

ISA - FROST & SULLIVAN 2010 - 12

India Semiconductor Market Update

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India Semiconductor Market Update

GROWTH, TRENDS AND FORECAST

Foreword

Foreword

Indian semiconductor market (2010-2012): Wired to growth!

The domestic market has witnessed continued growth of mobile devices, which is the highest in the world, exceptional march of telecom industry and resilient growth in the automotive and consumer segments. The rejuvenated growth of industrial segment and new found opportunity in the defense segment have ensured that India's electronics industry has just entered its golden decade. As different segments of the electronics industry chart the northward movement, the Indian semiconductor industry is on the anvil of scaling new peaks.

This elaborate report mapping the opportunities for the Indian semiconductor market across a plethora of end user applications is the fifth publication since the knowledge partnership between ISA and Frost & Sullivan in 2005. The first report published in 2005 was a comprehensive analysis of the Indian semiconductor market covering product markets to design services. Subsequently updates published in 2007, 2008 and 2010 captured the underlying opportunities succinctly. This 2011 report provides market estimation as well as forecasts for the different semiconductor product markets till 2012 while highlighting the key growth areas during this time period. This report assumes significance as the 2011 update is the first after the Indian economy regained its acceleration of economic growth after the hiatus of slowdown.

This report provides an elaborate demand side mapping of the semiconductor market in India. The application segments covered in this report includes:

- Mobile devices
- Communications
- IT and OA
- Consumer electronics
- Industrial electronics
- Automotive electronics
- Others includes aerospace, defense, medical electronics, and smart cards

Continuing dominance of the Indian economy has attracted attention for its ability to remain fairly insulated from global economic turbulence and exhibit resilient growth. A handful of sectors have contributed to this unabated rise of the Indian economy. Directly and indirectly electronics and semiconductors have been the backbone for the crucial sectors in India's economic ascent. This report equipped with insightful and forward looking information on one of the significant and emerging markets in the country gets published at a crucial juncture. It is uniquely positioned to be the perfect guide for making informed business decisions in the semiconductor and its allied markets in India.

Preface

Preface

The India Semiconductor Association ISA has played a catalyst's role in the growth of the semiconductor industry in India which is at the heart of the ESDM industry of the nation. Since its inception in November 2004, ISA has worked towards establishing a vibrant semiconductor ecosystem in the country. ISA has over 150 members from the semiconductor and electronics industry across India, with representation from every facet of the semiconductor driven ecosystem. ISA stands testimony to the manner in which the industry and the organization nourish and complement each other. Whether it is building a talent pool with up-to-date skills that the industry seeks or helping the industry gain global exposure, ISA has been at the forefront of creating visibility and awareness for Indian ESDM industry.

Research has been an important feature of ISA activities. Our reports have established the size and nature of the semiconductor market in India and its criticality in the global context. As with the previous ISA-Frost & Sullivan updates, the 2011 report contains validated data on market trends and statistics of the Indian semiconductor market. The ISA-Frost & Sullivan reports are regarded as a credible source of data and are a guide for manufacturers, analysts and investors of the industry.

The concerted efforts of the ISA subcommittee on Industry Research and the Frost & Sullivan teams are greatly appreciated. We would also like to acknowledge the support of several individuals and organizations from within and outside this industry for the study. We take this opportunity to thank each one of them for sharing their valuable insights.

We would especially like to acknowledge the Department of IT (DIT), Ministry of Communications and Information Technology (MCIT), Government of India for supporting ISA in research initiatives.

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Frost & Sullivan would wish to thank them wholeheartedly for their valuable time and guidance whenever we needed them.

Table of Contents

Research Objectives, Scope of the Study and Definitions	11
Executive Summary	13
Chapter 1: Total Indian Semiconductors Market	17
Revenue Forecasts (Total Market and Total Available Market)	17
Revenue Forecasts by Individual Semiconductor Products	18
Share of Individual Semiconductor Products in the Market Revenues (2010)	19
Application Segments in the Semiconductor Market	20
Share of Individual Application Segments in the Market Revenues (2010)	21
Chapter 2: Semiconductor Product Market	23
Revenue Forecasts	23
Discrete Semiconductor Market	23
Sensors Market	24
Analog Power Market	24
Analog Mixed Signal Market	25
Microprocessor Market	26
Microcontroller Market	26
DSP Market	27
Memory IC Market	27
Logic IC / FPGA Market	28
ASIC Market	29
ASSP Market	29
Chapter 3: Application Segments Market	31
TM and TAM Revenue Forecasts	31
Product-wise Share in the Market Revenue Forecasts	32
Mobile Devices Market	32
Telecommunication Electronics Market	36
Consumer Electronics Market	40
Automotive Electronics Market	44
IT and OA Electronics Market	48
Industrial Electronics Market	52
Other Electronics Market	57
Chapter 4: Total Indian Electronics Market	61
Chapter 5: Research Methodology and Appendix	65

Research Objectives, Scope of the Study and Definitions

This segment outlines the objectives, methodology, scope, and approach of the research adopted for this study. The objectives of the study for this research service are as follows:

- Assess the total semiconductor market (TM) and the total available market (TAM) in India
- Forecast the TM and the TAM for the period from 2010 to 2012:
 - By application segment product category
 - By semiconductor product category
- Map technology trends and market trends in the application-segment product category

The scope of the study encompasses the following product categories and application segments:

Semiconductor Product Categories

Semiconductor Categories	Semiconductor Components	Sub Categories
Discrete	Power Transistors	
	RF Discrete (Transistors)	
	Other Discrete (Diode, Small Signal and Switching transistors, Thyristors/ SCR, MOSFET)	
Sensors	Sensors (Includes pressure, temperature, current, and hall effect)	
Logic/ FPGA	Standard Logic ICs	
	Programmable Logic Devices (PLDs) including Field Programmable Gate Array (FPGA)	
Power Supplies	Amplifiers	
	Power Circuits	
Mixed Analog	Interface Circuits	
	Data Converters	
Memory	DRAM	
	SRAM	
	Flash	
	NVRAM	
	Other Memory IC (MRAM)	
Microcomponent	Microprocessors	
	Microcontrollers	4 Bit
		8 Bit
		16 Bit
		32 Bit
	Digital Signal Processors (Programmable)	8 Bit
16 Bit		
32 Bit		
ASIC	All custom and application specific IC's to be recorded	
ASSP	All application specific but standard products available off the shelf	

Definitions

Total Market (TM) for semiconductors: The total consumption of semiconductors in India, in any form (can be purchased locally, imported as part of CKD or SKD, or imported as a complete product), by any source (sources are directly from semiconductor company offices in India, distributor sales, or direct imports) in any currency (US\$ or Indian rupee).

Total Available Market (TAM) for semiconductors: Consumption of semiconductors in India by virtue of manufacturing of end user products in India + consumption through a local purchase order in India.

Total Market (TM) for end user industries: Total unit production (excluding assembly) + imported units (all forms – SKD, CKD or complete product)

Total Available Market (TAM) for end user industries: Total unit production (excluding assembly) + CKD imported units (to represent assembly activity in India).

Manufacturing: Includes manufacturing only from the printed circuit board level and does not include assembly activity through import of kits in the form of SKD or CKD. The semiconductors, in this case, are purchased through a local purchase order.

Assembly activity: Assembling of modules in Completely Knocked down Kits (CKD) form to form a product.

Local purchase: Local purchase signifies purchase of any component in India by raising an invoice in India.

Important Note:

1. **Total electronic industry sales (that is TM)** = {Total Manufacturing (products manufactured from board level) + Assembly activity (both for CKD's and SKD's) – Exports } + Imports (as complete product).
2. Any purchase of semiconductors that is made in India and is a part of an imported kit is considered as a local purchase.

Executive Summary

India continues to sustain its impressive GDP growth ably supported by the concurrent progress of multiple sectors. This tenacious rise, even as developed economies scrambled to get back to normalcy, has reinforced the robust foundation on which the economy is built. A GDP that is expected to triple in about 8-10 years has placed India in a vantage position and as the key business destination for local and foreign organizations. Even as all sectors have been steadily increasing their contribution to the economic growth, the stimulus provided by certain stalwart segments has been noteworthy. The segments of telecommunication, IT & OA, defense, and automotive hold the key to India's economic ascent in this decade. Electronics as the critical enabler for sustained and higher economic growth is appreciated by the stakeholders.

Indian electronics market estimated at \$65 billion in 2010 has a comparatively smaller size against the global electronics market of \$1.8 trillion. Despite its current minnow status, the Indian electronics market has gained global attention for the immense opportunities that remain uncorked. A burgeoning domestic market as well as the increasing export opportunities places the Indian electronics industry in an enviable position on the global map. Local manufacturing has thus been the focal point attracting the attention of all stakeholders. The government has realized the potential and is working on a policy framework that shall create the most favorable environment for manufacturing. The 2020 guidance is expected to catapult India's contribution to the global electronics industry to 15 percent from the current low contribution of around 2.5 percent.

Rising localization of electronics manufacturing is a bellwether for the propitious future of the local semiconductor industry. Increasing assembling and manufacturing activities bode well for the semiconductor market as it awaits the dormant opportunity to turn active.

Key Findings

The TM revenues for semiconductors in India during 2010 stood at \$6.55 billion. End user segments of wireless handsets, communications, and IT segments have played a key role in the expansion of the overall semiconductor revenues in 2010. The phenomenal penetration rate of mobile handsets, massive expansion of communication infrastructure, and drive to extend IT to the grassroots of Indian society are expected to be the growth drivers till 2012. Registering a CAGR of 22.7 percent, TM revenues are expected to touch \$9.86 billion during this forecast period.

