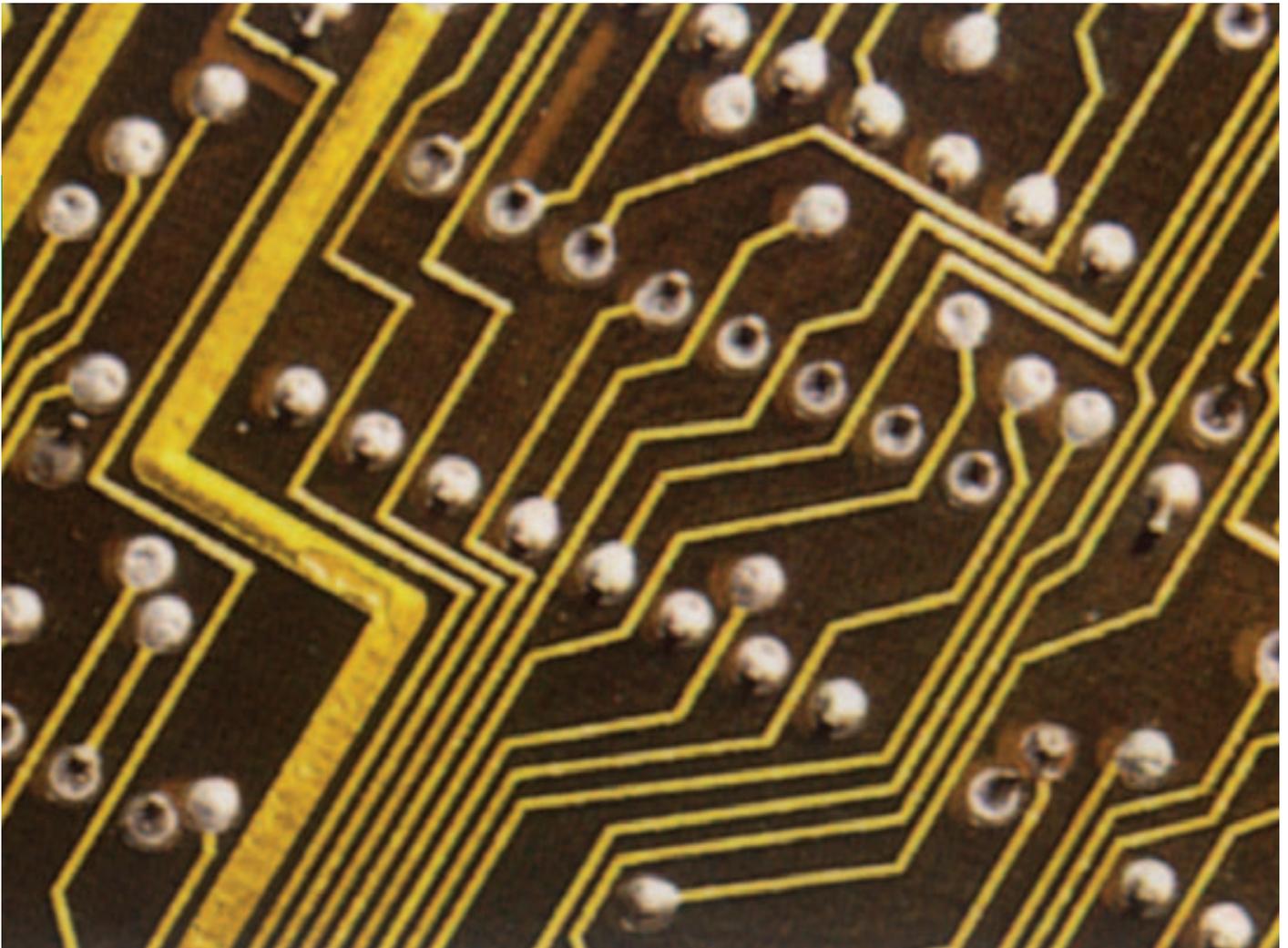


Semiconductors

MARKET & OPPORTUNITIES



Semiconductors

MARKET & OPPORTUNITIES

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Indian Semiconductor Sector at a Glance

GROWTH CURVE OF THE INDIAN SEMICONDUCTOR INDUSTRY

- The semiconductor market in India is expected to be worth US\$ 5.5 billion by 2009 from US\$ 2.7 billion in 2006, registering a CAGR of 26.7 per cent
- The contribution of the Indian market to the total global semiconductor market will rise from approximately 1 per cent in 2006 to 1.7 per cent in 2009
- This sector is expected to affect 12 per cent of India's GDP directly and 15 per cent indirectly, by 2015
- The Indian semiconductor and embedded design industry is expected to create approximately 3.5 million jobs by 2015

FACTORS FUELLING GROWTH

- The semiconductor and electronics sectors are closely related and mutually benefit each other i.e. growth in one sector leads to growth in the other. The consumption of electronic equipment in India is expected to rise to US\$ 363 billion by 2015 from US\$ 28.3 billion in 2005 at a CAGR of 29.8 per cent. This growing demand for electronics expected to drive the growth of the semiconductor sector in India
- Fast development of the semiconductor ecosystem and the electronic ecosystem in India is further driving the growth of the semiconductor sector in India, as both domestic and foreign companies are expanding their operations across the whole value chain in the country

ADVANTAGE INDIA

- A strong education infrastructure and the availability of design talent at competitive costs
- Continuous reduction in entry barriers to facilitate the entry of foreign companies
- Continuous improvement in infrastructure
- Government and the industrial sector collaborate with academic institutes to train manpower specifically for the semiconductor industry

INVESTMENT PLANS

- NXP Semiconductors (India) Pvt. Ltd. plans to invest approximately US\$ 300 million in India to set up an R&D facility and also to upgrade its operations over the coming years
- Conexant Systems, Inc., a leader in fabless semiconductor solutions for broadband communications and the digital home will invest approximately US\$ 250 million in India over the next few years. This investment will include developing new R&D facilities, expansion of the engineering workforce and capital equipment
- Cypress Semiconductor plans to build a solar fab centre in southern India with an investment of up to US\$ 50 million
- Videocon Industries plans to develop a semiconductor design-cum-fabrication complex near Kolkata with an initial investment of approximately US\$ 230 million
- Advanced Micro Devices (AMD) plans to invest US\$ 500 million in SemIndia's SEZ for semiconductors

SEMICONDUCTOR SECTOR

Both the electronics and the semiconductor sectors are mutually beneficial for each other and the growth in one sector leads to growth in the other.

The semiconductor sector involves pre-fabrication, fabrication (fab) and post-fabrication verticals. In the past four years, the Indian semiconductor market has grown from approximately US\$ 1.5 billion to approximately US\$ 2.7 billion. Further, the semiconductor market is expected to reach US\$ 5.5 billion in 2009 from US\$ 2.7 billion in 2006. India accounted for 1.09 per cent of the global semiconductor revenue in 2006 and this share is expected to reach 1.62 per cent by 2009, which will represent a CAGR of 26.7 per cent.

The demand for semiconductor solutions, the heart of electronic systems, is also expected to get a fillip as the consumption of electronic equipment in India will grow at a CAGR of 29.8 per cent to reach US\$ 363 billion by 2015, from US\$ 28.3 billion in 2005.

The growing demand for IT hardware and office automation products, and consumer electronics such as mobile phones, automotive products etc., is spurring the demand for semiconductors and a full-fledged semiconductor ecosystem in India.

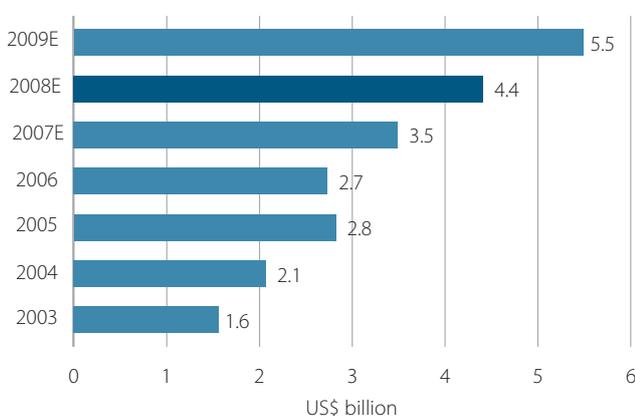
The major semiconductor end-user segments have been communications, IT and consumer electronics. At the same time, the important product sub-categories that would drive the semiconductor market in India are mobile handsets, wireless equipment, set-top boxes and smart-card terminals

The key drivers enabling the exponential growth of the sector are

- Growth of the chip design industry
- Unprecedented growth in domestic consumption of electronic goods
- Increased semiconductor content in the electronics industry
- Significant export potential for this industry

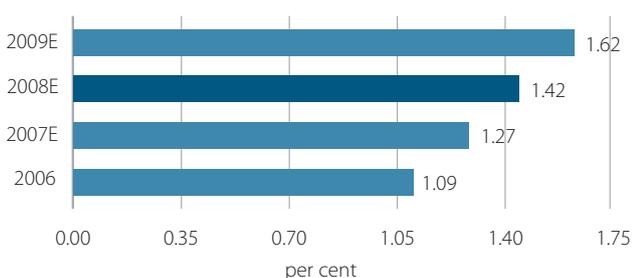
Semiconductors are poised to impact human life far more as they open up new possibilities in nanosciences, biotechnology, medical sciences, electro-mechanical devices, photonics, remote sensing and so on. India has a great potential to become a global hub.

**Total Semiconductor Market in India
(2003-2009)**



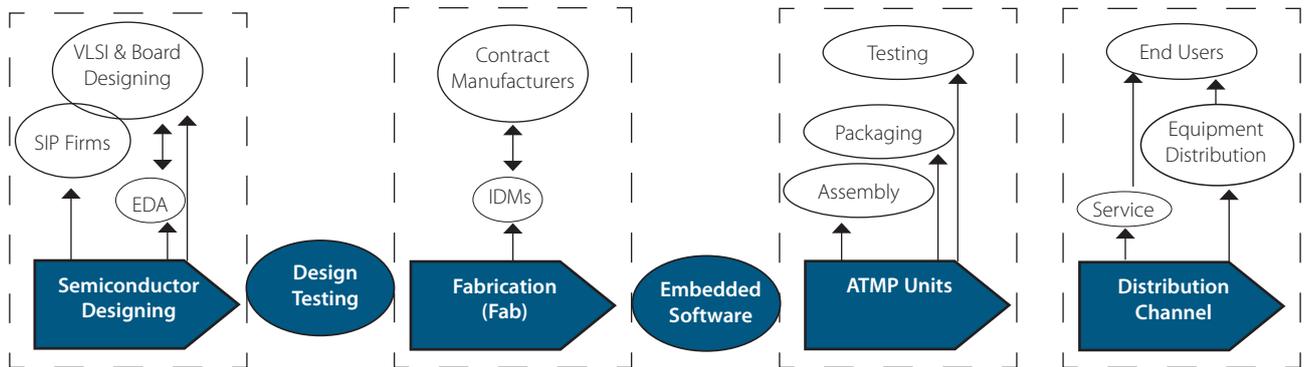
Source: ISA, F&S

**Percentage Share of the Indian Semiconductor Market in
the Global Semiconductor Market**



Source: ISA, F&S

Value Chain



Semiconductor Application Market

APPLICATION SEGMENT MARKET

The telecommunication segment is the largest application segment contributing to the semiconductor market. It registered a market share of approximately 43 per cent in 2006 and is expected to grow to 46 per cent by 2009.

