India-Japan Collaboration in the Semiconductor Space

India Semiconductor Association

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I. Indian semiconductor industry and market: An overview

There are around 200 semiconductor design companies in India today, both multinationals and domestic companies. Beginning with the entry of Texas Instruments in 1985, in the past 4-5 years there has been an increase in the setting up of offshore design and development bases in India. There has also been an increased employment of engineering human resource and execution of complex designs here.

The semiconductor industry in India focuses on VLSI design, board design, package design, embedded software and analog design. India has a talent cost advantage in terms of its availability, scalability and quality. Short product lead times, reduced entry barriers, rising government support, steadily improving infrastructure, growing domestic market and the consistency of consumption growth in the end-user market have also made India an attractive destination for both design and development.

Captive companies i.e. subsidiaries of multinational companies, while making strategic investments in India have looked at these positive parameters. Strong IP protection laws also make India a robust destination for design industry. Another area of strength in the Indian semiconductor industry lies in process compliance, which meets global standards.

	Captive ($ million)	Captive Percentage	Non-Captive ($ million)	Non-Captive Percentage	Total Revenues ($ million)
VLSI Design	361.15	62%	221.35	38%	582.5
Hardware/Board Design	40.5	29%	99.3	71%	139.8
Embedded Software	733.7	29%	1796.3	71%	2530

ISA-Frost & Sullivan Report, 2006

All the global top ten fabless design companies have India operations. The Indian semiconductor design industry is spread across the cities of Bangalore, NCR, Hyderabad, Chennai, Pune, Ahmedabad and Goa. Besides, 20 of the top 25 semiconductor companies have already set up ventures here.

The turnover of Indian semiconductor design industry in the year 2005 was USD 3.2 billion, hiring an engineering workforce of 75000. This is estimated to reach USD 43 billion by 2015 with a hiring potential of 780,000 professionals and a CAGR of close to 30% for this period.

The following table gives the potential business available in India in terms of design services.

	Share of overall revenues 2005 (%)	Share of overall revenues 2015 (%)
VLSI Design	US$0.6 billion (18)	US $5.1 billion (12)
Hardware/ Board Design	US $0.1 billion (4)	US $1.6 billion(4)
Embedded Software	US$2.5 billion (78)	US$ 36.3billion (84)
Total	US $3.2 billion (100)	US $ 43 billion (100)

ISA-Frost & Sullivan, 2006

During 1980-2005, global market for electronics grew at a CAGR of 7.5% while the world Gross Domestic Product (GDP) grew at a CAGR of 3%. In 2005-10, it is expected to grow at a CAGR of 6%, from US$ 1341 billion to $1791 billion. Electronics –whether it is office automation, consumer electronics, medical electronics, telecommunications or industrial automation will require more of the semiconductor industry in India.

India's total semiconductor consumption in 2005 was about USD 2.8 billion, met chiefly through imports. This demand is likely to exceed USD 36 billion by the year 2015.

The table below gives an indication of India's role in the global electronics market.

	2005	2015
Electronic equipment consumption	$ 28.2 billion	$ 363 billion
Contribution to global electronic equipment production	2%	11%
Electronic equipment production	$ 10.99 billion	$ 155 billion
Contribution to global electronic equipment production	< 1%	5%
Total market for semiconductors	$2.82 billion	$36.3 billion
Total global demand	$235 billion	$558 billion
Share in global semiconductor revenues	1.2%	6.5%

ISA-Frost & Sullivan, 2006

The semiconductor industry typically faces a dynamic market where constantly new product variants and models are demanded. The industry faces declining margins and a constant need to upgrade through research and development. This puts pressure on containing costs. The ecosystem too is showing potential to grow fast. Companies such as Flextronics and Nokia have set up large Special Economic Zones (SEZs), encouraging their suppliers too to move into these zones.

The major areas of use of semiconductors are communications, information technology and consumer electronics. Under these segments, the important subcategories driving the semiconductor market are mobile handsets, wireless equipment, particularly BTS equipment, set top boxes and smart card terminals. These are high growth areas with vast potential.