The heightened assembly activities in the wireless handsets and IT/OA segment supported the growth of semiconductor TAM revenues to \$3.14 billion in 2010. TAM revenues are expected to witness a robust growth reaching revenues of \$4.71 billion by 2012 growing at a CAGR of 22.3 percent. The entry of numerous indigenous manufacturers has changed the character of the mobile devices market. Most of these suppliers are expected to commence an indigenous assembly of their handsets thereby providing a boost to the TAM in the ensuing years. Desktops, though under intense pressure from Notebooks and Tablets, are expected to contribute towards semiconductor TAM revenues, riding on an expansion of IT network in the rural parts of the country. Yet another significant trend influencing the expansion of TAM revenues is the contribution made by equipment manufacturers and EMS companies in the telecom infrastructure equipment.

Key Vertical Market Trends

Mobile devices segment remains the largest contributor to both the TM and TAM revenues for semiconductors. Shortening replacement cycles and spiraling rural demand have ensured that the mobile devices segment retains its numero uno position in the TM and TAM revenue contribution. The entry of more than 50+ suppliers in handset market has widened the choices for consumers and enabled its much faster proliferation into the rural markets than anticipated. The introduction of a variety of multi-SIM feature rich handsets in the sub \$75 category has severely restricted the market for leading brands and intensified the price competitiveness. Supplementing the growth in volumes of the low price category handsets is the onset of 3G services that has ushered in the growth of 3G-enabled handsets market. In 2010, around 12-13 percent of handsets that were sold were 3G enabled and this proportion is expected to climb to 25 percent by 2012.

Augmenting the TAM, the three major brands are joined by few local suppliers that have forayed into indigenous assembly of their handsets. Though their production volumes are currently minuscule, the volumes are expected to amplify with their growing sales and export aspirations. In addition, more than a handful of other local suppliers are also exploring investments in local manufacturing that are expected to fructify in the current or next fiscal year. Propelled by these new plans, the indigenous production of wireless handsets is expected to touch new heights and ensure the continuance of wireless handsets as the leading contributor to TAM even in 2012.

Driven by government initiatives such as e-Governance and taking computing to the grassroots of Indian society, the IT/OA segment emerged as a close second contributor to semiconductor TM revenues in 2010. With the accelerated growth anticipated in Tablets, Notebooks, monitors, and flash memories over the next couple of years, IT/OA would be a significant contributor to TM revenues till 2012.

The communications segment, a key semiconductor revenue generator, is expected to witness an explosive growth in its manufacturing index that is reaching 77 percent by 2012, a quadruple leap from its 2009 levels. This tremendous growth in TAM is complemented by the EMS industry, primarily in the telecom infrastructure equipment manufacturing space. Expanding mobile network in remote and rural regions combined with the proliferation of 3G and WiMAX services is driving the demand for telecom infrastructure equipment. EMS companies, addressing the mobile infrastructure equipment manufacturers, have significantly expanded their capacities and are expected to continue further in the next two years. Such expansion in production is likely to result in the EMS

contribution to the communication TAM revenues to surge over 80 percent by 2012. From a semiconductor standpoint, EMS contribution in communication segment is expected to usher in the necessary traction for local semiconductor sales. TRAI's recommendation to the government to increase the domestic manufacturing level of telecom equipment and semiconductors is laudable. This move is seen as an acknowledgment of the immense potential for TAM revenues from the telecom segment, currently a cause for significant foreign exchange outflow.

The industrial segment has historically enjoyed a high manufacturing index but from a revenue standpoint, its contribution to TAM has been moderate. Increasing penetration of Notebooks have impacted the off line UPS market, an upsurge of poly phase energy meters over a single phase, and an impressive growth in AC drives market are having a destabilizing effect on the TM-TAM equilibrium in the industrial segment. At the same time, growth in high volume product segments such as CFL lamps and the emerging LED lamps are witnessing a heightened indigenous manufacturing. This development is expected to counter the negative effect of declining product markets and maintain the healthy state of manufacturing index. Since the per product semiconductor content across industrial products averages at about \$5, the opportunities it unfurls for semiconductor vendors is quite limited.

The automotive segment being a regulation driven industry, the rapid penetration of electronics based control systems into automobiles has been influenced largely by regulations governing safety and emissions. Despite the increasing indigenous character of automobile manufacturing, be it 2 or 4-wheelers, most of these safety systems and control units continue to be imported. This has hampered the manufacturing index from reaching unity. However, with most of the sophistication and safety systems being incorporated even in entry level vehicles, the volumes are expected to encourage local manufacturing. The Government of India has also launched a mission for electric vehicles and provided stimulus in the form of duty reductions. This stimulus is expected to

strengthen the case for investments of local manufacturing of electric vehicles. The higher electronic content in the electric vehicles ensures that as manufacturing takes off, contribution to TAM grows manifold.

Health care programs by the government aimed at taking the sophisticated health care facilities to the rural areas are influencing companies to design and develop India centric products. The underlying features are portability, lower prices, and user friendliness. This localization trend is expected to drive the increased demand for semiconductors by the medical segment in the coming years. The defense segment has also increased the extent of localized products in its procurement helped by the mandate of the offset policy. The ongoing modernization of defense equipment coupled with the offset policy is expected to benefit the local semiconductor market. The National ID program and the transition to smart cards based identification for driving license, e-passports, Kisan cards, and other welfare programs will serve to enhance the prospects of smart cards in the country.

Mixed Trend in Average Selling Prices

Trend of declining end product prices has a cascading effect on the prices of semiconductor components. The decline in ASP for various semiconductor components ranged from 5 to 10 percent and in cases of some components like discretely, the decline has been larger than 10 percent. In contrast, ASSP is expected to witness a growth in prices, helped by the ever increasing trend of transition towards standardized products and SoC. The recent natural calamity in Japan is expected to result in hardening of memory prices as 40 percent NAND and 15 percent of DRAM chips' capacities are centered in Japan. This impact is expected to be felt in Q2 and Q3 of 2011 in the form of marginally higher prices for memory chips.

Performance of Semiconductor Products

With the rapid proliferation of smart phones and 3G enabled phones with a high inbuilt memory and approximately 70 percent of mobile handsets adopting flash memory cards, memory chip will continue to lead the semiconductor TM. Memory is an integral component of all the IT/OA products and the increasing integration in consumer appliances further supplements the revenue contribution. Despite its leading position in the TM contribution, memories are relegated to a second position in the total semiconductor TAM contribution because of the higher level of imports in products such as Notebooks, USB memories, and flash cards.

ASSP has emerged as the leading contributor to TAM and the second largest TM contributor. Trend towards single chip solutions or SoCs, and the preference for standard products over application specific solutions have favored the design and usage of ASSP across product segments. The need for smaller form factor encourages the use of ASSP in handsets, where high volumes assist ASSP to be a critical contributor to TM and TAM now and in the future. While the dwindling demand for products such as desktops and CRT TVs have a minimal impact on the ASSP market growth, this is amply offset by the rapidly growing markets of LCD TVs and LCD monitors that depend on high-value ASSPs.

Processor being the most important part of all IT/OA products, MPU holds the status of being the third largest contributor to TM and TAM. Driven by the consumer need for faster computing devices, the processing power of IT products is constantly upgraded. This upgrade results in effectively increasing the MPU BoM value per computing device. Telecom equipment such as routers that have high growth prospects are expected to accelerate the market for MPU over the forecast period, on TM perspective though.

Global Tidings Drive Market Revival

2010 was a year of revival for the global semiconductor industry. Driven primarily by the memory market segments of DRAM and NAND flash that grew by over 80 and 40 percent respectively, the global semiconductor industry propelled itself to revenues of \$304.8 billion. This revenue represents a growth of 35.2 percent from its 2009 levels, which is a stupendous leap to say the least. However, the cyclical journey of the global semiconductor industry is expected to continue as the market is likely to register a single digit growth (of around 5-6%) in 2011. In contrast, the Indian semiconductor market that weathered the slowdown period bravely continued its growth-journey-clocking growth of 27.9 and 30.4 percent in TM and TAM revenues over 2009. This consistency in growth is expected to be carried forward in 2011 and 2012. Irrespective of such appreciable growth trends, the Indian semiconductor industry is expected to contribute less than 3 percent to the global semiconductor industry by 2012, which is indeed a cause for serious concern.

TAM and Actual Demand

Semiconductor TAM is a not an accurate representation of the actual demand serviced by local semiconductor vendors. It is a notional estimate as much of the activity in the country is in SKD format, where boards mounted with the semiconductors are imported. The need for local sourcing is further deprived by MNCs and EMS companies that follow a global sourcing model. In effect, there is very minimal actual demand from CKD assemblers and design houses that is addressed by the local semiconductor vendors. These factors validate the minuscule 1 or 2 percent contribution to their global revenues by the Indian counterparts of all the major semiconductor companies.

Monumental Opportunity in Electronics is Hidden Behind the Cloak of Manufacturing Deficit

The electronics industry in India has grown by leaps and bounds in the last eight to 10 years. Yet, the extent of value creation within the country is extremely limited. The growth of electronics manufacturing has lagged behind consumption. There is ample indication that high volume manufacturing opportunities are yet to be tapped in certain product segments. Despite efforts facilitated through policy changes and incentives, there has been a failure to create an ecosystem for nurturing electronics manufacturing within the country. The strengths in the form of a healthy electronic components industry and strong design expertise are yet to be utilized to realize manufacturing investments of high magnitude.

Highway to Successful Manufacturing

The government has to play the role of an enabler to encourage the local electronics industry in scaling new horizons. Creating the right ambience for growth is the prerogative and duty of the government as an empowered electronics industry will act as the game changer for the GDP growth. Apart from facilitating infrastructural developments that are required for the electronics industry, some of the following imperatives are needed for bolstering growth in electronics manufacturing in the country:

- Change in strategy from “Design led Manufacturing” to “Demand led Manufacturing”
- Promotion of export subsidies to create an environment for electronics exports
- PPP initiatives to develop “integrated electronics parks and clusters”
- Promotion of tax holidays and incentives for EMS companies investing in the country
- Policy to attract investment in setting up of ecosystem companies
- Identification and promotion of “killer application or product” segments for indigenous manufacturing – telecom equipment, mobile handsets, STB, LCD TV, LED lighting, medical devices, and auto-identification products, to name a few

Capitalizing on existing strengths to attract investments is a short-term strategy. However, the long-term vision of developing and sustaining a world-class electronics industry needs more concerted efforts and a planned strategy at the national level. As observed in most of the developed and aspiring countries, identifying and focusing on electronics as a priority sector and coming up with policies and initiatives focused on the industry has been a critical tool for success. Similarly, for the electronics industry to grow in India there is an immediate and pertinent need for the government to introduce a **National Electronics Development Plan (NEDP)**. This national strategy has to be formulated through discussions with key industry stakeholders including existing manufacturers and members of the SME sector, industry associations, respective government departments, and regulatory bodies. It must encompass strategies covering all the aforementioned factors and much more for encouraging the holistic development of the electronics ecosystem in the country.