Total Semiconductor Product Market in 2006	
Telecom	44%
IT & OA	32%
Consumer Electronics	7%
Industrial	6%
Automotive	3%
Others	8%

Source: ISA, F&S

IT and OA segments, along with the telecom segment dominate the demand for semiconductor products in India. These two segments control more than 75 per cent of the total semiconductor requirement in the country.

Estimated Total Semiconductor Product Market in 2009	
Telecom	46%
IT & OA	30%
Consumer Electronics	8%
Industrial	6%
Automotive	2%
Others	8%

Source: ISA, F&S

Semiconductor Designing

INDIAN SEMICONDUCTOR DESIGNING AT A GLANCE

Current Standing of the Sector

- The semiconductor design market in India was estimated to be at US\$ 3.3 billion in 2006
- International semiconductor companies are establishing a strong presence in India either by setting up their own design houses by offshoring their design related work to India
- Out of the top 25 semiconductor companies, 19 have their operations in India, including the top 10 fabless design companies of the world
- Foreign semiconductor companies such as Texas Instruments, Intel, Cypress, ST Microelectronics and Infineon accounted for approximately 70 per cent of the semiconductor design industry's total revenue in India in 2005

Sector Growth

- The semiconductor design sector in India is expected to reach approximately US\$ 14.4 billion and US\$ 43.1 billion by 2010 and 2015, respectively. From 2005 to 2015, this sector is expected to register a CAGR of approximately 29.5 per cent
- The increased flow of international companies setting up their offshore design and development bases in India and a simultaneous expansion of their existing operations in the country is expected to drive the revenues of the semiconductor design segment

Factors Fuelling Growth

- The emergence of the local market and the inflow of funds in India, in the form of venture capital, is fuelling the growth of the semiconductor design sector in India
- The advantage of India over many countries such as Taiwan and China in the form of robust developed software sector, copyright laws and availability of large number of English-speaking people, is boosting the growth of semiconductor designing in the country

Investment Initiatives

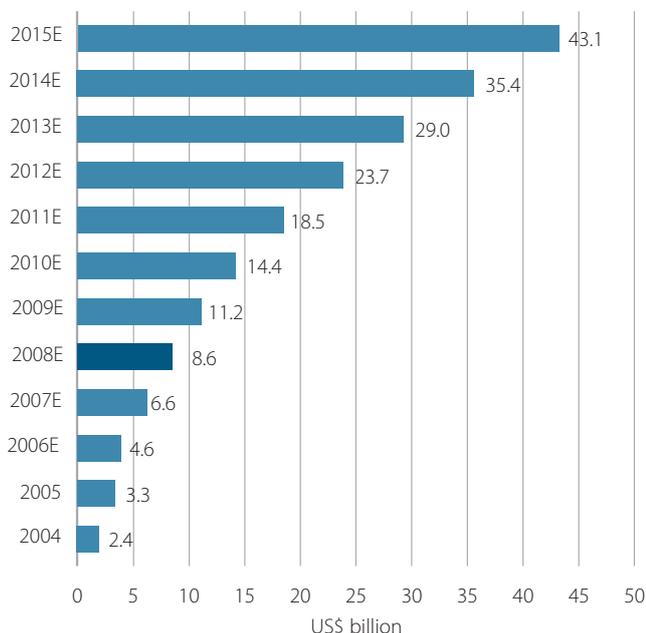
- Investments of more than US\$ 1 billion has been made by foreign semiconductor designing companies in India
- Various companies such as IBM, Broadcom, AMD, Cisco and Intel have announced their plans to invest in chip designs in India

India is on the world map in chip designing and the growing production and consumption of electronics across various sectors is further driving the growth of semiconductor designing in the country.

The semiconductor designing segment generated revenues of US\$ 3.25 billion in 2005 and is expected to reach approximately US\$ 14.4 billion and US\$ 43.1 billion by 2010 and 2015, respectively. From 2005 to 2015, it is expected to register a CAGR of approximately 29.5 per cent.

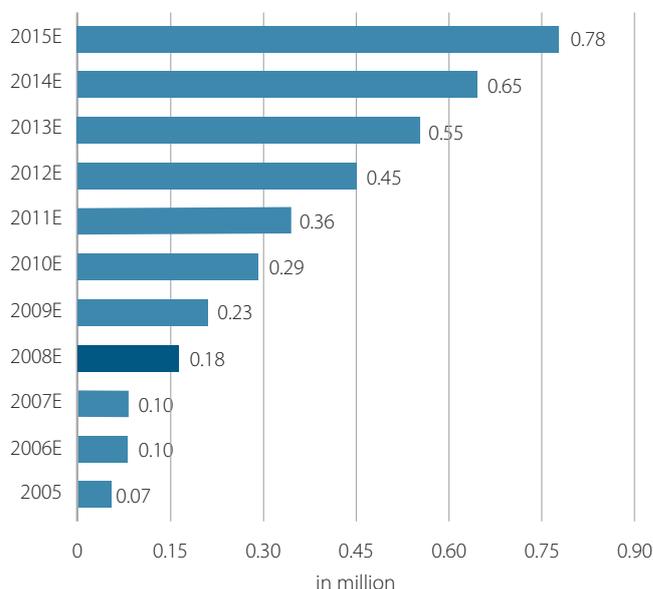
It is likely that India would be driving some of the major global developments in chip design, as the country's position seems very strong in both market potential and engineering resources. It is also likely that growth in the Indian semiconductor design market will lead to growth in the engineering workforce employed by this segment.

Total Semiconductor Designing Market in India



Source: ISA, F&S

Engineering Workforce Employed by Indian Semiconductor Design Market



Source: ISA, F&S

The engineering workforce employed by Indian semiconductor design market is expected to grow by approximately 11 times from 2005 to 2015.

It employed 0.07 million engineers in 2005 and this employment figure is likely to grow to 0.78 million by 2015, at a CAGR of approximately 27 per cent from 2005 to 2015.

COMPETITIVE LANDSCAPE

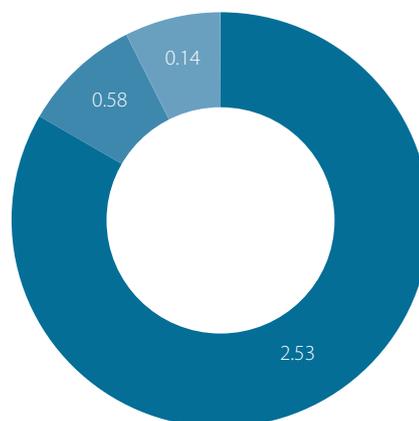
- Foreign multinationals such as Texas Instruments, Infineon, Intel, Cypress and ST Microelectronics, etc. and Indian companies accounted for approximately 70 per cent and 30 per cent, respectively of the total semiconductor designs produced in India in 2005
- Although designs of 90 Nanometre (nm) or larger in size comprise approximately 90 per cent of the total design activities in the country, Indian designers are also working with designs of 45 nm and 65 nm
- At present, all the global top 10 fabless design companies and 19 of the top 25 semiconductor companies have their operations in India
- The ISA-Frost & Sullivan report on the Indian semiconductor sector estimates that the number of chip designs executed in India will go up at a CAGR of 13 per cent over the next 10 years, from 320 in 2005 to 1,075 in 2015

There are 125 Integrated Chips (IC) design companies

operating in India and almost 50 per cent of the semiconductor design work in the country is carried out in the areas of wireless and wired communications.

Over the years, this segment has been designing chips for products such as PMP (Portable Media Players), set top boxes, LCD TVs and cell phones. With regard to the break-up of this segment's revenue, embedded software forms the major chunk. It accounted for 77.8 per cent of the designing market in 2005 and is expected to account for approximately 84.4 per cent by 2015.

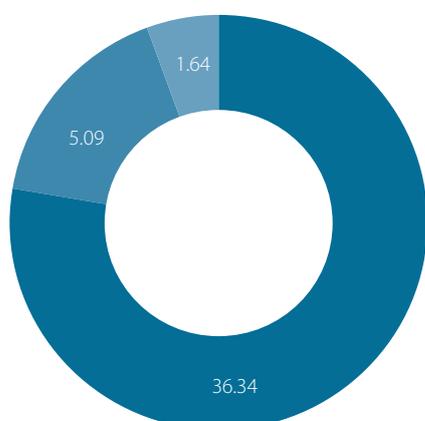
Indian Semiconductor Design Market Revenue Break-up in 2005 (US\$ Billion)



■ Embedded Software ■ VLSI Design ■ Hardware/Board Design

Source: ISA, F&S

Estimated Indian Semiconductor Design Market Revenue
Break-up in 2015 (US\$ Billion)



■ Embedded Software ■ VLSI Design ■ Hardware/Board Design

Source: ISA, F&S

Revenue of the different sub-segments- embedded software, VLSI design and hardware/board design is expected to register a CAGR of approximately 30 per cent, 24 per cent and 27 per cent respectively.

EVOLUTION OF SEMICONDUCTOR DESIGNING IN INDIA

Since 1985, when Texas Instruments became the first foreign semiconductor company to set up an R&D centre in the country, the Indian semiconductor ecosystem has been evolving with IP providers, fabless design services firms and integrated device manufacturers establishing and increasing their presence in the country.

Both the Indian government and the players operating in the sector are taking various initiatives to take the designing sector forward and forge a stronger position of India in the global semiconductor designing scenario. Both are giving special emphasis to improve education levels in the country to further build expertise related to designing and IT. For example, government institutions such as the Indian Institute of Technology (IIT), National Institute of Technology (NIT), private-funded institutions such as the Indian Institute of Information Technology (IIIT) and Indian design companies are playing a pivotal role in fostering an

Foreign and Domestic Companies Operating in Semiconductor Designing Segment

VLSI DESIGN COMPANIES IN INDIA	
Foreign Companies	Domestic Companies
Freescale Semiconductor, Inc.	TATA Consultancy Services Ltd.
Intel Corporation	Wipro Technologies Ltd.
National Semiconductor Corporation	Tata Elxsi Ltd.
Texas Instruments, Inc.	Sasken Communication Technologies Ltd.
NXP Semiconductors	MindTree Consulting Ltd.
Cisco Systems, Inc.	HCL Technologies Ltd.
Tessolve, Inc.	Hexaware Technologies Ltd.
HARDWARE/BOARD DESIGN COMPANIES IN INDIA	
Foreign Companies	Domestic Companies
Cisco Systems, Inc.	Wipro Technologies Ltd.
NXP Semiconductors	Sasken Communication Technologies Ltd.
Advance Micronic Devices Limited	MindTree Consulting Ltd.
Intel Corporation	HCL Technologies Ltd.
Flextronics International Ltd.	Ittiam Systems
EMBEDDED SOFTWARE COMPANIES IN INDIA	
Foreign Companies	Domestic Companies
Alcatel-Lucent	HCL Technologies Ltd.
Cisco Systems, Inc.	Ittiam Systems
NXP Semiconductors	Satyam Computer Services Ltd.
Intel Corporation	Wipro Technologies Ltd.
Flextronics International Ltd.	TATA Consultancy Services Ltd.
D-Link Corporation	MindTree Consulting Ltd.
Embedded Communications Computing Group	Tata Elxsi Ltd.

