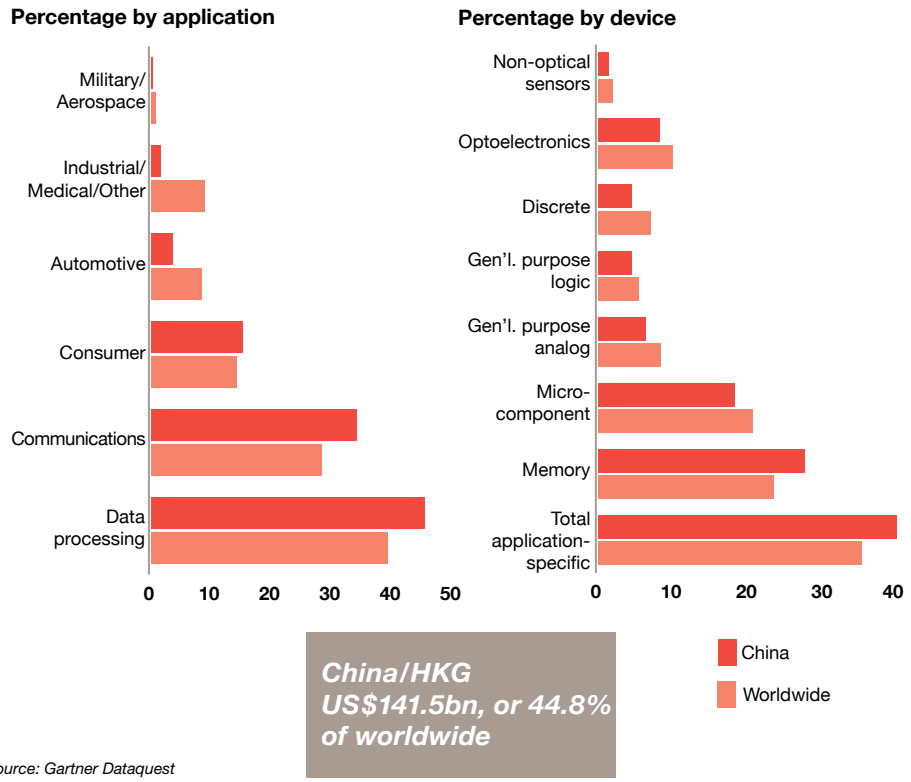
In 2013 China's O-S-D (optoelectronics-sensor-discrete) consumption market grew 11.2% to reach a new peak of US$31.7bn. For the second consecutive year this increase was much greater than the worldwide O-S-D market increase of 1%. As a result, China's share of that market grew to 54% in 2013 (from 49% in 2012). China's O-S-D market share is noticeably more concentrated in discrete devices than the worldwide market, with China's consumption representing almost 80% of the worldwide discrete market; 48% of the worldwide sensor market and only 38% of the worldwide optoelectronics market. Discrete devices continued to be the largest segment of China's O-S-D market (at US$14.6bn) and for the first year since 2004 was the fastest growing in 2013 at 13%. While sensors remained the smallest segment of China's O-S-D market (at US$4.2bn), it was the second fastest growing in 2013 at 12%. Optoelectronics continued as the middle segment at US$11.1bn while growing 9% in 2013.

During 2013 China's semiconductor consumption continued to be more concentrated in the communications and data processing (computing) applications sectors than the worldwide market, while becoming slightly less concentrated in the consumer, remaining less concentrated in the automotive and noticeably less concentrated in the industrial/medical/other and military/aerospace sectors. China's share of 2013 worldwide semiconductor consumption was largest for the communications (computing) sector, where it increased along with China's share of the 2013 worldwide data processing and automotive sectors. China's share of the worldwide consumer, industrial/medical/other and mil/aero sectors decreased during 2013.

During the ten years since our initial report there has been a noticeable shift in the distribution of China's semiconductor consumption by application. The share of China's consumption of semiconductors for the communications and data processing sectors has increased by eight and three percentage points, respectively, while the consumer share has decreased by almost 12 percentage points. Since 2003 China's consumption of semiconductors for communications and data processing (computing) applications has grown at a 20% and 18% CAGR, while consumption for consumer applications has only grown at a 10% CAGR. China's consumption for automotive applications is smaller, but has grown at a faster rate of slightly more than 20% while China's consumption for industrial applications, which decreased in 2013, has only grown at a 11% CAGR.

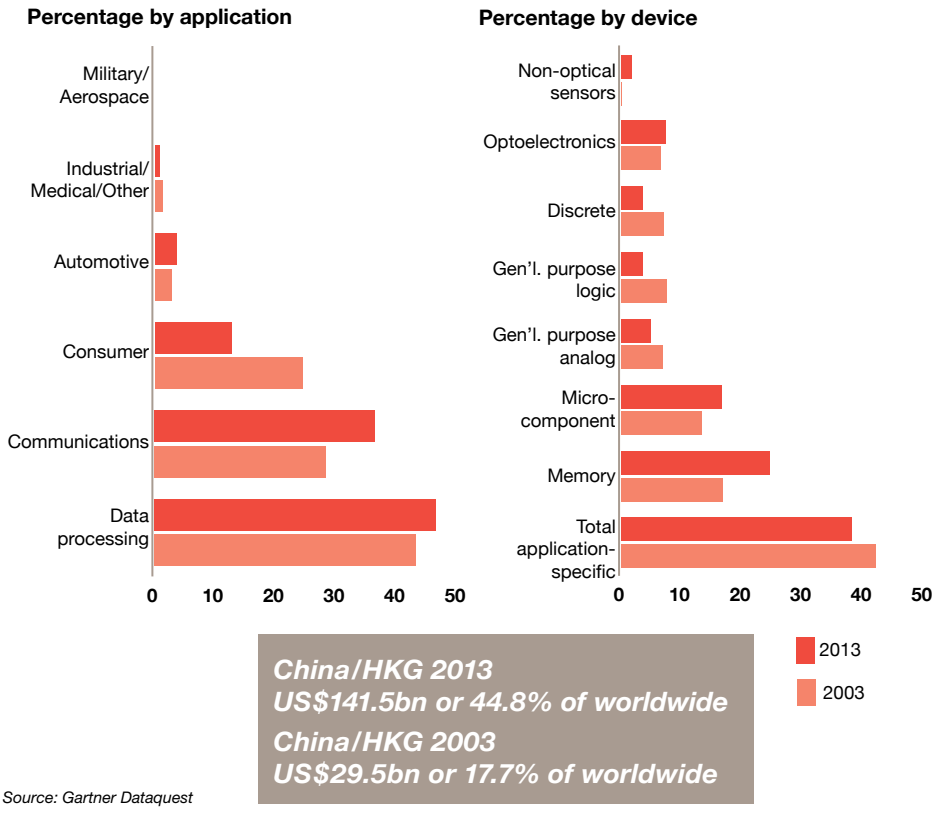
In 2013 China's O-S-D (optoelectronics-sensor-discrete) consumption market grew 11.2% to reach a new peak of US$31.7bn.

Figure 5: China compared with worldwide semiconductor market by application and device, 2013



Source: Gartner Dataquest

Figure 6: China Semiconductor market by application and device 2013 vs 2003



Source: Gartner Dataquest

Compared to 2012 China's semiconductor consumption became even more concentrated during 2013 in the application-specific and memory device sectors than the worldwide market. China's share of 2013 worldwide semiconductor consumption decreased by about two percentage points each for the general purpose analog, discrete and optoelectonics sectors, while it increased for all the other device sectors. The application-specific and memory device sectors continue to be the largest and increased their worldwide share by three and two percentage points each. Although it remained the smallest, non-optical sensors continued to be the fastest growing device sector of China's semiconductor consumption, increasing at a 50% CAGR from 2003. During the same ten-year period the microcomponent and memory sectors have grown at a 20% CAGR and optoelectronics at a 19% CAGR.

The past ten years have seen a very modest shift in the overall distribution of China's semiconductor consumption, with ICs increasing and O-S-D devices decreasing by slightly more than one percentage point. However, there has been a more noticeable shift within the distribution of the ICs. The memory device share of China's total semiconductor consumption has increased by almost eight percentage points and the microcomponent share by more than three percentage points. At same time, the application-specific and general purpose logic share of China's semiconductor consumption decreased by four percentage points each and the general purpose analog share by two percentage points. Among the O-S-D devices, the discrete device share of China's total semiconductor consumption decreased by almost four percentage points; the optoelectonic share increased by almost one percentage point, while the smaller non-optical sensors share increased by almost two percentage points.

The major global semiconductor companies continue to dominate the Chinese market. Table 2 lists the top ten suppliers with the largest value of semiconductors consumed in China during 2013. There have only been fourteen different companies among these top ten suppliers over the past ten years (since our initial report). Seven companies have been among the top ten suppliers to China every year from 2003 through 2013: Intel, Samsung, TI, Toshiba, SK Hynix, ST and Freescale. AMD joined the list in 2004 and has been among the top ten suppliers to China for the last ten years. Qualcomm, which joined this list for the first time in 2012 at number 10 displacing NXP, moved up to number six in 2013. NXP had been among the top ten suppliers to China for every year from 2003 through 2011, while MediaTek had been among the top ten for the three years 2007 to 2009 and Qimonda for only one year, 2006. During 2013 China's consumption of semiconductor products from these ten largest suppliers increased by 9.7%, slightly less than the growth of the overall semiconductor market in China,. The Chinese semiconductor consumption market continued its trend of becoming less concentrated than the worldwide market. The top ten suppliers' share of China's consumption declined to 42.9% in 2013, down from 43% in 2012 and 45% in 2011 and less than the 53% share the top ten suppliers to the 2013 worldwide market held. For the first

Table 2: Semiconductor suppliers to the Chinese market 2012–2013

	Rank		Revenue in US$M						Market share %
Company	**2012**	**2013**	**2012 IC**	**2013 IC**	**% change**	**2012 Semi**	**2013 Semi**	**% change**	
Intel	1	1	25,076	24,941	-0.5%	25,076	24,941	-0.5%	13.8%
Samsung	2	2	10,759	12,981	20.7%	11,450	13,723	19.9%	7.6%
SK Hynix	5	3	5,108	7,230	41.5%	5,108	7,230	41.5%	4.0%
Toshiba	4	4	4,235	4,876	15.1%	5,152	5,886	14.2%	3.3%
TI	3	5	5,062	5,273	4.2%	5,398	5,605	3.8%	3.1%
Qualcomm	10	6	3,171	4,658	46.9%	3,171	4,658	46.9%	2.6%
ST	6	7	3,351	3,450	3.0%	4,359	4,546	4.3%	2.5%
AMD	7	8	4,219	4,050	-4.0%	4,219	4,050	-4.0%	2.2%
Freescale	8	9	3,043	3,325	9.3%	3,561	3,958	11.1%	2.2%
Renesas	9	10	2,646	2,437	-7.9%	3,260	3,008	-7.7%	1.7%
Total Top 10			**66,670**	**73,221**	**9.8%**	**70,754**	**77,605**	**9.7%**	**42.9%**
Total Top 10 share of									
Chinese integrated circuit market			49.1%	49.1%	0.1%				
Chinese semiconductor market						43.0%	42.9%	-0.2%	

Note: Semi equals IC + Discrete (including LED) market

Source: CCID IC Market China 2013 & 2014 Conferences – March 2013 & March 2014

For the first time in our ten years of reporting it appears that it is possible that there were one or two Chinese companies within the top 30 suppliers to the Chinese semiconductor market in 2013.

time in our ten years of reporting it appears that it is possible that there were one or two Chinese companies within the top 30 suppliers to the Chinese semiconductor market in 2013. If either or both of the two largest Chinese semiconductor companies had all of their 2013 output consumed within China they would have been within the top 30 suppliers to that market. That is a notable change from 2012 and 2011 when they would not have been within the top 30 or 35 suppliers. Moreover, it is quite likely that with the recent industry consolidations at least one of the largest Chinese semiconductor companies will be among the top 20 suppliers to the Chinese semiconductor market in 2014.

Table 3: Top ten suppliers to the Chinese semiconductor market 2003–2013

	Rank										
Name of company	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Intel	1	1	1	1	1	1	1	1	1	1	1
Samsung	6	5	2	2	2	2	2	2	2	2	2
SK Hynix	9	6	7	3	3	3	4	3	5	5	3
Toshiba	3	7	6	6	5	5	3	4	3	4	4
TI	4	2	3	4	4	4	7	5	4	3	5
Qualcom								15	13	10	6
ST	2	4	5	8	8	7	5	6	6	6	7
AMD		10	10	5	6	6	6	7	7	7	8
Freescale	7	9	9	9	9	9	10	10	9	8	9
Renesas	10	11						9	8	9	10
NXP	5	3	4	7	7	8	8	8	10		
Infineon	8	8	8					11	11		
MediaTek					10	10	9	13	15		
Qimonda				10							
ON Semiconductor								14	12		
Supplied consumption value (US$M)											
Total top 10 ICs ($M)	13,414	18,669	24,399	30,672	37,971	43,909	44,019	56,848	63,443	66,670	73,221
Total top 10 semiconductors (US$M)							46,876	60,821	68,037	70,754	77,605
Total China IC market	24,989	35,037	46,423	59,493	73,937	85,949	83,091	108,585	124,789	135,623	149,036
Top 10 % China IC market	53.7%	53.3%	52.6%	51.6%	51.4%	51.1%	56.4%	56.0%	54.5%	52.2%	52.1%
Total China Semiconductor market							101,240	131,991	151,241	164,106	180,748
Top 10 % China Semiconductor market							46.3%	46.1%	45.0%	43.1%	42.9%

Note: Top 10 totals are based on each year's top 10 suppliers

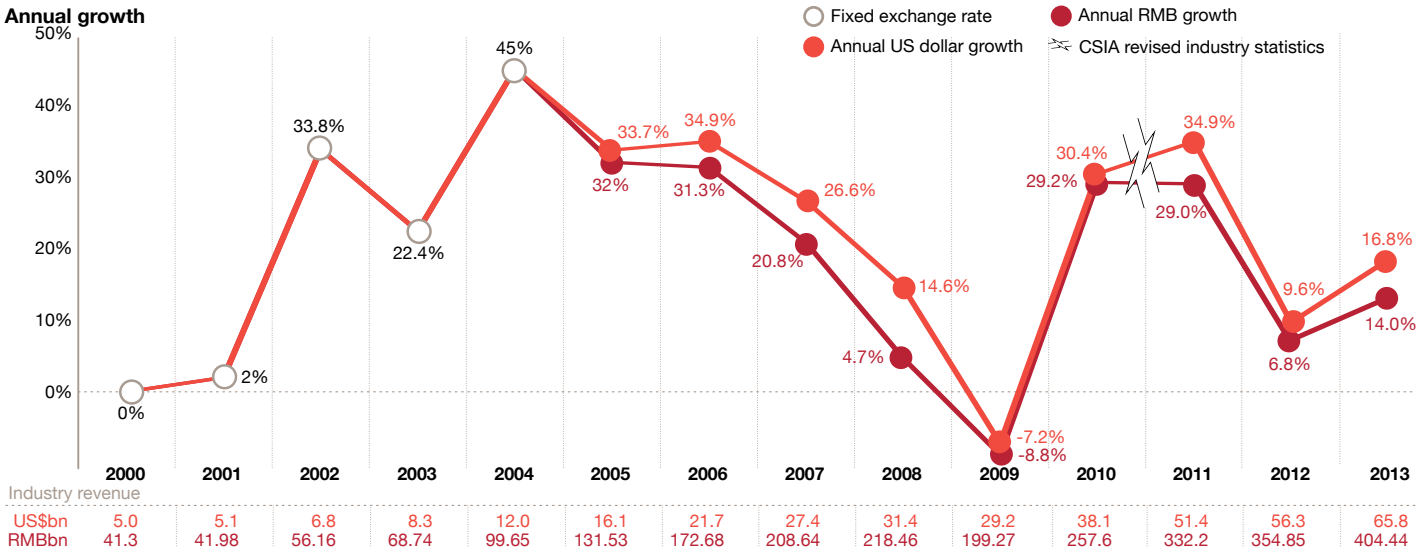
Source: CCID, CSIA, Changed from reporting IC to semiconductors (IC + O-S-D) in 2009

China's semiconductor industry

China's reported 2013 semiconductor industry growth continued to exceed both China's semiconductor consumption growth and the worldwide semiconductor market growth. During 2013 China's semiconductor industry grew by 16.7% to reach a record US$65.8bn. China's semiconductor industry has grown at an equal or greater rate than its semiconductor market consumption for eight of the past ten years. During 2013, US$9.4bn of additional fixed-asset investments were made in China's IC industry, up almost 71% from the nearly US$5.5bn in investments made in 2012. This US$9.4bn investment represented 16.1% of the 2013 total worldwide semiconductor capital expenditures. From 2003 through 2013, China's semiconductor industry has achieved a ten-year CAGR of 23.0% measured in US dollars (or 19.4% measured in local RMB currency). During this same ten-year period, China's semiconductor consumption achieved a 19.4% CAGR and the worldwide semiconductor market a 6.3% CAGR both measured in dollars.

Our earlier reports made a comparison between China's reported semiconductor industry revenue and the sum of worldwide semiconductor device sales plus foundry and assembly and test services (SATS) revenues which would measure China as accounting for almost 17% of the worldwide industry in 2013. However, that value is most likely overstated since a significant share of China's industry production is contributed by captive IDM wafer fabrication, assembly and test facilities rather

Figure 7: China's semiconductor industry revenue and growth, 2000-2014



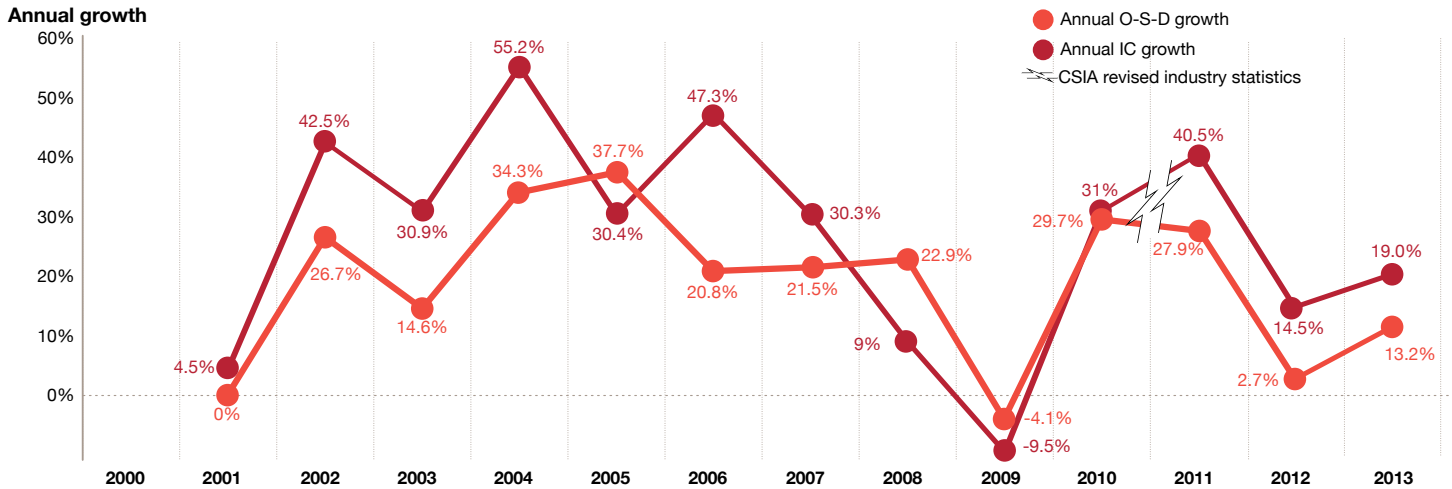
Source: CCID, CSIA

The overall performance of China's IC industry (the sum of IC design, IC wafer manufacturing and IC packaging and testing) continued to be the major contributor to China's overall semiconductor industry growth in 2013.

than just foundry and SATS facilities. Therefore, starting with the 2010 Update we added a more conservative alternate comparison against the sum of device sales revenue plus the value of all wafer fabrication and packaging, assembly and test production. That comparison indicates that China's semiconductor industry accounted for slightly more than 12% of the worldwide semiconductor industry in 2013, up from 11.6% in 2012. What is important is that both comparisons confirm that China's share of the worldwide semiconductor industry is continuing to grow, becoming both noticeable and significant. Looking forward, the Chinese authorities currently forecast that China's semiconductor industry revenues will grow to reach US$86bn by 2016. When compared to the sum of the SIA/WSTS forecast for worldwide device sales—plus all wafer fabrication and packaging, assembly and test values—that forecast projects that China's semiconductor industry will account for almost 15% of the worldwide semiconductor industry by 2016. This seems compatible with China's recent 16% share of worldwide semiconductor capital expenditures.

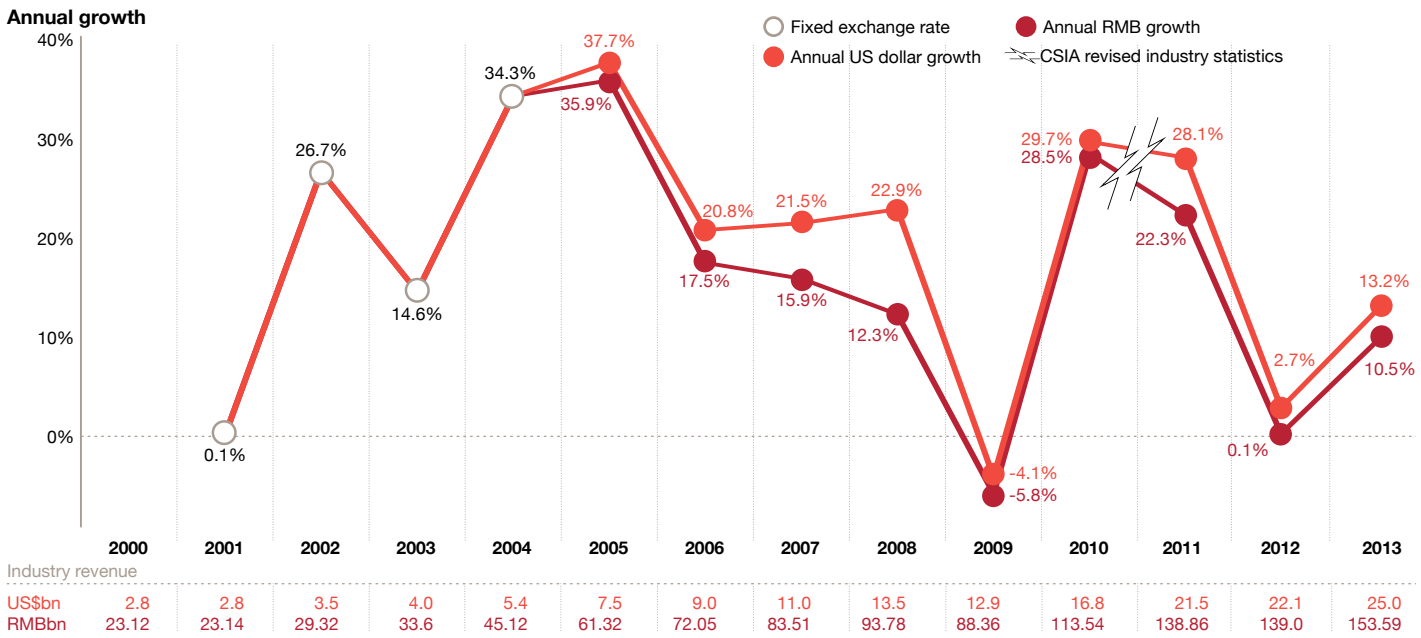
The overall performance of China's IC industry (the sum of IC design, IC wafer manufacturing and IC packaging and testing) continued to be the major contributor to China's overall semiconductor industry growth in 2013. IC industry revenues, measured in dollars, increased by 19%, to almost US$41bn in 2013. The same IC industry revenues measured in local RMB currency increased by 16.2% to 251bn RMB. Measured in dollars, two sectors of China's IC industry reported double-digit growth in 2013. As a prioritized sector and benefiting from the continuing growth of the smartphone and IC card markets, China's IC design sector grew by 33% in 2013 to a new record US$13.2bn. Thanks to an increase in both domestic and multinational demand, the IC packaging and testing sector grew by almost 19% in 2013 to a record US$18bn. Also, as measured in local currency, the IC packaging and testing sector topped the 100bn RMB mark for the first time in 2013. However, because of the fire at the SK Hynix Wuxi wafer fab facility and a slower than expected ramp up of Intel's Fab 68, the growth of China's IC wafer manufacturing sector slowed to just 4.3% in 2013 and did not reach US$10bn as had been expected.

Figure 8: China's O-S-D and IC industry revenue and growth, 2000–2013



Source: CCID, CSIA

Figure 9: China's O-S-D industry revenue and growth, 2000–2013

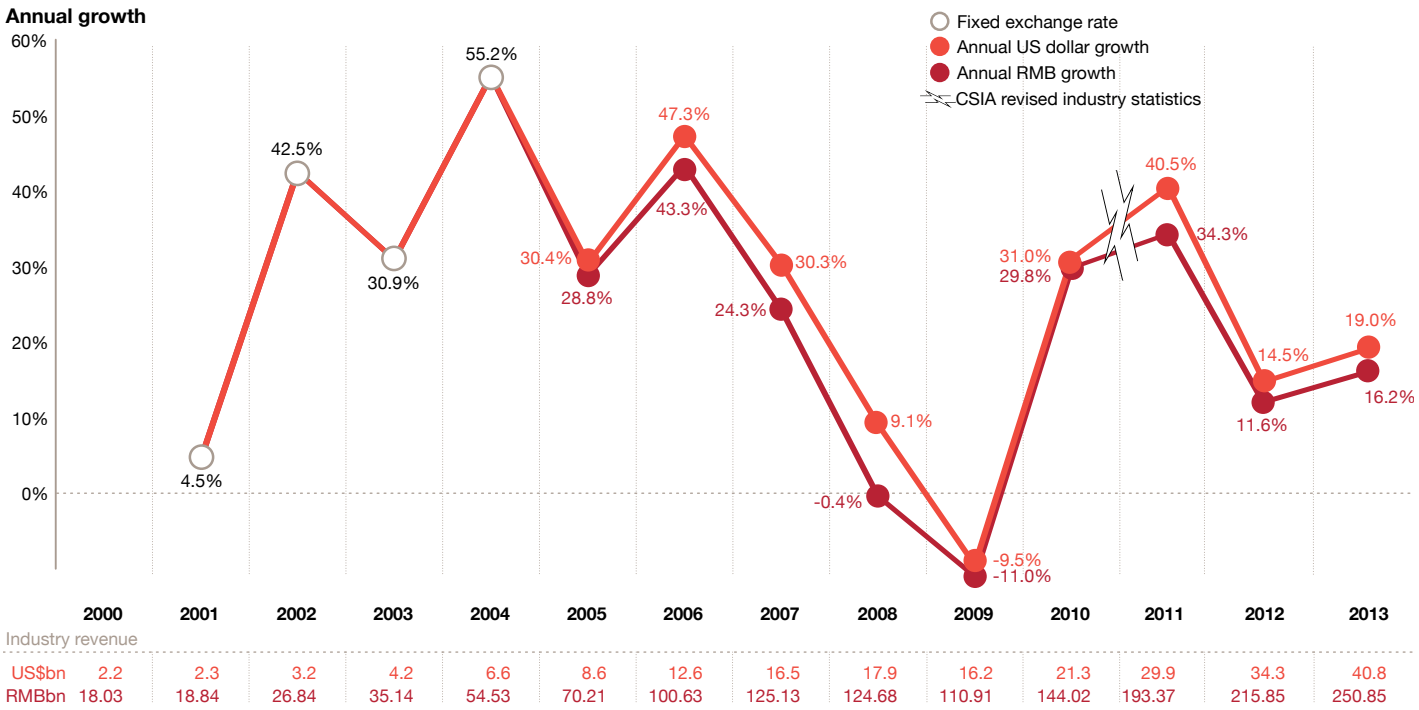


Source: CCID, CSIA

According to the China Semiconductor Industry Association (CSIA) China's IC industry unit production increased by 5% in 2013, and IC dollar unit average selling price (ASP) increased by 13%. Based upon the current reported revenue values, China's IC industry achieved an overall self-sufficiency ratio of about 27% (ratio of production versus consumption values) in 2013, which is a further increase from the 25% reported for 2012 and noticeably higher than the 20% average for the previous nine years since 2003. As noted in prior updates, based upon the CSIA's reported unit volumes, China's IC industry unit self-sufficiency ratio for 2013 might have been much greater if units were valued at worldwide market ASPs.