Total Indian Semiconductor Market

In 2010, the Total Market (TM) revenues generated in the Indian semiconductor market were \$6.55 billion. TM revenues are expected to reach \$9.86 billion in 2012, thus growing at a Compound Annual Growth Rate (CAGR) of 22.7 percent.

The corresponding Total Available Market (TAM) revenues for 2010 were \$3.14 billion. TAM is estimated to reach \$4.71 billion in 2012. The CAGR for the TAM revenues forecast is estimated to be 22.3 percent.

Chart 1.1 illustrates the TM and TAM for the total Indian semiconductor market from 2009 to 2012.

Growth Unplugged

2010 was a landmark year for the global semiconductor industry that rebound from one of its worst downturns. Growing at an impressive 35.2 percent over 2009, the industry crossed the \$300 billion mark bolstered by unplugged growth in the memories market. In comparison, the Indian semiconductor industry continued with its consistent growth performance registering a 28.3 percent growth in 2010 over 2009. Demand from all sectors contributed to this growth. Primary among them was the continuing proliferation of mobile handsets and increasing penetration of IT/OA products. A rejuvenated automotive industry that witnessed a record month on month sales in both the two and four-wheeler segments added the icing on the cake. The demand for semiconductors was thus sustained by this consistent growth in product segments through the year. Emerging product categories such as Tablets, 3G handsets, and LED lighting are expected to be the catalysts of the semiconductor TM growth in the next couple of years.

India is evolving as the center of activity for many vertical segments such as mobile devices, telecommunication, automotive and medical, among others. The evolution of India from a design to an R&D and manufacturing hub is a significant trend unraveling the potential in all these product markets. The overall economy at large and the semiconductor TAM within

Chart 1.1 : Total Indian semiconductor market : TM, TAM revenue forecasts, 2009-2012



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

that are beneficiaries of this welcome trend. The growing trend of indigenous manufacturing of products ranging from mobile handsets, telecom equipment, and medical devices to defense equipment are pointers towards a strengthening local semiconductor industry. Irrespective of the cyclical growth pattern that the global semiconductor industry shall witness, the Indian semiconductor market shall ride the consistent growth wave in the next two years and beyond.

Chart 1.2 compares the Indian semiconductor market revenues with that of the global market during the forecast period.

Chart 1.2 : Indian and global semiconductor market : Revenue forecasts comparison, 2009-2012



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Semiconductor Product Market

The aggregation of revenues of the different semiconductor products has been used to arrive at the market revenues.

Chart 1.3 and Chart 1.4 illustrate the TM and TAM revenue forecasts for the Indian semiconductor market respectively.

Chart 1.5 and 1.6 depict the share of different semiconductor products in the market revenues for 2010.

In 2010, the memories segment emerged as the largest semiconductor category in the Indian market, with a share of 23.4 percent of the TM. The dominance of memories is expected to continue throughout the forecast period. Growth of the IT/ OA and mobile handset segments are estimated to play a key role in ensuring that memory remains as the top contributor to the Indian semiconductor market TM. Despite being the largest TM contributor, the impact of the memories market growth minimally impacts local semiconductor vendors as the memory TAM accounts for just 41 percent of the TM. This ratio is expected to attenuate to 39 percent by 2012, indicating a huge opportunity loss due the low level of indigenous manufacturing of products that consume memory chips.

Chart 1.3 : Indian semiconductor market :
TM revenue forecasts, 2009-2012

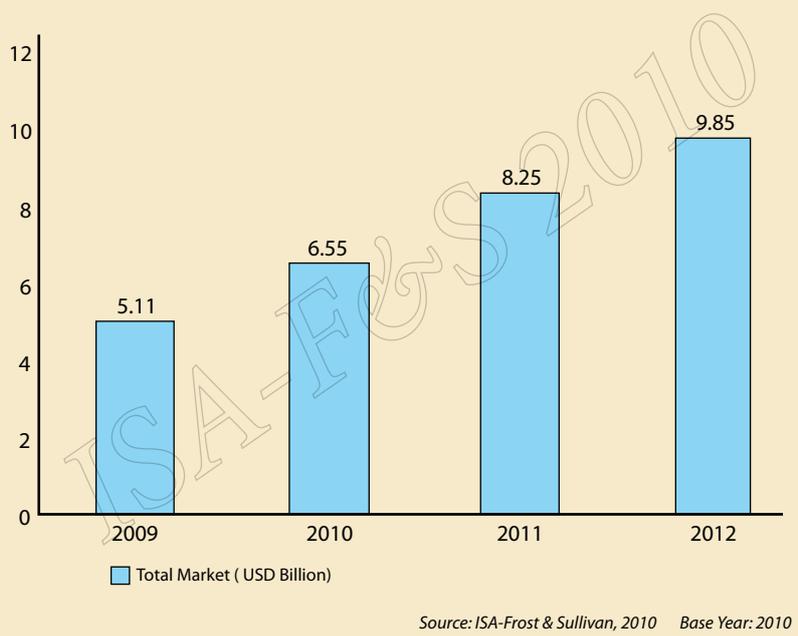


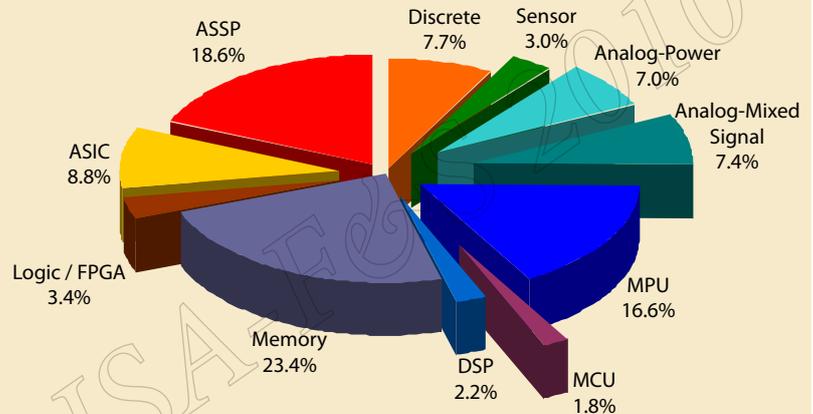
Chart 1.4 : Indian semiconductor market :
TAM revenue forecasts, 2009-2012



The trend towards inclusion of integrated ASSPs and preference for single chip solution in applications within IT/OA, wireless handsets, and consumer electronics has boosted the TM for ASSP. ASSPs are becoming more common even in low-end handsets and are the high-value components in fast growing products such as STB, LCD TV, and monitors, thus creating a huge market in the country. ASSP TAM is expected to ride on the adoption rate for smart cards, especially from the government sector as well as the growth in local wireless handsets, LCD TV, and STB manufacturing. The growing usage of ASSPs that replace the processor or controller, and analog chips by integrating the complete functionality has resulted in placing the ASSP segment in the second position in the overall pecking order of semiconductor products.

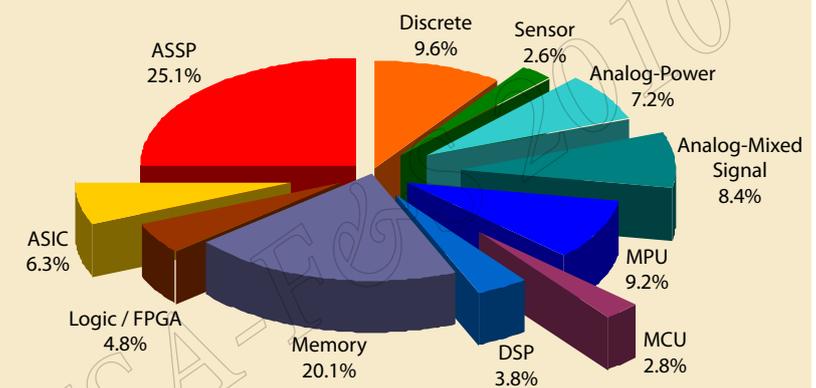
Processors being the heart of almost all IT/OA products continue to retain its position among the top three semiconductor product categories for 2010. Increasing complexity in usage of computing devices necessitate continuous improvement in processing power that results in an increase in the MPU dollar value per end product. The advent of high speed computing devices such as tablets furthers the cause of the MPU market. In addition, telecom infrastructure equipment requires high processing power for handling multiple signals and ensuring high quality of service to consumers. This requirement drives the dollar value of processors in the telecom infrastructure equipment and thereby aids growth in the processors TM and TAM market.

Chart 1.5 : Share of different semiconductor products in the TM revenues for 2010



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Chart 1.6 : Share of different semiconductor products in the TAM revenues for 2010



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Application Segments in the Semiconductor Market

Table 1.1 provides the application segments and their end-user products in the total Indian semiconductor market.

Table 1.1: Indian semiconductor market: Application segments and end users products.