‘engineering culture’ in the country. They are playing a key role in building up the skills in IT and designing. Overall, the Indian designing sector has become mature and now there are bodies that represent this sector in the Government and private companies are also joining these bodies.

Formation of VLSI Society of India

In 1989, the VLSI Society of India was formed with the aim of making the country a strong global force in VLSI. Since then, the society has been supporting technical events in the VLSI area by providing financial assistance and sponsorships. To bring together students, industry and the academia, it also holds workshops on emerging topics and runs short courses throughout the year. Efforts made by VLSI have revolutionised the scenario prevalent in the country. Now, over a 100 companies are working in India in the areas of design services, chip design, electronic design automation and embedded system design.

Formation of ISA with Industry Players as Members

India Semiconductor Association (ISA) was formed on the lines of Semiconductor Industry Association (SIA) and Fabless Semiconductor Association (FSA), to promote the capabilities of India in the semiconductor and embedded space. Since its formation in 2005, ISA has focussed on building and strengthening the semiconductor eco-system in India. More than 125 MNCs and Indian companies have joined it. The industry, through ISA, is also working with the academia and government to promote research and upgrade the curriculum to meet industry requirements.

ISA has entered into tie-ups with overseas bodies, and is in talks with FSA and SIA, as part of a rapid expansion of efforts to establish a semiconductor industry in India.

ISA, in association with VLSI Society of India has also launched the annual ISA Technovation Awards. There are various categories of awards such as lifetime achievement award, award to an academic institute in India for its remarkable work in the semiconductor space and award to young scholars.

Various Japanese firms such as Sony, Matsushita Electric, Sharp, Fujitsu, Rohm, Toshiba and Sanyo have already set up their software development centres in India. Other chip design firms such as Kawasaki Microelectronics, SoCrates Software and Renesas Technology too will be possibly setting up base in India in the near future.

“India has enormous appeal for different parts of the semiconductor value chain, from board, chip, and systems design to finished electronic products. It is emerging as a major design centre for integrated circuits, field-programmable gate arrays, and systems on chips.”

Ganesh Guruswamy,
Director and Country Manager,
Freescale India

TRENDS IN THE SEMICONDUCTOR DESIGNING SECTOR

Venture Capitalists (VCs) targeting the Indian Semiconductor Sector

India, with a growing domestic market and a large pool of engineers, is attracting a large number of VCs to invest in the domestic semiconductor design segment. Silicon Valley’s VC community and some other VC firms believe that it is no longer feasible to develop complete products out of the US, so they insist that the entire software or part of the chip should be developed in India. This trend started picking up from 2003 onwards. The country is now growing into a favourite destination of VC firms due to factors such as availability of skilled labour, strong local market and flexible regulatory framework of the Ministry of IT.

Technology Convergence

Various semiconductor consuming sectors such as digital media, consumer electronics, automotive and wireless are demanding devices with multi-features, having different technologies on a single platform. This demand is leading to a shift from discrete-based designs to microcontroller-based designs and the end products are becoming portable and smaller in size. Further, the growth of mobile applications is driving the combination of microprocessors and digital signal processors in order to take advantage of both the technologies. This growing trend is driving innovation in the semiconductor sector, especially the design segment to implement many technologies on a single platform.

Emergence of Design Start-ups

One of the trends that has been observed recently is the emergence of design start-ups in India. Lots of new start-

ups are coming up, followed by various cross-border deals. Many of the domestic and foreign start-ups are coming into the picture and expanding their operations in the country. Currently, it is not difficult to start a start-up unit, as financing schemes for these start-ups are available in the country. This trend is helping the sector to grow and will firmly embed India on the global map in the field of semiconductor designing. Some examples of these start-ups in India are as follows:

- Sasken Communications, Ittiam, TejasNetworks and Cosmic Circuits
- Companies such as Cosmic Circuits, Sankalp Semiconductor, Indrion Technologies and Ammos Software Technologies are start-ups that are managed by senior executives who have already worked with top multinational firms operating in this sector

The startup companies are quickly raising the level of domain expertise within India and at the same time are getting specialised in niche areas.

Designing Companies in India Moving up the Value Chain

Both, local and global semiconductor design companies are moving up the value chain as they have also developed capabilities to handle critical and complex design projects from their Indian centres.

Over the years, India has emerged as a BPO centre by providing backend support to global companies. By leveraging the present scenario, many local design companies started providing backend design services to many large global companies.

Further, riding on this bandwagon, many multinational semiconductor companies also started either offshoring their developing and designing work to India or started opening their own captive centres in the country. These designing companies in India are now moving up the value chain by moving from low end-to-end design activities to front-end design work. For example, Indian captive centres of various multinational companies such as STMicroelectronics, Freescale and NXP, rather than working on bits and pieces of chip design and collaborating with other centres across the world are actually doing end-to-end chip development. This has given rise to made-in-India chips, where the entire design cycle is completed in the Indian centre.

Chip designing companies are looking forward to not just India-designed chips, but also India-focused chips as these companies are also looking at India as a key product market. This confidence is based upon the country's sharp growth in mobiles and consumer electronics sector.

INVESTMENT PLANS

"In the past 6-7 months Japanese semiconductor design companies seem to have developed an interest in setting up development centres in India."

**Poornima Shenoy,
President, India Semiconductor Association**

Magma Design Automation, Inc. to expand its operations in India

Magma Design Automation, Inc. has 200 employees spread across three centres in India. Its Bangalore operations has moved to a new 40,000 sq. ft facility, which will enable Magma to expand in the region and provide prompt support to its growing customer base in India by taking advantage of the availability of world-class Indian engineering talent. The company is also focused on expanding its product portfolio and building its expertise in IC implementation.

Management Dynamics, Inc. expands Asia Pacific operations

Management Dynamics, Inc. announced expansion of its operations in Asia Pacific. This expansion is in the form of setting up of new sales and operational units in Europe and India to meet the demands for its growing Asian customer base.

Freescale Semiconductor, Inc. expands Indian operations

Freescale Semiconductor, Inc. is betting big on cutting edge design work out of India with a focus on designing chips for automobile, mobile communication and networking infrastructure.

Freescale Semiconductor is expanding its Indian operations with the development of a 300,000-sq.ft. campus in Noida. This centre is one of two centres of excellence in

the Asia-Pacific region and it focuses on IP development and System-on-Chip (SoC). Further, it is also expected to be the largest design centre outside the US once the expansion is complete. The company plans to expand its presence in India to 1,500 engineers over the next four years to support its global R&D efforts.

Cisco Systems, Inc. to invest US\$ 1.1 billion in India over the next three years

In 2005, Cisco announced the investment of US\$ 1.1 billion in India over the next three years. The company will invest in the following areas over the next three years:

- US\$ 750 million on R&D activities, including training, development and staffing
- US\$ 150 million on providing leasing and other financial solutions to Cisco's customers and partners
- US\$ 100 million on funding of Indian start-up companies
- US\$ 100 million on customer support operations such as technical services, channel development, etc.

Renesas Technology Corp. established its off-shore development centre in India

Renesas started outsourcing semiconductor software and hardware design to KPIT Cummins in 2004. Due to the strategic partnership, Renesas established its first Offshore Development Centre (ODC) at KPIT Cummins centre only. There are approximately 100 KPIT Cummins' engineers engaged in design work for Renesas and KPIT Cummins plans to increase the number of engineers assigned to this facility to approximately 500.

Conexant Systems, Inc. to invest US\$ 250 million in India

Conexant Systems, Inc., a leader in fabless semiconductor solutions for broadband communications and the digital home, is investing approximately US\$ 250 million in India over the next few years. The company operates in the engineering design domain in India at Hyderabad, Noida, Bangalore and Pune. With this investment, it plans to expand its operations in India and increase its headcount to 2,000 people in the next five years from the current strength of 775 people.

SanDisk Corp. opens flash memory design centre in India

SanDisk Corp. announced the opening of SanDisk India Device Design Centre Pvt. Ltd. in Bangalore. This centre will cater to the development of core elements of the company's flash memory products. This Indian design centre will initially concentrate on projects involving NAND memory and later the team will be expanded to include development work on Application Specific Integrated Circuits (ASIC) controllers as well.

Alliance Semiconductor Corp. to invest US\$ 50 million in India

Alliance Semiconductor Corp., a leading world-wide provider of analog and mixed signal products, systems solutions and high performance memory products, announced that it will invest approximately US\$ 50 million in its Indian design centre over the next five years. It will use this investment to expand its engineering and deployment services. Alliance Semiconductor also plans to recruit staff in India and double its engineering staff from 150 to 300 over the next three years.

Alereon opens up R&D facility in India

Alereon, Inc. announced the opening of Alereon Semiconductors Pvt. Ltd., the company's new product oriented R&D facility in Pune, India. The focus of this R&D centre will be to develop the company's patented Ultrawideband (UWB) chipsets for the next generation products.

"The product-oriented nature of Alereon Semiconductors provides exciting opportunities to the strong technical and skilled resources available here in India."

**Dr. Rajesh Zele,
Managing Director,
Alereon Semiconductors Pvt. Ltd.**

NXP Semiconductors to invest approximately US\$ 300 million in India

NXP Semiconductors (India) Pvt. Ltd., formerly Philips Semiconductors (India) Pvt. Ltd., plans to invest approximately US\$ 300 million in India. Out of the total investment, approximately US\$ 6 million would be spent on setting up a state-of-the-art new campus, while the balance would be spent on its R&D and sales.

“NXP is committed to providing India and other emerging markets with products that meet the needs of the aspiring consumer. Today 60 million households in India are already enjoying great audio-visual experience using NXP chips for CTV.”

**Frans van Houten,
President and CEO, NXP**

India has a credible IPR framework and excellent track record in Intellectual Property Protection. The growing middle class consumer base with very high disposable incomes has led to an explosive escalation in many other verticals such as gaming, TVs, telecommunication, retail, automotive and other areas.

EXAMPLES OF CHIPS DESIGNED FROM INDIA

The list of leading companies that are doing chip-designing work in India is not limited to Intel, IBM, etc. There are other leading companies as well that are designing chips in India such as TI, STMicroelectronics, Freescale, AMD, etc.