China's O-S-D industry sector reported significantly better performance in 2013 than worldwide O-S-D performance. Measured in dollars, China's O-S-D sector revenues increased 13.2% in 2013 to a record US$25bn. When measured in local RMB currency, China's O-S-D sector revenues increased by 10.5% and contributed more than 29% to China's total semiconductor industry growth in 2013. Within the sector, China's LED revenues grew by 36% to US$9.2bn, while discrete device revenues only grew by 3% to US$15.7bn. China's reported O-S-D production unit output increased by 11% and ASPs remained relatively unchanged during 2013. Measured in local RMB currency, China's O-S-D industry ASPs have been

Figure 10: China's IC industry revenue and growth, 2000-2013



Source: CCID, CSIA

relatively constant during the ten-year period from 2003 through 2013, decreasing just 0.1%. However, when measured in US dollars those same O-S-D ASPs have increased by almost 32% from 4.1 cents to 5.4 cents. Based upon revenue values, China's reported O-S-D industry achieved self-sufficiency for the fourth consecutive year in 2013, with an overall self-sufficiency ratio of about 110% (ratio of production versus consumption values).

Correspondingly, while the value of China's O-S-D exports exceeded the value of O-S-D imports for the fourth year in a row in 2013, the net export value, which had declined sharply in 2012, remained relatively modest for a second year.

Continues on page 23

Interview

S. H. Hong

Vice President
System LSI Business
Samsung Electronics

Samsung is the second largest semiconductor manufacturer in the world and the second largest supplier to the China semiconductor consumption market.

How has China impacted your company over the past 10 years? What is different about your company regarding China?

In the 1990s, Samsung established a memory semiconductor back-end processing company in Suzhou in order to secure cost competitiveness. As the demand for semiconductors in China grew, Samsung further established a sales company and a manufacturing company to meet local demand.

Over the last decade, Samsung's growth has been mainly powered by LSI products (DDI, MCU, MOSFET, etc.). However, with the rapid growth of Chinese smartphone makers in the late 2000s, Samsung has been focusing on expanding the China business by means of developing products—such as Image, Mobile AP, etc.—unique to the needs of the China market.

Today, our main operations for the semiconductor business remain in Korea, while overseas production takes place in both the US and China. The growth rate in China, however, is very high compared to Korea and other countries, but operations of a foreign entitle are heavily regulated by government policies.

How has China impacted the semiconductor industry over the past 10 years? What is different about the industry regarding China?

There is no doubt that China has been the fuel for the growth of worldwide semiconductor market. In the past, China's contribution has mainly been from the supply perspective as the "world's factory". In recent years, however, it has been making a significant contribution as a consumer, with its vast domestic market size.

It can also be said that the most significant influence the China market has had on the semiconductor industry is driving down the average sales price (ASP). Recent market trends seem to indicate that price competitiveness between semiconductor vendors is among the highest in China.

How will China impact the semiconductor industry over the next five to ten years?

It is expected that China will continue to lead the growth of the worldwide semiconductor market for the next 5-10 years. Since the mobile market, represented by smartphones and tablets, will be leading the overall IT and electronics industry, local Chinese manufacturers threatening the Big 2 (Apple, Samsung) are expected to continuously increase their market share. It is also likely that Chinese

companies will again demonstrate strong market presence upon commodification of smartphones and tablets as it did with PC and feature phones.

In addition, there are a number of unique features specific to the Chinese market, design, standards and specifications. For the memory business, low-price smartphones and white label tablets constitute a high portion of the product mix. Consequently, solution products are in a greater demand than unit products are. It is currently in transition from LP2 to LP3. For the System LSI business, small- and medium-sized customers with their own communication standards prefer SoC solution chips to unit products. Turn-key solutions are in demand.

What factors influence, enhance and/or limit China's impact on the semiconductor industry and market?

The following two factors are expected to impact the China market from the consumption/manufacturing perspective:

- In terms of consumption, how quickly will China's domestic market be saturated?
- In terms of manufacturing, how quickly will the "world's factory" relocate to newly booming markets (such as Vietnam, India, etc.) from China?

What challenges and opportunities will China provide your company over the next five to ten years?

The target market for Samsung has been laid out clearly—it is China.

While the China market is a business opportunity for Samsung, competition is becoming more and more intense, with the vast majority of semiconductor companies competing in it. Succeeding in the China market will become less likely unless Samsung secures an absolute advantage and dominates the rapidly growing local Chinese semiconductor companies.

The future of our business hinges on whether we make a breakthrough in China for further growth.

Samsung is establishing what will be the most technically advanced and largest capital invested wafer fab in China (20nm NAND fab in Xi'an).

Why and how did Samsung decide to make this investment?

Requests from our customers were the main reason for our investment in China.

Global manufacturers in China frequently asked for a local supply of semiconductors, and Samsung itself raised concerns over the need to diversify its production base. Currently, electronic products are mostly produced in China, and Samsung is planning to actively support global IT companies in China and Chinese companies through the Xi'an fab.

Samsung chose Xi'an based on its proximity to key customers and the production/research bases of global IT companies. Samsung also expects it will be able to gain access to top level talent through the Xi'an fab. As a strategic location selected for the Western development program administered by the Chinese government, Xi'an has a relatively well-developed industrial infrastructure, including reliable electricity and water supplies, and is considered to have long-term development potential.

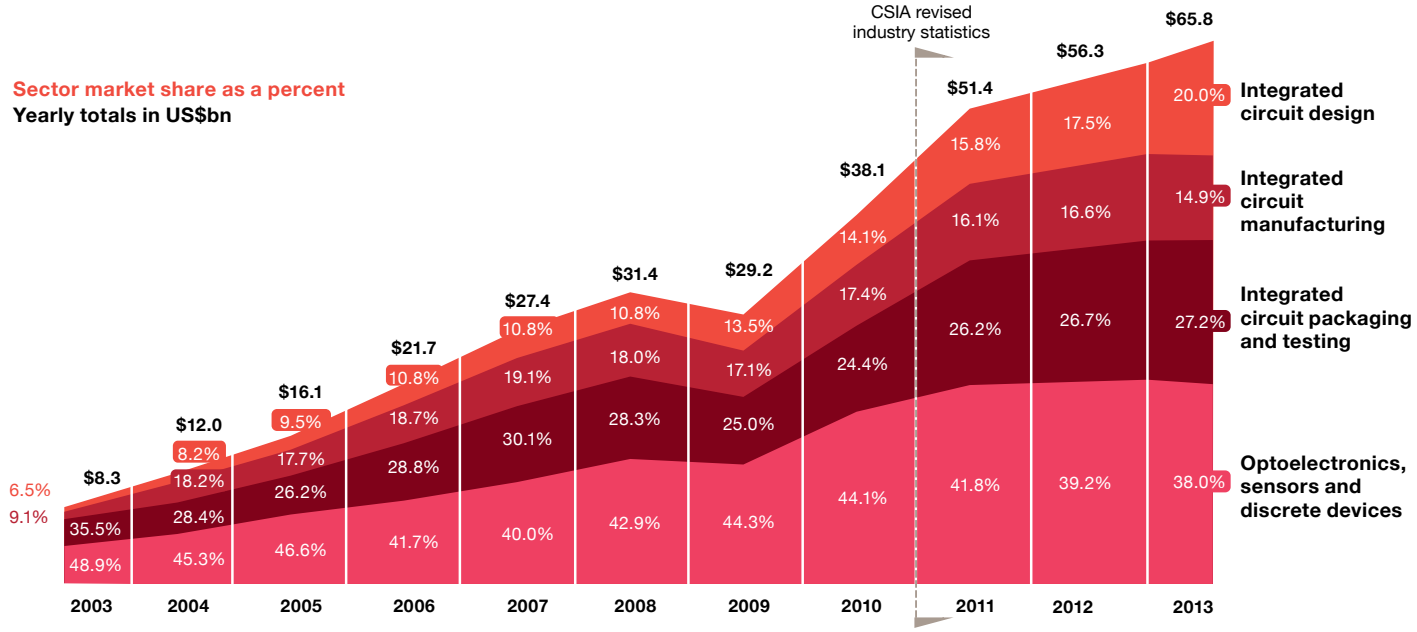
In terms of financing, while Samsung has been operating with capital investment without the use of local borrowing, some portion of the investment in the new fab in Xi'an is financed in China.

Where and how does Samsung plan to get the technologists needed to staff this fab?

One of the reasons Samsung chose Xi'an was its abundant source of labor and talent. Samsung expects that Xi'an will be able to fill the majority of its labor needs. To meet this objective, Samsung is already engaging with local colleges in Xi'an for operation of workforce development programs.

Today, our staff consists mainly of local hires. Secondees from headquarters are kept to the minimum level required to perform essential functions. Our manufacturing and foundry companies have reached over 99% of local hires while our sales companies have achieved an 80% rate for local hires.

Figure 11: China's semiconductor industry by sector 2003–2013



Source: CCID, CSIA

The distribution of China's industry has noticeably changed since our first report. Over the past ten years, from 2003 through 2013, the once very small IC design sector has grown at a 37.6% CAGR, the slightly larger IC manufacturing sector at a 29.2% CAGR, while the much larger O-S-D and IC packaging and testing sectors have only grown at a 20% CAGR. As a result, the IC design sector revenues have grown to exceed those of the IC manufacturing sector by an increasing amount since 2012, reorganizing the sector distribution from largest to smallest share of total industry revenue to the following in 2013:

1.	O-S-D devices	38.0%
2.	IC packaging and testing	27.1%
3.	IC design	20.0%
4.	IC manufacturing	14.9%

Source: PWC, CCID, CSIA

During the ten years for 2003 through 2013 China's three IC industry sectors have grown from 51.5% to 62% of China's total semiconductor industry.

As mentioned in our 2012 Update, we remain concerned that some of the industry and sector yearly and quarterly growth rates for the half decade before 2012 may be questionable because of the CSIA's inexplicable and significant October 2012 revision to the industry statistics for 2011 and 2012 year-to-date. However, we do believe the reported ten-year CAGR for China's semiconductor industry 2003 through 2013 remains reasonably representative.

IC and O-S-D consumption production gap and surplus

China's IC consumption/production gap increased again in 2013 to a new record annual high despite all the various government plans and efforts to contain it. This gap is the yearly difference between IC consumption and IC industry revenues. Based upon the most recent CSIA industry statistics, this annual gap grew by a further US$6.6bn (6.5%) in 2013 to reach US$108.2bn. During the ten-year span of our reports on China's semiconductor industry, this gap has grown from US$20.8bn in 2003 to US$108.2bn in 2013 by increasing every year except 2009. Further, depending upon how it is utilized, this reported gap may be understated or misleading for a couple of reasons. As explained in our appendix (available at www.pwc.com/chinasemicon), China's reported industry revenue values include some double counting of the value added by indigenous wafer foundries and/or package and assembly suppliers to the IC design sector revenues. Also, the gap does not adequately represent the difference between IC devices consumed in China versus those produced in China or, more specifically, those produced by indigenous Chinese companies. However, despite those caveats there have been some incremental improvements in the balance between China's IC consumption and production. The ratio of China's IC production revenue to IC consumption has shown some improvement. It had grown with yearly variability from

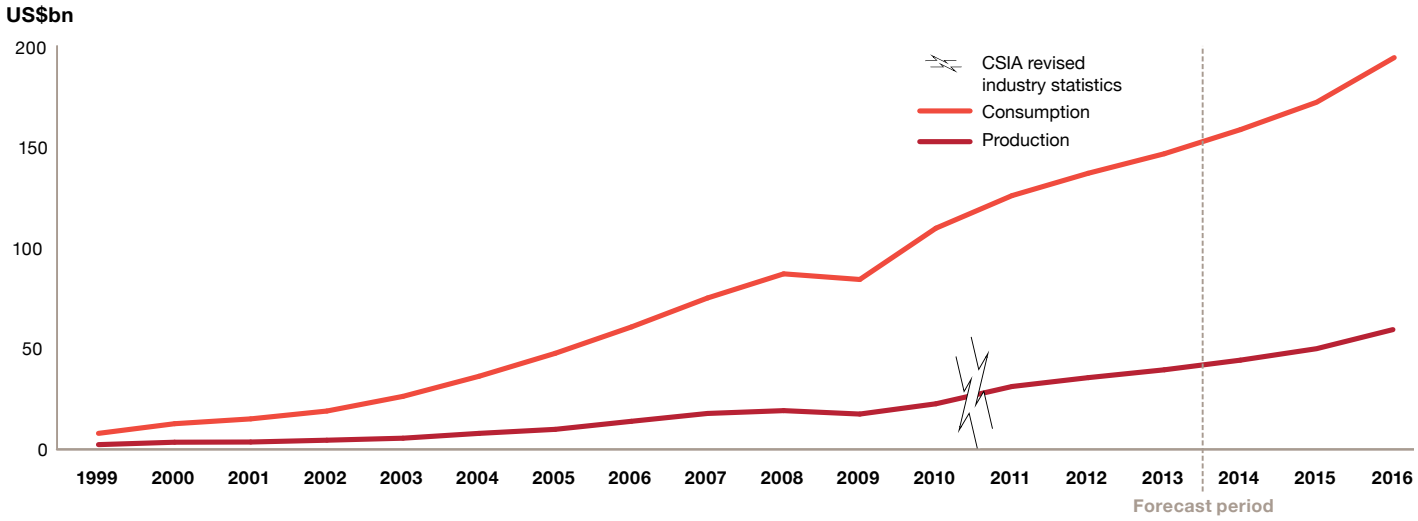
16% in 2001 to a peak of 22% in 2007 before declining slightly to 20% in 2008 and 2010. It is now reported to have grown to 24% in 2011, to 25% in 2012 and further to 27% in 2013. According to CSIA, this ratio is now expected to increase to 32% by 2016, which is up from the 28% they had forecast for 2015 a year ago. However, this will still result in a further increase in China's IC consumption/production gap. According to the CSIA 2014 report, China's IC market is forecast to grow to US$191bn by 2016, with IC industry revenue expected to reach US$61bn. This forecast implies a further widening of China's IC consumption/production gap to US$130bn despite all the Chinese government's plans and efforts to contain it. It is our belief that this gap continues to contribute to the Chinese government's ongoing initiatives to increase indigenous IC production.

According to the CSIA 2014 report, China's IC market is forecast to grow to US$191bn by 2016, with IC industry revenue expected to reach US$61bn.

Over the near term, China's IC consumption/production gap continues to represent an unparalleled market opportunity. But over the longer term, it represents a domestic industry void that will inevitability be filled. The question remains how will it be filled: will it be a combination of transfer and expansion of multinational companies or the emergence and growth of significant Chinese companies?

As discussed in our prior update, the only measure we have of China's O-S-D consumption versus production is an evaluation of what China's defines as their discrete sector which consists of discrete plus LED devices, but not other optoelectronic or sensor devices. This evaluation may be significant because it is so notably different from the IC consumption/production gap. Since 2005 there has not been a significant deficiency between China's reported discrete (including LED) production and consumption values. That difference has gone from a moderate US$374mn (5%) gap in 2005 to a modest surplus in 2008 and 2010 and now to significant surpluses of US$3.3bn (15%), US$ 1.9bn (9%) and US$2.2bn (10%) in 2011, 2012 and 2013. Although China's reported O-S-D sector revenues could be understated by as much as 7% since their reporting protocols do not include optoelectronics other than LEDs and sensors in the sector, that does not significantly change the relative sector growth measurements.

Figure 12: Comparison of China's integrated circuit consumption and production, 1999–2016



Note: Actual annual average FX rates used for 1999-2013, & 2013 average FX rate used for forecast 2014 - 2016

Source: CCID, CISA, PwC 2004–2012

Interview

John Peng

Senior Vice President
and General Manager
SMIC China Business Unit,
SMIC

Semiconductor Manufacturing International Corporation (SMIC) is a semiconductor foundry headquartered in Shanghai, China. SMIC is currently the largest and most advanced semiconductor foundry in mainland China and is the fifth largest semiconductor foundry worldwide.

How has China impacted your company over the past 10 years? What is different about your company because of China?

The continuous growth of the Chinese economy has greatly benefited SMIC over the past decade. China has gradually transformed itself from being a labor-intensive manufacturing country to a capital-intensive and value-added one. The demand for new technologies as well as effective and efficient manufacturing processes has increased. Over the years, numerous foreign electronic system vendors and semiconductor IC designers came to China to expand their operations locally and, most importantly, to capture the growing markets in China. Being able to continue to develop and offer needed manufacturing processes enabled SMIC to grow its business with these overseas customers and as their strategic partners in China.

On the other hand, Chinese system and fabless companies have also emerged to compete in both domestic and global sectors. The Chinese government's support policies to nurture China's domestic IC design ecosystem have also greatly benefited SMIC as many local IC designers select SMIC as their preferred foundry partner.

SMIC is an international and independent pure-play foundry with established worldwide offices in China, the US, Europe, Japan and Taiwan. SMIC's main foundry operations are conveniently located in Shanghai, Beijing, Tianjin and Shenzhen in China. With its locations close to major cities and key electronics manufacturing and IC design sites, SMIC has the largest pure-play semiconductor foundry operations in China when compared to other leading foundries. This unique position of being in China enables SMIC to better service both overseas and domestic customers' needs to operate in China.

How has China impacted the semiconductor industry over the past 10 years? What is different about the industry because of China?

China has approximately 1.36 billion citizens, which is close to 19% of the world's population. This represents an enormous market and huge demands for electronics goods; however, not all Chinese consumers could afford high priced electronics in the past. The demand for affordable goods provided great opportunities for local Chinese system vendors and IC designers to develop products and services to satisfy cost sensitive markets. This becomes more significant as the market transitioned from the PC era to the mobile computing era over the past decade. The growth of China's domestic electronic system vendors and IC designers has greatly impacted China's semiconductor industry developments and its position in the global market.

Besides China's large population and the advantage of specific targeted market segments, China has also driven the semiconductor market in its own unique ways through governmental policies that increase the competitiveness of local ecosystems. For instance, governmental policies have driven the growth of IC designers in the Telecommunications and Wireless chipsets (e.g.,TD-SCDMA), smartcards, bank cards, smart metering, etc. Many of these segments were closely related to local policy making and were constructively designed to give Chinese IC designers opportunities or an equal footing to compete against foreign counterparts. On the other hand, governmental funding for electronics and white goods has also driven and helped many local system vendors to open up domestic markets and has indirectly helped local IC designers as well. A series of electronics and white goods replacement programs for metropolitan areas were also designed to drive economic growth and consumer purchases. Moreover, central government programs to fund and to support local IC designers have also stimulated the growth of the domestic semiconductor industry. In short, local and central governmental support has greatly influenced the growth of China's semiconductor industry over the past decade.

Aside from governmental policies, another perspective is that the scale of China's investment in the semiconductor industry has been growing for the past decade.

How will China impact the semiconductor industry over the next five to ten years?

Today in China, there are well over 600 fabless IC designers competing not only for the Chinese market, but also against foreign players in the global market. Right now, we are seeing more integration among Chinese IC designers to better prepare themselves to compete in the global market. Also, we are seeing increasing demands on mobile computing devices, IoT (Internet of Things), automotive electronics and medical devices. China's domestic IC supply is expected to still fall short of meeting its IC demands. Through government funds, various investment programs and loan programs, China is expected to grow its semiconductor industry even further.

What factors influence, enhance, and/or limit China's participation and impact on the semiconductor industry and market?

As system vendors and IC designers continue to be more demanding on technology availabilities and manufacturing capacities, upstream players such as foundry suppliers will need to catch up with the technology developments and offerings that are essential to support the downstream demands. Companies in China need to invest more in R&D capabilities to shorten or to close the technology gap against the industry leaders. Moreover, it is essential for China to have a strong and committed capital investment throughout a long period of time to cultivate the business environment as well as the technology development cycles. More collaboration across local industries and supply chains shall take place to enhance the competitiveness of the domestic ecosystem.

What challenges and opportunities will China represent for your company over the next five to ten years?

There are some anticipated challenges and opportunities for the upcoming decade:

- Developing well-planned roadmaps and matching technologies to capture customers' design window and market demands.
- Investing in talent and technologists in the foundry industry to advance research and development efforts; acquiring more talent and cultivating innovative ideas will be increasingly important.
- Collaborating with local material suppliers, equipment vendors, design and IP services, OSAT (outsourced semiconductor assembly and testing), etc. to strengthen local eco-systems and shorten customers' cycle times.
- With rising environmental challenges, SMIC must continue to tighten its EHS (Environmental, Health and Safety) policies to meet regulation standards and to keep our operations green for environmental protection.

SMIC has been one of China's larger and leading semiconductor manufacturers for several years. How has SMIC contributed to local technology; academic; and R&D development?

SMIC contributes to local technology in many aspects. As one of the leading foundries in the world, SMIC continues to develop advanced technology and offer specialized technology to meet growing customer demands. With SMIC's continuous efforts in technology offerings, domestic IC designers can enjoy the technology availabilities to design and manufacture in China and to compete in the worldwide market. Over the past 10 years, SMIC's revenue from Chinese customers has grown at nearly 34% CAGR from 2004, which is quadruple the pure-play foundry industry's average growth.

Besides our technology competencies and offerings, SMIC has also increased its alliances with domestic equipment and materials vendors to cultivate the local supply chain and ecosystems. Over the past five years, SMIC has greatly increased its equipment purchases with local suppliers, at nearly 56% CAGR in terms of domestic equipment quantities and close to 67% CAGR in terms of equipment dollar values. SMIC also has dedicated engineering teams to collaborate with local equipment vendors and material suppliers to improve the quality of their products and services as well as regularly hosting troubleshooting sessions and developing case studies to resolve actual engineering issues and work together for future solutions. This is part of SMIC's pledge and dedication to be part of the ecosystem and to support the local semiconductor industry.

Moreover, in the academic and research domains, SMIC has been actively establishing and participating in university programs and collaborating with local government programs to both nurture the next generation of talent as well as design future R&D developments and directions. In fact, SMIC actively participates to support China's national projects, to conduct research and development on advanced process technology platforms and modeling and to co-share the successful results and IP developments, and to increase the talent pool with master and PhD educational programs.

Has this status made SMIC a highly preferred employer for new university graduates?

Certainly, for many, SMIC is considered as a leading entity in today's Chinese semiconductor manufacturing ecosystem. We are not only attracting talent domestically, but also gaining more international talent.

Section 2: IC design and manufacturing

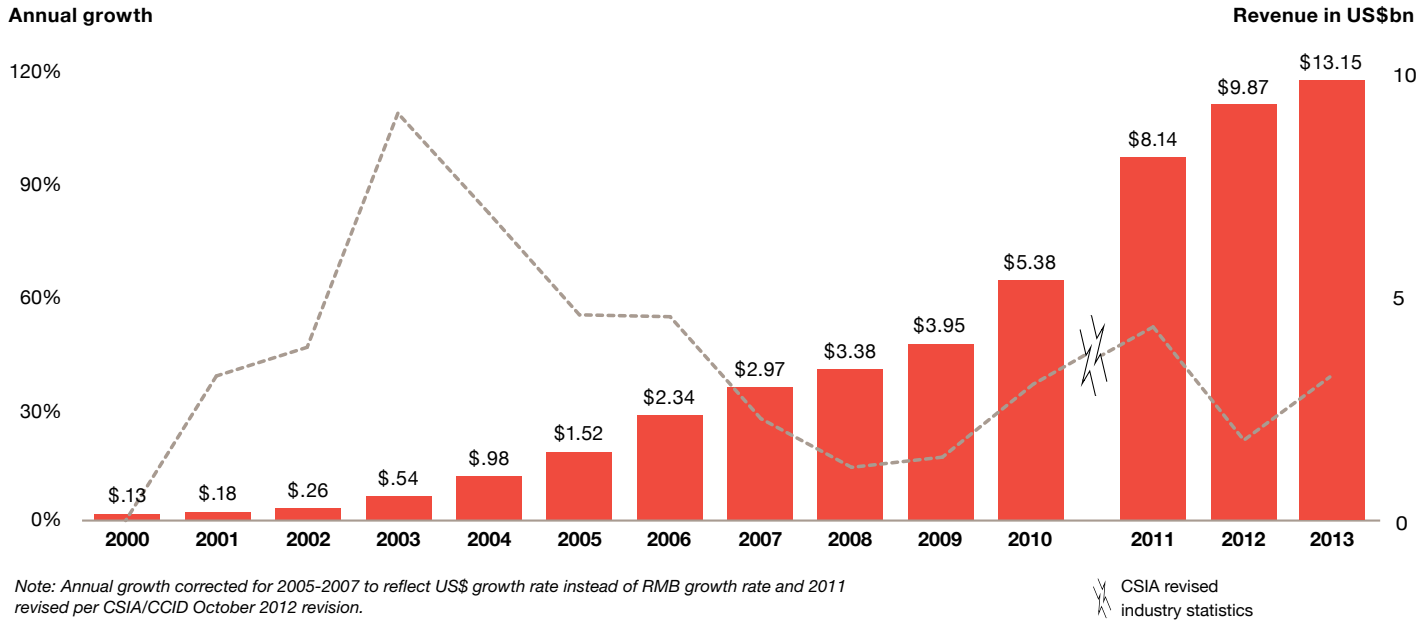
IC design in China

Integrated circuit (IC) design continues to be the fastest growing segment of China's semiconductor industry. It grew by 33% in 2013 to reach record revenues of US$13.2bn. During the ten years from 2003 through 2013 China's IC design (fabless) industry has grown at a 37.6% CAGR from US$541mn to over US$13bn. Measured in US dollars, IC design sector revenue contributed more than 37% to China's semiconductor industry revenue growth in 2013 and has grown to represent 20% of China's total semiconductor industry.

In addition, China's IC design sector was responsible for about 39% of the output of China's IC manufacturing (wafer foundry) sector and 11% of the output of China's IC packaging and testing sector. In total, China's IC design sector was responsible for about 29% of China's semiconductor industry revenue in 2013.

During the last ten years China's IC design industry has grown from representing just 0.4% of the worldwide IC market and 2.5% of the worldwide fabless IC industry in

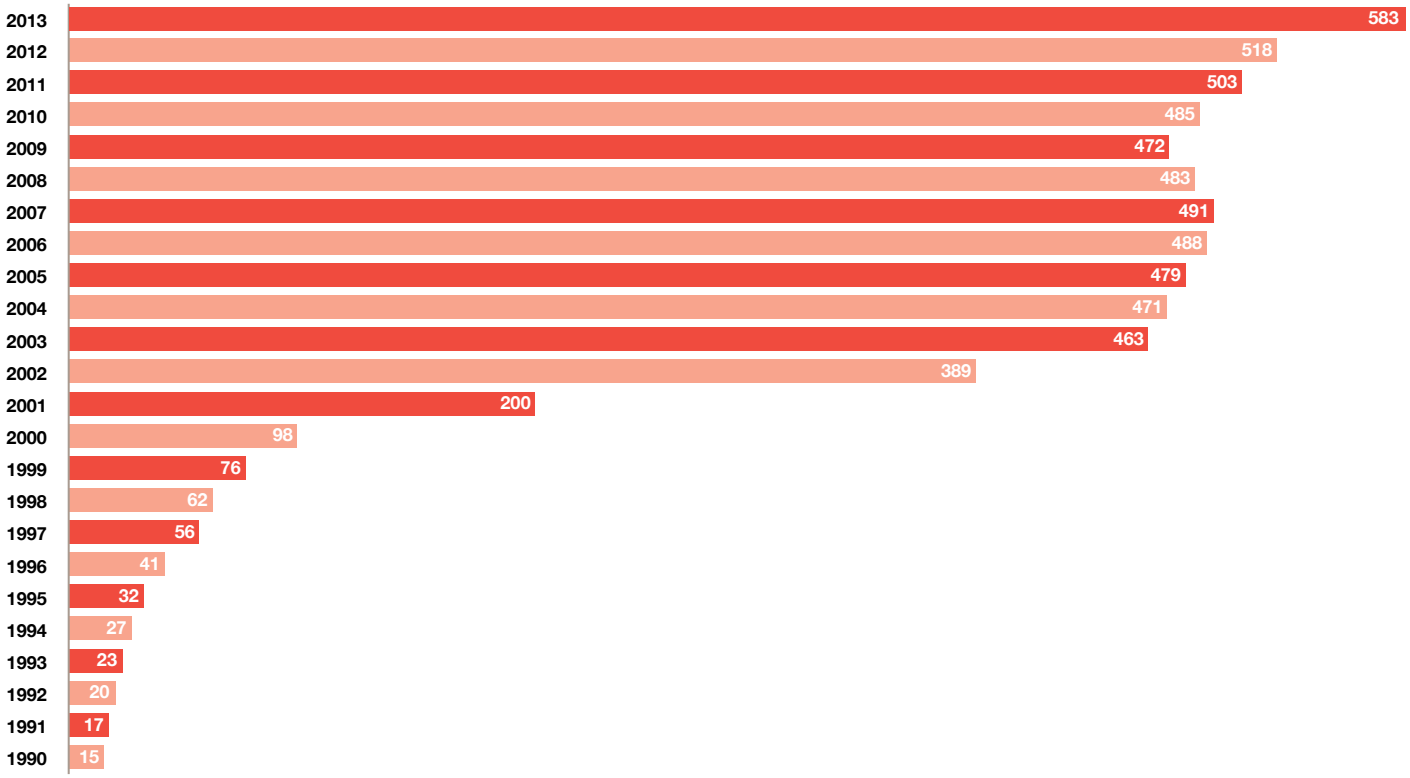
Figure 13: China's IC design industry revenue and growth, 2000-2013
(Total worldwide in US$bn)



Note: Annual growth corrected for 2005-2007 to reflect US$ growth rate instead of RMB growth rate and 2011 revised per CSIA/CCID October 2012 revision.