Wireless Handsets	Communi-cations	IT / OA	Consumer Electronics	Industrial Electronics	Automotive Electronics	Others
GSM Mobile Handsets (< USD 30)	Modems	Printers	CRTV	Inverters	CDI	Smart Cards
GSM Mobile Handsets (USD 30 to USD 75)	STM 4,16	Multi function Devices	LCD TV	UPS – Online	Flashers	Medical Electronics
GSM Mobile Handsets (USD 75 to USD 170)	STM 64	Netbooks	LED TV	UPS – Offline	Regulators	Aerospace & Defence Electronics
GSM Mobile Handsets (> USD 175)	GSM – BTS	Notebooks (< USD 500)	Set Top Boxes	Energy Meter – I Phase	Instrument Clusters – 2 Wheelers	
CDMA Mobile Handsets (< USD 30)	CDMA – BTS	Notebooks (> USD 500)	Digital Camera	Energy Meter – III Phase	Instrument Clusters – 4 Wheelers	
CDMA Mobile Handsets (USD 30 to USD 75)	Routers - Data Storage, Carrier Ethernet	Desktops (< USD 400)	Camcorder	AC Drives	EMS	
CDMA Mobile Handsets (USD 75 to USD 170)	WiMax – BTS	Desktops (> USD 400)	Refrigerators	DC Drives	ECU	
CDMA Mobile Handsets (>USD 170)	WiMax – CPE	Servers – single processors	Washing Machines	Weighing Scale – Low End	Electric Vehicles	
3G Handsets	DSLAM	Servers – Multi processors	Air Conditioners	Weighing Scale – High End	Immobilizers	
Data Cards	IP PBX	CRT Monitor	DVD Players	CFL	Power Windows	
	Media Gateway	LCD Monitor	Water Purifiers	LED Lighting	ABS	
		Storage Flash Memories & Cards	Microwave Ovens	Power Supplies	Remote Keyless Entry	
		Thin Client			Body Electronics – 2 Wheelers	
		CCTV				
		Tablets				

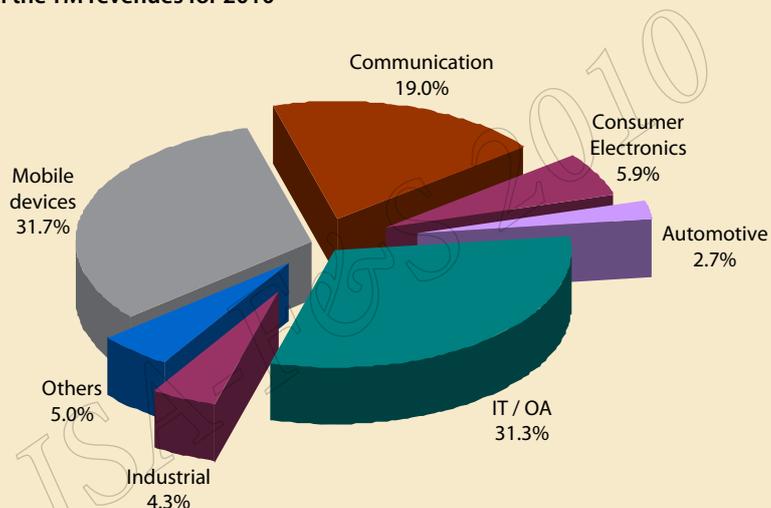
Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Chart 1.7 and Chart 1.8 depict the share of the different application segments in the TM and TAM revenues for 2010.

The mobile devices segment was the single largest contributor to both TM and TAM revenues in 2010. Massive rural uptake and shortening replacement cycles were the crucial drivers behind the augmenting mobile handset sales. The mobile devices segment accounted for 31.7 percent of TM and 39.8 percent of TAM in 2010. The entry of numerous of indigenous players in the mobile handsets market, many with committed investment plans for local manufacturing are expected to result in higher TAM revenues realization in the ensuing years. Only next to mobile devices, has been the IT revolution in the country marked by the government's initiative to take computing to the rural populace. Overwhelming growth in consumption of LCD monitors and storage flash memory, supported by the exuberant adoption of Tablets and increasing penetration of Notebooks have heralded the contribution of IT OA segment to the semiconductor TM revenues to reach 31.3 percent in 2010. Most of the high growth ITOA products being import reliant, the contribution of this sector to TAM stood at 18.9 percent in 2010, which does not commensurate with its gargantuan TM.

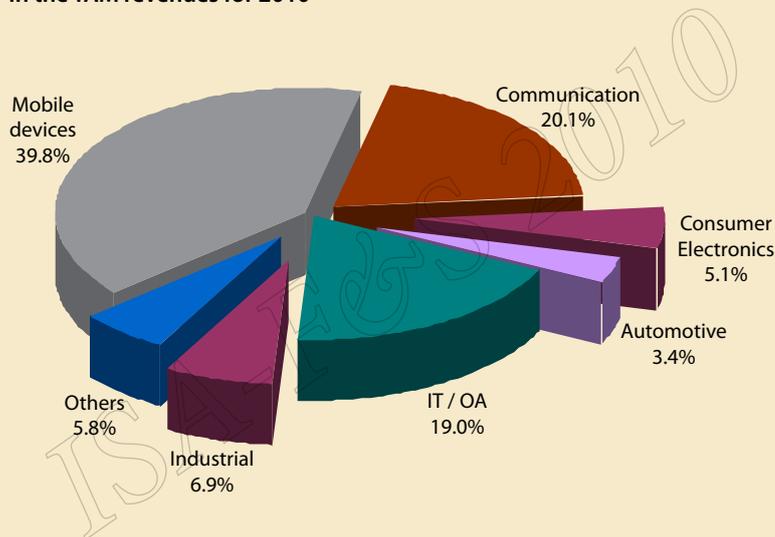
Industrial electronics has historically remained one of the key segments with high manufacturing index as most products are indigenously manufactured. The explosive growth in product segments such as CFL and LED lamps influenced by the demand for energy efficient lighting systems coupled with the robust growth in the power supplies market is expected to propel the TM growth during the forecast period. The increase in indigenous manufacturing of products such as CFL shall sustain the high momentum in manufacturing index. The deepening penetration of LCD TV and the emerging demand for LED TVs serve to strengthen the semiconductor TM from the consumer segment. Digital STB with their high semiconductor dollar value also aids in boosting the TM. However, the less local manufacturing activity in these products does not bode well for the TAM

Chart 1.7 : Share of different application segments in the TM revenues for 2010



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Chart 1.8 : Share of different application segments in the TAM revenues for 2010



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

though expectations are rife that these segments shall witness an uptake in local activity in the next few years.

Indian automotive industry has been on a growth tide with India gaining prominence as a manufacturing hub for both 2-wheelers and the small car segment. Increasing inclusion of electronics in the automobile industry warranted through the integration of safety and sophistication features propel the semiconductor TM revenues to newer heights. Growing indigenous manufacturing assists in heralding the manufacturing index to appreciable levels.

Semiconductor Products Market

Discretes Market

In 2010, the TM revenue for discrete semiconductors was estimated to be \$506.38 million. This revenue is expected to reach \$789.86 million in 2012. TAM revenues during the corresponding years are estimated to be \$301.64 million and \$448.40 million, respectively. With TM and TAM growing at CAGR of 24.9 percent and 21.9 percent respectively from 2010 to 2012, the discretes market is expected to account for 7.7 percent of the TM and 9.6 percent of the TAM revenues during 2010.

Chart 2.1 : Indian discrete semiconductor market : TM & TAM revenue forecasts, 2009-2012



Chart 2.1 displays the TM and TAM revenues forecast for discrete semiconductors from different application segments.

Mobile devices, industrial, IT/OA, and automotive are the key segments augmenting demand for discretes. Power transistors are crucial to the functioning of most industrial products as well as mobile devices and IT/OA products. MOSFETs and IGBTs are the high-power transistors used in most automotive control units and industrial systems. These transistors act as drivers for the discrete TM. The increase in indigenous manufacturing of handsets by MNCs as well as the proposed local manufacturing by many new handset vendors is expected to have a positive impact on the discretes TAM in the following years. BTS (GSM, CDMA, and WiMAX) are heavy consumers of discrete semiconductors. This consumption favors the discrete market TM and TAM as all these products are expected to witness explosive growth by 2012. Growth in TM and TAM for CFL and power supplies has a positive impact on the discretes TM and TAM. However, the need for reduced form factor in all devices has warranted the transition to system-on-chip designs and more integrated ICs. This trend is seen as challenging the market for discretes as they get integrated with other components on to a single chip.

Sensors Market

In 2010, the TM revenue for sensors was estimated to be \$196.57 million. This revenue is expected to reach \$343.49 million in 2012, growing at a CAGR of 32.2 percent. TAM revenues during 2010 and 2012 were estimated to be \$80.55 million and \$101.61 million, respectively, growing at a CAGR of 12.3 percent from 2010 to 2012. The sensors market accounted for 3.0 percent of the TM and 2.6 percent of the TAM revenues during 2010.

Chart 2.2 displays the TM and TAM revenues forecast for sensors from different application segments.

Mobile devices are the single largest segment contributing to the demand for sensors. For 2010, wireless handsets segment accounted for 73 percent of the total sensors TM highlighting the importance of this segment to the growth of the sensors market. The mobile devices segment TM and TAM are expected to grow at a CAGR of 25.6 and 11.8 percent respectively, and the sensors market TM and TAM is expected to mirror this growth. Apart from wireless handsets, the other major products driving the demand for sensors are digital cameras and camcorders. Both these product markets are poised for strong growth driven by their increasing affordability as well as the

**Chart 2.2 : Indian sensors market :
TM & TAM revenue forecasts, 2009-2012**



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

expanding disposable incomes in Indian households. While digital cameras and camcorder market growth has a positive impact on the sensors TM, the lack of local manufacturing of these products has an impeding effect on the sensors TAM. Desktops are another product segment that contributes minimally to the sensors TM and TAM. However, as the desktops market growth is expected to remain flat till 2012, and its contribution to the sensors TM and TAM is likely to be insignificant.