Total market revenue forecasts by application segment (India), 2004-2015

Year	Consumer		Communications		Automotive		Industrial		IT & OA		Others		Total	
	USD mill.	%	USD mill.	%	USD mill.	%	USD mill.	%	USD mill.	%	USD mill.	%	USD mill.	%
2004	203	10	829	40	76	4	122	6	657	32	169	8	2056	100
2005	298	11	1282	45	100	4	153	5	779	28	207	7	2819	100
2006	378	10	1884	50	122	3	187	5	987	26	245	6	3803	100
2007	471	9	3010	55	146	3	245	5	1282	24	289	5	5444	100
2010	791	6	7981	63	240	2	485	4	2612	21	564	4	12673	100
2015	1530	4	24297	67	460	1	1648	5	6966	19	1404	4	36304	100

ISA-Frost & Sullivan, 2006

Given India's potential market in electronics and automotive industry, Japan should find it extremely attractive to invest directly into this sector. This could also trigger investment into the semiconductor design segment to not only meet its offshore requirements of the Japanese electronics and automotive industry but also specific industries located in India.

Semiconductor policy of the Government of India, February 22, 2007:

- The policy incorporates a special incentive package to attract investments for setting up semiconductor fabrication and other micro and nanotechnology manufacturing industries.
- The incentives will be for the manufacture of all semiconductors, displays including Liquid Crystal Displays LCDs, Organic Light Emitting Diodes OLED, Plasma Display Panels PDP and any other emerging displays, storage devices, solar cells; photo voltaics; other advanced micro and nanotechnology products; assembly and test.
- A key benefit is the grant of the SEZ status. Through this, the government has provided both pre-operative and postoperative benefits to the industry, important for the development of its ecosystem.
- The government has however, provided two options to the project.

Type of unit	Threshold NPV of investments	Incentive in SEZ	Incentive in Non-SEZ
Fab unit	INR 2500 crore (USD 566 million)	20%	25% + exemption from CVD
Ecosystem unit	INR 1000 crore (USD 266 million)	20%	25% + exemption from CVD

Note: (Incentive in % of capital expenditure); CVD is Countervailing Duty

Impact of the semiconductor policy can be seen from the media coverage on proposed semiconductor industry related manufacturing in India:

- SemIndia promoted by an NRI consortium and headed by Vinod Agarwal announced a $3 billion "Fab City" project in 2006, including a $100 million ATMP facility. The project is located at Thukkuguda near New Hyderabad Airport, and SemIndia is looking at closing the financial package. SemIndia has the added advantage of land allocation. It has also progressed on SEZ clearance. Currently, it is setting up the first phase of its ATMP plant in Hyderabad.
- Infineon Technologies is the technology partner in the Indian semiconductor manufacturing plant planned by Hindustan Semiconductor Manufacturing Company (HSMC), a company floated by Devendra Verma, Managing Partner of the California-based investment company, Edgewood.
  The fab is to focus on four products — chipsets for mobile phones, direct to home TV set top boxes, automotive and smart cards. The first line, which would represent an investment of $1 billion, is scheduled to use 90-nm and 130-nm processes and 200-mm wafers.
- Consumer electronics maker Videocon Ltd. intends to spend $250 million to build a semiconductor facility in eastern or southern India. The company said it has found a technology partner and is scouting sites in West Bengal and Andhra Pradesh.
- Moser Baer has just announced a solar fab in collaboration with Applied Materials at a cost of USD 250 million at Greater Noida.
- US-based Solar Signet has just announced a solar fab to be set up.

II. Japanese semiconductor industry and market: An overview

The semiconductor industry in Japan, which proved to be a leader in the 80's, has seen a decline since the mid 90's. In 1990, Japan accounted for nearly 50% of the world's semiconductor shipments. This figure continued to decline and since 2000 it has fallen below 30%. Japan has been a leader in the semiconductor space with companies such as Toshiba, Renesas Technology, Sony, Sharp Electronics and Elpida Memory.

The Japanese chip makers started investing heavily into the semiconductor industry again from 2004 onwards, with a special focus on building and expanding facilities dealing with 300-millimeter wafers. They have started looking at the Indian semiconductor industry more seriously to expand their operations.

Initially, Japanese semiconductor manufacturers did not join their US and European counterparts in their entry into India, thus adopting the more cautious approach of 'wait and see'. The scenario appears to be changing, given India's strong design capabilities, and it has become attractive for Japan to look towards this sector.

Japanese semiconductor manufacturers are utilising the Indian design capabilities in two ways, viz, establishing their own design centres in India and/or tying up with Indian design services. In the Indian design centers, engineers from India may work at Japanese semiconductor manufacturing firms for a specific client, referred to as an Offshore Development Centre (ODC). For e.g. Toshiba Corp. of Japan has its ODC in Bangalore. It primarily handles development of firmware for Toshiba system-on-chip product. Kawasaki Microelectronics Inc. of Japan was the first to directly enter India, with its branch established in Bangalore in March 2006. Sony and Hitachi have also India design operations.