Source: China Center of Information Industry Development (CCID), China Semiconductor Industry Associates (CSIA)

Figure 14: Number of IC design enterprises in China, 1990-2013



Source: CCID

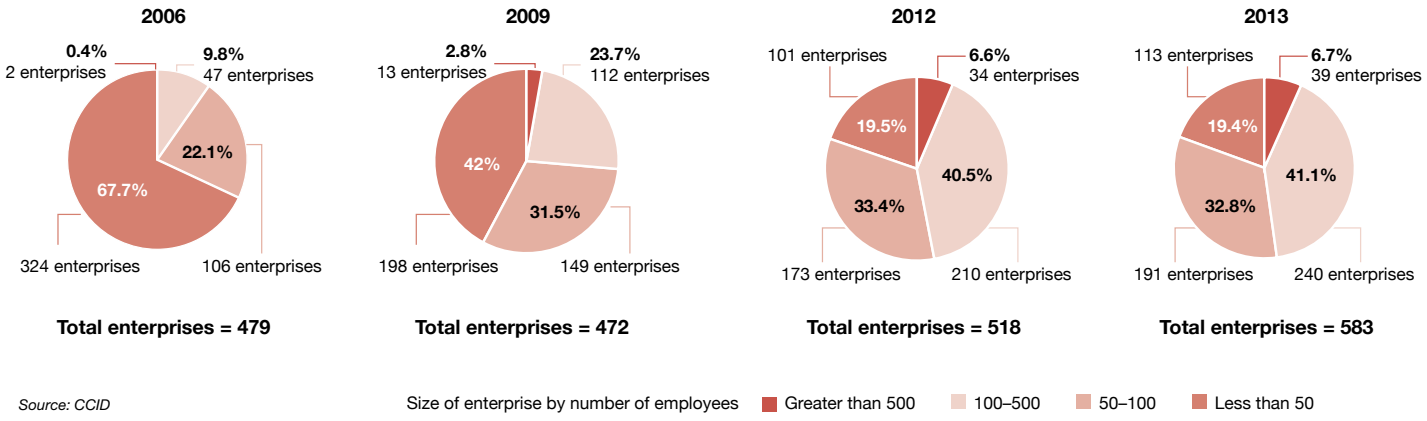
2003 to representing almost 5% of the worldwide IC market and 17% of the worldwide fabless IC industry in 2013.

China's IC design industry remains somewhat less concentrated than the worldwide industry. China's 2014 top ten IC design companies accounted for 43% (US$5.6bn) of China's 2013 IC design revenues while the worldwide top ten fabless semiconductor companies accounted for 65% of worldwide 2013 fabless IC revenues.

For most of the same reasons discussed in the 2012 update (growth of China's local electronic equipment manufacturers, increasing need for IT infrastructure from government, continuing improvement of cost and performance, low gross margins, high agility in terms of product cycles and volumes and favorable government industrial policy environment), CCID's latest forecast is for China's IC design sector industry to grow by a 21.9% CAGR over the next three years to reach US$23.8bn by 2016. If this forecast is realized, China's IC design sector would represent almost 22% of worldwide fabless semiconductor revenues and slightly more than 5% of the worldwide IC market.

According to CCID, the number of China's IC design enterprises increased from 518 in 2012 to 583 by the end of 2013. That increase of 65 additional IC design enterprises during 2013 is by far the largest net increase in the last ten years. However, it has been exceeded at least three times in China's earlier semiconductor history by the reported increase of 111, 189 and 74 IC design enterprises in 2001, 2002 and 2003. There is some consideration that this increase is not a measure of new design enterprises established in 2013, but rather it is a measure of new design enterprises counted and reported by CCID in 2013. Regardless, it is relatively certain that the number

Figure 15: China's IC design enterprises by employee count, 2006-2013



Source: CCID

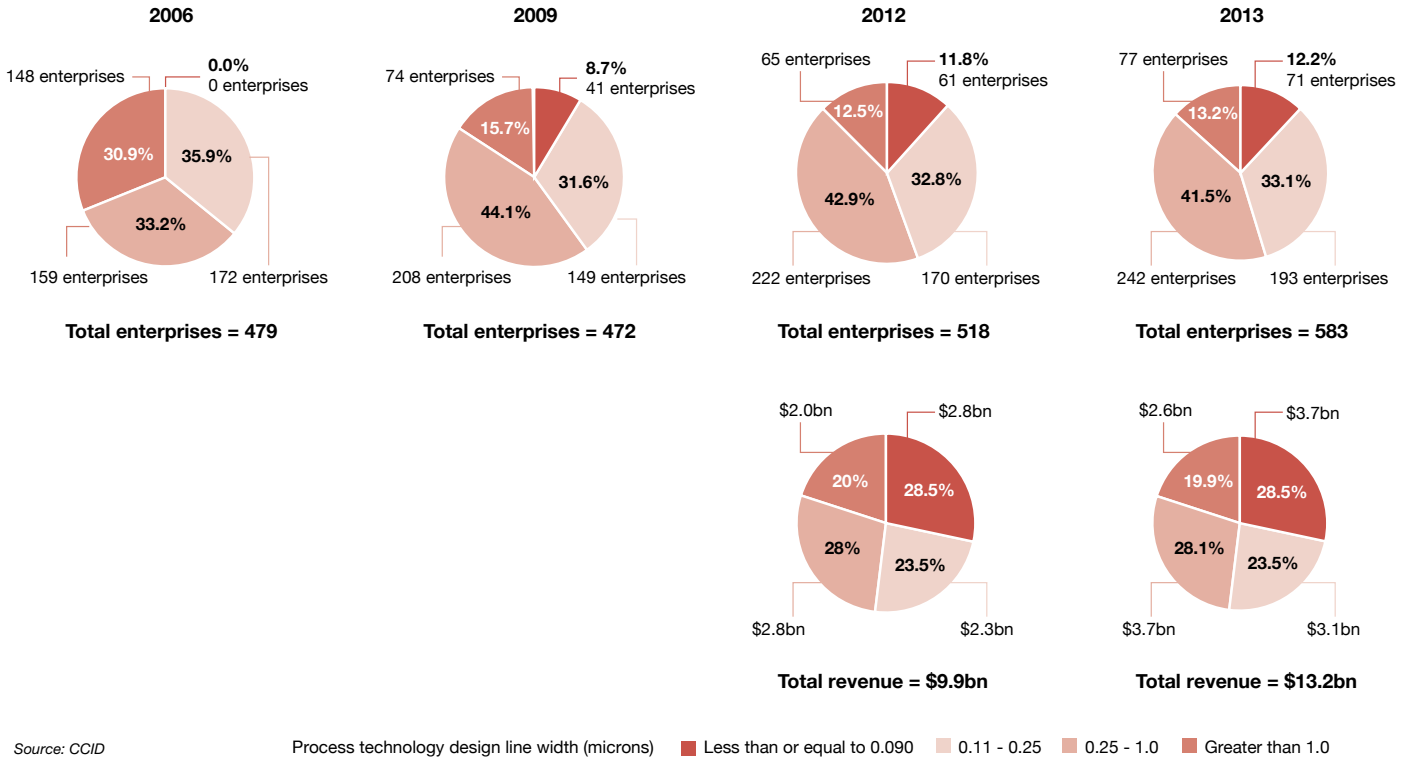
Employment growth in China's IC design sector increased with the significant addition of IC design enterprises in 2013.

of reported IC design enterprises increased from less than 500 in 2010 to more than 580 in 2013. It is reported that this increase is a consequence of the encouragement of the Chinese government policy offering tax incentives to promote the development of its semiconductor industry since the implementation of its 12th Five-Year plan in 2011. However, it is also reported that a number of new IC design companies set up during the past three years were mostly small-scale operators without much competitiveness. As we discussed in the 2012 update, there continues to be considerable scepticism about the size and make-up of this group of 583 enterprises as well as a great diversity among this group of enterprises. It is still estimated that there are no more than 100, possibly less, local indigenous IC design enterprises that are truly viable fabless semiconductor companies.

Of the 583 IC design enterprises reported at the end of 2013 as many as 240 could be the design or research and development (R&D) units or activities of foreign invested or subsidiary multinational companies (MNC). Of this group, PwC analysis has identified over 238 participants. The group is spread across the more than 280 multinational semiconductor companies and the 100 largest semiconductor-consuming OEM/ODMs identified in the Gartner market share databases. Over the past ten years this group has grown and become a bit more concentrated among the smaller companies. It includes the Chinese design activities of 16 of the top 25 semiconductor companies and 17 of the top 25 semiconductor consuming OEM/ODMs.

Employment growth in China's IC design sector increased with the significant addition of IC design enterprises in 2013. The total number of employees in the IC design sector increased by 14% in 2013 to about 128,000 with the distribution shifting slightly to the larger companies with more than 500 employees. This relative stability in employee density, resulting from the 12.5% increase in the number of enterprises and 14% increase in the number of employees, along with a significant, 33% increase in US dollar revenue, resulted in a slight 1.2% increase in the average number of employees per enterprise and a noteworthy 17% increase in average sales per employee productivity to US$103,000. As discussed in the 2012 update, the only relevant comparison of company employee productivity we have been able to make is of the nine

Figure 16: China's IC design industry by process technology, 2006-2013



Source: CCID

Chinese fabless companies that are included in the Global Semiconductor Alliance (GSA) Global Financials Report for 2013. The average 2013 sales per employee productivity of those nine Chinese fabless companies was US$236,000, which was a surprising 23% lower than a similar 2012 average and only 40% of the GSA report's average of US$594,400 for 171 worldwide fabless companies. Six of the eight Chinese fabless companies reported in 2012 had an increase in employee productivity in 2013. The two remaining companies reported in 2012 had decreases in 2013 employee productivity because they had decreases in revenues with increases in employees. Both the one Chinese IC design company absent from the GSA report for 2013, Spreadtrum Communications, and the one added to the GSA report for 2013, Montage Technology, had above-average employee productivity; but because of its much larger relative size, the absence of Spreadtrum caused the 2013 average of the nine GSA reported Chinese fabless companies to decline. Spreadtrum was absent from the GSA 2013 report because it was acquired by Tsinghua Unigroup during 2013.

China's IC design industry continued to make some reportable qualitative improvements during 2013, including a modest further migration to finer design line widths. According to CCID and CSIA, the number of design enterprises with design capabilities equal to or less than 0.25 microns increased by 14% in 2013 to represent slightly more than 45% of IC design enterprises, up from slightly less than 45% in 2012 and 43% in 2011. Seventy-one (71) of these enterprises had design capabilities for equal to or less than 90 nanometers, ten more than in 2012, and several have developed 40 nanometer phone chips.

During the last ten years the composition of China's IC design industry experienced considerable change as the sector's revenue grew by more than 24 fold.

During the last ten years the distribution of China's IC design industry's technology capabilities has become somewhat more divided between mature and advanced. The share of China's IC design enterprises with capabilities of equal to or greater than 0.35 microns has increased from 34% in 2003 to 54% in 2013; and the share with capabilities between 0.11 to 0.25 microns has decreased from 65% in 2003 to 33% in 2013, while the share with capabilities of equal to or less than 0.09 microns has grown to 13% in 2013.

During the last ten years the composition of China's IC design industry experienced considerable change as the sector's revenue grew by more than 24 fold US$541mn to US$13,150mn. In our initial report, we included a table (Table 4) that detailed "a select number of the fabless and contract IC design companies that appear to have competitive product lines and documented design wins—no company's (2003) revenue exceeded US$74mn." Of the eighteen companies included in that table only one, Datang Microelectronics, continued on to be part of a new merged company, Datang Semiconductor Design, that was one of China's 2014 top five IC design companies.

Datang Semiconductor Design, which was created from the 2013 merger of Datang Microelectronics and Leadcore Technology, was ranked fourth by the CSIA among China's 2014 top IC design companies based upon reported 2013 revenues of US$395mn. The other 2014 top five IC design companies only became recognized during the past decade.

HiSilicon Technologies, which was ranked first with 2013 reported revenues of US$2,120mn, was the former chip R&D center of the Huawei Company that was spun out in 2005. HiSilicon, which has considerable experience in telecom ASIC device R&D with capabilities of designing at the 0.11µm technology node, rapidly rose to rank first among China's IC design companies by 2007, a position it has maintained since then. A significant portion of its reported revenues are earned from servicing its parent, Huawei Company.

Spreadtrum Communications, which was ranked second, with reported 2013 revenues of US$1,013mn, was first reported in our 2006 update with 2004 revenues of US$16mn. It has maintained a sporadic, but overall fast growth for many years with vision and vitality in the development and marketing of mobile chipset platforms for smartphones, feature phones and other consumer electronics products, supporting 2G, 3G and 4G wireless communications standards. Spreadtrum holds a sizable market share in GSM/GPRS baseband chips and is making headway in the TD-SCDMA baseband segment. Spreadtrum, along with RDA Microelectronics, was recently acquired by Tsinghua Unigroup Ltd, an operating subsidiary of Tsinghua Holdings Co., Ltd., a solely state-owned limited liability corporation funded by Tsinghua University in China.

RDA Microelectronics, which was ranked third with reported 2013 revenues of US$455mn, was first reported in our 2009 update with 2007 revenues of US$14mn. RDA is China's RF IC leader. The company, which shipped its first product in 2005, researches, designs, develops, produces and sells radio frequency chips, power amplifiers, transceivers, front-end modules and mixed-signal system chips domestically and internationally. RDA Microelectronics also offers technical advisory services. RDA has recently agreed to be acquired by Tsinghua Unigroup Ltd., but the closing date has been postponed until the second half of 2014 in what is reported to have become a somewhat controversial set of transactions.

Beijing Nari Zhixin Microelectronics Technology (Beijing Nari Smart Chip (or IP Core) Microelectronics Co., Ltd.), which ranked fifth with reported 2013 revenues of US$350mn, is being reported for the first time in this 2014 update. NARI IP Core is the member of the NARI Group mainly engaged in chip devices, terminals, applications and design, development, production and sales and engineering services of integration solutions. NARI Group Corporation (NARI) is the largest whole set supplier of electric power equipment in China and is an active player in the global power industry. NARI is dedicated to providing technologies, products, services and total solutions for customers in other fields such as industrial control, energy and railway transportation. It is the only domestic power system company engaged in IC design. After four years of development, NARI IP Core has a team of more than 300, an automated chip production plant of 10,000 square meters, capabilities of advanced integrated circuit design at the 65 and 55 nm technology nodes, analysis, testing, custom chip design and services. Since 2010, NARI IP Core has successfully tapped out 21 SOC (system on a chip) chips (of which 10 models were tapped out in 2013) and 50 ICs of various types with strategic planning for four product lines: security; hosting; identification; and communications based on the field of intelligent electricity and radiating to other industries and fields.

Three other companies from the eighteen in our original report table continue on to be reported among China's 2014 top ten IC design companies. Hangzhou Silan Microelectronics was ranked sixth, with 2013 reported revenues of US$293mn; Beijing Vimicro was ranked ninth, with reported revenues of US$250mn; and CEC Huada Electronic Design was ranked tenth, with reported revenues of US$171mn. A different company, Shenzhen ZTE Microelectronics Technology, from the eighteen in our original report, is reported by CCID Consulting to be tenth among China's IC design companies with 2013 revenues of US$249mn. The remaining two of China's 2014 top ten IC design companies that only became recognized during the past decade were: China I.C. Design, ranked seventh, with reported revenues of US$291mn, was first reported in our 2005 update with 2004 revenues of US$55mn; and Galaxycore ranked eighth, with reported revenues of US$275mn, first reported in our 2011 update, with 2009 revenues or US$62mn.

Of the eighteen companies included in our original report's *Table 4: Select Chinese fabless and contract IC design companies*, 11 companies, including the five described above, continue to be recognized and reported among our table of Major Chinese semiconductor companies by revenue, with 2013 revenue exceeding US$61mn. The remaining seven companies have completely disappeared from view.

Chinese semiconductor companies

Table 4 lists the top 50 Chinese semiconductor companies that had the largest revenues in 2013. By definition, the companies on the list are the largest indigenous Chinese companies that design, manufacture (or have manufactured, the legal term for outsourcing), market and sell semiconductor devices. Therefore, neither foundries nor packaging and testing companies are included on the list. They, along with foreign semiconductor companies manufacturing in China, are included in a table later on in our report.

The threshold for inclusion in this 2013 listing has increased to US$52mn, up 4% from the US$50m used for the 2012 listing. Five companies qualified for inclusion on the 2013 listing for the first time, and one returned after a year's absence. They include three IC design companies, two discrete LED companies and one returning IDM (integrated device manufacturer). One of the new IC design companies was the result of a merger of two previously listed companies. The combined reported dollar revenues of the continuing 47 of these top 50 Chinese semiconductor companies increased by 39.2% in 2013, which is much higher than the 16.7% increase reported by China's total semiconductor industry. During 2013, these top 50 companies accounted for a record 16% of China's total semiconductor industry revenues. They accounted for 56% of China's IC design (fabless) revenues, but only 11% of discrete revenues and 8% of IDM and foundry revenues.

During the past ten years, our table listing of the top Chinese semiconductor companies has grown from 26 companies with average revenue of US$39mn first listed in the 2005 update to the 50 companies with average revenue of US$226mn listed in this 2014 update. The revenue of the largest listed company increased more than twenty times from US$93mn in 2004 to US$2,120mn in 2013, while that of the smallest listed company increased three and a half times from US$15mn to US$52mn. Only two of the current top ten Chinese semiconductor companies, Datang Semiconductor Design and Hangzhou Silan Microelectronics, were among the top Chinese semiconductor companies listed in the 2005 update. Nine other of the companies listed in the 2005 update are among the remaining companies in the current listing of top Chinese semiconductor companies. Tianjin Zhonghuan Semiconductor Co., Ltd., which had been listed in the 2005 update and subsequent updates through the 2013 update, was not included in the listing of top Chinese semiconductor companies as it was determined that the majority of its revenues were semiconductor materials business revenues and its semiconductor device business revenues did not meet the threshold for inclusion.

Table 4: Major Chinese semiconductor companies by revenue, 2013

	Rank		Sales revenue (RMB:100mn)				Revenue (US$mn)		
Name of company	2012	2013	2012	2013	Change	Sector	2012	2013	Change
HiSilicon Technologies Co., Ltd.	1	1	74.19	130.40	75.8%	●	1178	2,120	80.0%
Spreadtrum Communications Inc.	2	2	43.83	62.30	42.1%	●	696	1,013	45.6%
RDA Microelectronics, Inc.	3	3	24.69	28.00	13.4%	●	392	455	16.2%
Datang Semiconductor Design Co., Ltd.		4	18.92	24.00	26.8%	●	300	390	29.9%
Beijing Nari Smart Chip Microelectronics Co., Ltd.		5		21.50		●		350	
Sanan Optoelectronics	5	6	16.40	21.40	30.5%	▲	260	348	33.7%
No. 55 Research Institute of China Electronics Technology Group Corporation	4	7	19.70	20.05	1.8%	▼	313	326	4.3%
MLS Co., Ltd.	16	8	9.40	19.60	108.5%	▲	149	319	113.6%
Hangzhou Silan Microelectronics Co., Ltd.	6	9	12.64	18.00	42.4%	●	201	293	45.9%
Galaxycore Inc.	7	10	11.80	16.80	42.4%	●	187	273	45.8%

● Design (Fabless) ▲ Discrete (LED) ▼ IDM ⬣ Discrete

Name of company	Rank 2012	Rank 2013	Sales revenue (RMB:100mn) 2012	Sales revenue (RMB:100mn) 2013	Change	Sector	Revenue (US$mn) 2012	Revenue (US$mn) 2013	Change
Xi'an Microelectronics Technology Institute	52	11	2.16	15.90	635.4%	▼	34	259	653.4%
Beijing Vimicro Co., Ltd.	12	12	11.00	15.40	40.0%	●	175	250	43.4%
Shenzhen ZTE Microelectronics Technology Co., Ltd.	10	13	11.50	15.32	33.2%	●	183	249	36.5%
Fuzhou Rockchip Electronics Co. Ltd.	23	14	7.88	15.07	91.4%	●	125	245	96.0%
Jilin Sino Microelectronics Co., Ltd.	14	15	10.55	12.50	18.4%	⬣	168	203	21.3%
Shenzhen Netcom Electronic Co., Ltd.	17	16	9.37	12.19	30.1%	●	149	198	33.2%
Allwinner Technology	13	17	10.58	11.68	10.4%	●	168	190	13.0%
Elec-Tech International Co., Ltd.	15	18	10.27	10.52	2.4%	▲	163	171	4.9%
CEC Huada Electronics Design Co., Ltd. (HED)	18	19	9.36	10.50	12.2%	●	149	171	14.9%
Wuxi China Resouces Huajian Microelectronics Co., Ltd.	19	20	8.68	9.59	10.5%	▼⬣	138	156	13.2%
Foshan Nationstar Optoelectronics	21	21	9.00	9.00	0.0%	▲	143	146	2.4%
Suzhou Good-Ark Electronics Co., Ltd.	31	22	8.07	8.25	2.2%	⬣	128	134	4.7%
Wuxi China Resources Semico Co., Ltd.	27	23	6.30	8.12	28.9%	●	100	132	32.1%
Shandong Inspur Huaguang Optoelectronics Co., Ltd.	32	24	6.00	8.00	33.3%	▲	95	130	36.6%
Shanghai Fudan Microelectronics Co., Ltd.	26	25	6.74	7.89	17.1%	●	107	128	19.9%
GigaDevice Semiconductor	29	26	6.11	7.87	28.8%	●	97	128	31.9%
Shenzhen Jufei Optoelectronics Co., Ltd.		27		7.50		▲		122	
Xiamen Hualian Electronics Co., Ltd.	25	28	6.60	7.29	10.5%	▲	105	119	13.1%
Montage Technology Group Ltd.	34	29	4.93	6.82	38.3%	●	78	111	41.7%
Shanghai Huahong IC Co., Ltd.	22	30	6.68	6.77	1.3%	●	106	110	3.8%
Fosham Blue Rocket Electronics Co., Ltd.	30	31	6.07	6.71	10.5%	⬣	96	109	13.2%
Shanghai Epilight Technology Co., Ltd.	35	32	4.70	6.20	31.9%	▲	75	101	35.1%
Shenzhen Refond Optoelectronics Co., Ltd.	33	33	5.00	6.82	36.4%	▲	79	111	39.7%
Beijing Huadazhibao Electronic Systems Co., Ltd.	41	34	4.00	5.20	30.1%	●	63	85	33.3%
Guangzhou Hongli Opto-Electronics	40	35	4.90	5.00	2.1%	▲	78	81	4.6%
Changelight Co., Ltd.	44	36	3.70	4.90	32.4%	▲	59	80	35.7%
Chengdu Yaguan Electronic Co., Ltd.	37	37	4.22	4.66	10.5%	⬣	67	76	13.1%
Shantou Huashan Electronic Device Co., Ltd.	39	38	4.17	4.61	10.6%	⬣	66	75	13.3%
China Electronics Science & Technology Group Company No. 58 Institute	42	39	3.98	4.40	10.5%	⬣	63	72	13.2%
Shenzhen State Micro Technology Co., Ltd. (SMIT)	9	40	4.47	4.37	-2.4%	●	71	71	0.0%
Tongfang Microelectronics Company	48	41	3.32	4.32	30.0%	●	53	70	33.1%
Nationz Technologies Inc.	43	42	4.28	4.31	0.7%	●	68	70	3.2%
Silergy Semiconductor Technology(Hangzhou) Co., Ltd.		43		4.31		●		70	
Actions Semiconductor Co., Ltd.	47	44	3.40	4.24	24.7%	●	54	69	27.7%
Aqualite LED Ltd.		45	3.10	3.90	25.8%	▲	49	63	28.9%
Forward Semiconductor Company	45	46	3.49	3.86	10.5%	⬣	55	63	13.2%
Yangzhou JingLai Semiconductor (Group) Co., Ltd.	46	47	3.40	3.76	10.5%	⬣	54	61	13.2%
ShenZhen Si Semiconductor Co., Ltd.	36	48	4.32	3.75	-13.2%	⬣	69	61	-11.1%
Beijing MXTronics Co., Ltd.	38	49	4.21	3.53	-16.2%	●	67	57	-14.2%
Wuhan HC SemiTek Co., Ltd.	49	50	3.30	3.20	-3.0%	▲	52	52	-0.7%

● Design (Fabless) ▲ Discrete (LED) ▼ IDM ⬣ Discrete

Source: CSIA, CCID, GSA. Gartner, PwC

Interview

Rick Clemmer

President and CEO
NXP Semiconductors NV

NXP has been one of the ten largest suppliers to the China semiconductor market for eight of the last ten years. NXP has three manufacturing operations in China, including the first multinational established wafer fabrication enterprise.

How has China impacted your company over the past ten years? What's different about your company because of China?

Well, our most significant growth engine has come out of China. It depends on how you define China. But if you define China as Greater China, including Taiwan, roughly half of our revenue comes from Greater China.

It's a very significant market for us. One that we pay a lot of attention to and one that has been a significant growth driver for us. Over the last three years we've doubled our revenue in China.

On a growth basis, China, not including Taiwan, would probably be higher. It would be obviously a little lower of a percentage of our total revenue. But it would still be 36% to 38% that goes into China. I'm talking about shipments into China. The NXP value consumed in China could be even higher than 50%.

How has China impacted the semiconductor industry over the past ten years? What's different about the industry because of China?

The huge growth opportunity that has existed within China has been a major catalyst for the whole industry and the industry has taken advantage of that and participated in that.

Obviously, a number of goods produced in China get shipped to the rest of the world. But nevertheless, a great deal of the consumption actually takes place in China. And so it has a significant influence on the overall process.

If you include joint ventures, we have around 8,000 of our roughly 25,000 people located in China. So we don't have a disproportionate share because we still have a lot of our manufacturing outside of China, even though we have a large assembly test plant in Guangdong.

We do have a large sales and sales support operation in China. And, yes, there are definitely designs or application-specific efforts that we make that are unique because of China. We do have some designs specifically for the Chinese market, a result of their unique standards.

It's hard to say if China has had any impact on pricing. I think that semiconductor pricing is notorious. I mean, semiconductor companies are notorious for poor pricing in any case, so, I think maybe that China has potentially accelerated some of that. But I don't know that I would say that it's had an absolute impact because the industry doesn't do a great job of pricing to value in any case.

How will China impact the semiconductor industry over the next five years or ten years?

That remains to be seen. I think that the consumption in China will continue to outgrow the rest of the market, to have a higher growth rate, so it will continue to have a larger share of consumption in the semiconductor industry as we go forward.

China will have a larger share of the semiconductor industry as well, so we'll have significant influence associated with that. The reason I say it remains to be seen is, you know, clearly the participation or direction by the government could have an influence on what happens in the semiconductor industry in China.

I think that it truly remains to be seen over the next half decade to decade what impact China will have and I think that the worldwide semiconductor industry is aggressive enough on innovation that it can potentially continue to stay ahead of any of the requirements of the so-called local Chinese companies.

But I think Western companies, European and US companies, are going to have to figure out if there's a different way to do business in China when you start to talk about a decade out as well.

I think there will be differences, but it all remains to be seen. We participate in China as a direct sales vehicle, as a manufacturing entity and as a joint venture. So we're trying to be sure that we participate in China as a good Chinese citizen.

As I've said before, we'd like to be sure that we look as Chinese as possible in supporting our customers in China. And I think that will continue to be very important. The large number of manufacturing jobs that we have in China and the increasing number of design and engineering jobs we have in China are also important.

What factors influence, either enhance or limit, China's participation and impact on the semiconductor industry and market?

Oh, I'm not sure I understand that completely to be quite candid. I think the free market is obviously a very significant contributing factor to the ability to create innovation and stay in a significant position. So I think the Chinese government has to be sure that they facilitate the free market so that ultimately they can ensure they have products that are serving worldwide customers in the most cost effective manner possible.

I think there's always different debates and discussions. Whether it's software standards or whether there are certain applications that have to be provided by a Chinese-owned company. But I think the bottom line is for the Chinese economy to continue to be as successful in end markets as it has been, it's essential that they realize how important a free market system is and being able to facilitate that so they get the most creative and innovative technology.

We have not experienced or seen them doing anything that restricts that free market; just discussion around it and a lot of, if you will, noise about future actions and activities.

Well, what about this "almost" requirement for indigenous innovation as an example? Or value added content for government procurement?

Yes. That was my point. They'll potentially end up with not the most creative innovation in their products if that's a requirement associated with it because for some period of time, they won't have the most advanced technology or the most advanced innovations.

So if they really want to be competitive in the markets and in their general economy, then they need to be in a position where they can participate in that and support that.

What challenges and opportunities will China represent for your company over the next five or ten years?

Well, I think, again, China will represent a significant growth opportunity. As I've mentioned, we've doubled our revenues over the last three years so we think there's opportunity to grow at that same rate as we move forward for the next three years. I think that one thing that we have to be careful about is being sure that we're very flexible as far as the way we do business.