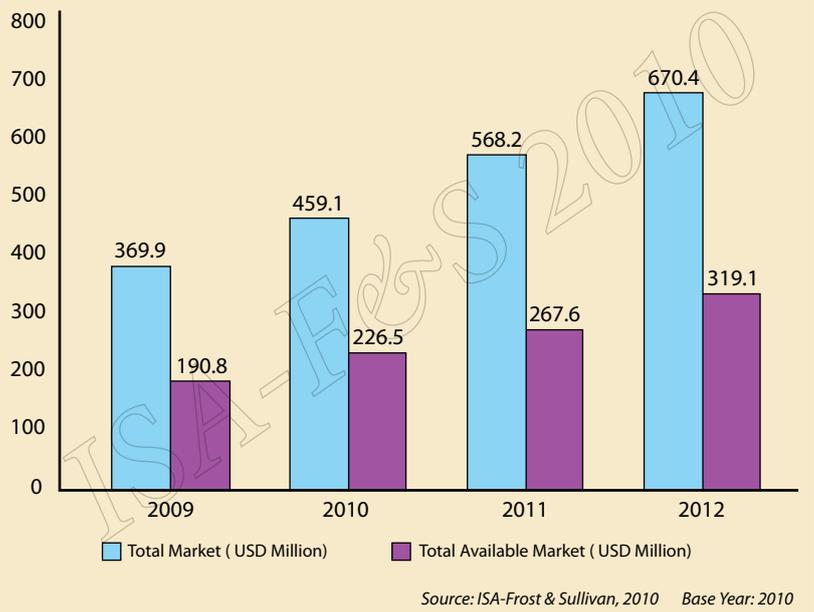
Analog – Power Market

In 2010, the TM revenue for analog power was estimated to be \$459.07 million. This revenue is expected to reach \$670.43 million in 2012, growing at a CAGR of 20.9 percent. TAM revenues during 2010 and 2012 were estimated to be \$226.52 million and \$319.08 million, respectively, growing at a CAGR of 18.7 percent from 2010 to 2012. The analog power market accounted for 7.0 percent of the TM and 7.2 percent of the TAM revenues during 2010.

Chart 2.3 displays the TM and TAM revenues forecast for analog power from different application segments.

Mobile devices are the biggest contributor to analog power TM and TAM. Power amplifiers remain the key component in the RF front end of wireless handsets, thus making handsets a major revenue contributing end user segment. Communication, IT/OA, and industrial are the other key contributors to the analog power market. The negligible volumes of local manufacturing of high growth IT/OA products results in the paltry contribution to analog power TAM. This contribution is evident from the analog power TAM being about 47.0 percent of TM from 2010 to 2012.

**Chart 2.3 : Indian analog power market :
TM & TAM revenue forecasts, 2009-2012**



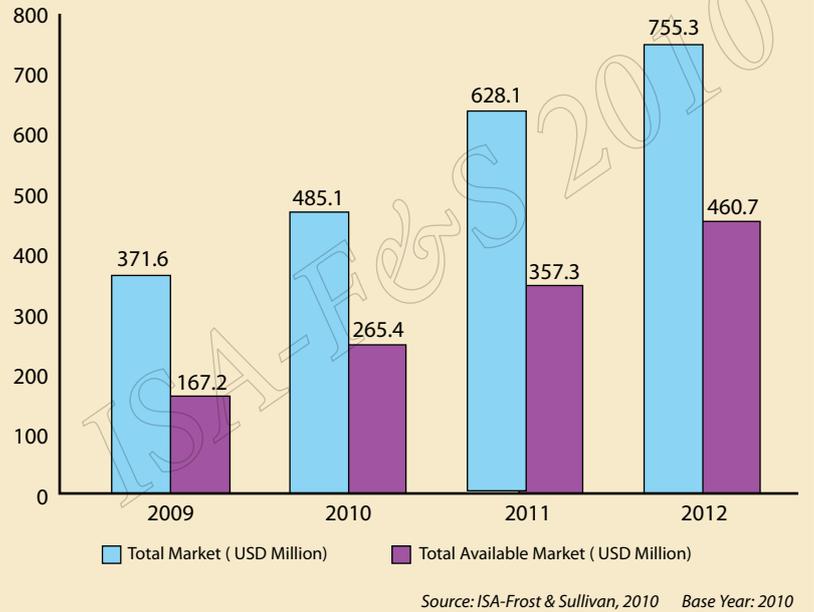
Analog Mixed Signal Market

In 2010, the TM revenue for analog mixed signal was estimated to be \$485.11 million. This revenue is expected to reach \$755.27 million in 2012, growing at a CAGR of 24.8 percent. TAM revenues during 2010 and 2012 were estimated to be \$265.44 million and \$460.67 million, respectively, growing at a CAGR of 31.7 percent from 2010 to 2012. The analog mixed signal market accounted for 7.4 percent of the TM and 8.4 percent of the TAM revenues during 2010.

Chart 2.4 displays the TM and TAM revenues forecast for analog mixed signal from different application segments.

Extensive digitization has led to complexities in IC design related to mixed signal interfaces for connectivity between the real world analog signals and the digital signals. Communication devices, specifically the base stations for mobile transmission work with both analog and digital signals, are thus becoming prime drivers for the mixed signal interfaces. The promising surge expected in BTS influenced by the continuous augmentation of mobile subscribers and the proliferation of 3G services provide a

**Chart 2.4 : Indian analog mixed signal market :
TM & TAM revenue forecasts, 2009-2012**



boost to the analog mixed signal TM. Medical devices and A and D segment are the two other significant contributors for AMS TM and TAM as these products extensively deal with processing of analog and digital signals in real time. The exuberant growth in analog TAM over the forecast period is attributed to anticipated spike in EMS manufacturing of telecommunication infrastructure, such as BTS. This boost in TAM is reflective of a significant upswing in the manufacturing index.

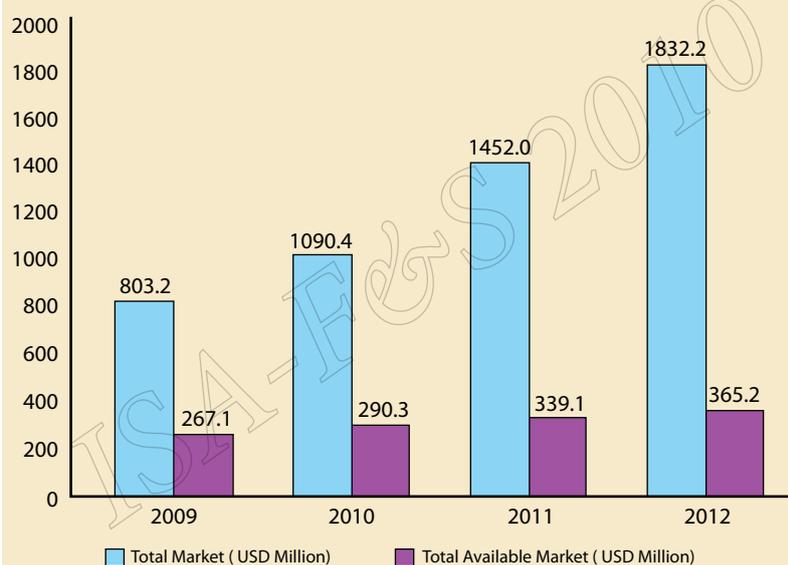
Microprocessor Market

In 2010, the TM revenue for MPU was estimated to be \$1,090.43 million. This revenue is expected to reach \$1,832.15 million in 2012, growing at a CAGR of 29.6 percent. TAM revenues during 2010 and 2012 were estimated to be \$290.26 million and \$365.24 million, respectively, growing at a CAGR of 12.17 percent from 2010 to 2012. The MPU market accounted for 16.7 percent of the TM and 9.2 percent of the TAM revenues during 2010.

Chart 2.5 displays the TM and TAM revenues forecast for microprocessor from different application segments.

Being omnipresent in all the IT/OA products has ensured MPU TM to witness consistent growth and the IT/OA segment to be its single largest contributor. Enhancing the processing capabilities of electronic products is driving the TM for MPU in a northerly direction. While the increasing penetration of notebooks over desktops aid in driving the TM for MPU, the absence of indigenous manufacturing of this high growth product has an obliterating impact on the MPU TAM

**Chart 2.5 : Indian microprocessor market :
TM & TAM revenue forecasts, 2009-2012**



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

growth. On the positive side, the migration to dual and multicore processors results in higher e-BoM for the MPU within the end product, thus adding to the TM and TAM revenues. The fact that even in plants assembling desktops, where the boards have been imported with all the other components, the MPU is still sourced locally thereby keeping alive the TAM for MPU.

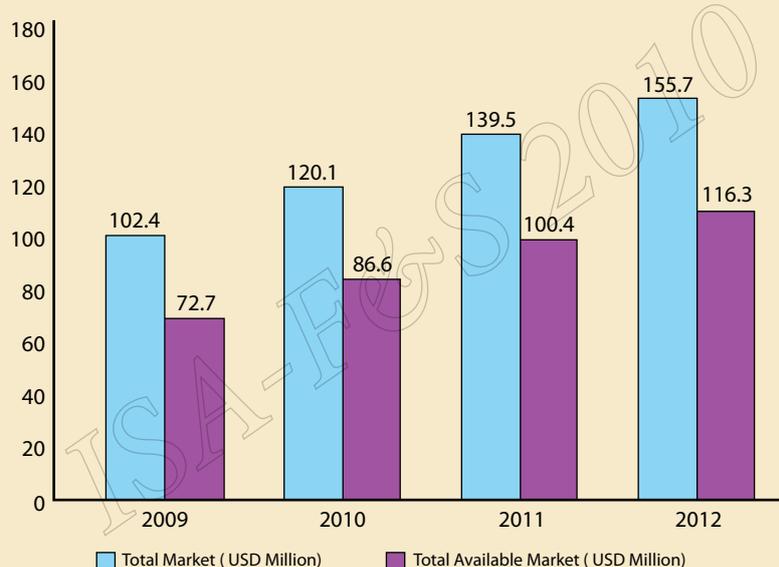
Microcontroller Market

In 2010, the TM revenue for MCU was estimated to be \$120.10 million. This revenue is expected to reach \$155.71 million in 2012, growing at a CAGR of 13.9 percent. TAM revenues during 2010 and 2012 were estimated to be \$86.58 million and \$116.27 million, respectively, growing at a CAGR of 15.9 percent from 2010 to 2012. The MCU market accounted for 1.8 percent of the TM and 2.8 percent of the TAM revenues during 2010.