- Cisco's team in Bangalore is the world's largest developer of custom-designed ASICs. The company started with ASIC verification in India in 1999 but at present it is also designing platforms in India that will go into Cisco's products
- Freescale developed a chip in India in collaboration with Alcatel. This chip is called GPON and will be deployed by BSNL with Alcatel Lucent for optical networks.
- The MPC8313E and the MCP8323E, Freescale's chips have been entirely designed in India. The MPC8313E is a processor that provides high-speed for digital multimedia applications at home by linking computers, printers and storage devices, whereas the MCP8323E will fuel

circuit boards to bring the new high-speed broadband technology, WiMax, to homes and offices

- The STi5107ST, a STMicroelectronics chip, is completely made in India. The chip comes with advanced security features and is a new addition to the company's family of set-top box decoders. STMicroelectronics has also developed megapixel camera chips in India
- Texas Instruments (TI) has developed several audio and multimedia chips in India
- Mobile Extreme Convergence (MXC) architecture and the Neptune platform that is now used in Motorola's Razr and Rokr cellphones has been developed by Freescale India. The company, in collaboration with TI, has also developed single-chip phones
- Cypress Semiconductor Corp. has developed several static memory chips in India
- The chip that powers the iPod, Apple Computer's MP3 player, was designed and engineered by Hyderabad-based Pinexe Systems' 80-engineer team. The team delivered the chip in 18 months and at a cost of US\$ 2 million- half the development time and at one-fifth the cost in the US
- Intel's Centrino Core Duo processor chip was mostly developed in India. The development process of Intel's Itanium and Xeon processors has been conducted in Bangalore, India. It is also expected that 'Whitefield', a Xeon processor, will be completely designed in India

SUCCESS STORIES OF DESIGNING COMPANIES IN INDIA

FREESCALE SEMICONDUCTOR, INC.

Freescale Semiconductor is a global leader in the design and manufacture of embedded semiconductors for the automotive, consumer, industrial, networking and wireless markets. The company has design, R&D, manufacturing and sales operations in more than 30 countries. It is one of the world's largest semiconductor companies with sales of US\$ 6.4 billion in 2006.

Footprint in India

Freescale Semiconductor started its India operations in 1998 with a mission of making the country a Centre for Excellence (CoE) in System-on-Chip (SoC) integration and

IP design. The company has its Indian headquarter at Noida, which is also its R&D centre. It also has its software and sales office in Bangalore. Freescale's Indian operations include the development of hardware and software designs for the wireless, networking and automotive markets. The company has invested approximately US\$ 50 million in its Indian operations in the past two years and plans to further expand its operation in the country. Given below is a summary of Freescale's Indian Operations.

Indian Design Centre

Freescale's design centre is based in Noida and employs approximately 700 engineers. Its Indian team works on digital and mixed signal IPs, SoC designs and low-tier to high-tier platforms and processors using some of the most advanced technologies such as 65nm, 90 nm, etc.

Indian Software Centre

Freescale's software centre, located in Bangalore, undertakes the development of software platforms, connectivity blocks, protocol stacks, OS porting and validation. This centre employs approximately 250 engineers and is also known as CoE.

Indian Sales Centre

Freescale's sales centre in Bangalore offers technical support to customers. These customers include both local and transnational design services and contract manufacturing companies.

Technology Developed

SoC Technology

Freescale India is working continuously to develop more efficient designs for SoC on the latest technologies such as 65 nm and 90 nm.

Innovative Technologies

Along with the SoC technology, Freescale India is also developing innovative technologies in the VLSI design segment through leading-edge process technologies, efficient design methodologies, creation of digital and

mixed-signal IPs and collection of low-tier to high-tier processor cores.

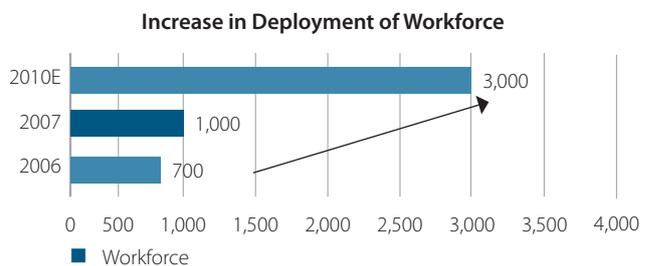
Milestones in India

Freescale's design centre in India works on some of the most advanced 65 nm, 90 nm designs for applications such as communications processors, wireless basebands and applications processing.

Freescale India launched the technology named MXC, which has been identified as the best application processor in 'Microprocessor Report'. Further, this design has also facilitated the making of the world's first voice call on a single core.

Freescale has been continuously growing in India over the past few years. The company filed 33 patents in the past two years and employed a workforce of approximately 1,000 people. To expand its operation further, the company plans to increase India headcount over the next three years.

India is one of the two CoEs of Freescale in the Asian region (China being the other) and is the largest design centre outside the US.



Latest News

Freescale plans to add 1,500 jobs in India with the opening of new campus in Noida

To expand its Indian operations, Freescale inaugurated a new 300,000 sq. ft. semiconductor design centre in India at Noida. The company plans to increase its Indian design team by 1,500 engineers over the next two years.

Freescale India expands operations in Bangalore

In order to support its R&D in software for wireless technologies, Freescale opened its 100,000 sq. ft. facility in Bangalore in 2006. The centre is envisioned to become one of the largest software centres for Freescale outside the US.

.Business Strategy

Partnering with Indian Design Houses

Freescale markets the solutions that it develops in partnership with Indian design houses through its global distribution channels. Thus, this strategy is helping the company to better cater to the regional and global markets.

Freescale has partnered with more than 25 independent Indian design houses that have hardware and software design capabilities, and also have the domain knowledge. Currently, the company is working with these design houses on different solutions such as motor controls, automotive electronics, power inverters, wireless communications and networking.

Investing in Talent

Globally, Freescale has always followed the strategy of investing in talent. As a part of its objective to expand its design operations in India, the company is investing in talent available across the country. Through this strategy, it plans to leverage the growing Indian market and the highly educated Indian workforce.

To Roll out Manufacturing Plant

With an objective to be a prominent player in the Indian semiconductor ecosystem, Freescale is employing the strategy of entering into semiconductor manufacturing by rolling out its manufacturing plant in the country, to utilise the benefits available under the Semiconductor Policy 2007.

ST MICROELECTRONICS

STMicroelectronics, headquartered in Geneva, came into existence in 1987 after the merger of SGS Microelettronica of Italy and Thomson Semiconductors of France. The company is known for forming strategic alliances with blue-chip companies and academia and investing heavily in R&D. Currently, it has operations in 36 countries and employs approximately 50,000 people across the globe.

Footprint in India

STMicroelectronics was one of the few companies that identified the growth potential of the Indian semiconductor market and started its Indian operations in 1987 as a 100-per cent subsidiary with just four employees. Currently, ST India has operations across six major locations in India- Greater Noida, Mumbai, Bangalore, Chennai, Pune and Hyderabad. Its Greater Noida centre is the company's largest R&D centre outside Europe.

The company's Indian centre is one of its major centres for developing key applications such as DVD, Set-Top Box (STB), multimedia, wireless-telecom, automotive and imaging solutions. Currently the company employs approximately 1,700 people in India.

Indian Operations Highlights

- ST India generated revenues of US\$ 78 million in 2005, growing at a CAGR of approximately 26 per cent over the past five years
- ST's Indian design centre has filed applications for 250 original inventions and out of these, 50 applications have already been granted patents from the US patent office
- ST's Indian centre develops reference designs, embedded systems, application-specific IP and high-value SoCs for various application segments such as telecommunications, digital communication, car multimedia, computer peripheral, etc.
- ST's design team in India focuses on VLSI design, embedded software development, application engineering and product design
- Approximately 15 per cent of ST Microelectronics' worldwide R&D in VLSI design and software are carried out in India

Milestones in India

- ST's designers in India have built embedded solutions for a series of applications including – Bluetooth, Wireless LAN, Digital Subscriber Line (DSL), STB and DVD. ST's major contribution is product design and development, and industrialisation of high-value SoC. One such example is STi5107, an STB decoder set-top box chip, which was entirely designed in India
- Its Indian arm is certified at CMM Level 5, the worldwide standard for assessing and improving software processes.

The Indian centre acts as a support centre for the company's worldwide IT applications and assists in business, financial, and human resource systems

- ST's India centre is responsible for the latest developments in the design platform, as it has the largest R&D centre of the company outside Europe. The Indian centre has also contributed to the development of design platforms by offering the 90 nm deep sub-micron Complementary Metal Oxide Semiconductor (CMOS) technology. These platforms allow ST's own designers, as well as the designers of its customers to exploit the potential of CMOS technologies in building market-leading products. Recently, the company also launched the latest 65 nm platform in India and is now developing libraries for the future 45 nm generations
- Its Indian centre has also contributed to the development of the application processor, Nomadik. This processor enables portable terminals to play music, take pictures, record video and host two-way visual communications in real time

Latest News

STMicroelectronics to expand Indian Operations over the next two years

To expand its operations in India, ST set up a new semiconductor design and development R&D facility in Noida in 2006. This R&D centre is the company's largest design centre outside Europe. At the same time, the company also plans to invest US\$ 30 million in India by 2008.

STMicroelectronics collaborates with premier Indian Institutes for R&D advancements

ST Microelectronics, in order to facilitate the expansion of VLSI and embedded system knowledge among the Indian students, developed new R&D labs in collaboration with BITS Pilani and IIT Delhi.

ST Considers India as the best investment destination

ST expects the Indian electronics market to grow at a rate 5.5 times higher than the worldwide growth rate. Therefore, the company plans to expand the range of its products with the introduction of latest technology and support in order to meet customer demand.

Business Strategy

Investments in Talent Pool

STMicroelectronics invests in talent pool globally to facilitate training and development of manpower. In line with its global strategy, the company is collaborating with various prestigious universities/institutes such as IIT Delhi, BITS Pilani, IIT Kanpur and Indian Institute of Science, Bangalore, in India to set up joint research and innovation labs. Through this strategy, the company plans to come out with products from India that will cater to the global needs of the company. This strategy of ST is also expected to facilitate the expansion of its designing operations in the country through leveraging skilled workforce of India.

Development of Strong Marketing Network

Over the years, ST has employed the strategy of developing a strong marketing network in India. This strategy has helped the company in becoming one of the leading suppliers of semiconductors in India with its top five customers being local and regional manufacturers. Continuing with the same strategy, the company also plans to expand its operations and reach in India by utilising its strong marketing network.

TEXAS INSTRUMENTS, INC.

Texas Instruments (TI) was founded in 1938 and is headquartered in the US. TI operates in two business segments, namely, semiconductors and education technology. In the semiconductor segment, the company designs, manufactures and sells integrated circuits. TI has its operations spread across 25 countries. In 2006, the company raised worldwide revenues of US\$ 14.25 billion, of which, the semiconductor segment and education technology segment accounted for 96 per cent and 4 per cent, respectively.

Footprint in India

The company has played a key role in building the IT ecosystem in India and is currently focused on supporting its global customers through its Indian operations.

TI started its operations in India in 1985 with the development and support of EDA software systems, which are used for IC design. In 1989, the company set up an R&D facility in Bangalore to enhance its operations in the Asia-Pacific region. With this, the company became the first MNC to set up an R&D centre in India. In 2006, TI opened another R&D centre in Chennai to focus on the wireless segment.

Through its Indian operations, TI operates in the area of library and software tools, SoC, signal processing technologies and microcontrollers. Currently, India is one of its largest design centres outside the US where approximately 1,400 are employed.