Other major Japanese chipmakers like Renesas Technology Corp have started using the Indian design services. In late October 2006, the company entered into a tie-up with KPIT Cummins Infosystems Ltd of India, which is a design firm. Under this tie-up, KPIT Cummins Infosystems established an in-house ODC specifically for Renesas Technology. The company expects about 500 KPIT engineers to be working for Renesas in the next three years.

Elpida Memory set up an ODC in Bangalore in April 2006 in partnership with FTD Technology. The ODC handles dynamic random access memory design for Elpida Memory. Its employee strength is expected to go up to 170 by 2009 from the present 10. NEC too has started contracting with Wipro Ltd. and Tata Consultancy Services for structured ASIC design services.

The number of Japanese companies in India has grown by 50% in the last three years. This lays down a strong foundation for Intellectual Property work in the semiconductor domain. Scope of collaboration and development of business interests in this sector exist.

Though the Japanese firms have reaped significant gains in the areas of Flash Memory and Charge Coupled Devices (CCDs), they are yet to take a lead in high value-added products such as CPUs and Field Programmable Gate Arrays (FPGAs).

III. Areas for collaboration:

Traditionally, Japan has been strong on system design. This has been the case over the last three decades and continues to be its core strength even now. In the semiconductor industry, Japan's manufacturing strength got eroded because of cost over riding factors. This is where countries like Taiwan came in to wrest the market with their lower cost delivered at high quality. This has led Japanese industries to shift their manufacturing to countries like Taiwan and China, which offered a cost advantage.

The Indian market leans more towards design services than manufacturing. Given India's technically skilled manpower and design strength and Japan's immense technological strength and innovation, there are a number of potential areas that can be explored where the two countries can work together to their mutual benefit. Some of the areas worthy of exploring are listed below.

- Nanotechnology: This is an area where Japan has taken major initiatives and collaboration in this field can have strategic implications for the Indian market. Some of the areas where nanotechnology can be applied include, advanced sensor networks for smart irrigation, water conservation, rural appliances based on solar power, consumer electronics, defense etc.

- Communication: Their technological advancement in the field of communication would go a long way in meeting the requirements of India and fulfilling aspects such as last mile connectivity, ubiquitous network connection, etc.

- Electronics and System Design: Given India's rising consumerism, this is an area that could have large implications from the Indian context. Currently, many of the products on offer are not tailor made to suit Indian needs and Indian market conditions. Japan continues to lead in producing advanced consumer electronics. There is thus immense scope here to explore this segment and develop products that are structured to meet Indian needs, requirements and conditions. System design is another area where India could benefit through collaboration. This being the core strength of Japan, India can identify areas where their expertise can be used and implement accordingly.

- Design Services: Currently Indian professionals are hired largely to provide design services for products produced elsewhere. The domestic market harbours immense potential to hire their services for products specifically meant for the home market. These services could be further extended to cater to products sold specifically in the Japanese market and to products specifically developed with Japanese technology to suit the Indian market

- Joint Research: Given India's pool of technically qualified professionals and the vast inroads that Japanese have made into technology, research is an area where the two countries can actively look at working together to explore future options in technology.

- Disaster Management: Japan has an excellent system in place to handle natural disasters. Given our vast country and the extent of natural disasters happening, we could do very well with a sophisticated technology for early warning systems. This could be tuned to meet the Indian scenario and would go a long way in handling such natural disasters.

- Standard Bodies: It would be a good idea to be part of their early discussions on their future commitments, plans concerning standards that are likely to operate five years down the line. Developing new standards would go a long way in pitching India on a higher plane in the field of technological availability.

- High end associated technologies: While memory design was also one of the areas of traditional strength for the Japanese semiconductor industry, this has now been somewhat commoditized. Currently the Japanese focus on high end associated technologies dealing with advanced processes such as manufacturing larger chips simultaneously, something that is currently difficult to achieve. This is an area India could explore possibilities of collaboration.

- Package Design and Testing: India has already entered this field and could benefit further by working closely with Japanese firms in this segment.

- Managing Resources Efficiently: Unlike India, Japan is smaller in size with far limited resources. But the difference is these resources have been managed very efficiently to manage a smaller country with a

higher density of population. India has lessons to learn in this sphere and could explore how technology has been deployed to manage limited resources.

- Ageing Population: Japan is faced with a rapidly ageing population. Products catering to older people will soon be in great demand. India too will be faced with a large ageing population in the coming years. The two countries could work together to develop products specifically meeting this market's requirements.

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