Chart 2.6 displays the TM and TAM revenues forecast for microcontroller from different application segments.

Industrial and automotive are the two segments that predominantly create a demand for microcontrollers. The single phase energy meters by virtue of their sheer volumes are the single largest demand creators for microcontrollers. Almost all electronic control units in

**Chart 2.6 : Indian microcontroller market :
TM & TAM revenue forecasts, 2009-2012**



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

automobiles, be it body electronics, power train, chassis, or infotainment systems, employ microcontroller units for central processing and control. From a technology standpoint, it is the 16 and

32-bit microcontrollers that are predominantly employed in most applications. There is also a visible trend towards increased adoption of 64-bit microcontrollers. Industrial and automotive being the two segments that have relatively higher levels of local manufacturing, the MCU also has a better TM to TAM ratio.

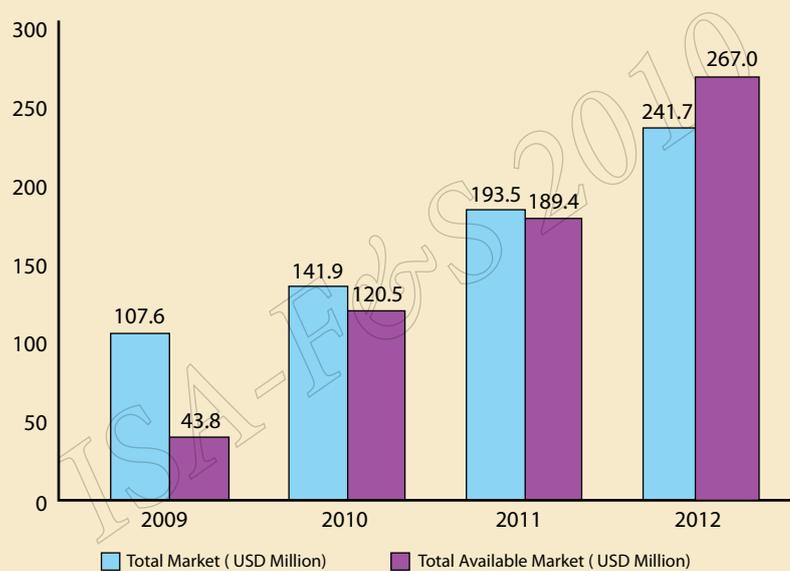
Digital Signal Processor (DSP) Market

In 2010, the TM revenue for DSP was estimated to be \$141.93 million. This revenue is expected to reach \$241.69 million in 2012, growing at a CAGR of 30.5 percent. TAM revenues during 2010 and 2012 were estimated to be \$120.51 million and \$267.00 million, respectively, growing at a CAGR of 48.9 percent from 2010 to 2012. The DSP market accounted for 2.2 percent of the TM and 3.8 percent of the TAM revenues during 2010.

Chart 2.7 displays the TM and TAM revenues forecast for DSP from different application segments.

BTS equipment (2G and 3G) is the single largest contributor to DSP TM and TAM accounting for over 90 percent of its TM and TAM revenues for 2010. The EMS sector contribution in the manufacturing of these BTS ensures that the DSP market enjoys a high TM to TAM ratio over the next two years. It is the only product segment that is expected to have a manufacturing index greater than unity

Chart 2.7 : Indian DSP market : TM & TAM revenue forecasts, 2009-2012



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

by 2012. This index is owing to the high volume manufacturing of BTS equipment by EMS companies targeted for exports. Industrial and medical are the other contributors to DSP.

Memory IC Market

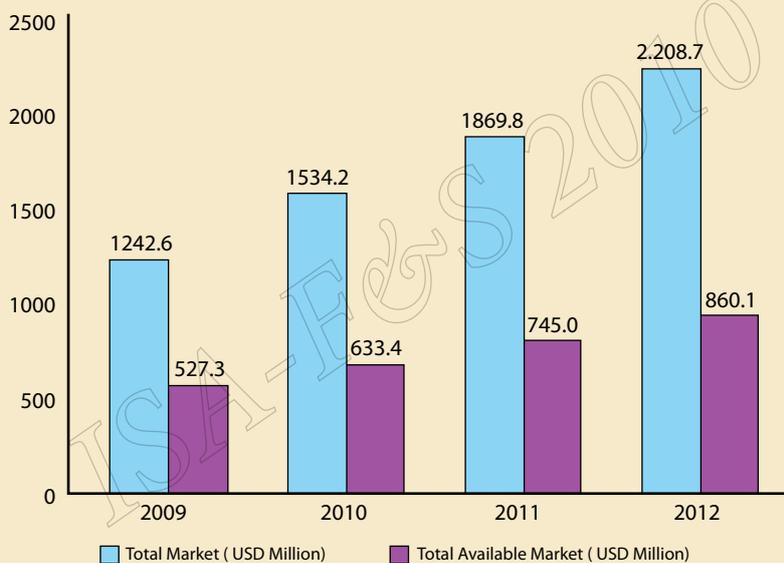
In 2010, the TM revenue for Memory was estimated to be \$1,534.24 million. This revenue is expected to reach \$2,208.66 million in 2012, growing at a CAGR of 20.0 percent. TAM revenues during 2010 and 2012 were estimated to be \$633.41 million and \$860.13 million, respectively, growing at a CAGR of 16.5 percent from 2010 to 2012. The memory market accounted for 23.4 percent of the TM and 20.1 percent of the TAM revenues during 2010.

Chart 2.8 displays the TM and TAM revenues forecast for memory ICs from different application segments.

Contributing to nearly one-fourth of the total semiconductor market TM, memory market is the unconquered leader of the semiconductor product markets for 2010. IT/OA segment accounts for nearly 60 percent of the memory market TM, with storage flash memory cards being the largest contributor. While the desktops market is influential in creating a sizable TAM for the memory market, the absence of local manufacturing of products, such as notebooks and flash memory cards take away this opportunity from memory TAM. The constantly increasing memory capacity in handsets, with even the low end handsets sporting significant on-chip memory, has positioned the wireless handsets segment to evolve as an important

contributor to memory TM and TAM. Increasing on-board and add-on memory for mobile handsets, digital imaging products, and computing devices are expected to boost the market for memory TM and TAM in the near future. In the short term, fab shutdowns and repairs following the earthquake in Japan (which supplies 40% of the global NAND flash demand and 15% of the global DRAM demand) is expected to impact supply and bring price fluctuations. While this impact is expected in Q2 and Q3 of 2011, the weight of the key contributing segments is enough to sustain memory's leadership position in the total semiconductor product market till 2012.

Chart 2.8 : Indian memory ICs market : TM & TAM revenue forecasts, 2009-2012



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

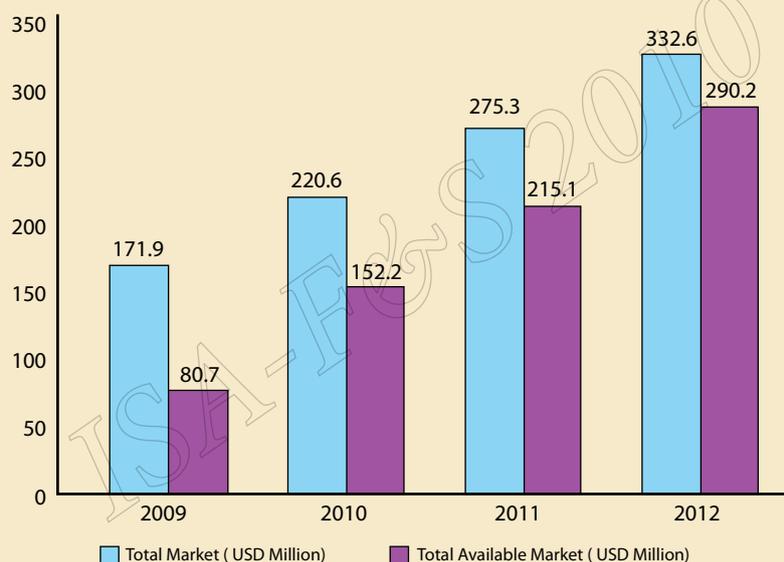
Logic IC / FPGA Market

In 2010, the TM revenue for logic and FPGA was estimated to be \$220.55 million. This revenue is expected to reach \$332.62 million in 2012, growing at a CAGR of 22.8 percent. TAM revenues during 2010 and 2012 were estimated to be \$152.15 million and \$290.24 million, respectively, growing at a CAGR of 38.1 percent from 2010 to 2012. The logic or FPGA market accounted for 3.4 percent of the TM and 4.8 percent of the TAM revenues during 2010.

Chart 2.9 displays the TM and TAM revenues forecast for logic ICs and FPGAs from different application segments.

BTS for GSM and CDMA is the single largest demand creator for logic ICs and FPGAs that have enabled the communications segment to account for over 67.2 percent of the logic and FPGA market TM for 2010. The increasing control features in certain home appliances such as refrigerators, washing machines, and air conditioners are seen a driving force for logic IC demand. FPGAs find application in sensitive defense applications, for example cryptography. FPGAs are also used as a replacement for microprocessors

Chart 2.9 : Indian logic ICs / FPGAs market : TM & TAM revenue forecasts, 2009-2012



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

in conventional high-performance computing applications in scientific research. The rapid growth in the communications segment TAM influenced through the EMS contribution growth is also a driver for the logic and FPGA TAM growth over the forecast period.