MAJOR HIGHLIGHT OF TI'S JOURNEY IN INDIA	
1989	TI India set up a design centre for mixed signal ICs
1990	TI India set up a design centre for application-specific products in 1990
1998	TI India launched the first Digital Signal Processor (DSP) fully designed in India
1998	TI India announced the sector's first programmable resolution analog to digital converter
1999	TI India launched xStream DSP technology for high-speed printer applications and Monet
2000	TI India opened a centre for design of 3G-wireless chipsets and a centre for developing Wireless LAN (WLAN) chipsets
2005	TI India launched the single chip solution, LoCosto, for mobile phones. This solution was designed and developed in its Bangalore centre

Latest News

Texas Instruments sets up new R&D centre in Chennai

TI set up its new R&D centre in India at Chennai, to facilitate the growth of telecommunication market in India. The company plans to provide support to open standard technologies such as GSM and DVB-H from this new centre, which will enable India to reach its goal of 500 million mobile phone subscribers by 2010.

Texas Instruments gets ready to grow its semiconductor business in India

As the wireless, telecom, entertainment, medical and automotives sectors are witnessing an exponential growth, TI is gearing up to grow its semiconductor business in India. For this, the company is expanding its sales offices and partnership network in the country.

Texas Instruments joins hands with IISc

TI collaborated with Bangalore-based Indian Institute of Science (IISc) as the first university outside the US for its research projects. In this, IISc will receive a funding of US\$ 400,000 over the next five years. The research work will involve 20 faculty members and 150 students working on several projects. This existing research partnership between TI and IISc is an extension of the research programme that began in 1996, whereby TI set up its 550 DSP labs in India.

Texas Instruments and Tata Elxsi join forces on 802.16e System

TI and Tata Elxsi collaborated in 2006 for IEEE 802.16e infrastructure products. This partnership will enable the company to quickly roll out solutions targeted at the mobile WiMAX market.

Business Strategy

Making India the R&D Centre

With an objective to expand its operations in Asia and utilise Indian talent pool in designing, TI set up its R&D centre in India. Since then, the country has emerged as one of the most favourable destinations for the company. Continuing with the same strategy in the future, India will remain its R&D centre because of various growing sectors such as automotive, wireless, telecom, entertainment and medical.

Not to enter into semiconductor manufacturing in India

With the objective to focus on research and product development in multiple areas in order to provide customised solutions, TI is strategically unlikely to set up a fab facility in India.

Expansion of partner network and sales offices

To expand its footprint in India, TI is expanding its sales offices and partner network in the country. At present, the company has four distributors and four offices in India, including R&D centres in Bangalore and Chennai. As a part of this strategy, it also started competency centres in association with leading companies in India to provide

application platform design support to TI's global customers. Through this strategy, TI India also plans to facilitate various Indian companies in reaching out to the international customers by offering its marketing network.

Importance of India to the Company

- The rapidly growing sectors such as wireless, telecom, entertainment, medical and automotive, offer a great opportunity to TI as they are fuelling the demand for semiconductors in India
- India has set the target of reaching 500 million mobile phone subscribers by 2010. For this, low-cost mobile phones have got a tremendous potential and at the same time, also offer a great opportunity to semiconductor companies. Thus, it is expected that the single chip solution, LoCosto, launched by TI India offers a great opportunity to the company as this chip will bring the cost of the mobile phones down to less than US\$ 20
- TI employs the strategy of cost reduction not by retrenchment but by hiring skilled staff, which can be beneficial for the organisation in times of crisis. Therefore, in this sense, India with its abundant skilled talent pool offers a lot of opportunity to the company

CADENCE DESIGN SYSTEMS, INC.

Cadence Design Systems, Inc. is headquartered in San Jose, California, with sales offices, design centres and research facilities around the world to serve the global electronics sector. The company plays an important role in the creation of today's integrated circuits and electronics and enables global electronic-design innovations.

It is also known for designing and verifying telecommunications equipment, networking, advanced semiconductors, computer systems and consumer electronics, Cadence® software and hardware. In 2006, Cadence employed approximately 5,200 people and generated revenues of approximately US\$ 1.5 billion.

Footprint in India

Cadence's centres in Noida and Bangalore provide IT support, global customer care, human resources, finance and administration functions.

Cadence operates in India through its wholly owned subsidiary, Cadence Design Systems (I) Pvt Ltd. The company's Indian operations were set up through the merger of Gateway Design Automation and Cadence Design Systems in 1987. Its Indian operations include R&D, field operations (sales, technical field organisation, marketing and global customer care) and support functions. The field operations team provides sales and engineering support across all Cadence platforms.

Cadence's Highlights in India

- Cadence India has consistently been rated among the best IT employers in India by the IDC / Dataquest surveys
- In 2006, Cadence was called a "Small Wonder" in one of the surveys
- Cadence was one of the founding members of the India Semiconductor Association (ISA) and is closely associated with the VLSI Society of India
- The Corporate Resource Centre, based in Noida, is the largest R&D site of Cadence outside the US

Products and Services

Cadence's design solutions encompass various areas such as digital IC design, verification, custom IC design, system interconnect, design for manufacturing and a unique offering called Cadence Kits. These Cadence Kits boost productivity by addressing the challenge of handling increased silicon complexity.

Major Initiatives

Cadence University Programme

Cadence is committed to helping its customers by providing them with a pool of engineers experienced in using EDA tools. All degree-granting institutions are eligible to subscribe to Cadence University Programme. In India, over 100 institutes train their VLSI students on Cadence EDA platforms, allowing students to use the technologies and develop the skill sets required in the real world.

Finishing School Programme

In April 2006, Cadence India partnered with the University of California, Santa Cruz, Extension (UCSC Extension),

USA, and Time to Market, Inc. (TTM), a provider of IC design services and training, to launch the Cadence-TTM-UCSC Extension Finishing School Program (FSP). The FSP is a first-of-its-kind initiative in India and is an advanced learning programme in VLSI and electronic design for new graduates and sector professionals. This joint initiative aims to teach design engineers the latest in design technology and is also intended to create a design-aware talent pool in the country.

Verification Alliance Programme

To support Cadence verification solutions, the company launched the Verification Alliance Programme, which is a network of experts who provide services, training and IP development. This alliance helps in improving the adoption of new technologies and efficiency of the verification teams at Cadence. Companies that are part of the programme include GDA Technologies, Inc., Ingot Systems, Inc., Innoaide, Inc., IntelliProp, Inc., KPIT Cummins Infosystems Ltd., Manipl Dot Net Pvt. Ltd., MindTree Consulting Ltd., nSys Design Systems Pvt. Ltd., Oski Technology, Inc., Silicon Interfaces, StellarIP Solutions, Inc., Tata Elxsi Ltd. and TES PV Electronic Solutions (P) Ltd.

Power Forward Initiative

To reduce risk and increase predictability in chip power reduction, Cadence launched the Power Forward Initiative that links design, verification and implementation. To achieve its goal, the Power Forward Initiative calls for the refinement and promotion of a new open specification that captures essential design intent for power and links the design, implementation and verification domains. Some of its members include AMD, Applied Materials, ARM, ATI, Freescale, Fujitsu, NEC and TSMC.

Open Choice Programme

To build, validate and deliver accurate models for Cadence design and verification solutions, the Cadence Open Choice Programme facilitates open collaboration with leading IP providers and enables interoperability. This programme optimises the electronics design chain and accelerates customer time-to-market.

Business Strategy

Opening of Corporate Resource Centre

The corporate resource centre is contributing to Cadence's product lines across four platforms- verification, digital IC, custom IC and silicon package board co-design.

Nurturing of Talent from Early Stages

Cadence is taking some proactive measures to address the demand-supply gap of trained VLSI design engineers that exists in India today. Examples of the major initiatives taken by the company are Finishing School Programme, Verification Alliance Programme, Power Forward initiative and Open Choice Programme.

Innovation @ Work

Innovation has always been the backbone of Cadence's organisational culture. Cadence India has been encouraging innovation in its working culture by encouraging employees to file patents, write papers and participate in technical conferences. The company organises the Technical Conference of Cadence India (TECCI) every year to allow employees to showcase their work to their peers.

Semiconductor Manufacturing

Semiconductor manufacturing is a capital-intensive sector and requires approximately US\$ 3 billion investment for setting up a chip-manufacturing unit. Some of the established countries in chip manufacturing are China, Taiwan, Singapore, etc. India is looking to tap some share of this chip manufacturing which is expected to translate into a big business.

From the 10-micron manufacturing process of the 1970s, through 1.5 micron in the 1980s and 0.13 microns of the last decade to 90nm, chip makers have followed Moore's law to increase the power of chips while reducing the chip size.

SEMICONDUCTOR MANUFACTURING IN INDIA

Semiconductor manufacturing is not so prominent in India and this presents a big opportunity to the chip manufacturing companies to set up their fabs in the country.

The growing market of electronics offers a large opportunity to global semiconductor companies to set up their manufacturing plants in the country. Recently, setting up of some fabs has been proposed and the approved ones are expected to be operational between 2009 and 2010. The Indian government has also proposed to develop a 'Fab City' in Hyderabad, which is expected to house 10 manufacturing plants.

Recently, a new trend has been noted in India. Companies are setting up their solar fabs in India with the latest technologies. It is likely that roughly seven to eight Solar Photovoltaic (SPV) units will be set up in India, with an investment of US\$ 5–6 billion. The number of solar chip fab units in India is expected to surpass the number of semiconductor chip fab units in the next few years. One of

the reasons for this trend is that SPV, with a capacity of 100 MegaWatt (MW) requires investments of approximately US\$ 300 million, compared to investment of US\$ 1.5–2 billion to set up a semiconductor chip-making unit.

Sector Landscape

Currently, there are no operational wafer fabs in the country and semiconductor manufacturing is limited to only three government companies (Bharat Electronics Limited, Society for Integrated Circuit Technology and Applied Research and Semi-Conductor Laboratory). Further, these government companies manufacture not for commercial purpose but for strategic reasons. We can infer that semiconductor manufacturing is not so prominent in India and the semiconductor ecosystem in the country is currently dominated by VLSI design services and embedded software design services.

Factors Fuelling Growth

Indian government has realised the importance of chip manufacturing and is currently giving various incentives to global semiconductor companies to set up their chip manufacturing plants in the country.

- The Indian government announced various tax incentives to motivate companies to start their chip-manufacturing operations in the country
- Construction of a new international airport in Hyderabad, which is slated to begin carrying passengers and cargo by 2008, is expected to boost chip manufacturing in India. 'Fab City' is located just outside Hyderabad and Hyderabad is within two hours flying time to all the major cities in India and three-five hours flying time to all major cities in the Middle East and South East Asia

- Chip manufacturing is getting a fillip in India as various Electronics Manufacturing Services (EMS) providers and mobile-phone equipment manufacturers such as Samsung, Motorola and Nokia, are setting up their plants in India. For example, by 2011, 10- 20 per cent of mobile phone production in India could be for exports. There is good scope for chip-manufacturing companies to partner with these EMS players and leverage this opportunity.

Importance of India to Chip Manufacturers

If the semiconductor companies can locate manufacturing in the same country as their design operations, then they can gain considerable benefits.

EMS and Design Companies Entering India

Many of the semiconductor companies and systems companies are establishing their presence in India. Various EMS companies are also setting up shop in the country. Thus, the entry of these companies and the establishment of design centres in India may make it necessary for the semiconductor companies to set up their manufacturing plants in the country as well.