We consider different capital structures, different ways of doing business. You know, we now have an equity investment in a Chinese public company and we sit on the Board. We have a couple of joint ventures. We just created a new design joint venture with Datang.

So, our intent is to ensure that we have the flexibility to do business in ways that lets us continue to participate in this significant growth opportunity in the Chinese market, ways that we think will present themselves over the next half decade to decade, which will give us an opportunity to be a leader.

What do you see is driving the growth opportunity over the next five or ten years? Do you think that China will continue to have a further increasing share of total electronic systems production or do you think it is primarily that China's domestic consumption will drive the growth?

I think both will be a factor in their growth. I think there are areas, for example, in smart lighting, where the domestic consumption in China will represent a much more significant opportunity than any other market around the world. And then there's other areas where they'll continue to be effective in producing products that get consumed in other parts of the world.

I'm a big fan of the Chinese and what they've been able to do and what I think they can continue to do.

How has NXP contributed to local technology, academic and R&D development?

Well, we've increased our R&D activities in China significantly over the last five years and plan to continue to do that. We've worked with a number of universities in China relative to providing them core capability in microcontrollers as well as some other various areas.

And we actually offered awards and employment opportunities to some of the students in those areas. China, as I've already said, continues to be very significant and, frankly, we'd like to employ more Chinese.

I definitely expect the percentage of our total R&D expenditures that occur in China to grow. I don't actually have the percentage off the top of my head, but I definitely expect that percentage to grow.

We've been instrumental in working with various activities in China to actually put them at the forefront. For example in mobile payments. If you look at the contactless banking cards that are being rolled out *en masse* in China, they're at the forefront from a technical basis, based on some of the activities that we've been involved with, e.g., China UnionPay.

And that's a perfect example of the success of the Chinese and their ability to decide what kind of technology needs to be deployed for contactless banking payments, and their ability to roll it out in a fraction of the time it would take the US. Europe has been on EMV chips, pin chip or credit cards for a long time. And China is just moving a step beyond that while the US is still thinking about what they want to do to try to reduce fraud from credit card activities.

Has taking these steps made NXP a highly preferred employer for new Chinese university graduates?

I wouldn't say that necessarily. I mean, we're still not a household or a classroom name so I wouldn't say that it necessarily has made us a preferred supplier. I think that we're much better known than we were five or six years ago. And hopefully we'll continue to become more familiar and well-known.

Has it made you a target for or source of recruiting by other Chinese semiconductor companies?

Yes, somewhat. I would say as much as anything else from other international semiconductor companies that have tried to basically go out and recruit some of our employees because of the activities they've been able to drive and their customer engagements.

What role did Chinese incentives play in your achieving this status?

They contributed somewhat early on, although I wouldn't say that they've been a significant factor. That's probably not fair either. I mean, we certainly have tax incentives on, for example, the joint venture that we just signed with Datang. So there are government incentives that play a role relative to our deployment associated with it.

What concerns do you have about how you will protect your and your customers' IP deployed in your various ventures there?

Well, that's always a concern. I think for us as a company we have to be sure that we run faster than the Chinese do. So I think staying ahead of them is one of the only ways to protect your IP such that it doesn't have the same inherent value. But it's something that is always a challenge and you have to be sure that it can be dealt with.

We don't have our most advanced research in China. Most of our research in China is more customer-specific, taking our fundamental core technology and adapting it for Chinese customer use. So, from that side, the most advanced technology isn't there at the current time, although we continue to put more and more advanced technology there all the time.

If you think back over the ten years to get to the status you now have in China, what have been your greatest challenges?

You know, I think the Chinese market is not that much different than the rest of the world's semiconductor market. It's all about having the right technology lined up for the right product.

So ensuring that you've got the technology that can meet the requirements of the customers in China, whether it's for export—or ultimately now moving more towards the consumption side—is absolutely critical because if you can't meet those requirements for customers then obviously you won't be in a position to support them for an extended period of time. I don't think that is any different between China and the rest of the world.

Are there any things that are different because it's China?

Well, I think sometimes some of the customer requirements are potentially more demanding than they may be in the other parts of the world. But, you know, that's kind of it. I don't think there's a lot of other things that are totally different, that represent a significant difference.

Do you have any Chinese competitors?

We have a very broad product portfolio. So there are some competitors in narrow ranges of our product portfolio, Chinese competitors. And clearly we try to watch those as closely as we can. It is hard to define when you look at Chinese companies whether they are new fabless design companies or Chinese IDMs because they're pretty closely associated with their foundry partners as well. So I would say they are both in some cases.

I think over the coming years, there will be a number of them that will develop into very significant competitors.

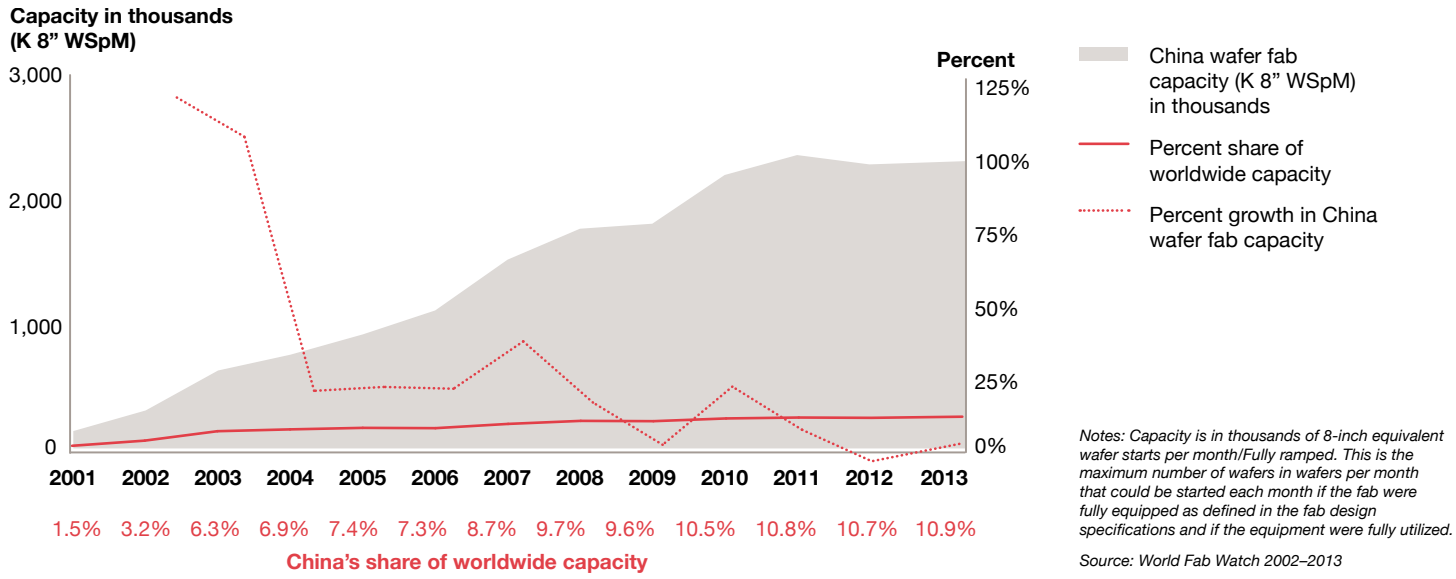
Wafer fabrication capacity

Overall, 2013 was a second year of wafer fab capacity rationalization rather than growth for both China and the worldwide industry. During the past year, eleven new LED fabs and one discrete power fab started production in China with a combined nominal capacity of 52K 8”-equivalent wafer starts per month (WSpM), while twelve existing LED fabs, along with one discrete, one foundry IDM and one R&D fab, with a combined nominal capacity of 20K WSpM were decommissioned. The net result was that the number of fabs in production in China during 2013 decreased by three, to 160, while their net nominal capacity increased by about 2%. By comparison, the number of fabs in production worldwide decreased by one, for a net decrease in nominal capacity of less than 1%. Consequently, China’s share of worldwide fab capacity in 2013 increased slightly to 10.9%.

Most of China’s 2013 wafer fab capacity rationalization occurred among the O-S-D sector LED fabs. All of the twelve existing LED fabs that were decommissioned in 2013 were relatively small, 2-inch fabs with an average capacity of less than 1K 8”-equivalent WSpM. They were replaced by five larger 2-inch, three 4-inch, one 6-inch and one 8-inch LED fabs with an average capacity of almost 4K 8”-equivalent WSpM. As a result, although the number of China’s O-S-D LED production wafer fabs decreased by one during 2013, to 69, their average capacity increased from 2.7K 8”-equivalent WSPM in 2012 to 3.8K in 2013 and China’s total LED wafer fab capacity increased by more than 40% in 2013 to 262K 8’-equivalent WSpM.

China was also able to increase the effective utilization of its wafer fab capacity during the past year by more

Figure 17: China’s wafer fabrication capacity and share of worldwide capacity 2002-2013



Notes: Capacity is in thousands of 8-inch equivalent wafer starts per month/Fully ramped. This is the maximum number of wafers in wafers per month that could be started each month if the fab were fully equipped as defined in the fab design specifications and if the equipment were fully utilized.

Source: World Fab Watch 2002–2013

Table 5: Summary of listed major Chinese semiconductor companies by report/update 2004-2014

Report/ Update date	Number of companies	Sales revenue (RMB:100mn) Minimum	Average	Maximum	Sales revenue (US$mn) Minimum	Average	Maximum	% China's semi industry
2004	11	0.52	3.21	6.23	6	37	75	
2005	26	1.21	3.21	7.67	15	39	93	8.4
2006	30	1.63	3.83	12.58	20	47	155	8.5
2007	27	2.09	5.66	13.46	26	71	169	8.3
2008	29	2.30	5.96	12.90	30	78	170	8.6
2009	33	2.15	6.07	30.94	31	87	445	8.8
2010	38	2.05	5.63	39.11	30	82	572	11.2
2011	43	2.25	7.29	44.10	33	107	652	12.2
2012	50	2.85	9.05	66.68	44	140	1,032	13.0
2013	50	3.12	9.69	74.19	50	154	1,178	13.7
2014	50	3.20	13.21	130.40	52	215	2,120	16.3

Source: CSIA, CCID, GSA, Gartner, PwC

than 16% by further equipping and ramping production at existing fabs, as well as improving their overall utilization while worldwide effective fab utilization, increased by slightly more than 5%.

The overall relative composition of China's wafer fab capacity changed moderately during 2013. Because China further increased its disproportionately large share (26%) of worldwide LED fab capacity while maintaining its 21% share of worldwide discrete fab capacity, it continued to have a much higher mix of smaller wafer size (150mm or less) and mature technology node (0.7µm or greater) fab capacity than worldwide. At the same time, its share of worldwide intermediate technology node (0.2 to 0.028µm) capacity increased to 15%, while its share of advanced technology node (28nm or less) remained at zero. During 2013 there were still no Chinese wafer fabs in production at the advanced technology node (28nm or less), although the number of worldwide fabs in production at that node increased from 46 to 61 and their aggregate capacity by 21%. Similarly, China's mix of larger 300mm wafer size and leading-edge technology node fab capacity remained less than worldwide. Not one of the eleven additional 300mm fabs that started production during 2013 were in China.

That relative composition is expected to change somewhat during the next year as 13 of the 38 new wafer fab under construction worldwide are in China, representing 21% of new committed capacity. The 13 include the Samsung Xi'an 300mm NAND Flash fab which, when it enters production in 2014, will become China's largest and most advanced technology wafer fab. When all are in full production, China will have moved somewhat closer to having a representative mix of larger wafer size and advanced technology wafer fab capacity.

Foundry production continued to constitute the largest share of China's wafer fab capacity in 2013 at 43% of total compared to the worldwide average of 27%. IDM production only constituted 24% of China's wafer fab capacity, compared to 52% worldwide. That mix will only slightly change when all the committed fabs currently under construction are brought into production, with China's foundry

production decreasing to 42% and IDM production increasing to 28% of total compared to 28% and 52% worldwide.

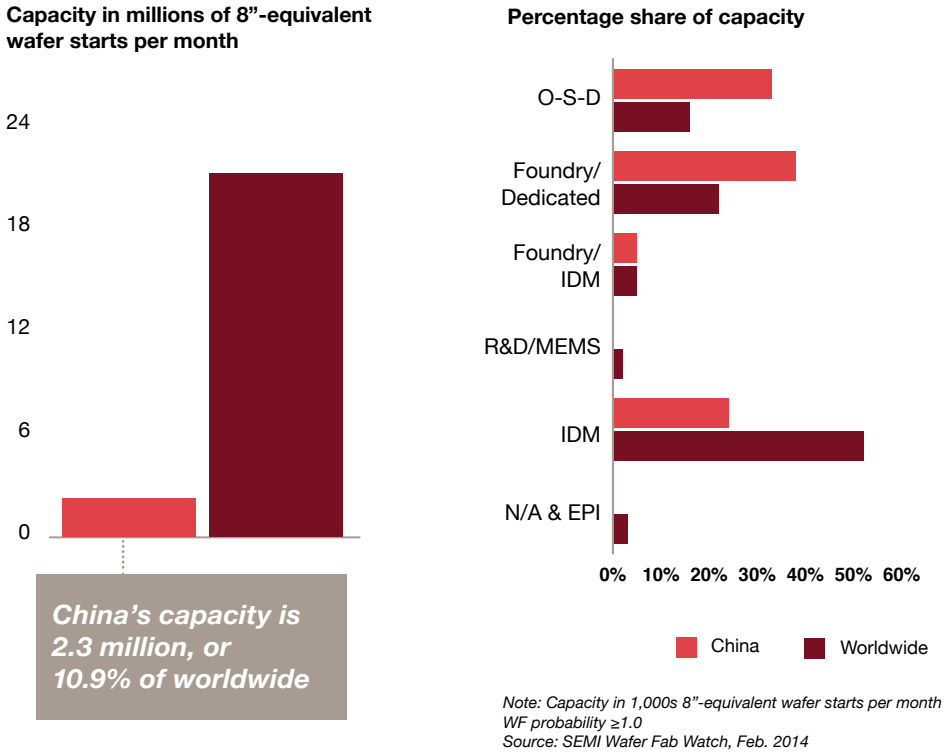
The average capacity of China's wafer fabs in production at the end of 2013 was 14.4K 8"-equivalent WSpM per wafer fab compared to the worldwide average of 19.6K. According to the SEMI World Fab Watch database, China had only one fab—S.K. Hynix C2—with a capacity of more than 300K 8" WSpM and two—Intel Fab 68 and TSM Fab 10 (Songjiang)—with a capacity of 100 to 200 K 8" WSpM, which together accounted for 23% of China's total fab capacity. The remaining majority of China's fab capacity was distributed:

8"-equivalent WSpM		
≥ 50K	8 fabs for	20%
≥ 10K	43 fabs for	40%
≥ 1K	77 fabs for	16%
< 1K	26 fabs for	1%

As several companies had more than one wafer fab in production in China by the end of 2013, the distribution of China's wafer fab capacity by company was somewhat concentrated with the following ten companies (listed in order of 8"-equivalent WSpM capacity) accounting for 59% of China's total wafer fab capacity.

S.K. Hynix	13%
SMIC	13%
Hua Hong Grace	6%
Intel	5%
TSMC	5%
CR Micro	5%
Hua Li Microelectronics	3%
Hangzhaou Silan Microelectronics	3%
XMC	3%
China Resources Huajing Microelectronics	3%

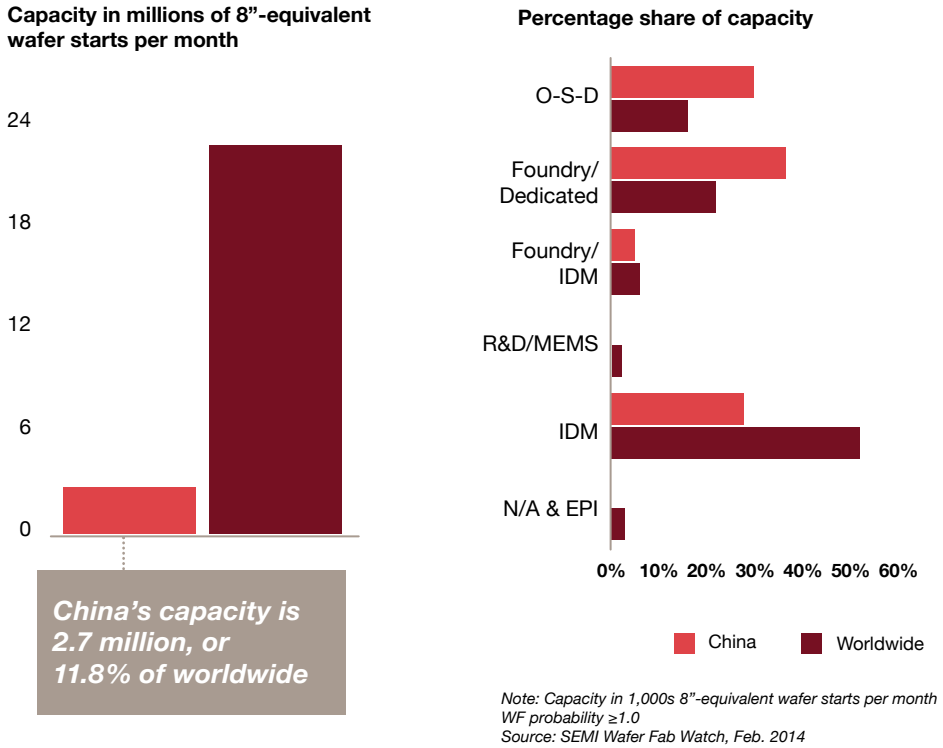
Figure 18: Current wafer fab capacity comparison, China and worldwide



Note: Capacity in 1,000s 8"-equivalent wafer starts per month
WF probability ≥1.0
Source: SEMI Wafer Fab Watch, Feb. 2014

During the past ten years, from the end of 2003 through 2013, the number of wafer fabs in production in China has increased by 186% from 56 to 160 (for a 11.1% CAGR) while their capacity has increased by 314% (for a 15.3% CAGR). Over the same time period, China's share of worldwide wafer fabs in production has increased from 6.2% to 15% and share of worldwide wafer fab production capacity from 5.7% to 11%. Of the 160 wafer fabs in production in China at the end of 2013, 53 had started production before the end of 2003, representing 32% of China's 2013 capacity; 48 had started production between 2004 and 2008, representing 45% of 2013 capacity and 39 had started production between 2009 and 2011, representing a further 19% of 2013 capacity. Ten fabs, 2% of capacity, started production in 2012 and five fabs, 1% of capacity, started production in 2013, with the production start of five fabs, 1% of capacity not known. Wafer fab capacity also became less concentrated during the past ten years. The top five companies only accounted for 42% of China's capacity in 2013, down from 68% in 2003. Based upon installed wafer fab production capacity of 8"-equivalent wafer starts per month (WSpM), only one of the top five companies in 2003, SMIC, was among the top five in 2013. SMIC was ranked first in WSpM capacity in 2003, with 39% of China's total, followed by Grace, Hua Hong NEC, ASMC and CSMC in order of capacity. Last year, S.K. Hynix was ranked first with 13.2% of China's 2013 WSpM capacity, followed by SMIC with 12.6%; Hua Hong Grace with 6.3%; Intel with 5.1% and TSMC with 4.8%.

Figure 19: Current and committed wafer fab capacity comparison, China and worldwide



Note: Capacity in 1,000s 8"-equivalent wafer starts per month
WF probability ≥1.0
Source: SEMI Wafer Fab Watch, Feb. 2014

Interview

Wang Xinchao

Chairman and CEO
Jiangsu Changjiang Electronics Technology Co., Ltd. (JCET)

Jiangsu Changjiang Electronics Technology Co.(JCET) is the largest SATS (semiconductor assembly & test services) enterprise in China and is ranked sixth in the global semiconductor packaging and testing industry.

There are three major factors that positively impact the development of JCET.

Mobile communication and electronics, including cell phones, tablets and other mobile terminals, have become the largest market for consumer electronics in recent years. Specifically, mobile phones, which have reached almost 18 billion in 2013, have been and will be the most important application for a long period of time. When looking at the mobile phone market evolution very closely, the "high-end" Apple and Samsung smart phones are reaching the market saturation stage; the basic "feature" phones are shrinking rapidly; and the real high growth is coming from "mid/low-end" smart phones. Currently, this high growth "mid/low-end" smart phone market is dominated by Chinese brands such as Huawei, Lenovo, ZTE, Coolpad and, most recently, Xiaomi. The tablet market is showing a very similar trend for the Chinese manufacturers as well. These market trends and developments have provided huge opportunities for the Chinese domestic IC design houses to grow, and it's no surprise that some of them have been enjoying the fastest growth in past few years.

JCET is the largest domestic OSAT (outsourced semiconductor assembly and test) in China with annual revenues of US$850mn in 2013. Chinese domestic IC design houses are a major customer base for JCET, and JCET is dedicated to providing full support for the fast growth of these largest Chinese domestic IC design houses. JCET is also becoming the main packaging and test supplier for most of the top Chinese IC design houses and their fast growth in the Chinese market has been one of the major driving forces for the development of JCET.

In 2013, the size of the worldwide semiconductor industry was slightly over US$300bn, and statistics showed that China's imported semiconductors accounted for more than US$200bn. That number was higher than the petroleum products China imported for the year. Semiconductors were the single largest imported product for China. The critical applications of semiconductors for the entire electronic industry and the heavy reliance on the import has alerted Chinese central and local governments to realize the importance of the domestic semiconductor industry, prompting many suggestions, proposals and government policies aiming to enhance the development of the domestic semiconductor industry at all levels. As the largest domestic IC OSAT company in China, JCET is well positioned to support the upcoming growth of the entire Chinese semiconductor industry.

JCET, with semiconductor assembling and test facilities based on China's Great Yangtze River Delta, one of the most advanced and development regions in China, has been aggressively focusing on large scale and cost effective manufacturing. More importantly, it is the strategy and heavy investment in advanced technologies that have brought the steady growth of JCET in the long run. Currently, JCET has two worldwide IP technologies, Cu Pillar Bumping and Flip Chip, and MIS (Molded Interconnect System) high density substrate and packaging solution. With the unique advantages of high density and high performance, Cu Pillar Bumping and Flip Chip have become a mainstream technology for advanced semiconductors and packaging applications. MIS is also gaining in market applications at a very fast pace worldwide. The combination of large scale manufacturing and technology advancement has ensured that JCET supports the development of IC packaging applications in both China and worldwide.

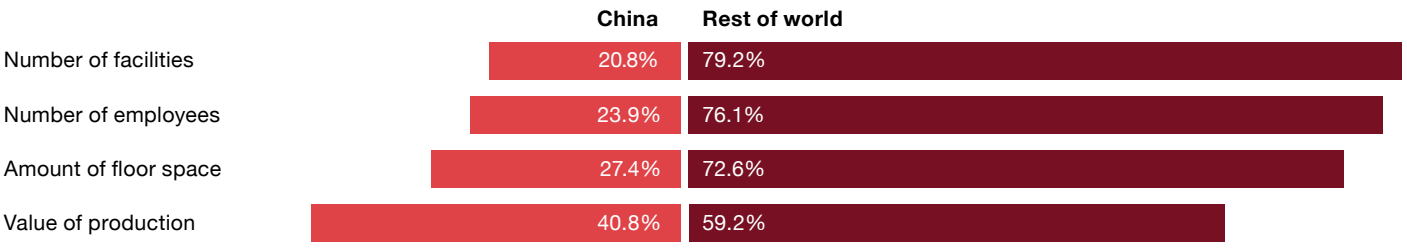
Packaging, assembly and test capacity

Semiconductor packaging, assembly and test (SPA&T) nominal capacity in China was modestly consolidated during 2013 while unit production was increased by more than 6%. During the past year, China reported the closure of five SPA&T facilities; including three Japanese IDMs, one US SATS (semiconductor assembly and test services) and one Chinese SATS facility; the addition of one existing, but previously not reported facility; the opening of three new facilities and the consolidation of a few others, resulting in a 2.5% decrease in net manufacturing floor space, but with a 1.1% increase in number of employees. During the same time, the number of SPA&T facilities in the rest of the world increased by seven, while their total manufacturing floor space fell by 1.4% and employee numbers fell by 2.6%. As of the end of 2013, China had 116 SPA&T facilities in operation, a decrease from an adjusted total of 118 in 2011. These 116 facilities represent 21% of the total number of worldwide SPA&T facilities, more than 27% of worldwide SPA&T manufacturing floor space, and 24% of reported worldwide SPA&T employees.

Although China's manufacturing floor space—a proxy for potential manufacturing capacity—decreased at a slightly greater rate (2.5%) than worldwide (1.4%) during 2013, it still represented 27.4% of worldwide SPA&T manufacturing floor space. As a result, China's SPA&T facilities continued to rank first in share of SPA&T manufacturing floor space for the fifth year, noticeably ahead of Taiwan (at almost 20%) and Japan (at 11%). China's SPA&T facilities also ranked first in number of reported employees, with 24% of worldwide employees at the end of 2013, ahead of Taiwan (19%) and Malaysia (17%).

At the end of 2013 China had five of the 18 planned new worldwide SPA&T facilities which represented almost 90% of the reported planned manufacturing floor space. All of the new planned worldwide SPA&T facilities are SATS facilities, with eight in Taiwan, five in China and three in South Korea. At the end of 2013, there were no new IDM SPA&T facilities planned worldwide.

Figure 20: Comparision of China and all remaining countries' SPA&T resources, 2013



Source: Gartner

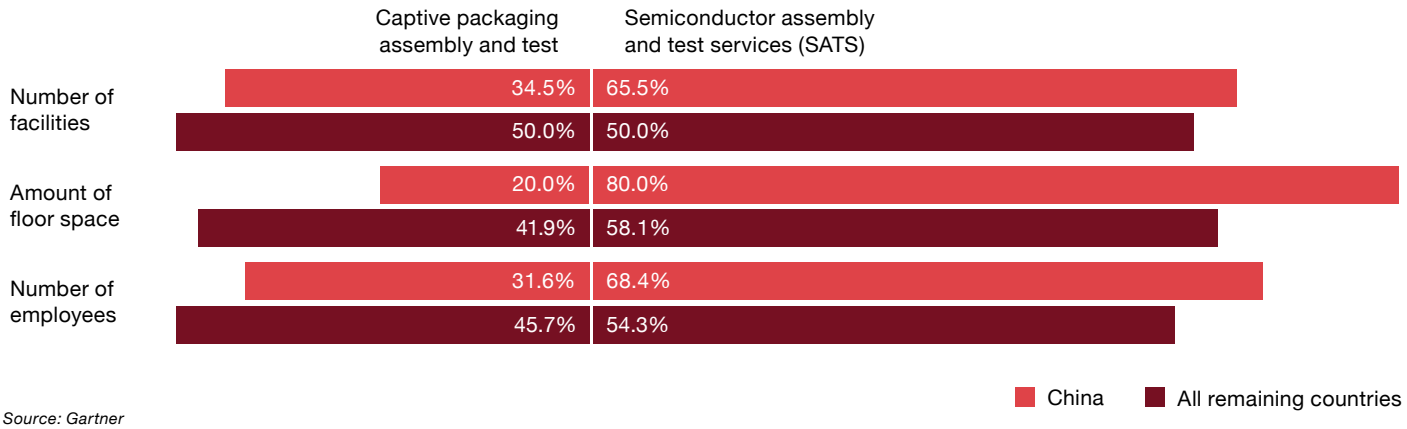
The ownership of China's SPA&T facilities changed noticeably during the past year, with the share of facilities owned by Japanese companies decreasing from 15% to 11%, while the share owned by Chinese companies decreased from 32% to 31%. This was offset by increases in the share belonging to companies from the US (22%), Taiwan (15%) and Singapore (5%), while the share belonging to companies from Korea (6%) remained unchanged.

China's SPA&T capacity continues to be more concentrated in the SATS sector than that of other regions: 80% of China's SPA&T manufacturing floor space and 64% of China's SPA&T facilities were dedicated to the SATS sector in 2013 versus 58% and 54% for all other countries. Eight of the ten largest worldwide SATS companies had one or more facilities in China for a total of 19 out of the 83 top ten SATS facilities worldwide. These 19 facilities accounted for 32% of the top ten SATS manufacturing floor space worldwide. One of the ten largest worldwide SATS companies is a Chinese company, Jingsu Changjiang Electronics Technology (JCET), ranked sixth in 2013, and there is a second Chinese SATS company, Nantong Fujitsu Microelectronics (NFME), ranked 18th in 2013 within the top twenty. In total, there were 28 Chinese SATS companies with 36 existing facilities that accounted for 18% of worldwide SATS manufacturing floor space in 2013.

Packaging, assembly and test remains the largest of China's semiconductor manufacturing activities when measured in terms of value added, production revenue, employees and manufacturing floor space, although this relationship is often missed because it is allocated between two separate industry sectors: the IC packaging and testing and the O-S-D sectors. The composite weighted average of China's 2013 SPA&T production is now estimated to be about 58% of worldwide, up from a revised 52% in 2012.