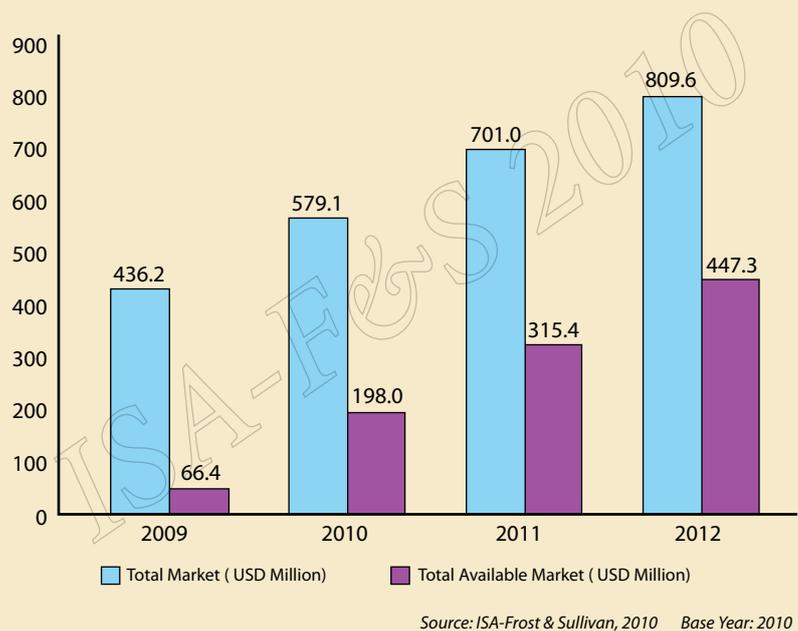
Application Specific Integrated Circuit (ASIC) Market

In 2010, the TM revenue for ASIC was estimated to be \$579.13 million. This revenue is expected to reach \$809.60 million in 2012, growing at a CAGR of 18.2 percent. TAM revenues during 2010 and 2012 were estimated to be \$198.00 million and \$447.27 million, respectively, growing at a CAGR of 50.3 percent from 2010 to 2012. The ASIC market accounted for 8.8 percent of the TM and 6.3 percent of the TAM revenues during 2010.

Chart 2.10 displays the TM and TAM revenues forecast for ASIC from different application segments.

Driven by the demand for proprietary chips that have high levels of integration resulting in reduced form factor, the ASIC market has been on the upswing. Clearly, end user products that demand ASIC are the ones that place paramount importance on unique chip designs. The select application segments that require ASIC products are routers, GSM and BTS, aerospace, defense applications, and

Chart 2.10 : Indian ASIC market :
TM & TAM revenue forecasts, 2009-2012



smart cards for government initiatives. The high value product markets such as routers that drive the demand for ASIC are characterized by negligible local manufacturing. However, the rapid growth in the communications segment TAM influenced by the growth in BTS manufacturing by EMS is also a driver for the explosive ASIC TAM growth over the forecast period.

Application Specific Standard Products (ASSP) Market

In 2010, the TM revenue for ASSP was estimated to be \$1,216.74 million. This revenue is expected to reach \$1,720.41 million in 2012, growing at a CAGR of 18.9 percent. TAM revenues during 2010 and 2012 were estimated to be \$789.57 million and \$1,030.01 million, respectively, growing at a CAGR of 14.2 percent from 2010 to 2012. The ASSP market accounted for 18.6 percent of the TM and 25.1 percent of the TAM revenues during 2010.

Chart 2.11 displays the TM and TAM revenues forecast for ASSP from different application segments.

The need for System-on-Chip (SoC) solutions that package all the relevant semiconductor components for a given application has made ASSP, a noteworthy market. Wireless handset is the dominant contributor to ASSP TM and TAM. The integration of multiple functionalities into SoC solutions for the handset, even for the low end types, makes the handset segment the high-volume demand creator for ASSPs. Other notable

Chart 2.11 : Indian ASSP market :
TM & TAM revenue forecasts, 2009-2012

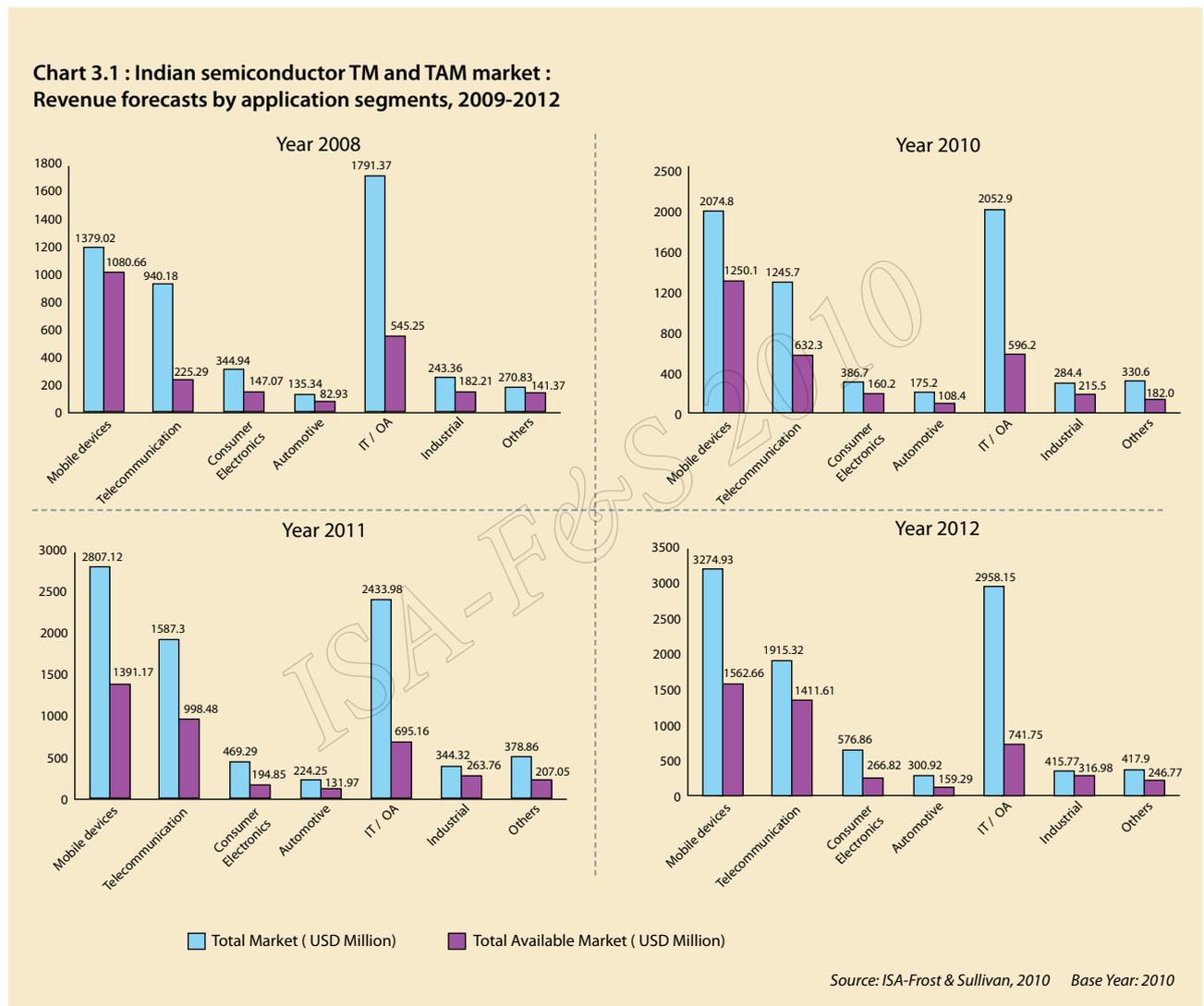


consumers, though at relatively lower volumes include the set-top boxes, LCD monitors, and notebooks. Considering that all these end user markets are high volume generators, the ASSP market is well positioned for significant gain during the forecast period.

Application Segments Market

Different application segments offer varied potential for semiconductors in the Indian market. The contribution of the different application segments to the overall TM and TAM revenues of the semiconductor market is discussed in the following sections.

Chart 3.1 illustrates the TM and TAM revenue forecasts for different application segments in the semiconductor market.



Mobile devices

India's mobile devices market has witnessed continuous move towards achieving maturity in the manufacturing ecosystem. This trend is fueled by the continuing market demand coupled with the entry of newer players into the manufacturing ecosystem. The prominence of mobile devices as a key contributor to the semiconductor market revenues gets reinforced with every passing year. The mobile revolution continues to generate interest globally, for its high growth rate and the transformation that it has been able to bring about. From an era of enabling mobile telephony for subscribers, this industry has grown to fulfill the users' needs through high-technology based handsets. The dynamism displayed through constant upgradation of devices has enhanced the expectation level of users. Decline in prices coupled with increasing disposable incomes have led to a new avenue for demand creation – replacement.

Though the low to medium priced handsets market is growing appreciably, smart phones have become the cynosure of all eyes. Introduction of 3G by many service providers offer subscribers few reasons to resist the migration to these services through enabling handsets.

The demand drivers of replacement of handsets are the enhanced features and affordable pricing across the different categories. As user sophistication increases, manufacturers vie with others to package the highest value with the natural collateral of price decline. While smart phones drive the urban markets, greater functionality in basic phones perk up demand from rural areas. Given the large installed base of mobile handsets and the propensity for frequent upgrades, the replacement demand from existing users presents a lucrative market for manufacturers. There is an ever increasing preference for high-end handsets and the younger generation's comfort and desire to exploit mobile Web 2.0 technologies.

3G Handsets

The much awaited 3G services finally became a reality towards the end of 2010 opening up vistas for a multitude of services for subscribers. Enabling the range of services on offer makes it imperative for the users to adopt handsets with commensurate features, thus driving the upgrade market.

In the past one year, approximately 17-18 percent of the total handsets sold were accounted for by 3G enabled. It is envisaged that 3G enabled handsets will achieve market penetration of 15 percent of the existing subscriber base by 2013, registering a growth estimated at higher than China.

The launch of 3G services is expected to lead to a natural demand creation for smart phones. The advent of high-speed data enabling services is expected to divert the focus onto operating software, multimedia infrastructure, security, and video streaming. It has also been observed that handsets in the price range of \$100 and above incorporate smart functionalities such as optimized web browsers, GPS, widgets, and Wi-Fi. The tilt in usage is expected to be 80:20 towards urban users. Key services such as video download, music downloads, Internet applications and search will find increasing favor among the users. The increase in smart features and other capabilities have favored a corresponding increase in the semiconductor content per handset even for the mid-priced handsets.