Growing Electronics Market

The world is increasingly becoming 'Electronics-Centric' that requires both semiconductors and software. At the same time, Information and Communication Technologies (ICT) are growing in India. The country's electronic equipment consumption, which was approximately US\$ 28.2 billion in 2005 is expected to reach US\$ 363 billion by 2015. Therefore, India, with its growing consumer electronics market and huge defence and R&D needs, offers a great opportunity to chip manufacturers.

Importance of Chip Manufacturing to India

Semiconductor Segment constitutes a significant proportion of India's imports

So far, manufacturers of electronic devices in India have been dependent on countries such as China, Taiwan, Korea or Singapore to source their semiconductor product requirements.

Considering the rate at which the demand for electronics is growing in India, the country will be importing approximately US\$ 150 billion worth of semiconductors over the next 10 years. Thus, by establishing semiconductor manufacturing in India, it can complete the eco-system from system design to chip design to embedded software to semiconductor manufacturing to system manufacturing and can reduce its dependency on semiconductor imports.

Semiconductor segment is creating large number of employment

Semiconductor manufacturing segment will create more than 8.5 million new direct and indirect jobs in India by 2016 and will add approximately US\$ 100 billion to India's GDP.

The absence of major chip fabrication plants presents an opportunity to the semiconductor and EMS companies setting up their operations in the country.

National Semiconductor Policy

To be self-reliant in chip manufacturing and attract semiconductor companies to set up their manufacturing plants in the country, the Indian government announced 'National Semiconductor Policy' or 'Fab Policy' in 2007. Under this policy, the Government has proposed special incentives to encourage companies to come to India for semiconductor and related ancillary manufacturing.

Incentives available under the National Semiconductor Policy

- The policy covers LCDs, storage devices, plasmas, photo-voltaics, solar cells and nanotechnology products and also includes assembly and testing of these products
- There is also an option that state governments can provide additional incentives to semiconductor companies
- Assuming a 1:1 debt to equity ratio for the project, government restricts its participation to 26 per cent of the equity capital
- In case of units located outside the SEZ, the Countervailing Duties (CVD) on capital goods will be exempted
- In case of units located outside SEZ, government will carry

25 per cent of the capital expenditure for the stated time duration

- 20 per cent of the capital expenditure of a semiconductor manufacturing unit located inside of Special Economic Zone (SEZ) will be carried by the government for the first 10 years.

Regulations under National Semiconductor Policy

The threshold investment for a semiconductor manufacturing (wafer fabs) plant will be approximately US\$ 575 million and for other ancillary units (storage devices, organic LED, micro or nanotechnology products) approximately US\$ 220 million.

Incentives are not extended to older plants having second-hand equipment.

Incentive Plans Offered

Industry experts believe that the Indian market can support three large foundries costing approximately US\$ 3 billion each.

As the demand for chips that are used in products such as mobile phones, LCDs, smart cards, automobiles, PCs, ADSL modems and set-top boxes is rising in India, global chip manufacturers are bound to set up their factories in the country to tap the local market. At the same time, global firms are starting their manufacturing operations in India, both at the semiconductor level and at the end product level.

Recently there have been some investment announcements in manufacturing by some semiconductor companies. This endorses the fact that sector has responded positively to the National Semiconductor Policy and the incentives available under it.

Videocon Industries to launch design-cum fabrication complex

Videocon Industries Ltd. plans to soon launch a semiconductor design-cum-fabrication complex near Kolkata at an initial investment of approximately US\$ 230 million. The company also has plans to set up two SEZs in West Bengal. It is expected that the proposed semiconductor design-cum-fabrication facility will incorporate R&D, training, incubation and commercial activities under one complex.

Cypress Semiconductor to build a solar fab in India

The US-based semiconductor design and manufacturing company, Cypress Semiconductor Corp. plans to build a solar fab centre in southern India with an investment of up to US\$ 50 million. For this, the company is in consultation with the Government of Andhra Pradesh to set up a new fab unit. This fab will be used to produce solar cells and wafers.

Signet Solar to set up three fabs in India

Signet Solar, Inc., a global company, is planning to invest approximately 2 billion to establish a solar photovoltaic manufacturing base in India. The company will build three solar photovoltaic manufacturing facilities in India with each manufacturing facility expected to have an annual output of about 300 MW. The construction of its first fab in India will begin by early 2008.

IEMC to set up US\$ 3 billion fab

India Electronics Manufacturing Corp. (IEMC) is proposing to set up a 12-inch fab at US\$ 3 billion.

Moser Baer to establish the world's largest thin film solar fab in India

Moser Baer Pvt. Ltd. is establishing the world's largest thin film solar fab at Noida with an investment of US\$ 250 million over the next three years. For this, the company signed a technology partnership with US-based Applied Materials to manufacture large area thin film solar modules. It plans to start with solar modules capable of generating 40MW of power initially and ramp up to 200 MW by 2009. This fab's commercial production will begin from March 2008 and it will start generating revenues from April 2008 onwards.

Hynix Semiconductor may consider India for chip manufacturing

According to O.C. Kwon, Senior Vice-President, Hynix Semiconductor, Inc., the company will consider emerging markets such as India to set up a manufacturing facility in the future as part of its global expansion strategy.

SemIndia to set up US\$ 3 billion fab

Advanced Micro Devices (AMD) announced a broad agreement with SemIndia covering manufacturing, technology licencing and business development to meet the growing demand for computers based on x86 microprocessors in India.

SemIndia plans to set up a US\$ 3 billion – 12-inch fab in Hyderabad, which will manufacture semiconductor wafer chips, using technology from AMD. The 200-Millimeter (mm) and 300 mm lines will make chips for consumer and industrial electronics to cater to the Indian market.

NTSI to set up US\$ 0.6 billion fab

Nano-Tech Silicon India Pvt. Ltd. (NSTI), promoted by Dr. Jun Min, plans to set up an 8 inch fab in Hyderabad at US\$ 0.6 billion.

HSMC Plans to Set-Up US\$ 4.5 Billion Fab

Hindustan Semiconductor Manufacturing Co. (HSMC) plans to invest US\$ 4-4.5 billion to set up an 8 inch fab in two phases.

In Phase I, HSMC will invest approximately US\$ 1 billion to set up a plant that would produce 200 MM wafers and chips to a tolerance of up to 90 NM within two years. In Phase II, the company will graduate to 65 nm chips and its fab will focus on - mass consumer devices for mobile phones, smart cards and direct to home TV set top boxes.

CONCLUSION

It is likely that India will be able to achieve investments of US\$ 10 billion by 2010 in semiconductor manufacturing.

Overall product development can be done in a more cost-effective manner if the fabless chip design houses in India can find chip manufacturing at the same location. If wafer fabrication units are set up in India, then it will act as a catalyst in the growth of the overall semiconductor sector. Because of India's competitive and skilled labour, the country can also be developed into a contact manufacturing hub in the coming years. Thus, this overall positive environment may attract other global semiconductor companies such as Intel and Qualcomm, which are considering entering into

chip manufacturing in India, to set up their manufacturing operations in the country.

- Companies planning to set up solar PV plants are also expected to provide clean and affordable renewable energy, via thin film solar modules, to the Indian customers
- The Indian sector will do well to invest its capacities in innovative solutions, rather than trying to recreate manufacturing capacity in semiconductors
- Manufacturing of electronics has seen remarkable progress in the last 18 months with majors such as Nokia, Motorola, Flextronics and Foxcon now investing in India

“India would be the only country in the world with robust models in chip design, chip manufacturing and electronics manufacturing.”

Poornima Shenoy
President, India Semiconductor Association

“The semiconductor market in India will see heightened activity with an increase in the electronic equipment manufacturing sector in India.”

Aditya Sapru
Managing Director and Partner,
South Asia and the Middle East, Frost & Sullivan

SUCCESS STORIES OF SEMICONDUCTOR MANUFACTURING COMPANIES IN INDIA

BHARAT ELECTRONICS LIMITED

Overview

Bharat Electronics Limited (BEL) was established in 1954. BEL is an ISO 9000:2001 and ISO 14001 certified company and currently has three integrated fabs. Out of the three fabs of BEL, one fab is dedicated to the manufacturing of integrated circuits, second for discrete power transistors and the third one for discrete small signal transistors.

The company designs, develops and manufactures products that cater to radars, telecommunications, defence communications, solar systems, sound and vision broadcasting, opto-electronics and electronic components.

BEL also does chip design, fabrication, testing and assembly of semiconductors. The company has approximately 95 per cent of the Indian market share for strategic electronics. About 67 per cent of its turnover is from indigenous design and 33 per cent of it is from foreign technology transfers. For 2006-07, BEL recorded its highest ever turnover of approximately US\$ 912 million, exports of US\$ 11.6 million and employee strength of 12,337.

Awards and Achievements

- BEL became the first defence PSU to acquire operational MINIRATNA CATEGORY-I status for the year 2001-02
- It is one of the selected PSUs, which has signed a Memorandum of Understanding (MoU) with the Department of Defence ever since the Government of India introduced performance measurement system in 1989-90
- BEL secured a large number of orders for the LED-based solar traffic signals in Bangalore, Hyderabad and New Delhi

Technology and Products

BEL is the only company to have a bi-polar fabrication unit in India. High speed, high voltage and high power transistors are made in this unit. The company uses 3-micron technology for its bipolar and CMOS processes to manufacture semiconductor products.

BEL's manufactured semiconductor products/ICs are used in para-military organisations, defence services and some government organisations such as Meteorological Department, All India Radio, Doordarshan, Department of Telecommunications, Police Wireless, etc.

Strong R&D wins awards for BEL

BEL has a strong R&D department, which has always been proactive to technology shifts. The company spends approximately 5 per cent of its turnover on R&D every year. Due to its strong R&D, there has been a steady decrease in its dependence on borrowed foreign technology in recent years. The proportion of indigenous products has risen to approximately 70 per cent in 2005-06, compared to 65 per cent in 2004-05 and 50-60 per cent in 2003-04. At the same time, BEL has won several awards in the R&D domain:

- Award for 'Contribution in Areas of Defence R&D' for 2001-02, sponsored by the Society for Defence Technologists
- Award for 'Excellence in Professional Electronics' for 1998.
- 'Defence Technology Absorption Award' for 1998

Future Plans

BEL plans to explore business opportunities that the Indian government's current and future aerospace and defence electronics segments offer. For this, the company signed an MoU with Northrop Grumman Corporation to expand business opportunities in India.

Some other plans of the company are as follows

- BEL plans to start manufacturing of white LEDs for home lighting. These LEDs have high energy efficiency and a long life
- The company also plans to manufacture more specific semiconductor products for telecom and atomic energy

SOCIETY FOR INTEGRATED CIRCUIT TECHNOLOGY AND APPLIED RESEARCH

Overview

Society for Integrated Circuit Technology and Applied Research (SITAR) is a silicon chip manufacturer that supplies chips to defence and space organisations in India.

The company is an ISO 9000:2001 certified company that does chip design, fabrication, testing and assembly of semiconductors. SITAR is also into module manufacturing and smart card printing. Further, the company is also the only silicon chip manufacturer, which has been engaged in the semiconductor chip design, development and manufacture of ICs for automotive and commercial sectors.