During the past ten years, from the end of 2003 through 2013, the number of SPA&T facilities in production in China has increased by 51%, from 77 to 116 (for a 4.2% CAGR), while their capacity has increased by 175% (for a 10.6% CAGR). Over the same time period, China's share of worldwide SPA&T facilities in production has increased from 17.7% to 20.8% and its share of worldwide SPA&T manufacturing floor space from 10.5% to 27.4%. During the past ten years China has added a disproportionate share of larger SPA&T facilities as the

Figure 21: Comparison of China and all remaining countries SATS share of SPA&T capacity, 2013



Source: Gartner

The top five companies only accounted for 33% of China's capacity in 2013, down from 48% in 2003.

average size of China's SPA&T facility has increased from 108K to 197K square feet of manufacturing floor space while the worldwide average decreased from 181K to 150K. Of the 116 SPA&T facilities in existence in China at the end of 2013, 48 had started production before 2003, representing 36% of China's 2013 capacity; 38 had started production between 2004 and 2008, representing 37% of 2013 capacity and seven had started production between 2009 and 2011, representing a further 8% of 2013 capacity. Three SPA&T facilities, 6% of capacity, started production in 2012 while the production start of 20 facilities, 13% of capacity, is not known. SPA&T capacity also became somewhat less concentrated during the past ten years. The top five companies only accounted for 33% of China's capacity in 2013, down from 48% in 2003. Based upon reported manufacturing floor space capacity only two of the top five companies in 2003, ASE and STATS ChipPAC, were among the top five in 2013. ASE (including GAPT) was ranked first in manufacturing floor space capacity in 2003 with 22% of China's total, followed by Intel, SDI, STATS ChipPAC, and Integrated Microelectronics in order of capacity. Last year, JCET/JCAP was ranked first with 9.5% of China's 2013 SPA&T capacity, followed by Tanshui Huatian Technology with 8.3%; ASE with 7.0%; Chipmore with 4.7%; and STATS ChipPAC with 3.5%.

Regional structure

The Yangtze River Delta, or East China region, continues to have the heaviest concentration of China's semiconductor industry. It accounted for 55% of China's IC industry revenues in 2013, down from a peak of 71% in 2007 and 2008, and 57% in 2012. Of the 160 semiconductor wafer fabrication facilities in operation in China at the end of 2013, 84 are located in the East China region, representing 66% of China's total wafer fabrication capacity, an increase from 79 facilities for 64% of capacity in 2011. Similarly, East China had 69 of China's 116 SPA&T facilities in operation during 2013, representing 65% of China's total SPA&T capacity. This was also an increase from 65 facilities for 62% of capacity in 2011. The majority of these plants are located in Shanghai, Suzhou and Wuxi. Four of China's top ten IC design firms are also located in this region.

The Bohai Ring, or North China region, which is mainly constituted by Beijing, Tianjin, Hebi and Shangdong, accounted for 19% of China's IC industry revenues in 2013, down from its peak of 23% in 2011. Twenty-one of China's wafer fabrication and ten of China's SPA&T facilities are located in this region, representing 9% and 4% of China's total wafer fabrication and SPA&T capacity, respectively. That is a reduction of one SPA&T facility from 2011 with a 1.6 percentage point decrease in share of China's total SPA&T capacity. Four of China's top ten IC design firms are also located in this region.

As a result of the continuing strong growth of IC design firms, the Pearl River Delta, or South China region, accounted for 15% of China's IC industry revenue in 2013, up from 13% in 2012 and 9% in 2011. The two of China's top ten IC design firms that are located in this area accounted for 42% of top ten revenues for 2013. The 24 SPA&T facilities that are located in this region accounted for 16% of China's SPA&T capacity in 2013, down from 17% in 2011, while the number of wafer fabrication facilities in the region decreased by three, to 23, continuing to only represent 7% of China's total wafer fabrication capacity. The majority of the region's semiconductor manufacturing plants are located in Shenzhen, Dongguan and Zhuhai.

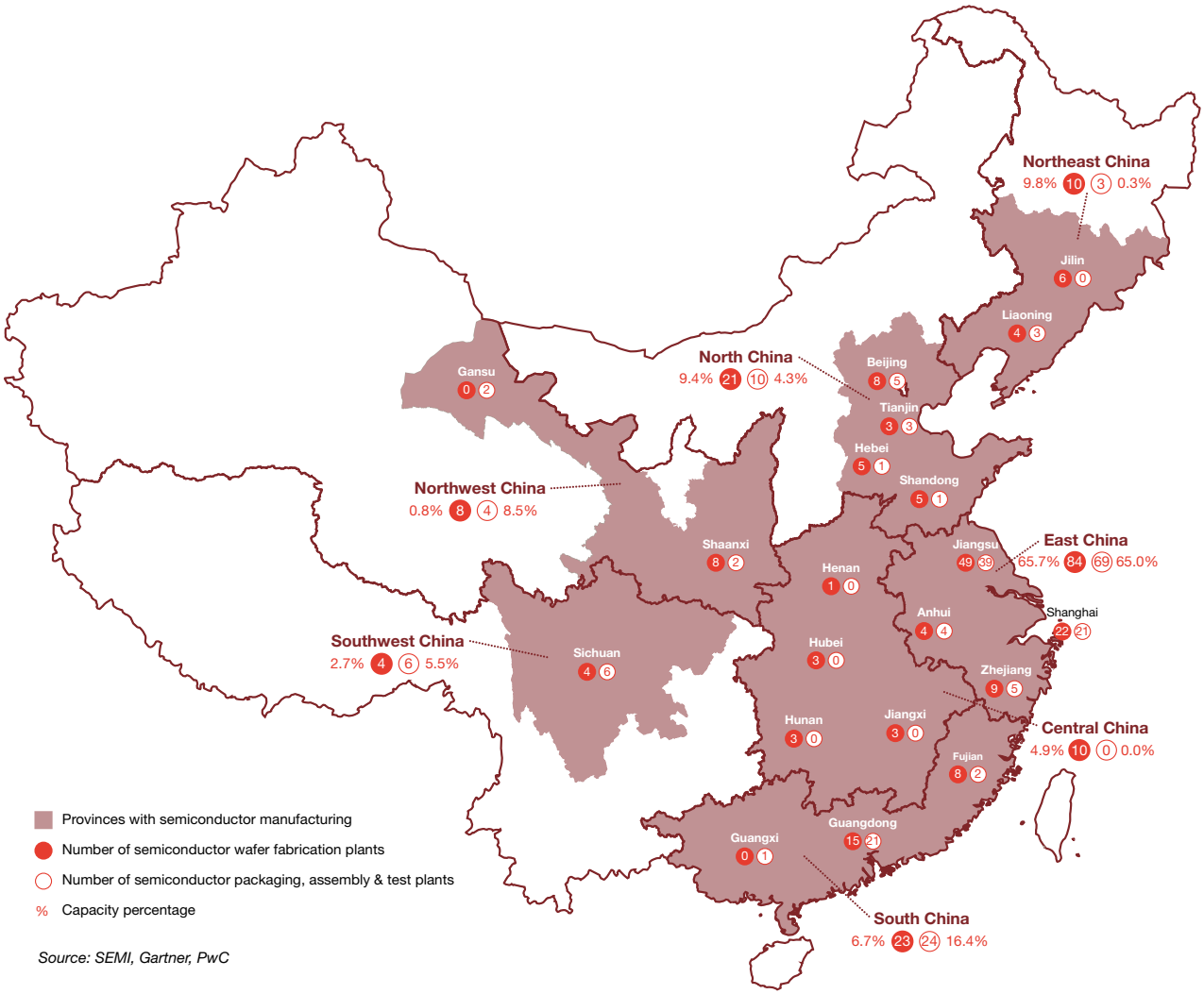
The four other regions of China accounted for the remaining 11% of the country's IC industry revenues in 2013. Of China's 160 semiconductor wafer fabrication facilities, ten are located in Northeast China, including Dalian and Jilin, representing 10% of China's capacity; ten in Central China for 5% of capacity; four in Southwest China, including Chengdu, Chongqing and Leshan, for 3% of capacity and eight in Northwest China for 1% of capacity. Four of China's 116 SPA&T facilities are located in Northwest China for 9% of China's capacity; six in Southwest China for 6% of capacity and three in Northeast China for 0.3% of capacity.

During the past five years, there has been a noticeable shift in the regional location of China's IC industry with South China and the four other regions gaining share and the East and North China regions decreasing share. China's IC industry revenue from the four other regions of Central, Southwest, Northeast and Northwest China, increased by more than 750% in the last five years. It has grown from 3% of China's total IC industry revenues in 2009 to 11% in 2013. Similarly, South China's IC industry revenues increased by more than 360% during the same period and its share of China's total IC industry revenues increased from 8% to 15%. While East China's IC industry revenue doubled during those five years, its share of China's total IC industry revenue decreased from 69% to 55%.

Similarly, North China's share decreased from 21% to 19% as its IC industry revenues only increased 82% during the past five years.

The above summary is not intended to simplify or dismiss the challenging geographic diversity and dispersion of China's semiconductor industry that suppliers and customers need to address for success. There are at least 270 semiconductor wafer fabrication or packaging and testing plants currently in production spread across 20 different provinces in China. They span from Jilin in the North to Guangdong in the South and from Zhejiang in the East to Sichuan in the West, across an area of about 1,700,000 square miles (4,400,000 square kilometers).

Figure 22: China's 2013 semiconductor manufacturing capacity by province and region



Source: SEMI, Gartner, PwC

Section 3: Manufacturing, Greater China, growth scenarios

China's domestic OEM buying power

Table 6 is a listing of the top ten Chinese OEMs (original equipment manufacturers) taken from China's Ministry of Industry and Information Technology (MIIT) report of "Top 10 Chinese Electronic Information Enterprises in 2014." MIIT ranks these companies based upon a comprehensive assessment of revenue, profit, assets, R&D, etc. rather than revenue alone. Each of the top ten had 2013 revenues of US$7.3bn or more. These ten largest Chinese OEMs had a 10% increase in their combined revenues during 2013 after a 9% increase in 2012 to reach a record total of US$206bn. Their combined revenue increase was somewhat less than that of China's electronic information industry which increased 13%, measured in US dollars (or 10% reported in RMB) during 2013. Assuming the semiconductor content of their products was 27% (the average for all of China's electronic equipment production in 2013), these ten Chinese OEMs or their semiconductor consuming subsidiaries could have been responsible for semiconductor consumption of US$55bn, or 30% of China's total semiconductor consumption market.

During the past nine years—since 2004—the MIIT top ten Chinese OEMs have achieved an average CAGR (compound annual growth rate) of 21% per year. Seven companies have been included among the MIIT top ten Chinese OEMs every year since 2004: Huawei (ranked No. 6 in 2004); Lenovo (No. 4); Haier Group (No. 1); Hisense Group (No. 3); ZTE (No. 5); Changhong (No. 9) and TCL (No. 2). Since 2004, Midea Group (No. 7) was reclassified as other than an electronic information enterprise, while Konka Group (No. 8) and Skyworth (No. 10) were reclassified to the second tier of the top 20 and those three were replaced in the MIIT top ten by China Electronics Corp., Founder Group Co., and BYD, which was later replaced in 2013 by Inspur Group.

The US$55bn semiconductor consumption that these top OEMs could have been possibly responsible for is usually identified as "Brand TAM" (total available market), meaning the total semiconductor devices consumed in all the products branded with any of the OEM's brands or names even though some of those products were designed and/or manufactured by other ODM (original design manufacturers) or EMS (electronic manufacturing services) companies. For example, the motherboard of Lenovo PCs are usually made by ODMs (such as Quanta), rather than by Lenovo itself. Since 2009 we have had analysts estimate the semiconductor consumption by OEMs based upon design (semiconductor selection by OEM engineers), which is identified as "Design TAM". We feel this provides a more meaningful insight relative to the market influence of the various Chinese OEMs. The top ten OEM 2013 Design TAM semiconductor consumption was reported to be US$19.0bn, an increase of slightly more than 13% from 2012, but still just 10.5% of China's total semiconductor market, which is just up fractionally from 2012.

Table 6: Chinese Top OEMs by revenue and semiconductor consumption 2010–2013 (US$bn)

	Rank (per MIIT)		Revenue			Semiconductor consumption (Design TAM)			Purchase TAM		
Name of company	**2012**	**2013**	**2012**	**2013**	**Change %**	**2012**	**2013**	**Change %**	**2012**	**2013**	**Change %**
Huawei	1	1	35.4	38.6	9.1%	4.3	4.9	14.2%	2.9	3.1	6.3%
Lenovo	2	2	33.9	38.7	14.3%	6.1	7.3	19.7%	5.2	6.3	20.2%
China Electronics Corp.	3	3	29.0	31.3	7.8%	0.1	0.1	5.8%	0.2	0.2	-14.3%
Haier Group Company	4	4	25.8	29.1	12.6%	0.5	0.6	20.0%	0.5	0.6	21.0%
Hisense Group	6	5	12.8	15.0	17.2%	0.5	0.7	31.7%	0.5	0.7	28.7%
ZTE	5	6	13.3	12.1	-9.0%	3.1	2.8	-11.2%	2.9	2.7	-8.0%
Changhong Electric Co.	7	7	8.3	9.5	14.6%	0.3	0.4	26.2%	0.3	0.4	33.3%
TCL	8	8	11.0	13.8	24.8%	1.5	1.7	19.2%	1.6	1.9	18.3%
Founder Group Co.	9	9	9.8	11.0	12.2%						
Inspur Group	11	10	6.4	7.3	14.6%	0.1	0.2	139.8%	0.1	0.2	139.8%
BYD Company Ltd.	10	11	7.7	8.6	16.2%	0.2	0.3	10.0%	0.8	0.7	-11.0%
Total top ten			**186.8**	**206.4**	**10.5%**	**16.7**	**19.0**	**13.4%**	**15.0**	**16.7**	**10.9%**

Notes: Inspur replaced BYD as No.10 in 2013 and is included in 2013 Top Ten total but not 2012 total. BYD was included in the 2012 total and not the 2013 total
China Electronics Corp. (CEC) includes Great Wall and Kaifa Technologies, but Great Wall's purchasing TAM and Kaifa's designTAM are too small to be tracked separately
Founder Electronics TAM included in Acer TAM since 2010

% Semi penetration						**9.1%**	**9.3%**		**8.2%**	**8.2%**	
Semiconductor consuming subsidiaries											
Great Wall Technology	3	3	15.4	15.1	-1.9%	0.1	0.1				
Kaifa Technology									0.2	0.2	-14.3%
Haier Electronics Group	4	4	8.9	10.1	13.1%	0.5	0.6	20.0%	0.5	0.6	21.0%
Hisense Electric Co.	6	5	4.1	4.6	12.2%	0.5	0.7	31.7%	0.5	0.7	28.7%
Companies tracked from previous years											
BYD Company Ltd.	10	11	7.4	8.6	16.2%	0.2	0.3	10.0%			
Skyworth	13	13	4.5	4.9	9.4%	0.5	0.5	7.2%	0.6		
Konka Group	17	18	2.9	3.2	11.1%	0.4	0.5	29.3%	0.4		

Source: MIIT, Gartner, Thomson Reuters, Company reports

This top ten OEM Design TAM has averaged about 10% of China's semiconductor market for the past four years, an increase from 8.1% in 2009. Similarly, the calculated Design TAM semiconductor content of the combined revenues of these top ten OEMs increased from 8.3% in 2009 to 9.1% in 2012 and to 9.3% in 2013.

Another way of measuring the influence of these OEMs on semiconductor consumption is based upon their direct purchases. This is identified as "Purchasing TAM". The top ten OEM 2013 Purchasing TAM semiconductor consumption was reported to be US$16.7bn, an 11% increase from their 2012 reported Purchasing TAM. These values are less than their Design TAM because some of the OEMs (for example Lenovo) will design a product specifying key components and then consign manufacturing and purchasing to an EMS company.

As a result of this analysis, we continue to believe that Chinese OEMs influence and/or purchase a significant and increasing number of semiconductor devices. They could be important customers for many of the international semiconductor companies intending to participate in the continuing growth of the Chinese semiconductor market. However, we also expect that their design and purchasing decisions will be influenced by the recently (24 June 2014) released Chinese government "New Document 4", "Guidelines to Promote National IC Industry Development". As a result, the strategies of these OEMs could affect the design and sales operations of several international semiconductor companies.

Top Chinese semiconductor manufacturers

Table 7 lists the 50 largest semiconductor manufacturers in China—those reporting 2013 revenues of US$171mn or more. This revenue threshold is up 25% from the US$137mn threshold in our 2013 update, which reflects the continuing growth in number and size of Chinese semiconductor manufacturers.

The combined 2013 revenues reported for these top 50 enterprises is US$29.9bn, representing 45% of China's total 2013 semiconductor industry revenue of US$65.8bn. This is an increase in combined revenue, but a decrease in share from the revised US$28.7bn, or 51% of US$56.3bn now reported for 2012. China's industry continues to be noticeably less concentrated than the worldwide industry, where the top 10 companies accounted for 53% of the total market. The combined reported revenues of the continuing 49 of these top 50 manufacturers increased by 3.1% in 2013, which is significantly less than the increase (13.7%) reported by China's total semiconductor industry. Almost all of this difference

Table 7: Major Chinese semiconductor manufacturers (including groups) in 2013

	Rank		Sales revenue (RMB: 100mn)				Sales revenue (US$mn)		
Name of company	2012	2013	2012	2013	Change	Sector	2012	2013	Change
HiSilicon Technologies Co., Ltd.	4	1	74.19	130.40	75.8%	●	1,178	2,120	80.0%
SK Hynix Semiconductor (China) (incl Hitech JV)	2	2	171.15	129.40	-24.4%	■◆	2,717	2,104	-22.6%
SMIC (Semiconductor Manufacturing International Corp.)	3	3	106.76	126.50	18.5%	⬣	1,695	2,057	21.4%
Intel Products/Semiconductor (Chengdu/Dalian) Co., Ltd.	1	4	314.00	93.10	-70.4%	■◆	4,984	1,514	-69.6%
XINCHAO Group	5	5	66.49	77.20	16.1%	◆	1,055	1,255	18.9%
Micron Semiconductor (Xi'an) Co., Ltd.	6	6	66.23	73.21	10.5%	◆	1,051	1,190	13.2%
Freescale Semiconductor (China) & (Tianjin) Co., Ltd.	7	7	65.05	66.80	2.7%	●◆	1,033	1,086	5.2%
Spreadtrum Communications Inc.	12	8	44.00	62.30	41.6%	●	698	1,013	45.0%
Samsung Electronics (Suzhou Semi & LED) Co., Ltd.	8	9	55.41	59.60	7.6%	●▼◆	880	969	10.2%
RFMD (RF Micro Devices (Beijing) Co., Ltd.	11	10	45.00	56.00	24.4%	◆	714	911	27.5%
Huizhou Cree	10	11	45.70	52.60	15.1%	▼	725	855	17.9%
Nantong Huada Microelectronics Group Co., Ltd.	14	12	41.33	45.40	9.8%	◆	656	738	12.5%

● IC design ▲ Discrete ▼ Discrete (LED) ⬣ Foundry ■ IDM ◆ Packaging and testing

Table 7: Major Chinese semiconductor manufacturers (including groups) in 2013 (continued)

	Rank		Sales revenue (RMB: 100mn)				Sales revenue (US$mn)		
Name of company	2012	2013	2012	2013	Change	Sector	2012	2013	Change
ASE Assembly & Test (Shanghai+ Khunshan+WeiHai +Suzhou) Ltd.	13	13	44.10	41.33	-6.3%	◆	700	672	-4.0%
China Resources Microelectronics (Holdings) Ltd.	15	14	35.20	39.20	11.4%	▲●■	559	637	14.1%
Renesas Semiconductor (Beijing & Suzhou) Co., Ltd.	18	15	32.63	37.88	16.1%	●◆	518	616	18.9%
TianJIn ZhongHuan Semiconductor Co., Ltd.	20	16	11.78	37.30	216.6%	▲	187	607	224.4%
Diodes Shanghai Co., Ltd.	19	17	28.90	35.90	24.2%	◆	459	584	27.3%
Tianshui Huatian Technology Co., Ltd.	31	18	18.32	35.40	93.2%	◆	291	576	97.9%
TSMC (Shanghai) Co., Ltd.	16	19	34.17	35.30	3.3%	⬣	542	574	5.8%
Shanghai Huahong (Group) Company Ltd.	9	20	46.01	35.20	-23.5%	●⬣	730	572	-21.6%
Lite-On Technology	21	21	24.80	29.60	19.4%	▼	394	481	22.3%
Everlight Electronics	27	22	21.90	28.50	30.1%	▼	348	463	33.3%
RDA Microelectronics, Inc.	22	23	24.69	28.00	13.4%	●	392	455	16.2%
Shangahi Panasonic Semiconductor Co., Ltd.	17	24	33.70	27.70	-17.8%	◆	535	450	-15.8%
Infineon Technologies (Wuxi) Co., Ltd.	23	25	23.00	27.00	17.4%	◆	365	439	20.3%
SanDisk Semiconductor (Shanghai) Co., Ltd.	25	26	22.50	27.00	20.0%	◆	357	439	22.9%
Amkor Technology China Ltd.	29	27	19.56	25.00	27.8%	◆	310	407	30.9%
Datang Semiconductor Design Co., Ltd.		28	18.93	24.00	26.8%	●	300	390	29.9%
Beijing Nari Smart Chip Microelectronics Co., Ltd.		29		21.50		●		350	
Sanan Optoelectronics	33	30	16.40	21.40	30.5%	▼	260	348	33.7%
No. 55 Research Institute of China Electronics Technology Group Corporation	28	31	19.70	20.05	1.8%	■	313	326	4.3%
STATS ChipPAC	24	32	22.66	20.00	-11.7%	◆	360	325	-9.6%
ST Microelectronics	30	33	19.23	19.98	3.9%	◆	305	325	6.4%
MLS Co., Ltd.		34	9.40	19.60	108.5%	▼	149	319	113.6%
Siliconware Technology (Suzhou) Co., Ltd.	36	35	13.81	18.22	31.9%	◆	219	296	35.1%
Hangzhou Silan Microelectronics Co., Ltd.	38	36	12.64	18.00	42.4%	●▲⬣	201	293	45.9%
China Huada Integrated Circuits Design (Group) Co., Ltd.	34	37	16.12	17.90	11.1%	●	256	291	13.8%
Galaxycore Inc.	39	38	11.80	16.80	42.4%	●	187	273	45.8%
Xi'an Microelectronics Technology Institute		39	2.16	15.90	635.4%	■	34	259	653.4%
Beijing Vimicro Co., Ltd.	43	40	11.00	15.40	40.0%	●	175	250	43.4%
Shenzhen ZTE Microelectronics Technology Co., Ltd.	41	41	11.50	15.32	33.2%	●	183	249	36.5%
Shenzhen National Holdings Co., Ltd.	40	42	11.50	14.96	30.1%	●	183	243	33.3%
HeJian Technology (Suzhou) Co., Ltd.	37	43	13.48	13.70	1.6%	⬣	214	223	4.1%
Leshan Phoenix Semiconductor Co., Ltd. (ON Semi JV)		44	12.35	13.26	7.4%	◆	196	216	10.0%
Jilin Sino Microelectronics Co., Ltd.	45	4	10.55	12.50	18.4%	▲	168	203	21.3%
Shenzhen Netcom Electronics Co., Ltd.	49	46	9.37	12.19	30.1%	●	149	198	33.2%
Allwinner Technology	44	47	10.58	11.69	10.5%	●	168	190	13.2%
UTAC Dongguan, Shanghai Ltd.	35	48	14.36	11.07	-22.9%	◆	228	180	-21.1%
Fairchild Semiconductor (Suzhou) Co., Ltd.	36	49	10.27	10.71	4.3%	◆	163	174	6.8%
Elec-Tech International Co., Ltd.	47	50	10.27	10.52	2.4%	▼	163	171	4.9%

● IC design ▲ Discrete ▼ Discrete (LED) ⬣ Foundry ■ IDM ◆ Packaging and testing

Source: MIIT, Gartner, Thomson Reuters, Company reports

in rate of increase was the result of a 70% reduction in the reported 2013 revenues of Intel's operations in China, which reflects a combination of changes in factory loading, product mix and transfer pricing. During 2013 these top 50 enterprises accounted for 71% of China's IC chip manufacturing (foundry and IDM) revenues; 69% of IC packaging and testing revenues; 49% of IC design (fabless) revenues; but only 18% of O-S-D revenues.

The top 50's share of 2013 IC chip manufacturing and IC packaging and testing are fifteen to twenty percentage points lower than the 2012 share due to the 70% reduction in the reported 2013 revenues of Intel's operations in China.

This table includes eight groups that each own one or more companies in the various sectors of China's semiconductor industry.

These groups are listed rather than their several individual companies in order to better reflect their increasing significance in the growth and concentration of China's semiconductor industry.

This approach also corresponds to the CSIA's (China Semiconductor Industry Association's) current reporting practice, which reports the group totals (by industry sector) in response to requests by the groups.

The eight groups with their most significant companies are:

	Revenue (US$mn)			
	2010	**2011**	**2012**	**2013**
China Resources Microelectronics (Holdings) Ltd.	669	631	559	637
Wuxi China Resources Microelectronics Co., Ltd. (CR Micro) (former CSMC)–Foundry	179	169		
Wuxi China Resources Huajing Microelectronics Co., Ltd.–Discrete	168	134		
Wuxi China Resources Semico Microelectronics Co., Ltd.–IC design	91	124	100	132
XINCHAO Group	944	969	1,055	1,255
JECT (Jinangsu Changjiang Electronics Technology Co., Ltd.)–Pkg & Test	531	611	714	850
Natong Huada Microelectronics Group Co., Ltd.	618	620	656	738
Natong Fujitsu Microelectronics (NFME)–Pkg & Test	254	251	251	287
Shanghai Huahong (Group) Co., Ltd.	555	671	730	572
HHNEC (Shanghai Huahong NEC Electronics Co., Ltd.)–Foundry	367	389	372	
GSMC (Grace Semiconductor Manufacturing Co.)–Foundry		231	233	
Shanghai Huahong IC Co., Ltd.–IC design	96	94	106	110
China Huada Integrated Circuits Design (Group) Co., Ltd. (CIDC Group)	215	246	256	291
CEC Huada Electronics Design Co., Ltd.–IC design	74	127	149	171
Beijing Huada Zhaibao Electronic Systems Co., Ltd.–IC design	55	75	63	85
Nationz Technologies Inc.	104	88	68	70
Shenzhen National Holdings Co., Ltd.	163	173	183	243
Shenzhen State Microelectronics–IC design	61	73	71	71
Shenzhen Sunmoon Microelectronics–IC design				
Shenzhen State Micro Technology–OEM				
Hangzhou Silan Microelectronics Co., Ltd.	224	206	201	293
Hangzhou Silan Microelectronics Co., Ltd.–Design	96			
Hangzhou Silan Integrated Circuit Co., Ltd.–IDM/Foundry		96		
Hangzhou Silan Azure Co., Ltd–LED	58	53	29	29
Tian Shui Hua Tian Technology Co., Ltd. (TSHT)	216	275	291	576
Tianshui Huatian Technology Co., Ltd.–Pkg & Test		203		
Tianshui Huatian Microelectronics Co., Ltd.–Pkg & Test			257	398

Table 8: Top 10 Chinese semiconductor manufacturers 2003-2013

	Rank										
Name of company	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
HiSilicon Technology					24	11	7	8	5	4	1
SK Hynix				11	4	1	2	2	2	2	2
SMIC	2	2	1	1	2	3	3	3	3	3	3
Intel	7	8	10	9	17	17	1	1	1	1	4
Xinchao Group	8	7	5	7	7	8	6	6	6	5	5
Micron										6	6
Freescale	1	1	2	2	1	2	4	4	4	7	7
Spreadtrum								15	8	12	8
Samsung			18	21	18	15	15	18	7	8	9
RFMD		4	4	4	5	7	5	5	16	11	10
Huahong Group	4	3	7	5	8	12	11	12	9	9	20
Hangzhou Cree									12	10	11
ASE					20	18	16	14	10	13	13
Natong Huada Micro	10	9	12	13	12	13	13	9	13	14	12
China Resources Micro	24	13	15	16	6	6	8	7	11	15	14
Panasonic	16	16	11	8	10	9	10	11	14	17	24
Renesas	3	5	6	10	9	5	9	10	15	18	15
Leshan Radio	5	10	13	15	15	16	14	16			
ST Microelectornics	6	11	3	6	11	10	12	13	18		
ASMC	9	12	19	17	25						
HeJian Technology		6	8	12	14	23	22	25			
Infineon/Quimonda			9	3	3	4	17	17	22	23	25

China semiconductor industry revenue (US $mn)	8,282	12,006	16,053	21,660	27,431	31,434	29,171	38,053	51,402	56,325	65,758
Total Top 10 manufacturers (US$mn)	2,372	3,752	4,354	6,709	8,954	9,605	9,409	12,015	14,503	16,048	13,724
Top 10% China semiconductor industry	28.6%	31.3%	27.1%	31.0%	32.6%	30.6%	32.3%	31.6%	28.2%	28.5%	20.9%

Source: CCID, CSIA

In addition to these eight groups, Table 7 also lists a single entry for each of several multinational semiconductor companies that have more than one manufacturing facility in China though each facility may be legally organized as a separate company. These companies include ASE, Diodes, Freescale, Hynex, Intel, Renesas, RFMD, Samsung Electronics, ST Microelectronics and UTAC. Each listing reflects the combined revenues of all the companies' manufacturing facilities in China.