Technology and Products

Salient Features of the SITAR Manufacturing Facility

- 1 micron (μ) digital CMOS process
- Wafer processing capability of 6-inch
- Fab turn around time (after receiving masks) of 6 weeks
- The fab is upgradable to 0.6 micron

- Technological processing capability of 100,000 wafers per annum

SITAR has a diversified product portfolio consisting of computer chips, content addressable memory, frequency synthesizers, digital signal processors, complex multipliers, etc. The company has also entered the sensor market to develop products such as radiation sensors, acoustic sensors and bolometer. In 2005, it became the first company in India to come out with integrated 'Micro Electro-Mechanical Systems' device.

Partnership

In 2003, Electronics Corporation of India Limited, Society for Electronic Transactions and Security and SITAR formed a conglomerate called NASCENT (National Smart Card Consortium of Enterprises) to provide smart card-based applications. In this, SITAR will provide the needed integrated circuit chips (ICs) for different applications.

SEMI-CONDUCTOR LABORATORY

Overview

Semiconductor Complex Limited was established in 1983 as an integrated facility for VLSI-based systems and subsystems and to develop and manufacture LSI/VLSI chips. The Department of Space in India took over the company's administrative control from the Department of Information Technology in 2006 and renamed Semiconductor Complex Limited to Semi-Conductor Laboratory (SCL).

Overall, SCL's operations are in the areas of chip designing, fabrication, testing and assembling of semiconductors, and manufacturing VLSI based systems and subsystems. Over the years, the company has also been serving various sectors such as defence, telecommunications, consumer electronics, industrial and space. Concurrently, it also provides turnkey IT (hardware and software) solutions for various e-governance applications and helps to develop and train manpower in the area of VLSI design.

- SCL entered into a technical collaboration with American Microsystems, Inc., USA in 1984 for the development of 5µm CMOS technology
- The company is ISO 9000:2001 and ISO 9002 certified
- It also acts as a foundry for fabrication of Micro Electro Mechanical Systems (MEMS) under the Govt. of India's National Programme on Smart Materials (NPSM)

Technology and Products

SCL had collaborated with American Microsystems, Inc. for the development of 5µm CMOS technology. Subsequently, SCL has developed 3 micron, 2 micron, 1.2 micron and 0.8 micron technologies along with specialised technologies such as Electrically Erasable Programmable Read-Only Memory (EEPROM) and Charge Couple Devices (CCD), through its own R&D efforts.

Salient Features of SCL's Manufacturing Facility

- Its fab is upgradeable to 0.6 micron
- It has technological capacity to process 100,000 wafers per annum
- Its fab turn around time is eight weeks
- It operates at 0.8µm and 1.2µm CMOS and other special processes using 6-inch wafer

Future Plans: To Upgrade its VLSI Facility

SCL plans to upgrade its VLSI facilities by enhancing its technology and infrastructure. The upgrading will enable the company to acquire the capabilities needed to manufacture high complexity semiconductors and imaging devices. This in turn would reduce the dependence on foreign manufacturers in the micro-electronic devices.

Assembly Testing Mark Pack (ATMP)

“ATMP units have led to the development of the semiconductor industry in some countries and taken them into wafer fabrication and high-end design activities.”

Vinod K. Agarwal
Chairman and CEO, SemIndia

A significant percentage of the total revenue of the semiconductor sector can be attributed to the ATMP segment. This is the post-fabrication stage, wherein the chip reaches the testing lab and undergoes probing. In this, faulty chips are identified and the rest are taped out for shipment. This post-fabrication stage completes the overall value chain of the semiconductor sector and complements the semiconductor ecosystem. The development of ATMP units has enabled various countries such as Taiwan, Singapore, Malaysia and South Korea to progress from ATMP to wafer fabrication and high-end design activities. Thus, this backdoor entry into chip making has led to the development of the overall semiconductor sector in these countries.

ATMP IN INDIA

Currently, the number of ATMP units in India is very small, but various firms including both domestic and foreign testing and packaging companies are foraying into IC testing. It is generally said, that for India to emerge as a complete semiconductor solution provider, it has to develop into an ATMP hub.

Segment Size

According to Veerappan, co-founder, Tessolve, the global ATMP market is approximately US\$ 14 billion and if India can tap even 5 per cent of this market by 2015, it will translate into big business for the country.

Incentives Available for Setting up ATMP Units in India

ATMP units are entitled to tax exemptions under Software Technology Parks of India (STPI) norms. Some of these exemptions are:

- Custom Duty exemption
- Excise Duty exemption
- Central Sales Tax reimbursement
- Corporate Tax exemption on 90 per cent export turnover
- Sales in Domestic Tariff Area (DTA) up to 50 per cent of the FOB value of exports permissible

“Proper policy indicates the government’s determination to support the industry’s growth. This will help companies attract investments.”

Bob Kondamoori
Managing Partner, Sandalwood Partners

Growth Prospects of ATMP Units in India

As the product life cycle is becoming shorter, companies are looking to set up their base near the customers. As the demand for semiconductors is growing in India, global semiconductor companies are also looking forward to set up their testing and assembly plants in the country, so that the chips can reach the local market much quicker. At the same time, proximity to fabrication and testing units will strengthen IC design and will encourage the growth of the overall semiconductor sector in the country. In all, it can be said that the prospects of ATMP units are very good in India because of the following reasons:

Upcoming Fabs and Manufacturing Facilities

There are some semiconductor fabs coming up in India. These fabs may require in-house operations to carry out assembling and testing of their ICs and to have full control over the manufactured ICs. At the same time, the decision by some of the consumer electronics majors such as Samsung, Nokia, LG and Dell to set up their manufacturing plants in India also augurs well for assembling, testing and packaging of chips and final products.

Growing Domestic Electronics Market

The presence of a growing domestic electronics market consisting of MP3 players, Personal Computer (PC), digital cameras and mobile handsets offers a great opportunity for mix-signal testing, flash testing and packaging of memory devices.

India – A Low Cost Country

ATMP units are located predominantly in low-cost countries such as Malaysia, Philippines and Costa Rica. India with its abundant skilled, low-cost, and competitive workforce offers a tremendous opportunity to these companies. Although the number of testing and packaging companies is still small, the efforts of firms such as Tessolve, SemIndia and Analog Devices, which have forayed into integrated-circuit (IC) testing, is just the beginning.

“Wafer manufacturing is the core of hardware sector and must be the highest priority. Setting up this ATMP demonstrates SemIndia’s commitment to eventually bring wafer manufacturing to India.”

Rajendra Khare

Chairman, India Semiconductor Association (ISA)

Recent Investment Announcements

Intel plans a US\$ 400 million testing and packaging unit

India is one of the fastest growing markets for PCs and to tap a percentage of this growing pie, Intel Corp. plans to invest US\$ 400 million to establish a testing and assembly facility in India near Bangalore or Chennai. With this, the company can reach local PC manufacturers much quicker.

Tessolve setting up a US\$ 200 million TAPP facility

Tessolve, Inc., along with its investors has announced to invest US\$ 200 million for a Testing Assembling Packaging and Prototyping (TAPP) facility in Chennai.

SemIndia to set up a US\$ 100 million ATMP unit

SemIndia is setting up a US\$ 100 million ATMP unit at Maheshwaram, near Hyderabad and plans to roll out its first chip by March 2008. This ATMP unit will be located over 25 acres with an initial built-up area of 200,000 sq. ft. It is the first step towards its proposed US\$ 3 billion chip fabrication factory.

Other players setting up their ATMP units in India

There are also some other players that are showing interest in the ATMP segment in India. For example, players such as ASE of Singapore, Arizona-based Amcore and Taiwan-based UTSC are looking forward to invest in the Indian ATMP segment.

Current Trends

Venture Capital (VCs) eyeing the ATMP segment

There are some VCs eyeing the Indian semiconductor ATMP segment. For example, Sandalwood Capital Partners, India-focused venture fund, is keen to invest in the ATMP segment. For this, the company has taken certain initiatives:

- Sandalwood announced the investment of US\$ 30 million in the SemIndia’s phase1 – proposed test and assembly facility in Hyderabad
- The VC plans to invest close to nearly US\$ 25 million over five years in the Tessolve’s upcoming ATMP unit in Sriperumbudur near Chennai. For this, it will invest in the ATMP unit through TAPP Semiconductor India
- Currently, Sandalwood is aiming to increase its investment to US\$ 1 billion in the next three years in technology-related business. Currently the company has US\$ 150 million under management

Outsourcing of assembly and testing services is fuelling ATMP revenue

Outsourcing of assembly and testing services is expected to give a fillip to the revenue of ATMP units in India. Foreign

companies are expected to outsource their work to these ATMP units in India and at the same time, captive design centres of semiconductor companies such as Intel, TI and AMD are also expected to outsource their work to these ATMP units. This trend is further supported by the fact that the market for outsourced assembly and testing services has grown from 30 to 40 per cent in the past five years.

SUCCESS STORIES OF ATMP UNITS IN INDIA

SEMINDIA

SemIndia, a consortium of NRI entrepreneurs and is promoted by technocrats, entrepreneurs and sector experts to realise India's vast potential in semiconductors and electronics.

The main objective of SemIndia, an Assembly Test Mark Pack (ATMP) company, is to act as a catalyst for the growth of the semiconductor industry in India and make the country a global hub for semiconductor products, chip manufacturing and IP creation.

The company has its operations in fabrication, probing and sorting, assembly, testing and packaging of semiconductor chips. These chips are used for personal computers, cell phones, set-top boxes and broadband connectivity. Further, the company also has strategic and business partnerships with various companies such as AMD, Flextronics, CH2MHill, Broadcom, IMEC, Surbana and Base Oxygen Corporation (BOC) for marketing, distributing and manufacturing customised products for the Indian market. Currently, it is also working with the Government of India (GoI), Government of Andhra Pradesh (GoAP) and Indian Semiconductor Association (ISA) with the aim of bringing down the price of semiconductor products.

SemIndia operates in India through three companies

SemIndia Fab Ltd.

This company focusses on manufacturing semiconductors and the assembly and test operations.

SemIndia Systems Private Ltd.

This is an ISO 9001:2000 certified company. The company is focussed on designing, developing and manufacturing

innovative products such as STB, Gigabit Passive Optical Network (GPON), IPDSLAM, WIMAX, ADSL modems, media players and rural phones.

SemIndia Fab City Ltd.

This company is focussed on developing the entire semiconductor ecosystem in India.

Through the innovative technologies and designs, SemIndia Systems Private Ltd. generated revenues of US\$ 40 million for 2007 and is expected to cross US\$ 100 million in 2008.

Business Strategy

Entered into Strategic Partnerships

To evolve a comprehensive ecosystem for manufacturing in India and to gain presence in the same, SemIndia has entered into strategic partnerships with global semiconductor companies. For example, the company entered into partnership with IMEC for R&D of new semiconductor technologies; with AMD for business development and semiconductor manufacturing; and with Flextronics for manufacturing of electronic products.

Exponential Growth Model

To take advantage of the exponentially growing Indian demand for electronics and semiconductors, SemIndia has adopted an effective business model for the country. This business model focusses on achieving import substitution, consumption growth and market development. This strategy is likely to help the company in achieving a strong foothold in the country and expand its operations.

Growth through innovative products and technologies

To be an end-to-end semiconductor company, SemIndia plans to grow inorganically in the semiconductor designing segment and organically in the manufacturing and ATMP segments. For this, the company set up SemIndia Systems, a company focussed on designing, developing and manufacturing innovative products,

and creating demand for ICs from the electronics industry in India.

News and Announcements

SemIndia to set up US\$ 3 billion fab

SemIndia is proposing to set up a US\$ 3 billion, 12-inch fab in Hyderabad, which will manufacture semiconductor wafer chips, using technology from AMD. The 200 mm and 300 mm lines will make chips for consumer and industrial electronics for the Indian market. This project will be completed in two phases, wherein Phase-I will see an investment of US\$ 1 billion and Phase-II an investment of US\$ 2 billion. This fab unit will make chips with a circuitry width of 65 to 90 nm and will employ approximately 2,000 people.

AMD plans US\$ 500 million investment in SemIndia's SEZ

The world's second-largest computer chip maker AMD is planning to invest approximately US\$ 500 million in SemIndia's chip manufacturing facility near Hyderabad. Apart from this, Singapore-based Flextronics has also announced that it will also pick up a minority stake in this venture.

SemIndia setting a US\$ 100 million ATMP unit

SemIndia is setting up a US\$ 100-million ATMP unit in Hyderabad and plans to roll out its first chip by March 2008. This ATMP unit will be located over 25 acres with an initial built up area of 200,000 sq. ft and it is the first step towards its proposed US\$ 3-billion chip fabrication factory.

IMEC to develop foundry processes for SemIndia

IMEC (Europe's semiconductor research institute), signed a MoU with SemIndia to develop 130 nm and 90 nm CMOS processes for logic and mixed-signal products. The company also plans to develop both 65 nm and 45 nm foundry type semiconductor processes in the future for SemIndia.

TESSOLVE INC.

Footprint in India

Tessolve Inc. was founded in Silicon Valley in the US by Indian engineers. The company set up its engineering test facility in Bangalore in 2004 to cater to the infrastructural gap that existed in the post-fabrication stage. Its Indian unit, Tessolve Services Pvt. Ltd., operates in hardware design, failure analysis and reliability testing. The company offers infrastructure facilities, as well as a range of services for handling all the post-fabrication activities of semiconductor companies.

Tessolve Services Pvt. Ltd. is also the first Indian semiconductor company to set up operations in Singapore. Some of the major clients of the company are Texas Instruments, Alliance Semi-conductor, 2Wire, Insilica, SCL, National Intersil and Wipro. It had 62 test engineers and 7 tester platforms in India, as on March 2007. Currently, Tessolve aims to be among the top-10 and top-5 semiconductor testing companies in the next five years and ten years, respectively.

- Tessolve delivers world-class engineering and test support services and also provides geographic cost benefits and co-location advantages to chip design houses in India and abroad
- Tessolve offers a complete range of product engineering services to global and local customers

Services Offered

To the semiconductor companies, Tessolve offers its different services ranging from first wafer test to production test programme and support. Over the years, the company has developed its expertise in offering services to a range of device types and industries, which include WiMax, microprocessors, converters, videos and memory chips.

Factors of Success

Unique Indian Strategy

Unlike a typical assembly and testing firm, Tessolve has always been seeking to provide inputs at the design stage. This helps the designing companies to develop a right design for the right product. This strategy of the company was unique in the Indian context and

has helped it in getting business from the chip design companies in India.

Provider of low cost, scalable testing platform

Tessolve is known for using latest testing technologies to test digital and mixed-signal devices for its customers in India. The company purchased 'Agilent 93000 Pin Scale' system to test ICs, SOCs and Systems-in-Packages (SIPs). This step has provided it the low-cost and scalable platform for chips testing. It has also positioned Tessolve as India's leading independent semiconductor test house.

News Flows

Tessolve setting up a testing assembling packaging and prototyping facility in India

Tapp Semiconductor, a subsidiary of Tessolve, announced the setting up of a Testing Assembling Packaging and Prototyping (TAPP) facility in India at Chennai. The company is slated to invest US\$ 200 million in this facility over a period of four years. From this facility, it will provide different services such as package design, test development and hardware design.

Sandalwood exploring investment options

Sandalwood Capital Partners, an India-focussed venture fund, is in parley with Tessolve and HSMC. Tessolve is in the process of setting up a TAPP facility for semiconductors in India at Chennai and HSMC is exploring investment options in the country.

Why Invest in the Indian Semiconductor Sector

STRONG GROWTH IN RELATED VERTICALS

The semiconductor design requirements of such verticals provide an opportunity to multinational companies to come to India and tap the potential

The Indian semiconductor sector is likely to witness a strong growth rate as a result of strong growth rate expected in some of the related sectors such as automotive, consumer electronics and durables, IT hardware and office automation, telecommunications, etc. These related sectors are expected to drive the growth of semiconductors in India as there is a strong interlinking between the two.

From 2005 to 2015, the market for semiconductors in automobile sector and electronics and durables sector is expected to register a CAGR of approximately 16.5 per cent and approximately 17.8 per cent, respectively.

From 2005 to 2015, the market for semiconductors in IT hardware and office automation sector, telecommunication sector and commercial electronics sector is expected to register a CAGR of approximately 24.5 per cent, 34.2 per cent and 26.8 per cent, respectively.

STRONG ACADEMIA

A country such as India with its quantitative and qualitative engineering workforce is capable of attracting many global companies to set up their operations in the country.

The semiconductor sector is knowledge intensive and requires a large pool of engineering workforce. For a country to attract semiconductor companies, it requires abundant engineering workforce with the requisite experience. In that sense, India looks very strong with an edge over other countries as its 306 universities and over 15,000 colleges, churn out approximately 3,50,000 engineering graduates annually, compared to 70,000 and 1,00,000 graduating in the US and Europe, respectively.

The number of engineering workforce in India employed in VLSI, hardware/board design and embedded software development is expected to grow at a CAGR of 26.4 per cent.

At the same time, the country also offers capable and highly experienced workforce. Workforce with an experience of more than 10 years is expected to increase to 15 per cent by 2010 from 8 per cent in 2005.

Market for Semiconductors Across Different Industry Verticals (US\$ million)

	2004	2005	2006	2007	2010	2015
Automobile Sector	76.3	100	121.9	145.9	240.2	459.5
Electronics and Durables Sector	202.9	297.9	378.4	471.4	791.1	1529.5
IT Hardware and Office Automation Sector	660.0	780	1000	1280	2610	6960
Telecommunication Sector	828.6	1281.5	1884.3	3010	7980.8	24297.2
Commercial Electronics Sector	121.6	153.4	186.9	245.4	484.7	1647.6

Engineering Workforce Employed by Different Design Sector Verticals in India				
YEAR	TOTAL DESIGN MARKET	EMBEDDED SOFTWARE DEVELOPMENT MARKET	VLSI DESIGN MARKET	HARDWARE/BOARD DESIGN MARKET
2005	74,850	60,220	11,300	3,330
2006E	102,120	83,500	14,200	4,420
2007E	140,235	116,305	18,060	5,870
2008E	178,675	148,790	22,300	7,584
2009E	227,265	190,030	27,455	9,780
2010E	286,220	241,000	33,135	12,085
2011E	360,440	305,665	39,850	14,925
2012E	454,010	387,665	47,910	18,436
2013E	545,665	465,196	57,700	22,770
2014E	653,365	558,236	67,000	28,130
2015E	781,780	669,885	77,150	34,745

AVAILABILITY OF DESIGN TALENT

India offers a large pool of technically and scientifically skilled English-speaking workforce. At the same time, the country also offers plenty of semiconductor design talent at competitive cost. For example, an employee in the engineering services costs US\$ 25 per hour in India, which is approximately one-third for a similar employee of comparable skill and experience in the US. Approximately 20 per cent of the Fortune 500 companies have their research and development operations in India and recruit managerial and engineering staff locally for their Indian operations.

Opening offshore design or research centres in India gives companies a significant cost savings of up to 25 to 50 per cent.

GROWING INDUSTRIAL AND GOVERNMENTAL SUPPORT

The initiatives taken by the Government and the industry are providing new business opportunities to the existing companies to move up the value chain.

The semiconductor designing market alone is expected to create 781,780 jobs by 2015. But at the same time, less than 1 per cent of graduating engineers in India have the skills required by the semiconductor sector. To bridge this gap, the Indian government and private players are taking various initiatives such as collaborating with academia,

promoting participation of experienced professionals in training activities, allowing FDI, etc.

Government Support

The Government of India has been taking various initiatives to support business activities of the semiconductor sector in India. To attract electronics companies to invest in India, it is establishing a favourable environment for FDI, reducing taxation rates, giving fiscal and financial benefits to the sector, etc. Major initiatives taken by the Government are as follows:

- Companies incorporated in India (any entity other than a branch), even those with 100 per cent foreign ownership, are considered as domestic companies under the Indian law. Further, corporate income tax rate applicable to these companies is the same as the tax rate applicable to domestic companies
- Various acts such as the Indian Copyright Act 1957; Patents Act, 1970; Trademarks Act 1999; and The Designs Act, 2000 have been enforced to safeguard the intellectual property rights in the semiconductor industry
- FDI relating to electronics and information technology hardware manufacturing has been allowed through the automatic route, which does not require any prior approval either from the government or RBI
- To make India a globally competitive semiconductor market, the Indian government has taken various initiatives in the form of allowing investment support to the industry in research activities, tax incentives to training programmes, etc.

- Set up an autonomous body, Software Technology Parks of India (STPI), under Department of Electronics, Government of India. This body is coordinating with technical universities to integrate VLSI skills into the regular engineering curriculum
- The Ministry of Information Technology in India came up with a policy to develop Electronic Hardware Technology Park (EHTP) to encourage exports of electronic hardware items

ISA initiated a programme called University Gateway to identify and tap talent in VLSI design. It is currently running two such initiatives- Si-Quest and ISA-VTU collaboration, aimed at creating awareness and identifying design talent across campuses and enhanced industry-academia interaction, respectively.

Industrial Support

Various institutes such as V3Logic, Bitmapper, Accel Ltd., Bennis Technologies, Calorex, Vedant, and Sandeepan have started offering short duration courses ranging from one month to one year in VLSI Design.

Various foreign, as well as domestic companies operating in the semiconductor sector such as Cadence, ATI, Synopsys, Texas Instruments, Magma Graphics, etc. are providing support to the semiconductor sector in India by taking initiatives to upgrade the skills and knowledge of local design engineers. Collectively, these companies are spending more than US\$ 1 million annually in the form of monetary contributions for education or grants on software and tools for design labs in universities.

TI, STMicroelectronics and most other large multinationals are engaged in university programmes to help build design expertise in India. TI, for example, has programmes in DSP design that reach 10,000 students per year at 350 universities.

ISA has been taking various steps to bridge the gap between the sector and academia.

Exchange Rate Used

Year	Exchange Rate (INR/US\$)
2000-01	45.75
2001-02	47.73
2002-03	48.42
2003-04	45.95
2004-05	44.87
2005-06	44.09
2006-07	45.11

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