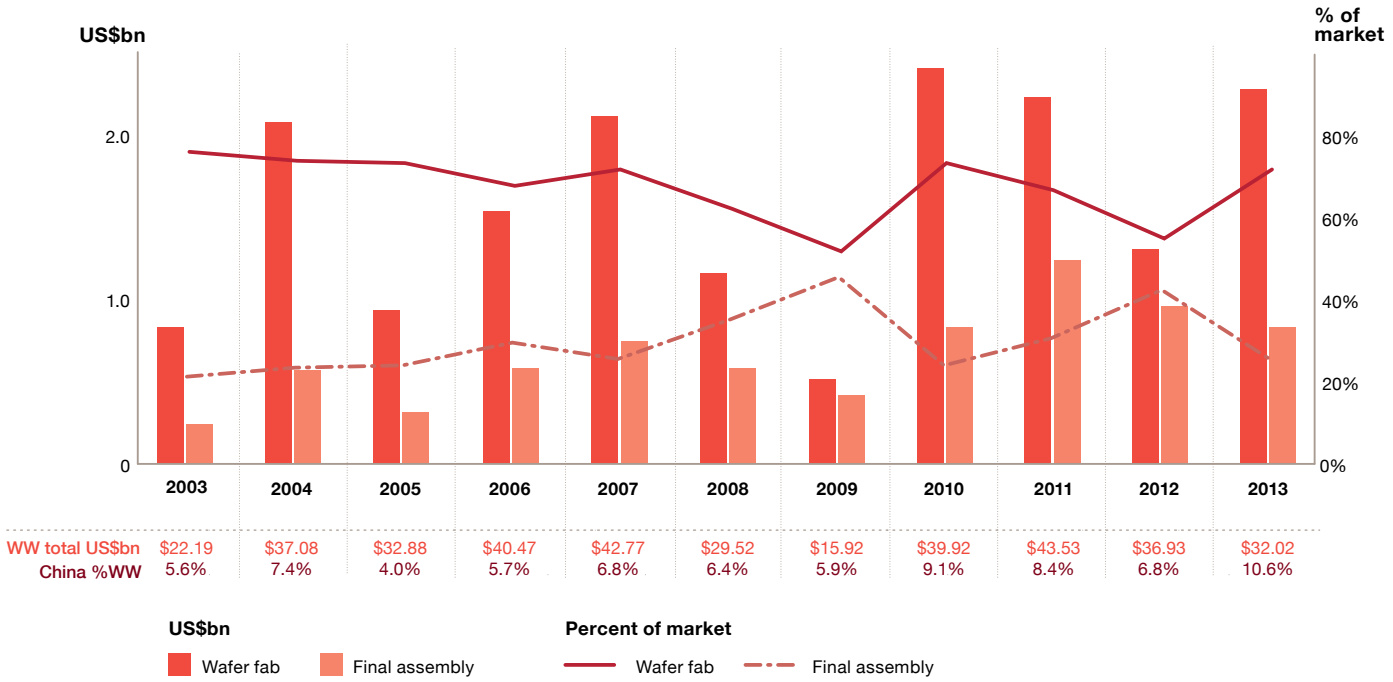
Ten years ago, our table of Major Semiconductor Manufacturers in China, 2003 consisted of only 30 enterprises with revenues exceeding US$20mn. The combined revenue of those 2003 top 30 manufacturers was US$3.32bn compared to the US$24.9bn combined 2013 revenue of the top 30 manufacturers of Table 7. During the past ten years since 2003 the average revenue of China's top 30 semiconductor manufacturers has increased by more than 640% and the minimum revenue threshold for inclusion in that group has increased by more than 1,600% from US$20mn to US$348mn. Only 17 of the 2003 top 30 Chinese semiconductor manufacturers have continued to be among the 2013 top 50 manufacturers. All of the 2003 top ten manufacturers continued to be among the 2013 top 50, but only four of those were among the 2013 top ten manufacturers: Intel, SMIC, Xinchao Group and Freescale. The other six 2003 top ten manufacturers—Renesas, Huahong (Group), Leshan Radio, ST Microelectronics, ASMC and Natong Fujitsu—were ranked anywhere from number 13 to 50 among the 2013 top 50 manufacturers.

Table 8 shows the relative ranking history of China's top ten semiconductor manufacturers during the period from 2003 through 2013. The composition of the top ten manufacturers has been notably more dynamic than that of the top ten suppliers shown in Table 3. There have been twenty-two different groups or companies that have been among China's top ten manufacturers during one or more of the years from 2003 through 2013. Only three—SMIC, Xinchao Group and Freescale—have been among the top ten for every year during that period. By contrast, three others—ASMC, ASE and Spreadtrum—have only been among the top ten for one single year during that period. During the period from 2003 through 2013 China's top ten semiconductor manufacturers have accounted for an average 28.4% of China's total semiconductor industry revenues.

Semiconductor equipment

China's semiconductor equipment market continues to remain a relatively small share of the worldwide market. In fact, 2013 was the first year in which China accounted for 10% or more of the worldwide semiconductor equipment market. That is compatible with our estimate that in 2013 China's semiconductor industry accounted for about 12% of worldwide semiconductor value added. A portion of China's semiconductor industry capacity has been increased during the past ten years by the acquisition or transfer of previously owned equipment from other locations. During the past ten years, from 2003 through 2013, China's aggregate semiconductor equipment market accounted for just 7.1% of the worldwide aggregate market and was split 70% wafer fabrication and 30% final assembly and test. China's share of the worldwide semiconductor equipment market has varied from 5.6% in 2003 to a low of 4% in 2005 and a previous peak of 9.3% in 2010, followed by 8.4% and 6.8% in 2011 and 2012 before reaching 10.6% in 2013. Despite that variation, China's semiconductor equipment market growth has been much stronger that the worldwide market. It has grown at a 10% ten year CAGR, second only to Taiwan at 13.3% and much stronger than the worldwide market growth rate of 3.8%.

Figure 23: China's semiconductor equipment market size and distribution



Source: SEMI, Solid State Technology 2006-2009, 2013

Interview

Cristiano Amon

Executive Vice President, Qualcomm Technologies, Inc. and Co-President of QCT

Qualcomm Incorporated is a world leader in 3G, 4G and next-generation wireless technologies.

How has China impacted your company over the past ten years? What's different about your company because of China?

We introduced our technology and products in China well over a decade ago, during the deployment of the second generation (2G) of wireless communications. We began working with Chinese manufacturers, not just the infrastructure vendors at the time, but also the handset manufacturers, as the industry transitioned from 2G to third generation (3G).

In the mid-2000s Chinese OEMs signed up for 3G licenses, and were able to start building 3G networks and are now moving fast to 4G.

At the same time, the Chinese handset manufacturers have been not only supporting China in China, but outside China as well. Many of them are now global companies. And we have had a very long history of collaboration working with the Chinese wireless industry in the deployment of 3G and 4G technologies in China and outside China as well as supplying chipsets to their 3G and 4G smartphones and tablets.

So China provided a market you wouldn't have had otherwise. But how has that made your company different? Or is it just a bigger market?

The wireless industry has been in constant evolution. You'll remember at some point—in the early days of cellular—you had companies like Motorola, Ericsson and Nokia.

Later, those companies were joined by companies such as LG, Samsung and Pantech from Korea. Then you had newcomers such as Blackberry and now you have Apple with the iPhone, as well as smartphones made from companies in Taiwan like HTC.

What we see now is, as the landscape in China evolves, a lot of the Chinese manufacturers are not solely focused on China, but also on moving outside the region to become part of the global wireless industry.

One of the great things about being in the wireless industry is that it is one of the largest industries in consumer electronics, with growth opportunities for many players to enter the space. To answer your question about how China has impacted our company over the past ten years, we've had the opportunity to work with many Chinese customers to help develop their own products. Many of our customers have become household names in China and, increasingly, overseas. We help them become global, making wireless a lot more diverse not only by expanding

the total size of the ecosystem with the growth in China, but also with the growth in many of those areas from OEMs that are based in China. And Qualcomm continues to invest in research and development in China, expanding existing relationships and launching new technology collaborations.

Does Qualcomm have any operations in China?

Yes. If you look at our semiconductor business today, we support a lot of customers. If you look at total number of customer engagements, there are more than 50 different customers in China just on the handset manufacturing, design and supplier, of smartphones and tablets.

We have a large organization that supports all of those customers by assisting with the design of their products using our chipsets. We also have a lot of engineers doing R&D. We have branches in Beijing, Shanghai, Shenzhen and Xi'an. We have two R&D centers, one in Beijing and one in Shanghai. And we employ more than 1,200 engineers in China.

How would you compare your operations in China to your other operations worldwide?

That's an interesting question. I think we are truly a global company. For example, when we think of R&D, we have R&D in China for China and also as part of our global R&D. We have R&D in the United States. We have R&D in Europe. We have R&D in India.

So I think the best way to answer your question is we started operations in China well over ten years ago. But because we look at the industry as one global opportunity we don't look at China in a stand-alone manner.

I think we have an R&D organization that is very global. We have people that are focused on China operations, but they're not necessarily only in China. They're in China; they're in the United States and Europe; they're in India.

China as a country probably has the largest number of OEMs and our customer engagements continue to increase.

You have many different brands of OEMs and ODMs that are based in China. So in terms of customer engagement per country, China has the largest number of handset OEM brands.

How do you feel that China has impacted the total semiconductor industry over the past ten years? What's different about the industry because of China?

Let me try to address your question in two pieces. The first thing is scale. China is a growing economy. But in terms of the wireless industry, it's also a very vibrant, innovative region.

Customers are upgrading, they're moving into higher tier phones and higher tier technology. So I think what China brings is two things.

So the scale of China itself and the growth scale of the Chinese-based handset manufacturers that are becoming global is the first part. And then the other part is that China is very focused on the speed of innovation.

While the transition from 2G to 3G took some time in China, the transition to 4G is probably one of the fastest deployment rates of 4G in the industry.

And I think that basically creates a very good virtual cycle for the semiconductor industry; creates opportunity for new technology that drives our new chipsets for a growing opportunity.

Are most of Qualcomm's sales in China to Chinese OEMs?

I can't be precise about this. But we look at the China industry. It's a global industry. So we sell our chipsets to, by definition, global OEMs. And those OEMs, whether they're based in the United States or Korea or China, they will be selling their products globally.

So, when you look at the presence of our products in China, we have domestic OEMs that buy our products for use both in China and outside China. But we also have global OEMs that buy our products in different locations to use globally as well as in China. Like I said, we look at the whole wireless industry as one global opportunity for Qualcomm.

China now represents more than 50% of the total worldwide semiconductor market and it's been there for at least the last couple of years. When you look at that, two things stand out.

One, the vast majority of the integrated circuit sector consumed in China is still being sold by non-Chinese companies. And most of the usage is basically for non-Chinese.

Basically its products that get assembled, tested and manufactured in China but then get exported out of China. The other read we have is that basically as a consumer of semiconductors, China has gone from being the smallest region to the largest region in a very short period of time—from 2003 to around 2007.

That said, how do you think China is going to impact the semiconductor industry over the next five or ten years?

Can I come back and make a comment about what you said about the semiconductor industry in China before answering this new question?

Certainly.

What's interesting is that today you can observe both of those scenarios that you outlined. For example, let's just say you have OEMs that are based in Korea and you have OEMs that are based in the United States. They both have manufacturing operations in China and will consume semiconductors in China to manufacture their products and sell them, sometimes in China, and sometimes globally.

But you also have Chinese manufacturers. Examples of those include new and upcoming very successful OEMs like Xiaomi. Other ones, such as Oppo, are headquartered in China and they consume chipsets for production that they build not only for China's domestic consumption but also global consumption.

I think we will see the co-existence of these two types of scenarios. However, another thing to notice is that the Chinese OEMs that are global players are, in many cases, gaining new business and gaining share outside China.

So, we may have a situation where we start to see the reverse of what you described earlier. There's a growing amount of Chinese semiconductor consumption based on Chinese OEMs. They're buying semiconductor technology not only for their domestic consumption, but also for global consumption.

So what do you think is going to happen over the next five to ten years? How do you relate to that?

I think the fact that China took an important step in leading the world in speed of transition of their networks to the latest technology such as LTE is creating an interesting phenomenon in the industry where consumers will look at their mobile device and their smartphone as their primary vehicle to access the Internet, and we'll see continued growth.

China has a very vibrant number of Internet players. With the LTE technology, I think the cycle of upgrades and desire for more technology in those phones is going to be faster. They will want more CPU speed, more GPU speed for graphics performance, more connectivity and the latest modem as well as higher display resolution.

All that is going to create a very important virtual cycle for the semiconductor industry in China with both the adoption of new technologies in one vector and the other vector being the scale provided by China itself and the ambitions of the Chinese OEMs to grow into opportunities outside China.

What factors or influences do you think either enhance or limit China's participation and impact in the semiconductor industry?

Can you define for me what you mean by China's participation in the semiconductor industry?

Well right now if you look at China's reported semiconductor manufacturing revenues including their fabless semiconductor sector, which they describe as IC design; their chip manufacturing, which would include SMIC, Huahong Grace and their other wafer fabs; and all their packaging and testing operations. You take all of that revenue that they report and you compare it to worldwide, they represent about 12% of the worldwide value added in semiconductors.

Understood.

Okay. About ten years ago they probably were 2% of the worldwide. So that's grown noticeably. But the question is what influences it going forward or what's going to limit it going forward?

So I think as the opportunity in China increases, we're likely to see China's participation in semiconductor manufacturing to be much larger. And I think, in essence, the opportunity and collaboration that we have with SMIC, which has been publicly announced, is along those lines.

We think that China's commitment to invest in semiconductor manufacturing and foundry combined with the technology transition and a virtual cycle of more technology innovation into the mobile space in China creates an opportunity that could significantly increase Chinese participation in the semiconductor industry.

And I think Qualcomm, as a company that is a customer of the semiconductor manufacturing industry, is looking at China in a very positive light as we collaborate to help build their foundry industry with companies like SMIC.

Our read is that right now SMIC is one or two generations behind leading edge. Do you feel that they ultimately will catch up?

Yes. And I think you actually hit a very, very important point. That's actually one of the value adds of our relationship. We're a company that bases its products on the leading edge. And I think one of the things that we bring to the Chinese foundry industry is actually the ability to collaborate to help the Chinese foundry industry reduce their development time on the leading edge.

One of the key value adds of our relationship with the China semiconductor industry is our ability to help those companies tackle this growth opportunity in the wireless industry, to be able to offer leading-edge technology.

What challenges or opportunities is China going to represent for your company over the next five years to ten years?

From a business opportunity it's the usual things: speed, scale, agility to anticipate industry needs. One of the good things about the tech industry is you have to always adapt and you have to always anticipate the industry requirements and be the first to respond.

I think the industry is full of examples of what happens when you don't follow the growth opportunity. And I think that's what we have to do for our customers in China. We expect the same from our suppliers.

But I think the other opportunity in China is a great opportunity for the entire industry. I think China is now very well positioned in this whole transformation happening in the industry worldwide. And we're very happy being part of that.

One other thing we didn't talk about is that Qualcomm previously announced plans to invest up to US$150 million intended to help support the creation and growth of new Chinese technology companies through our venture capital arm, Qualcomm Ventures.

China this year announced a big national IC development fund valued at 120 billion RMB, which is about US$19 billion over ten years.

They're also supporting several regional funds with a number being quoted of 600 billion RMB, which is well over US$100 billion. Is your fund involved in that?

I believe it's independent, but I think it aligns to the vectors you just outlined. But it's being run independently by our corporate venture capital arm.

Do you see those announced initiatives as being competitive to Qualcomm or complementary to Qualcomm?

Our point of view on that is it's complementary because we're looking at helping to further catalyze that start-up ecosystem. So we actually see that as a positive. You know, one plus one equals three.

Do you have any Chinese direct competitors?

I think we're probably in the most competitive industry on the planet. We have lots of competitors. And there are multiple vectors of competition. We have competitors in China in multiple technologies. For example, in the cellular industry we have competitors in connectivity, competitors in Bluetooth, competitors in CPU, application processors and in modems.

There's probably a number of Chinese semiconductor design companies that compete with us. And on top of that there's a full force of global competitors in the semiconductor industry.

We talked a lot about wireless. Are there unique Chinese design standards and specifications that impact the semiconductor industry or your business?

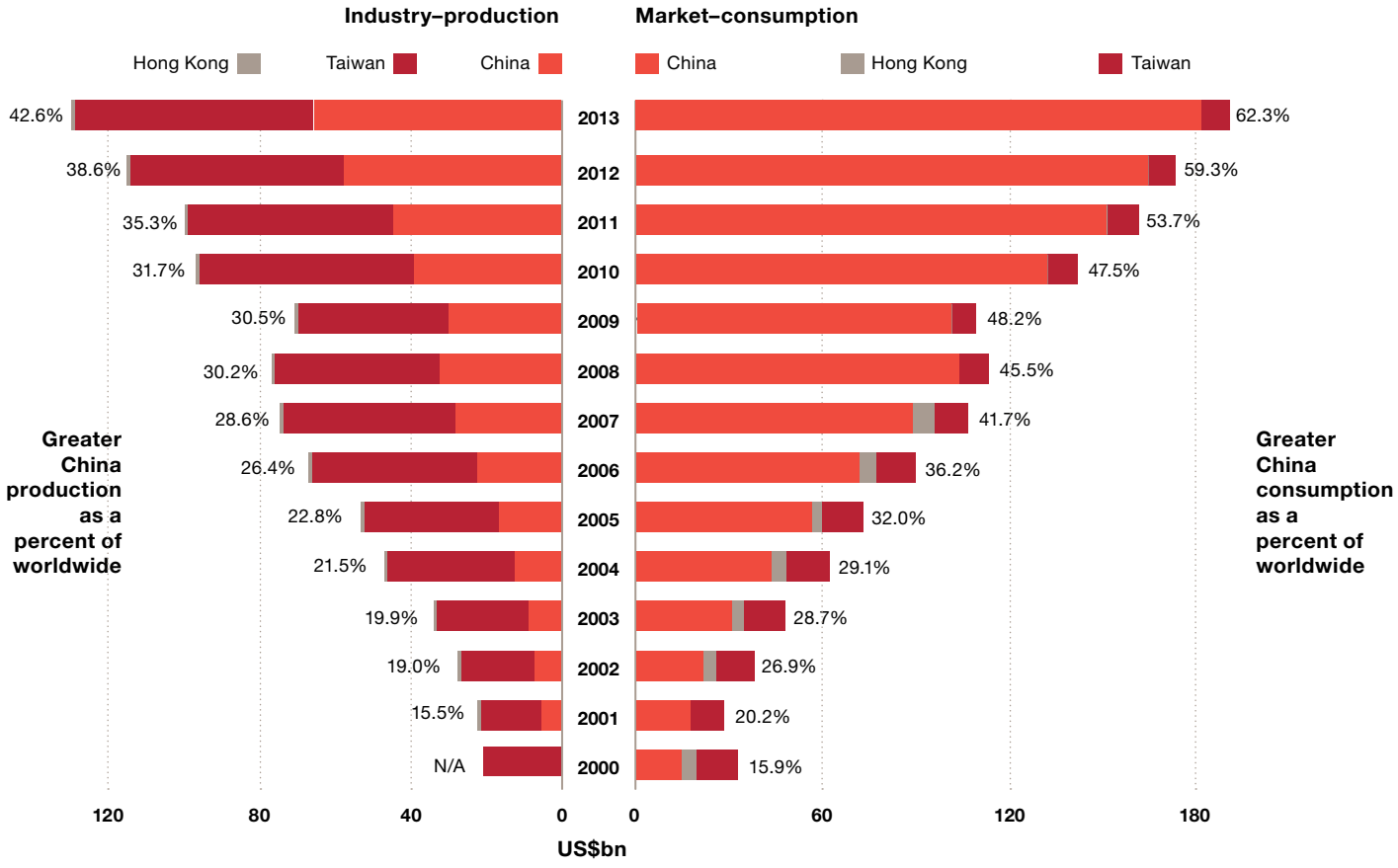
We don't think so. What is interesting about China, since we are talking about the semiconductor industry in general, is its position as a player in the global industry. The OEMs in China are looking for the ability to use what they produce for the China domestic industry so they can export and gain share globally. That is creating a very positive momentum towards globalized standards and technologies.

Greater China

Greater China's consumption and production of semiconductors continued to grow much faster than the worldwide semiconductor market to reach new record levels during 2013. Measured in US dollars, Greater China, which includes mainland China, Hong Kong and Taiwan, accounted for more than 62% of the worldwide semiconductor consumption market in 2013.

Taiwan's semiconductor industry continues to play an important and strategic role in the global and Greater China markets. The advantages of cost efficiency, flexibility and speed resulting from a vertically-integrated infrastructure and an industry cluster effect have made it one of the major IC producers in the world. At the same time, Taiwan's growing economic relationship with mainland China and

Figure 24: Greater China share of the worldwide semiconductor industry, 2000-2013



Note: While Greater China's reported semiconductor industry revenue for 2013 equaled 42.3% of worldwide semiconductor industry consumption revenue, it represented 33% of worldwide semiconductor device sales; plus foundry and assembly and test services revenue; and 24% of worldwide semiconductor device sales; plus the value of all wafer fabrication and packaging, assembly and test production.

Source: CCID, CSIA, TSIA, SIA/WSTS, PwC

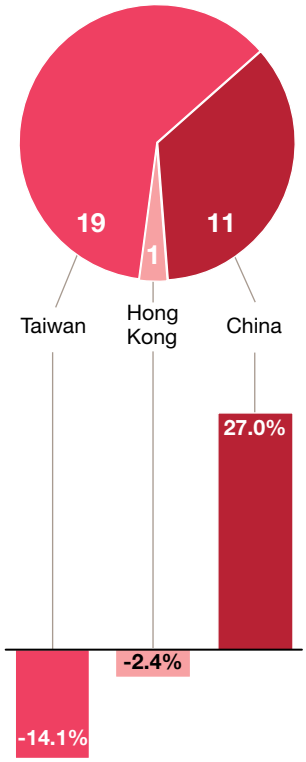
Table 9: Greater China companies among worldwide top 100 OEM/ODM companies by Semiconductor Design TAM

Company	Market	Design TAM (US$mn) 2011	2012	2013	% change 2011-2013
Ability	TWN	715	643	432	-39.6%
Acer	TWN	4,257	3,439	2,621	-38.4%
A-Data	TWN	476	418	442	-7.1%
ASUSTeK	TWN	2,773	3,244	3,199	15.4%
Changhong	CN	326	332	419	28.5%
Compal Electronics	TWN	1,504	1,359	1,406	-6.5%
Coolpad	CN	190	551	738	288.4%
Delta Electronics	TWN	474	463	457	-3.6%
ECS	TWN	509	457	450	-11.6%
Gigabyte	TWN	577	542	541	-6.2%
Haier	CN	567	513	611	7.8%
Hisense	CN	384	517	681	77.3%
Hon Hai	TWN	3,894	3,316	2,988	-23.3%
HTC	TWN	2,453	1,741	1,019	-58.5%
Huawei	CN	3,811	4,331	4,945	29.8%
Inventec	TWN	840	704	707	-15.8%
Lenovo	CN	7,717	8,064	9,548	23.7%
Lite-On	TWN	494	641	923	86.8%
MSI	TWN	833	672	556	-33.3%
Oppo Electronics	CN	111	172	402	262.2%
Pegatron	TWN	1,308	1,251	1,219	-6.8%
Qisda	TWN	1,176	1,169	1,204	2.4%
Quanta	TWN	1,330	1,716	1,694	27.4%
Skyworth	CN	337	456	489	45.1%
TCL	CN	1,735	1,651	1,694	-2.4%
TPV	HKG	1,158	1,462	1,743	50.5%
Transcend	TWN	716	648	800	11.7%
USI	TWN	420	450	512	21.9%
Wistron	TWN	1,361	1,158	1,263	-7.2%
Xiaomi	CN	19	111	491	2484.2%
ZTE	CN	2,749	3,130	2,779	1.1%
Grand total = 31		**45,791**	**45,510**	**46,924**	**2.5%**

Source: Gartner

Greater China's total OEM/ODM companies by Design TAM

Number of companies by market by 2011-2013 growth



Even though Taiwan numbered the most companies, it experienced the lowest Design TAM growth from 2011-2013.

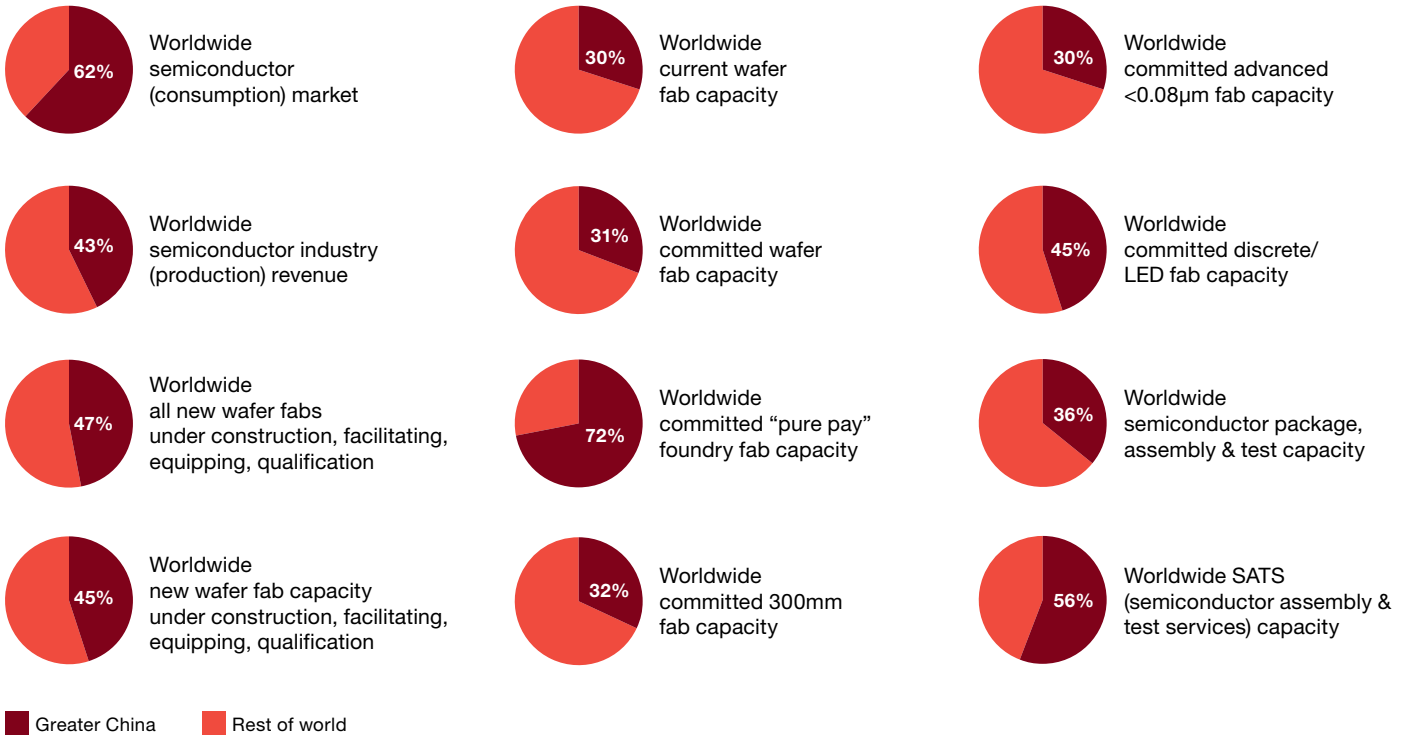
the gradual loosening of investment restrictions between the two sides have helped accelerate the integration of their respective semiconductor industries.

Taiwan's IC industry revenues as a whole (including design, manufacturing, packaging and testing) grew 15.6% to US$63.4bn in 2013, accounting for around 20% of the worldwide semiconductor market, according to the Taiwan Semiconductor Industry Association (TSIA). The TSIA projects overall local industry growth of 16.4% in 2014, largely driven by continuing strong demand from the mobile device market, led by smartphones and tablets, as well as opportunities from the development of the Internet of Things (IoT).

The output value of Taiwan's IC design or fabless semiconductor sector grew 16.9% to US$16.2bn in 2013, ranking second globally behind the US. Consolidation and M&A activity in Taiwan's fabless sector has accelerated this year, particularly in the mobile driver IC space, amid rapid growth in the market for wearable and IoT devices. International chipset vendors are increasingly looking to tie up with Taiwan-based IC design houses, primarily small players with single specializations, in order to meet end-market demand as well as to expand their business ecosystems in China.

Taiwan remains the clear leader in the dedicated IC foundry segment of the semiconductor industry. Taiwan's foundry sales grew 17.1% to US$25.5bn in 2013, accounting for around 60% of global foundry revenues. Taiwanese contract chipmakers continue to aggressively expand production and develop new technology to fend off competition, maintaining their capital and R&D spending at record levels to ensure sufficient 28nm and below capacity in future years to meet growing demand for high-end chips.

Figure 25: In 2013 Greater China represented:



Note: While Greater China's reported semiconductor industry revenue for 2013 equaled 42.3% of worldwide semiconductor industry consumption revenue, it represented 33% of worldwide semiconductor device sales; plus foundry and assembly and test services revenue; and 24% of worldwide semiconductor device sales; plus the value of all wafer fabrication and packaging, assembly and test production.

Source: CCID, Gartner, IC Insights, SEMI World Fab Watch, TSIA, WSTS, PwC 2012

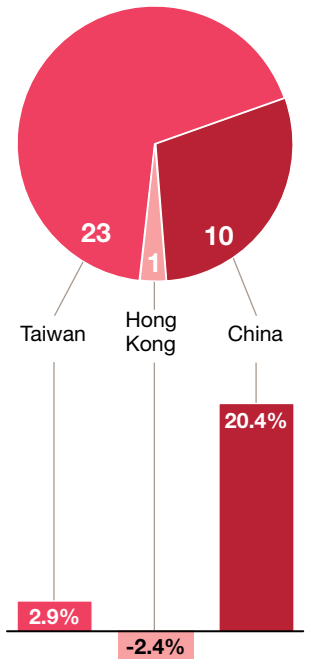
Table 10: Greater China companies among worldwide top 100 OEM, ODM and EMS companies by Semiconductor Purchasing TAM

Company	Market	Purchasing TAM (US$mn) 2011	2012	2013	% change 2011-2013
Ability	TWN	816	729	469	-42.5%
Acer	TWN	2,239	1,780	1,410	-37.0%
A-Data	TWN	476	418	442	-7.1%
ASUSTeK	TWN	1,637	2,040	2,195	34.1%
BYD	CN	847	790	703	-17.0%
Cal-comp	TWN	772	849	718	-7.0%
Changhong	CN	389	395	485	24.7%
Compal Communications	TWN	208	479	412	98.1%
Compal Electronics	TWN	4,909	4,496	4,827	-1.7%
Coolpad	CN	190	551	738	288.4%
Delta Electronics	TWN	482	470	464	-3.7%
ECS	TWN	1,013	918	903	-10.9%
Gigabyte	TWN	1,106	1,065	1,057	-4.4%
Haier	CN	513	487	578	12.7%
Hisense	CN	421	554	720	71.0%
Hon Hai	TWN	18,522	20,376	20,521	10.8%
HTC	TWN	2,671	1,743	983	-63.2%
Huawei	CN	2,674	2,869	3,050	14.1%
Inventec	TWN	2,590	2,131	2,131	-17.7%
Lenovo	CN	5,863	5,793	6,742	15.0%
Lite-On	TWN	622	776	1,059	70.3%
Mitac	TWN	508	526	519	2.2%
MSI	TWN	1,252	1,079	870	-30.5%
Pegatron	TWN	5,305	6,018	7,161	35.0%
Qisda	TWN	752	817	787	4.7%
Quanta	TWN	6,177	6,237	6,273	1.6%
Skyworth	CN	413	532	569	37.8%
TCL	CN	1,435	1,742	2,032	41.6%
TPV	HKG	1,765	1,677	1,722	-2.4%
Transcend	TWN	716	648	800	11.7%
TSMT	TWN	662	676	725	9.5%
USI	TWN	971	1,018	1,124	15.8%
Wistron	TWN	3,486	3,278	3,723	6.8%
ZTE	CN	2,454	2,914	2,680	9.2%
Grand total = 34		**74,856**	**76,871**	**79,592**	**6.3%**

Source: Gartner

Greater China's total OEM, ODM & EMS companies by Purchasing TAM

Number of companies by market by 2011-2013 growth



China, with its 10 companies, experienced more than 20% Purchasing TAM growth from 2011-2013.

Taiwan's foundry sales grew 17.1% to US$25.5bn in 2013, accounting for around 60% of global foundry revenues.

Although it accounts for only a small portion of the global market, Taiwan is making a comeback in the memory-chip manufacturing segment. Taiwan's DRAM revenues grew 31.2% to US$8bn in 2013. The local sector is healthier now than at any point in the past few years, in part because of consolidation spurred by the decision of US-based Micron Technology to greatly increase its stake in Taiwan. Another contributing factor is the product diversification to more applications, reducing dependence on PC DRAM.

Taiwan is also the world's leading provider of IC packaging and testing outsourcing services. The annual production value of the local sector grew 4.4% in 2013, to US$13.7bn, accounting for about 55% of the global market for IC SATS (semiconductor assembly and test services). With the continuing trend towards smaller, more lightweight electronic products, Taiwanese IC SATS suppliers are increasing spending on production equipment for advanced technologies, in particular to cater to high-end communications chip makers.

There has been a gradual relaxation in Taiwan's restrictions on China-bound semiconductor investments in recent years, reflecting the closer economic links with China. In October 2013, the Taiwanese government allowed local chip makers to invest in existing facilities in mainland China, providing they use production technologies at least one generation behind the most up-to-date one in Taiwan, up from a two-generation gap previously.

Taiwanese foundries TSMC and UMC both operate 8-inch (200mm) chip plants in the East China. TSMC's Shanghai plant focuses on production of high voltage process products, MCUs, smartcards and embedded SoCs. UMC's Suhzhou fab is run by its Chinese subsidiary, Hejian Technology, and focuses on production of LCD driver and power management ICs. The two foundry companies are ramping up production capacity in China to cope with rising demand.

UMC announced in October 2014 that it also plans to invest US$1.35bn over the next five years in a three-way joint venture with the Xiamen City Government and Fujian Electronics and Information Group to build a 12-inch fab in Xiamen. The new venture will use relatively mature 55nm and 40nm processes, which will be one generation less advanced than the 28nm technology that UMC uses in Taiwan. UMC expects its funding to progress in installments starting in 2015, pending approval from the Taiwanese government. This development was prompted in large part by China's strategic push to build up its semiconductor industry.

Greater Chinese companies have grown to dominate worldwide semiconductor outsourced manufacturing. With the merger of China's HHNEC and GSMC (Grace Semiconductor Manufacturing Company) in 2012 and UMC's completed acquisition of Hejian, four of the top five (3 Taiwanese +1 Chinese), seven of the top ten (5 Taiwanese + 2 Chinese) and 11 of the top 20 (6 Taiwanese + 5 Chinese) pure-play semiconductor wafer foundries were Greater China companies, accounting for US$29bn, 81%, of total worldwide 2013 foundry revenues. By the end of 2013, Greater China also represented 71% of worldwide pure play wafer foundry capacity. Similarly, six of the top ten (5 Taiwanese + 1 Chinese) and 11 of the top 20 (8 Taiwanese + 3 Chinese) SATS suppliers were Greater China companies, accounting for US$12bn or 48% of total worldwide 2013 SATS revenue. Also by the end of 2013, Greater China represented 64% of worldwide SATS manufacturing

Driven by the Chinese market, Greater China's semiconductor consumption increased to a record level of US$191bn in 2013, growing by 10% or US$18bn, during the year. China's consumption of semiconductors continued to be more than eighteen times that of Taiwan's in 2013, with a significant portion of that consumption created by Taiwanese EMS and ODM companies operating in China.

Greater China's semiconductor industry (production) revenue also increased to a new record level of US$130bn in 2013. Both the Chinese and Taiwanese industry sectors significantly exceeded the worldwide industry, growing by 17% and 14%, respectively, in 2013, while the worldwide industry only grew by 5%. During the past ten years, from 2003 through 2013, China's IC industry has grown at a 25.4% CAGR, while Taiwan's industry has only grown at a 10.3% CAGR. As a result, Taiwan's IC industry revenues were only 1.5 times as large as China's reported IC industry revenues in 2013, down from being more than 5.5 times as large in 2003.

2013 was the first year in which Greater China's IC production growth slightly exceeded its IC consumption growth. As a result, while Greater China's IC consumption still exceeds its IC production, Greater China's annual IC consumption/production gap decreased fractionally in 2013 to slightly less than US$55bn. This ends a trend of over a decade of steady growth from 2000 through 2012. While this gap is still significantly less than that of China's alone, it continues to account for more than 21% of the total worldwide IC market.

There were 31 Greater China OEM and ODM companies among the worldwide top ten semiconductor consumers in 2013 based upon Design TAM, up from 27 such companies in 2012 and 24 in 2011. Compared to the 27 Greater China top semiconductor Design TAM consuming companies in 2012, one company from Taiwan, Yulong, did not qualify, while one new company from Taiwan, USI, and four from China—Changhong, Coolpad, Oppo Electronics and Xiaomi—joined the 2013 top semiconductor consumers.

Of these 31 companies, 19 are in Taiwan, eleven in China and one in Hong Kong. Their combined total Design TAM accounted for 15% of worldwide in 2013 as it had for the prior two years. However, the mix within Greater China has changed. Since 2011, the Design TAM of the 19 Taiwanese companies has decreased by 14% and that of the one Hong Kong company by 3%, while the Design TAM of the 11 Chinese companies has increased by 27%. Samsung Electronics, at US$30.1bn, is reported to have the largest Design TAM worldwide in 2013, up a significant 65% from 2011, while Lenovo at US$9.5bn is reported to have the largest Design TAM in Greater China, up 24% from 2011.

There were 34 Greater Chinese OEM, ODM and EMS companies among the worldwide top ten semiconductor consumers in 2012 based upon Purchasing TAM. This is an increase from 33 such companies in 2012 and 30 in 2011. Compared to the Greater China 33 top semiconductor Purchasing TAM consuming companies in 2012, two companies from Taiwan, Largan Precision and Yulong, did not qualify, while two new companies from China, BYD and Coolpad, plus one from Taiwan (USI), joined the 2013 top Purchasing TAM semiconductor consuming companies.

Of these 34 companies, 23 are in Taiwan, ten in China and only one in Hong Kong. Their combined total Purchasing TAM accounted for 25% of worldwide in 2013, a fractional decrease from 26% in 2012, but an increase from 24% in 2011. Their combined Purchasing TAM increased by US$5bn from US$75bn in 2011 to US$80bn in 2013, with US$3bn of that increase reported by the ten companies in China. Samsung Electronics is also reported to have the largest Purchasing TAM worldwide in 2013, at US$29.5bn, up a dramatic 69% from 2011 and 44% greater than the second largest, Hon Hai. However, Hon Hai is reported to have the largest Purchasing TAM in Greater China at US$20.5bn, up 11% from 2011.

Both the Chinese and Taiwanese industry sectors significantly exceeded the worldwide industry, growing by 17% and 14%, respectively, in 2013, while the worldwide industry only grew by 5%.

Government considerations

The Chinese government has been offering incentives to promote the development of the semiconductor industry for more than a decade. As discussed in our 2012 Update, State Council Rule 4 (2011) was intended to be the most important government policy for the Chinese semiconductor industry during the 12th Five Year Plan (FYP) period (2011 through 2015) and to be the successor to the policies of State Council Rule 18 (2000), which applied during the 10th and 11th FYP periods. As a result of those policies, China's semiconductor industry has grown to account for more than 12% of the worldwide semiconductor industry in 2013, up from 1.5% in 2000.

Likewise, the number of IC design enterprises in China has grown from about 100 in 2000 to almost 600 by the end of 2013. However, there continues to be considerable scepticism about the size and make up of these enterprises and many are reported to be small-scale operations without much competitiveness. China's IC consumption continues to greatly exceed IC production, and more than 90% of its consumption still relies on imported ICs. Chinese government stakeholders have been reconsidering the risks posed by the country's heavy reliance on others for semiconductor components and capabilities and have initiated policy changes that are intended to correct this dependence.

In June of 2014 the Chinese central authorities announced new "Guidelines to Promote National IC Industry Development", otherwise known as "New Document 4", unveiling a program to promote the IC industry by setting up a state-level lending group and special national and regional investment funds. The "Guidelines" are intended to stimulate the dynamism and creativity of IC companies and accelerate the pace at which China's IC industry catches up with international leaders. They call for focusing on design and manufacture, with great efforts made to boost the IC packaging and testing industry and make breakthroughs in key equipment and materials usage.

The basic principles underlying the "Guidelines" were identified as: Demand-oriented; Innovation-driven; Software and hardware combined; Key points breakthrough and Open development.

The "Guidelines" set ambitious development targets for China's domestic IC industry including:

a) By 2015 achieve IC revenue greater than RMB 350bn (US$57bn) per year; large scale manufacture of 32/28 nm chips; high-end packaging test to account for 30% of total packaging test revenues; and achieve production application of 65-45 nm critical equipment, 12-inch wafers, and other critical materials.

b) By 2020 achieve at least 20% annual industry-wide revenue growth; large-scale manufacture of 16/14 nm chips; packaging test technology at the international advanced level; IC design of mobile end-product, network communication, cloud computing, IoT and Big Data devices at the international advanced level and Chinese critical equipment and materials included in the international procurement system.

c) By 2030 become an acknowledged and accepted global leader in all primary segments of the IC industry supply chain.

The "Guidelines", which continued and extended the incentives of the earlier Document 18 (2000) and Document 4 (2011) policies, also included the establishment of a National Industry Investment Fund of RMB 120bn (US$19.5bn) to be invested between 2014 and 2017 to support the development of IC and related industries and promote industrial restructuring and upgrading. The reported purposes of the fund are: 1) National level support and funding; 2) Support target IC enterprises and 3) Facilitate the IC industry consolidation and enhance the competitiveness of the leading IC enterprises. The fund is to be allocated as follows: 40% wafer manufacturing; 30% chip design and 30% packaging and testing. The National Industry Investment Fund was set up at the end of September 2014 and is expected to start official operation by the end of 2014.

The "Guidelines" also provide for the establishment of several regional local government and private equity investment funds for a total of an additional RMB 600bn (US$97.5bn). The reported purpose of this pacesetting fund is to promote resource integration and M&A through investment in key enterprise projects and innovative entities or platforms. Beijing had already established an IC Industry Equity Investment Fund of RMB 30bn (US$4.9bn) in June of 2013 and the central government followed suit by introducing the National Industry Investment Fund. Other provinces and cities including Anhui, Shanghai, Shandong, Tianjin, Wuhan and Shenzhen are following the Beijing model, establishing local funds to support the IC industry. Government funds are to act as a lead to attract more private equity investment. As a result, equity investments will likely replace monetary subsidies as the major form of government support for the semiconductor industry in the future. Local analysts predict that by the end of 2015 the total equity funds established by China's central and local governments for the semiconductor industry will exceed RMB 200bn (US$32.5bn).

To avoid dissipating these investment funds by fragmentation, the government will focus on creating national champions—a small set of leaders in each critical segment of the semiconductor value chain (including design, chip manufacturing, assembly and test, and equipment)—in a few provinces in which there is the potential to develop industry clusters. One example of this focus on creating national champions is the acquisition of two of the 2013 top three Chinese fabless semiconductor companies, Spreadtrum and RDA, by

the state-owned Tsinghua Unigroup with the aim of combining them into a single entity. An example of the focus on potential industry clusters is the cooperative agreements SMIC made with the national and local governments to secure a US$1.2bn joint investment for their new 300mm wafer fab facility to be built in the Beijing Economic and Technology Development Area. The investors include Beijing Municipal Commission of Economy and Information Technology, the Institute of Microelectronics of the Chinese Academy of Science and the Beijing city government.

It is not clearly stated in the new Document 4 whether the National Industry Investment Fund may limit its investments to Chinese semiconductor companies or place certain restrictions on investments for wholly owned foreign owned enterprises (WFOE) or Sino-foreign joint venture (JV) semiconductor companies. However since one of the key spirits of the new Document is to protect national security it may be sensitive for foreign invested companies to be involved in projects that may have information security concerns. Also since the new Document encourages technology innovation and aims to make Chinese semiconductor companies become first ranked players in the global market place it seems to indicate the government will be more willing to support domestic semiconductor companies who develop and own IP in China. Therefore, while Document 4 does not clearly disallow WFOE or JV to apply for the investment fund, government authorities may have their internal guidelines on which entities are entitled to enjoy benefits which may restrict WFOE and JV participation.

After many years of planning China's first Anti-Monopoly Law (AML) was enacted in 2007 and became effective in August 2008, but specific enforcement was modest until new Chinese leadership came into office. The AML first introduced the concept of "Concentration of Business Operations" and subsequently a number of regulations or guiding opinions on the "Concentration of Business Operations" have been enacted by the Ministry of Commerce (MOFCOM). In January 2011 the enforcement authorities in China- the National Development and Reform Commission (NRDC) and the State Administration for Industry and Commerce (SAIC) published five new regulations implementing the AML.

Since then more antitrust activities were seen over the last 21 months than the previous four years as China is making more efforts to put its laws to work. Several large multinational companies, including leading IT and semiconductor companies have been subject to antitrust investigations. These investigations come after crackdowns in 2013 which saw Chinese regulators impose record fines of $242mn for market abuse. Observers advance several rationales for these recent developments including: China trying to protect domestic firms; China trying to control prices in politically sensitive sectors; Pressure from domestic firms that feel premium prices for goods they use are reducing their already razor-thin profits; China's increasing awareness of antitrust activities in other countries/ regions against the same firms; and Anti-monopoly regulators at central and local government level trying to impress top Chinese party and government officials who have stressed the need for China to move up the value-added chain, and cybersecurity. In response to US and European trade groups saying China's antitrust investigators were unfairly targeting foreign business, Chinese antitrust regulators have reported that only about 10 percent of their anti-monopoly investigations have involved foreign businesses.

Antitrust oversight in China is shared among three government agencies plus one coordinating committee. It is called the "3+1" mode for enforcement of the anti-monopoly regime in China.

The Ministry of Commerce (MOFCOM) of the Government of the People's Republic of China, formerly Ministry of Foreign Trade and Economic Co-operation (MOFTEC) is an executive agency of the State Council of China. It is responsible for formulating policy on foreign trade, export and import regulations, foreign direct investments, consumer protection, market

Equity investments will likely replace monetary subsidies as the major form of government support for the semiconductor industry in the future.

competition and negotiating bilateral and multilateral trade agreements. The Anti-monopoly Bureau of MOFCOM is responsible for reviewing on concentrations of undertakings according to law and investigating into cases on concentrations of undertakings reported by anti-monopoly enforcement authorities. It has jurisdiction over antitrust cases which involve the legality of mergers and acquisitions.

The National Development and Reform Commission (NDRC) of the Government of the People's Republic of China, formerly State Planning Commission, is a macroeconomic management agency under the Chinese State Council, which has broad administrative and planning control over the Chinese economy. The Department of Price Supervision of the NDRC is in charge of drafting administrative laws and regulations for price supervision and inspection; guiding and organizing price supervision and inspection, and handling activities and cases related to commodity prices, service prices and fee collection involving violation of price-related laws by central government agencies, handling price monopoly activities and reconsideration cases and appeals concerning the punishment of price violations and decisions. It has jurisdiction over antitrust cases which involve pricing.

The State Administration for Industry and Commerce (SAIC) is the authority in the People's Republic of China responsible for advancing legislation concerning the administration of industry and commerce in the People's Republic. The function of the Enforcement Office for Anti-Monopoly and Countering Unfair Competition of the SAIC is to stipulate regulations on anti-monopoly and countering unfair competition issues: to enforce the work of anti-monopoly, to investigate unfair competition, bribery claims, smuggling and other illegal economic cases. It is mainly responsible for enforcement work regarding agreements, the abuse of dominant market position and the abuse of administrative power to eliminate or restrict competition (except for price-fixing behavior. Therefore it has jurisdiction for all other anti-competition cases. Unlike NDRC it has conducted most of its investigations to date at the sub-national level, via provincial and local associations of industry and commerce.

In addition, the Anti-Monopoly Committee founded by the State Council in 2008 is responsible for coordination of the above three agencies.

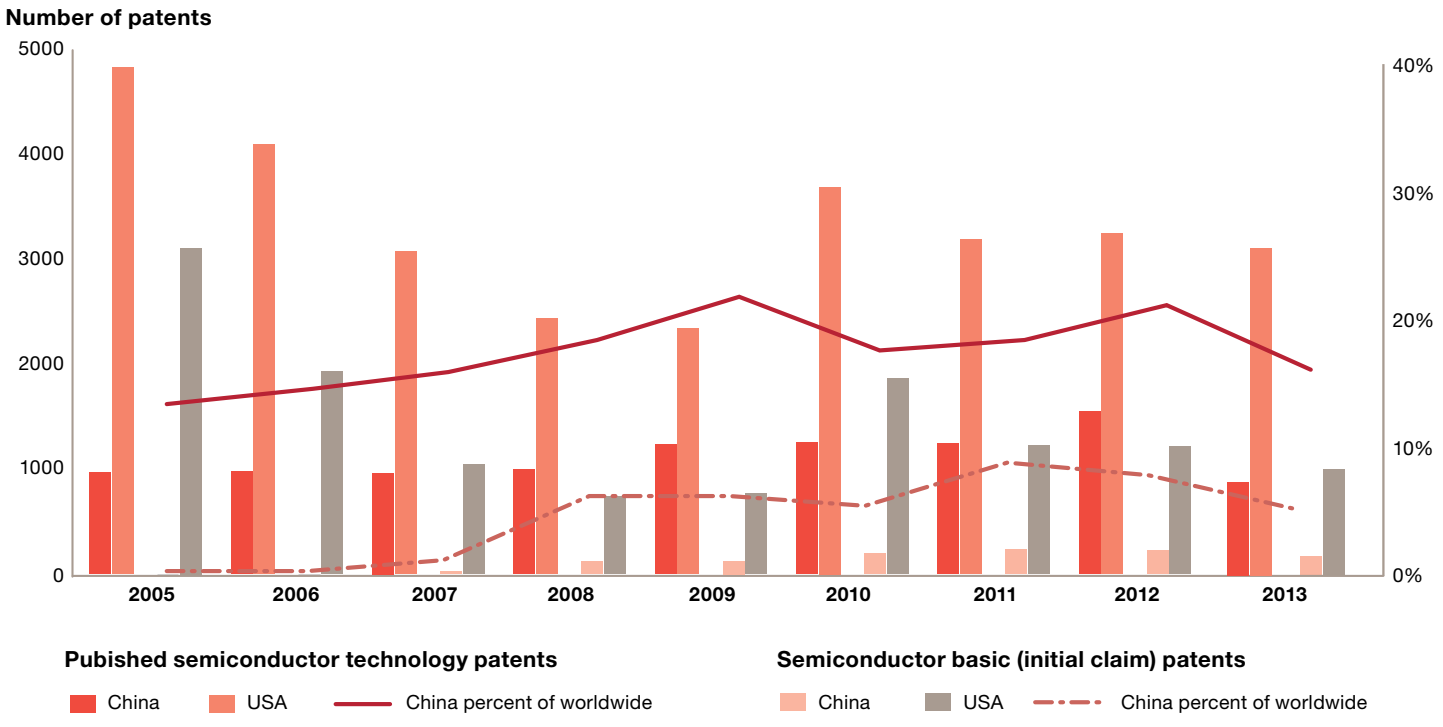
It is important for all companies doing business in China to be aware of China's relatively recent focus on antitrust law enforcement. China's antitrust law enforcement is undeniably at the initial stage and it is likely that changes will be made as authorities become more experienced in dealing with the multitude of antitrust investigations. There are reasons to believe the China's market environment purified through antitrust probes will be helpful for Chinese and foreign companies to compete in a fair market for the ultimate benefit of foreign and Chinese consumers. Therefore companies should keep China's antitrust law enforcement in mind as they set strategies and tactics for their participation in China.

Semiconductor patents

Intellectual property (IP) and its protection continues to be an area of specific focus in China's 12th FYP. One of the policy objectives of the 12th FYP for the semiconductor industry is to foster a group of semiconductor firms that will develop into global leaders in terms of both technology standards and market share. The government has implemented various tax and other incentives to support this objective for new/high technology enterprises (NHTEs).

One of the qualification criteria for NHTE status is core proprietary IP rights. Since 2005, China's share of worldwide semiconductor patents published by year has increased from 7.6% in 2005 to a peak of 14.9% in 2009 then varied between 10.7% and 12.7% for the next three years before declining to 10.7% in 2013. (These values for China's share of worldwide semiconductor patents published during 2005 through 2012 are somewhat lower than those

Figure 26: China versus worldwide semiconductor patents 2005-2013



Source: Derwent 2013

reported in our 2013 update as a result of our reference to a new Thomson Innovations patent database with a more comprehensive coverage of total worldwide patents).

What may be of more interest is the gradual growth of China's share of the first instance of a semiconductor patent publication, referred to as the basic patent statistic. According to data from the Thomson Innovation patent database, China, which had less than a 1.0% share in 2005 or 2006, started to grow its share of worldwide semiconductor basic patents published from 1.1% in 2007 to 9.8% in 2011, 10.7% in 2012 before declining to 7.3% in 2013. During the past five years, from 2009 through 2013, slightly less than 8% of patents on semiconductor inventions have been first issued in China compared to 51% in the US.

Further research with the Thomson Innovation patent database reveals that most of these Chinese semiconductor patents are still being issued to companies outside of China. There was only one Chinese company or institution, Ocean's King Lighting Science & Technology, among the top ten assignees.

The top ten assignees, accounting for 25% of the 1,102 semiconductor technology patents/ applications issued/ published in China in 2013, were the following multinational companies:

Company	# of patents
Taiwan Semiconductor Manufacturing Co., Ltd. (TSMC)	77
Semiconductor Energy Laboratory Co. (SEME)	48
Samsung Electronics Co., Ltd. (SMSU)	25
Sharp Corporation (SHAF)	24
Sony Corporation (SONY)	20
LG Innotek Co. Ltd.	19
Fujitsu Ltd.	17
Ocean's King Lighting Science and Technology Co., Ltd.	17
Toshiba Corporation	15
IBM Corp. (IBMC)	13

Source: *Thomson Innovations*

Correspondingly, the top ten assignees, accounting for 34% of the 213 semiconductor basic (initial claim) patents/applications issued/published in China in 2013, were the following Chinese companies and institutions:

Ocean's King Lighting Science and Technology Co., Ltd.	16
Institute of Microelectronics of Chinese Academy of Science	12
Tsonghua University	10
Semiconductor Manufacturing International Corp. (SMIC)	8
Peking University	5
Fudan University	5
Hongfujin Precision Industry (Shenzhen) Co., Ltd.	5
University of Electronic Science & Technology of China	4
Chinese Academy of Science Institute Chemistry	4
Shenzhen Huaxing Optoelectronic Technology Co., Ltd.	4

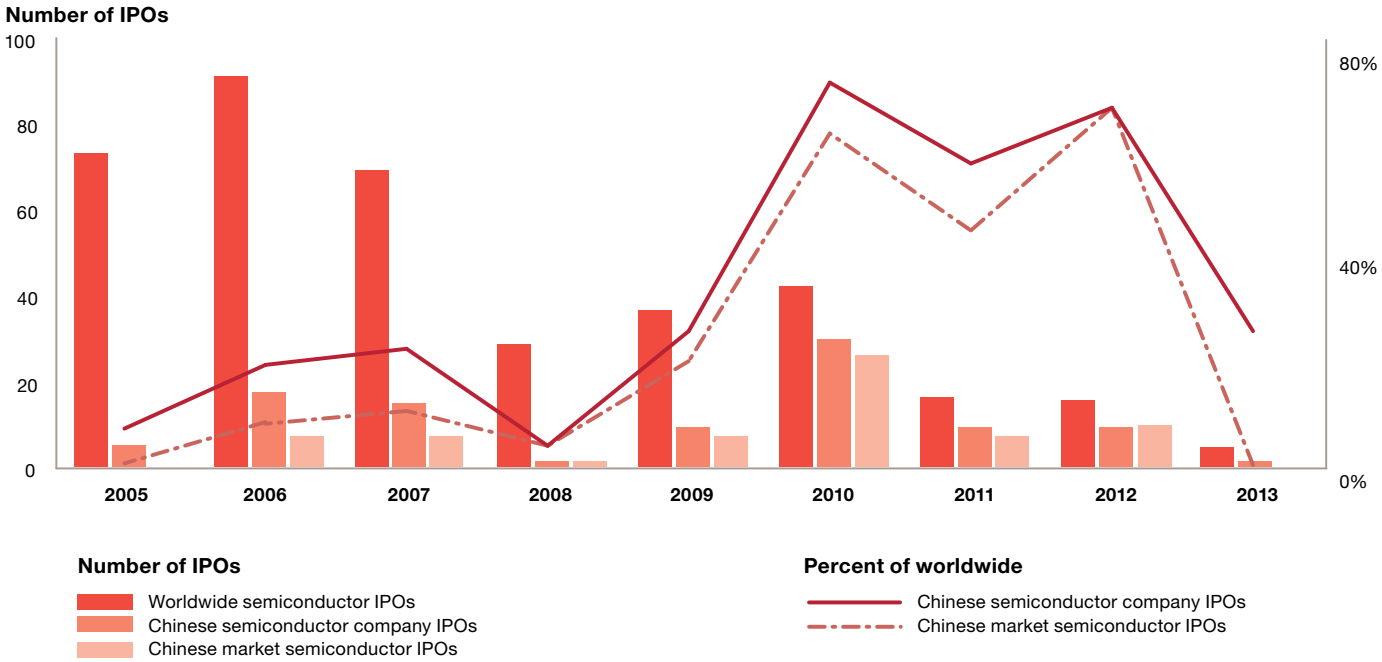
Source: *Thomson Innovations*

Financial markets and IPO funding

As reported in our prior updates, China had emerged in 2009 as a significant source of new companies and financial funding for semiconductor start-ups. According to PwC's Global Technology IPO Reviews, that momentum continued through 2010 as China overshadowed the US and the rest of the world with the most technology IPOs (with proceeds greater than US$40mn) and China's Shenzhen exchange displaced NASDAQ as the leading exchange for those technology IPOs. China's predominance in technology IPOs continued through 2011, even as the global market for technology IPOs started to decline.

China's technology IPOs and money raised experienced a steady decline during 2012. By Q4 2012 China had only one technology IPO and had no semiconductor IPOs since Q2 2012. After three years of growth in IPOs, the decline in economic growth led to lower numbers of technology companies listing in both China and Greater China.

Figure 27: China versus worldwide semiconductor IPOs 2005-2013



Chinese semiconductor company = domiciled in China
Source: Thomson Financial 2010, 2011, 2012, 2013, 2014

According to Thomson Reuters, since 2005, China has been the fourth largest acquirer nation for semiconductor M&As, with 6.7% of all worldwide deals.

China saw technology IPO activity decline throughout 2012 due to slowing growth and change in posture by the Chinese Security and Regulatory Commission (CSRC) relative to new filings. China's share of total IPOs in 2013 was negatively impacted by the freezing of the local IPO market in late 2012 by the CSRC. Consequently, no technology IPOS were listed on Chinese stock exchanges in 2013 compared to 46% of the worldwide total in 2012 and 43% in 2011. As a result, Chinese companies accounted for just 13% of worldwide technology IPOs in 2013 as compared to 46% in 2012 and 56% in 2011. However, a Chinese company did account for one of the four (25%) worldwide semiconductor IPOs in 2013. It was listed on the NASDAQ rather than a Chinese stock exchange and accounted for 23% of worldwide semiconductor IPO proceeds in 2013.

When the CSRC announced in late 2013 it would resume IPO approval, it was expected that 2014 would be robust for Chinese IPOs. Eleven Chinese companies, 42% of the worldwide total technology IPOs, went public in Q1 2014, all on the two Chinese exchanges. Thirteen Chinese companies went public in Q2 2014, however, eight listed in the US and three on the Hong Kong exchange. The Chinese exchanges had only two technology IPOs in Q2 2014 due to an ongoing regulatory backlog from the IPO freeze which began in Q4 2012 and went to Q4 2013. During Q2 2014 China's regulators announced they would limit IPOs in China to around 100 during the second half of 2014, a move that was expected to encourage Chinese firms to consider an overseas listing. However, Chinese technology companies continued their comeback, with ten companies, 56% of the worldwide total, going public in Q3 2014; six listed on the two Chinese exchanges and two on the Hong Kong exchange. Notably these Chinese technology IPOs included Alibaba—the largest IPO on record—which, by successfully listing on the NYSE, set the stage for a continued healthy flow of Chinese companies going public on cross-border exchanges. Four of the Chinese IPOs were the only semiconductor companies listed in Q3 2014 with two each listed on the Shanghai and Shenzhen exchanges. The Chinese stock market has been steadily processing the large backlog of applicants in the pipeline. Furthermore, the potential amendment relaxing the profit requirement rule for internet/mobile internet companies could encourage more technology companies to list on Chinese exchanges in the future.

In addition to IPOs, Chinese companies have also become a significant participant in semiconductor mergers and acquisitions (M&As). According to Thomson Reuters, since 2005, China has been the fourth largest acquirer nation for semiconductor M&As, with 6.7% of all worldwide deals, following the US (30.5%), South Korea (13.6%) and Japan (7.8%). During the same period, China was the third largest target nation for semiconductor M&As, at 7.7% of all worldwide deals, following the US (28.7%) and South Korea (14,1%). Further, as noted in our 2011 update, recent changes in China's tax incentives for semiconductor NHTEs (New High Technology Enterprises) may increase the degree of concentration in China's semiconductor industry and indirectly work to accelerate mergers between companies in the industry. According to Thomson Reuters, Chinese companies have been the target of 119 and the acquirer of 127 semiconductor industry related M&A deals since 2010. Chinese companies were the acquirer for 36 deals completed in 2011, 32 completed in 2012, 42 completed in 2013 and 17 completed during the first three quarters of 2014. Of these 127 Chinese semiconductor M&A deals, 103 involved the acquisition of other Chinese assets and 24 of foreign assets, including ten from the US, five from Germany, and two each from Italy and Taiwan.

Table 11: China versus worldwide semiconductor IPOs 2005–Q3 2014

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Q1/14	Q2/14	Q3/14	Total 9.75 Yrs 2005–Q3/14
Worldwide semiconductor IPOs													
Number of IPOs	73	91	69	28	36	42	16	15	16	5	5	4	400
Proceeds (US$mn)	3,006.0	3,663.8	3,727.1	678.2	1,693.6	6,202.6	2,645.0	1,445.4	325.3	154.5	490.6	533.0	24,565.10
Chinese semiconductor company IPOs													
Number of IPOs	5	17	15	1	9	30	9	10	1	2	2	4	105
% of worldwide	6.8%	18.7%	21.7%	3.6%	25.0%	71.4%	56.3%	66.7%	6.3%	40.0%	40.0%	100.0%	26.3%
Proceeds (US$mn)	407.9	743.6	1,109.5	37.4	1,308.9	4,493.6	1,323.0	1,020.0	71.0	134.6	347.8	533.0	11,530.30
% of worldwide	13.6%	20.3%	29.8%	5.5%	77.3%	72.4%	50.0%	70.6%	21.8%	87.1%	70.9%	100.0%	46.9%
Chinese market semiconductor IPOs													
Number of IPOs	0	7	7	1	7	26	7	10	0	2	2	4	73
% of worldwide	0.0%	7.7%	10.1%	3.6%	19.4%	61.9%	43.8%	66.7%	0.0%	40.0%	40.0%	100.0%	18.3%
Proceeds (US$mn)	0.0	285.5	351.6	37.4	1,270.7	4,062.5	1,220.0	1,020.0	0.0	134.6	347.8	533.0	9,263.10
% of worldwide	0.0%	7.8%	9.4%	5.5%	75.0%	65.5%	46.1%	70.6%	0.0%	87.1%	70.9%	100.0%	37.7%

Note: Chinese semiconductor company = domiciled in China

Source: Thomson Reuters 2010-2014

Production growth scenarios

Since our original 2004 report, PwC has examined the effects that different levels of growth in the Chinese integrated circuit (IC) semiconductor industry would have on the greater industry. We initially used scenarios that spanned the time period from 2003 through 2010, analyzing the developments, investments and milestones that would have to be accomplished for China to achieve each level of growth during the forecast period. With the start of China's 12th Five Year Plan we revised the basic assumptions and business models used for our further scenario analysis of China's IC industry.

The following is a concise summary of our analysis of the revised (2011) conservative, moderate and aggressive growth scenarios developed for China's IC industry over the period from 2010 through 2015. The conservative and moderate scenarios reflect China's capabilities, while the aggressive scenario reflects its stated intentions. The analysis covers the assumptions, business models, developments, investments and milestones for each scenario over that five-year period. These scenarios are described in considerable detail in our 2011 update.

The moderate scenario is based upon an assumption that China completes and fully equips all the current and the two committed IC wafer fabs facilities that were under construction at the end of 2010, ramps them into full production and operates them at a utilization and effectiveness that averages 90% of their WFW nominal capacity and earns an average of US$600 per 8-inch equivalent wafer. It further assumes that all of the resulting wafer fab output is packaged and tested in China in addition to the 2010 volume of imported wafer devices packaged and tested in China, and that China's IC design sector grows at a moderately higher CAGR to meet the MIIT's 12th FYP objectives.

The conservative scenario is based upon similar wafer fab completion assumptions reduced to 70% of nominal WFW capacity, with all of the resulting wafer fab output packaged and tested in China in addition to the 2010 volume of imported wafer devices packaged and tested in China. It also assumes that China's IC design grows at a 10% CAGR, slightly higher than China's forecast GDP growth.

The aggressive scenario assumes that China's IC industry and IC design sectors achieve the goals established by MIIT as part of China's 12th FYP. Those goals were for China's IC industry to achieve revenue of RMB 330bn and China's IC design sector to have revenue of RMB 70bn by 2015. At the 2012 average FX rate, these goals equate to US$52.3bn and US$11.1bn.

The IC consumption scenario is based upon China's MIIT's 12th FYP expectations for 2015 coordinated with the CSIA forecast for earlier years.

Figure 28 illustrates these three scenarios along with China's reported IC industry performance. Although China's IC consumption market exceeded worldwide semiconductor market growth for a third consecutive year in 2013, it missed the CSIA forecast growth by just 1.3%. However, based upon the current CSIA reports, China's IC industry production revenue has exceeded the aggressive growth scenarios for the three consecutive years of 2011, 2012 and 2013.

There has been a significant increase in the volume of imported wafer devices packaged and tested in China. There has also been an increase in the revenue earned per wafer start capacity resulting from improvements in wafer fab capacity utilization and technology/price increases. During the last three years, China's IC industry has reported a 20.3% RMB and 24.2% US dollar CAGR. During this period, China's IC design sector reported a 34.7% US dollar CAGR, IC packaging and testing 24.3% and IC manufacturing 13.9%. Based upon these results, it seems reasonably probable that China's IC industry will follow or exceed the last (2011) aggressive growth scenario through 2015 and achieve the MIIT revenue goals of RMB 330bn, with IC design reaching RMB 70bn. During 2013, more than US$9bn of additional fixed-asset investments were made in China's IC industry to bring the total for the last three years to almost US$20bn. This increase in investment rate clearly supports the aggressive growth scenario requirements.

Considering China's progress and status compared to the current (2011) scenarios, it now seems appropriate and reasonable to develop a further (2014) revision of those scenarios covering the next five years for analysis and reference.

This (2014) revised moderate growth scenario is based upon an assumption that China completes and fully equips all the current and the five committed IC wafer fabs facilities that were under construction at the end of 2013, ramps them into full production and operates them at a utilization and effectiveness that averages 90% of their WFW nominal capacity and earns an average of US$640 per 8-inch equivalent wafer. It further assumes that all of the resulting wafer fab output is packaged and tested in China in addition to a volume of imported wafer devices packaged and tested in China

that grows at the same rate as the wafer fab output, and that China's IC design sector grows at the CCID/CSIA forecast (2016/2013) CAGR of 21.9%. According to this moderate scenario, China's IC industry revenues would reach US$72.6bn in 2018.

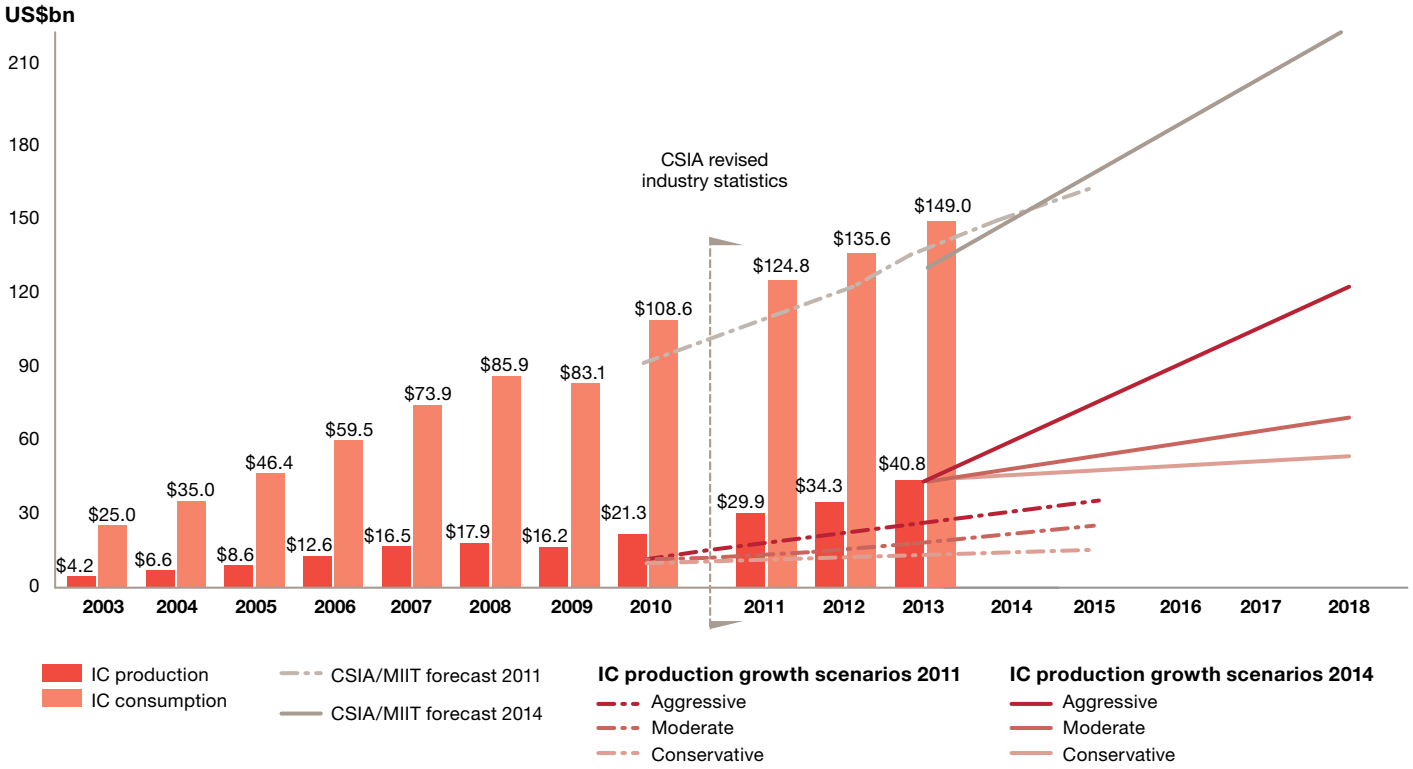
This (2014) revised conservative growth scenario is based upon similar wafer fab completion assumptions reduced to 75% of nominal WFW capacity and an average of US$600 per 8-inch equivalent wafer, with all of the resulting wafer fab output packaged and tested in China in addition to a volume of imported wafer devices packaged and tested in China that grows at the same rate as the wafer fab output. It also assumes that China's IC design grows at a 10% CAGR, slightly higher than China's forecast GDP growth. According to this conservative scenario, China's IC industry revenues would only reach US$50.2bn in 2018.

This (2014) revised aggressive growth scenario is based upon the assumption that China's IC industry is able to continue to grow at the same 25.4% CAGR that it achieved between 2003 and 2013. According to this very aggressive scenario, China's IC industry revenues could reach US$126bn and represent 21% of worldwide IC industry value added in 2018.

This (2014) revised IC consumption scenario is based upon the assumption that the CSIA 2014 forecast for an 8.7% CAGR IC market demand growth rate from 2013 through 2016 will continue through 2018. According to this scenario, China's IC consumption will grow to US$226bn in 2018 and represent almost 66% of worldwide IC consumption.

In conclusion, this set of (2014) revised growth and consumption scenarios project that even with the most aggressive growth it will be 2018 before China's IC industry revenues meet the MIIT objectives of equalling at least 50% of IC consumption.

Figure 28: China's integrated circuit production and consumption 2011 and 2014 growth scenarios compared with actual



Source: CSIA CCID, World Fab Watch, PwC

About this report

The 2014 update assesses the current status of the semiconductor industry in China and how it has changed since our previous update. As with our previous reports on this issue, we conducted a second-order analysis for the 2014 update. To accomplish this, first we reconciled data from different, incomplete and often contradictory reports from various sources. These sources included industry associations and third-party research firms located in Asia and the West. Then we analyzed the reconciled data with an eye towards filling in gaps and revealing information that was not apparent in the original source material. We also interviewed industry executives to obtain current views from various parts of the value chain.

This year we found reasonable consistency between various sources about the direction and relative magnitude of the changes in China's semiconductor market and industry. However, there was still a noticeable variation between sources about absolute size of the market.

For our top level reporting of China's semiconductor consumption market and production industry, we have continued to utilize the values reported by CCID Consulting. They provide the most comprehensive detail about China's market and industry available and their reports are the principal source of information for Chinese policymakers.

For some of our detail analysis we have utilized alternate sources that provide information not available elsewhere and have, wherever possible, tried to base each such analysis on a homogeneous data source. For example, for our analysis of China compared with worldwide semiconductor market by application and by device; and of semiconductor consumption versus purchases China versus worldwide by region we have continued to utilize the values reported by Gartner (GDQ) as they provide database information for each of those markets that is reconciled on a worldwide basis. As a consequence, the value of some metrics may vary slightly between different figures and tables. We acknowledge these differences and trust that they will not divert our readers' attention from the value and significance of the findings of the report.

Our intent with this method remained to construct a more comprehensive, meaningful, and yet quantitatively based, picture of the industry than is otherwise available. Using this method, we surfaced additional findings and considered the ramifications of those findings for multinational semiconductor industry companies.

The growth of China's semiconductor market—which consists primarily of electronics manufacturing services (EMS) companies, original design manufacturers (ODMs) and original equipment manufacturers (OEMs) that consume chips in China—continues to be a major catalyst for changes in the industry. For this reason, we assessed the status of the market in depth and considered its effects on semiconductor production: wafer fabs; packaging, assembly, and test facilities; and integrated design manufacturers (IDMs) of the industry. We also reviewed the status of the fabless and design companies in China.

A couple of further points we should note on the data sources, the metrics we use or developed had to be sufficiently comprehensive and consistent to be useful for the type of report we wanted to publish. For that reason, we elected to use the World Semiconductor Trade Statistics (WSTS) values for the worldwide semiconductor market wherever possible although several other market research firms have reported greater values. The WSTS values are the only official values recognized by the various industry associations, including the China Semiconductor Industry Association (CSIA), that are members of the World Semiconductor Council. We have elected to convert the Renminbi (RMB) currency values from various Chinese data sources to US dollar values at the year-end foreign exchange rate for the year reported while recognizing that many of the semiconductor transactions in China are originally priced in dollars or other foreign currencies and converted to RMB on a contemporaneous basis for local reporting purposes.

Appendix

Despite increasing international interest and press coverage, market reports and statistics of the Chinese semiconductor industry remain difficult to obtain and are often subject to misinterpretation or skepticism. Nonetheless, this report is based, in part, on data derived from Chinese sources. We use this data for two reasons. First, Western sources on the subject are incomplete and somewhat divergent and second, this is the same data used by the Chinese policymakers.

The two principal indigenous sources for most Chinese semiconductor industry and market reports, data and statistics are the China Center for Information Industry Development (CCID) Consulting and the China Semiconductor Industry Association (CSIA). Both are associated with the Ministry of Industry and Information Technology (MIIT) and share common data sources and industry analysts. Below we delineate how these Chinese sources differ from conventional semiconductor industry statistics.

Definitional differences

Because both sources compile their data and write their reports in Chinese, their English-language translations of the reports contain a number of anomalies. For example, while traditional industry reports use three orders of magnitude, usually including thousands (kilo), millions (mega), and billions (giga), China's reports use two orders of magnitude, ten-thousands and hundred-millions. So analysis requires a translation to a common standard.

When CCID and CSIA measure and report on the China semiconductor market their data is based upon a consumption model. They obtain data on the output of China's electronic systems production, calculate the consumption of semiconductors in every electronic product, value at current local average selling prices, and add all the consumption to get the total of China's semiconductor market size. CCID collects output data on electronic system production from MIIT, (Ministry of Industry and Information Technology), National Bureau of Statistics of China, General Administration of Customs of PRC, CCID's Electronic Products Research Database and other industry associations and organizations. This is different from World Semiconductor Trade Statistics (WSTS) and most international market research firms which measure and report on the worldwide semiconductor market based upon a sales model. The WSTS and others compile their reports of semiconductor market size based upon sales revenue data collected from semiconductor companies. As a consequence, there can be significant differences and discrepancies resulting from the use of these two different models and from major inventory changes, dislocated purchasing, WSTS' lack of Chinese company participants and the difference between worldwide and Chinese local average selling prices.

In addition, CCID has had to make some noticeable adjustments to their historical Product Structure of China Semiconductor Market database to bring it into complete

and inclusive alignment with the international definitions of the O-S-D (optoelectronics, sensors and discretes) market segments. It appears that prior to 2008 CCID included LEDs in their discrete market segment and only reported photo electrics rather than all optoelectronic devices.

Further, both CCID and CSIA compile and analyze their industry or production data based upon a structure that is somewhat different from that employed by Western analysts. This industry structure is not clearly defined in their English-language reports, but may be best described by the following statement contained in CSIA's seminal report, An Investigation Report of China's Semiconductor Industry 2002:

"The term 'the semiconductor industry' in this report covers IC [integrated circuit] design, IC manufacture, packaging and test, semiconductor discrete device and semiconductor supporting sector, etc. In view that the investigation on supporting sector is not comprehensive, the term 'China semiconductor industry' in 'General Introduction' and in its relevant statistic data excludes this sector."

Therefore, according to CCID, CSIA, and MIIT usage, their reports on the Chinese semiconductor industry are based upon an industry structure organized into the following sectors:

- **IC design**: This sector includes IC design companies, institutes and laboratories, as well as all fabless IC semiconductor companies in China regardless of ownership structure. Most of the revenue and all of the unit production reported for this sector come from product sales by fabless semiconductor companies.
- **IC manufacture**: Sometimes identified as the chip manufacturing industry, this sector includes wafer foundries, wafer fabrication plants of foreign IC semiconductor companies and Chinese IC integrated device manufacturers (IDMs). As a result, the revenue and unit production reported for this sector is a heterogeneous mix of wafer and finished product unit sales.
- **IC packaging and testing**: This sector, which is sometimes identified as the encapsulation and testing industry, includes the IC semiconductor packaging, assembly and test (SPA&T) plants of foreign semiconductor companies, as well as all IC semiconductor assembly and test services (SATS) plants and companies in China.

  This sector does not include the discrete SPA&T plants of foreign semiconductor companies or the IC SPA&T activities of Chinese IDMs. Nor does it include LED plants since the CSIA continues to include LEDs within the discrete industry. Because some SPA&T plants of foreign semiconductor companies use a wafer/die sale/buy-back or imported processing business model and others use a consigned wafer/die or another toll-processing business model, the revenue reported for this sector is not homogeneous and is potentially misleading. However, reported unit production is relatively homogeneous.
- **Discrete device:** This sector includes all Chinese discrete IDMs and several Chinese SPA&T plants, as well as all discrete wafer fabrication and SPA&T plants of foreign semiconductor companies in China. It also includes LEDs which CSIA continues to

include within the discrete industry sector. Because many of the SPA&T plants of foreign semiconductor companies use a consigned wafer/die business model rather than the fully-costed IDM business model, the revenue reported for this sector is not homogeneous and can be misleading. However, reported unit production is relatively consistent and reliable.

Data compilation methods

Both the CCID and CSIA compile their industry data from reports or survey responses filed by the various entities in each industry sector. These entities usually report their activities as separate stand-alone companies, and the CCID and CSIA consolidate the reports from each company in an industry sector without any eliminations or offsets. The results are often industry-sector totals that are aggregates of different inputs and therefore misleading. For example, the data might include foundry wafer revenues and wafer shipments combined with IDM finished-unit product sales revenues and unit shipments.

Because at least three of the largest SPA&T plants of foreign semiconductor companies use a wafer/die sale/buy-back business model, their reported revenues are approximately two and a quarter times as large as they would be if reported using the conventional consigned wafer/die (cost less die) basis. This reporting difference is significant and could account for an overstatement of 15% in the 2011 revenues for the IC packaging and testing sector, 6% in the 2011 revenues of the Chinese IC industry, and 3% in the 2011 revenues of the overall Chinese semiconductor industry.

Probable double-counting: A hypothetical example

Because of the way the CCID and CSIA compile their data, without any eliminations or offsets, it is very probable that there will be instances of double-counting between sectors. The following example—a hypothetical manufacturing flow for a Chinese fabless semiconductor company that is using both a Chinese wafer foundry and SATS company to manufacture its products—illustrates the impact of this approach.

In our example, Average Semiconductor is a fabless semiconductor company in the IC design sector; XMIC is a wafer foundry in the IC manufacturing sector; XSE is a SATS company in the packaging and testing sector; and Solectron is an electronics manufacturing services (EMS) customer.

Further assume:

- Average buys 1,000 wafers (200mm) from XMIC for US$650 per wafer, for a total of US$650,000
- Average consigns the 1,000 wafers to XSE for assembly and testing in plastic QFN or PLCC packages with 1,250 net die per wafer and a die-free package cost of $0.17 per package, for a total of 1,250,000 finished units and value of US$212,500
- Average sells the 1,250,000 finished units to Solectron for an average selling price of US$1.00 per device, for a total of US$1,250,000

Under CCID and CSIA reporting practices, the revenue at each stage is included in the total—a divergence

Using CCID and CSIA reporting practices, these transactions would be classified and recorded as shown in the table.

Revenue comparison

	Pieces	Revenue	Revenue using industry standards
IC manufacturing sector	1,000	$650,000	Not reported
Packaging and testing sector	1,250,000	$212,500	Not reported
IC design sector	1,250,000	$1,250,000	$1,250,000
Total	2,501,000	$2,122,500	$1,250,000

(All revenues are in US$)

from traditional industry standards. Consequently, in this example, the total Chinese semiconductor industry revenue is overstated by 70% and the unit shipments by 100% relative to conventional industry standards.

Implications of statistical disparities

Compared with the more conventional practices and standards of the World Semiconductor Trade Statistics (WSTS) and related industry associations and analysts, these differences in CCID and CSIA reporting practices and standards could lead to noticeable variability in reported Chinese semiconductor industry results. This variance would be greater or lower depending upon the mix of business models employed.

Furthermore, these differences could have a significant impact on China's ability to gauge the need for or to even manage the output of nationwide IC production (for example, to meet a greater share of its domestic consumption).

Consider the accounting impact as it relates to an IC device that is wafer fabricated, packaged, assembled, and tested in China. Using the current CCID/CSIA reporting practices, the average reported semiconductor industry revenue could range from 62-162 RMB, depending on the scenario:

- **62 RMB:** The device is manufactured by a wafer foundry and SATS supplier for a foreign fabless semiconductor company.
- **100 RMB:** The device is manufactured and sold by a Chinese IDM.
- **162 RMB**: The device is manufactured by a Chinese wafer foundry and SATS supplier for a Chinese fabless semiconductor company and sold by that fabless company.

This variance is significant, creating an operational and planning challenge for both China and the global semiconductor industry.

For the future, increasing international interest and visibility may encourage CCID and CSIA to replace their current Chinese semiconductor industry reporting practices and standards with more common international standards and practices. For example, the CSIA is a member of the World Semiconductor Council (WSC). They should be encouraged to participate in the World Semiconductor Trade Statistics (WSTS) programs. If China elects to change to more conventional semiconductor industry reporting practices and standards, the country may find it desirable to revise the CSIA objectives accordingly.

Statistics used in our report

Despite the evident disparities, we use the aggregate statistics as reported, while carefully noting that they represent China's semiconductor industry as reported in China—that is, the sales revenue of all semiconductor companies in China as reported to the Chinese authorities. We do so because we have no way to determine which business model is being used by every company, and because Chinese policymakers themselves rely upon these result. Although the tendency is for these sources to overstate the size of the industry, understatement is far less likely, we want to be careful not to understate the impact of China on the industry as a whole. Still, in cases where the Chinese have identified individual company revenues, we have been able to augment that data with information from other sources.

Identifying Chinese semiconductor companies

For a variety of translation and structural reasons, the English names of many of the Chinese semiconductor companies are often a source of confusion. Many companies have English names that are different from the literal translation of their Chinese names and often inconsistently incorporate location prefixes. As a result, the same company may be identified by a number of different English names in various reports and articles.

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Industrial perspectives

During the preparation of this report, we benefited from interviews with the following executives:

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We also benefited from discussions with numerous participants in the IC Markets China 2014; CSTIC (China Semiconductor Technology International Conference) 2014; LED China 2014; and other related conferences.

PwC can help

If your company needs assistance doing business in China, or you just want to have a deeper discussion about what's happening in the market and how we can help, please reach out to one of the technology industry leaders listed here.

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About PwC's Technology Institute

The Technology Institute is PwC's global research network that studies the business of technology and the technology of business with the purpose of creating thought leadership that offers both fact-based analysis and experience-based perspectives. Technology Institute insights and viewpoints originate from active collaboration between our professionals across the globe and their first-hand experiences working in and with the technology industry.

About PwC

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