Demand for multiple radios and ASSP's for specific handset related applications is likely to pick pace during the second half of 2011 with LTE TDD (Long Term Evolution Time Division Duplex) acting as a primary driver for its adoption. LTE TDD technology along with WiMAX shall boost broadband access adoption for the Indian market.

Several operators with licenses to deploy LTE TDD technology are anticipated to roll out their services thus driving demand for smarter phones. Operators are likely to roll out WiMAX for rural areas to deliver low cost broadband, which implies a different set of demand arising for handsets addressing the rural market.

The total mobile handsets market for 2010 was estimated to be 180 million. Out of these, 125 million were GSM handsets, 32 million were CDMA, and 23 million were 3G enabled handsets. GSM continues to remain the dominant standard with mobile handsets. During 2010, the decline in the average selling price (ASP) of mobiles by 11.3 percent has opened up possibilities of manufacturing. Newer entrants are attempting to set up greenfield manufacturing facilities to address the burgeoning domestic demand. The intense competition is also compelling handset manufacturers to introduce newer models and invent newer products. While market entrants get attracted by the large market volumes and growth, their focus is expected to be on the abundant opportunities in the rural and semi-urban market.

GSM is growing faster than CDMA leading to lesser demand for CDMA handsets. Even in the multi-SIM handset category, which has gained enormous prominence in the past couple of years, dual SIM GSM phones are increasingly favored. This prominence implies that CDMA is losing out on market share. With the introduction of number portability, CDMA might further decline in market volumes.

The semiconductor TM revenue for the wireless segment was estimated to be worth \$2,074.78 million in 2010. TAM in 2010 was \$1250.06 million. The TM and TAM are expected to grow at CAGRs of 25.6 percent and 11.8 percent respectively from 2010 to 2012 to reach revenues of \$3,274.93 million and \$1,562.66 million respectively.

Chart 3.2 illustrates the semiconductor TM and TAM revenue forecasts in the mobile devices segment for the period from 2009 to 2012.

Chart 3.2: Indian mobile devices semiconductor market: TM and TAM revenue forecasts, 2009-2012



Chart 3.3 illustrates the key revenue generating application and semiconductor product segments within mobile devices for the period from 2010 to 2012.

Chart 3.3: Mobile devices: Key semiconductor and product segments, 2010-2012

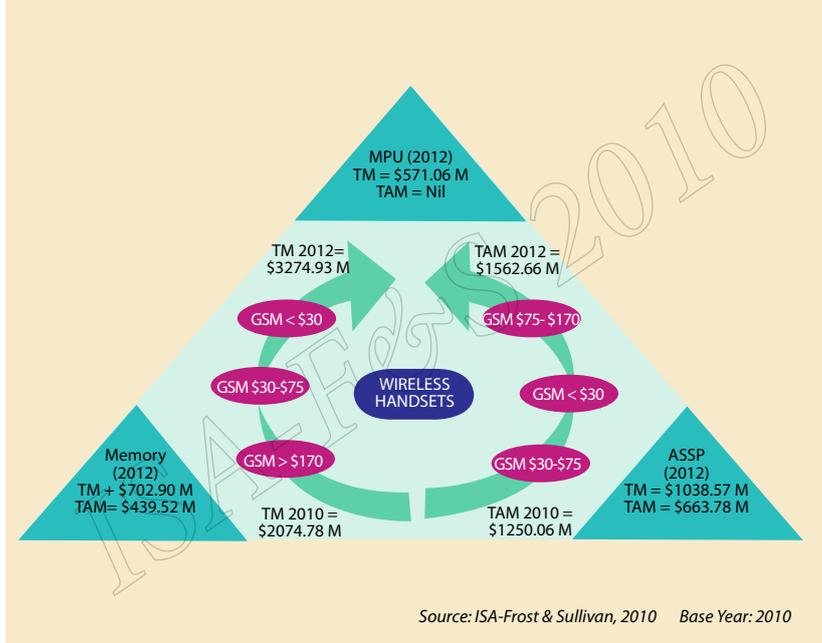


Table 3.1 provides the share of different end user products in the wireless handsets segment semiconductor market revenues (in \$ millions).

Product		2009		2010		2011		2012	
		TM	TAM	TM	TAM	TM	TAM	TM	TAM
GSM	<\$30	247.78	144.42	291.72	174.64	320.98	204.17	317.82	229.85
	\$30-\$75	192.27	539.53	218.04	610.05	226.28	667.47	226.18	744.10
	\$75-\$170	294.12	389.87	332.77	449.67	362.59	502.04	344.25	559.63
	>\$170	94.86	0.00	225.30	0.00	286.31	0.00	367.90	0.00
CDMA	<\$30	95.17	5.32	82.86	12.28	79.00	13.72	75.78	23.54
	\$30-\$75	80.70	0.94	70.80	3.00	65.82	3.36	55.75	5.15
	\$75-\$170	42.97	0.58	49.84	0.42	50.70	0.41	52.39	0.40
	>\$170	51.29	0.00	97.20	0.00	108.64	0.00	112.26	0.00
3G		266.98	0.00	675.00	0.00	1258.25	0.00	1661.33	0.00
Datacards		12.88	0.00	31.25	0.00	48.54	0.00	61.27	0.00

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Table 3.2 provides the different semiconductor products TM and TAM revenue forecasts (in \$ millions) in the wireless handsets segment.

Year	2009		2010		2011		2012	
	TM	TAM	TM	TAM	TM	TAM	TM	TAM
Discretes	85.53	60.21	122.27	70.23	160.47	78.58	183.82	88.60
Sensors	80.30	58.98	142.85	67.37	210.73	74.40	257.87	83.01
Analog Power	120.39	97.79	170.51	113.48	222.22	126.59	253.16	142.38
Analog Mixed Signal	130.96	98.71	182.80	115.15	235.97	128.87	267.53	145.37
MPU	110.17	0.00	266.00	0.00	440.85	0.00	571.06	0.00
MCU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memory	321.46	307.31	464.85	353.63	612.63	392.37	702.90	439.52
Logic / FPGA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ASIC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ASSP	530.20	457.67	725.50	530.19	924.25	590.35	1038.57	663.78

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

The Indian mobile devices industry is exhibiting strong signs of scaling the growth curve by attracting increasing number of players. The industry traditionally dominated by heavyweights like Nokia, Samsung, and LG, now hosts a number of domestic players with formidable strategy for the Indian market. Key companies are Micromax, Spice Mobiles, MVL, Maxx Mobile, Wynn Telecom, and Lemon Mobiles. This development is leading to a repositioning of companies dependent on the local-market-based products and manufacturing.

Select domestic mobile handset companies have graduated from trading to become indigenous handset manufacturers. Increasing confidence in the market growth and its sustainability has led private equity (PE) firms to fund many emerging manufacturers to the tune of \$1 billion. Notable among these are Gee Pee Infotech, Karbonn Mobile, Lava Mobile, Olive Telecom, and Spice Telecom. Micromax, which has grown to become a premier mobile handset manufacturer, is taking the IPO route to finance its growth plans. It is anticipated that a major part of the funding will be channelized to establish manufacturing infrastructure for these aspirants. Table A - 1 in the Appendix gives some of the proposed manufacturing plans of various handsets companies.

The growing clamor to establish manufacturing units in India offer interesting insights over a period of time. Economies of scale will be detrimental in the fructification of these manufacturing plans as emulation of the Chinese model of manufacturing remains uncertain. Nokia, with the largest manufacturing unit at Sriperumbudur, accounts for over 80 percent of the TAM in the mobile devices category.

Increasing influx of indigenous suppliers has highlighted the prominence of chip designers and IP vendors in the value chain. Many vendors are opting for the services of indigenous chipset design and IP vendors to offer products tailored for local requirements. Surge in local design services is expected to have a positive impact, though minimal, on the local semiconductor demand for mobile devices.

Few semiconductor components, such as memory, continue to witness price fluctuations in the range of 25-30 percent. Also, power IC is now integrated into the main chip with no change being reflected in the ASP. While sensors' unit cost is on the rise, this is the resultant of integration of two or more sensors for handsets in the \$170 price band. The transition towards a single-chip solution for most of the handsets results in the overall reduction in components. However, additional features in low to medium priced handsets and growth of smart phones will more than negate any decline in eBoM because of integration.

Data Cards

Mobility requirement is the key to the growth of data cards market in India. This factor has been amply complemented by the number of notebook users who are the primary users of data cards. High speed connectivity, earlier considered a prerogative of fixed broadband service, has been breached by the introduction of data cards with speed in excess of 7 Mbps. The ease of installation and use have led to an increasing number of users to embrace data cards thus sending price downwards, stimulating further demand

The data card market in India is witnessing a 100 percent Y-o-Y growth rate and is expected to gain further traction on account of introduction of 3G services. Market estimates suggest that about 1.5-2.5 lakh data cards are sold every month

Earlier, lower speed of access coupled with higher prices acted as a major impediment in the adoption of data cards in India. However, with the launch of EVDO data card services, penetration is expected to increase. Considering the growth in volumes and positive guidance, Alcatel and Epi Valley are contemplating entry into manufacturing. ZTE, which currently imports all the components, has plans to convert its testing centre at Manesar into a manufacturing plant during the second half of 2011.

Telecommunications

India's mobile telephony revolution has metamorphosed the telecom industry, which has leapfrogged to become one of the fastest growing markets in the world today. 2010 was yet another prosperous year for the Indian telecom sector that witnessed the roll out of 3G services, the surge in tele-density to over 120 percent (national average) even in many Class C telecom circles and government stimulus for indigenous manufacturing of telecom gear. While growth in the mobile devices segment continued robustly, broadband penetration did not have much to cheer. The industry also witnessed intense competition in tariffs leading to operators offering rates as low as 1 paisa. Private operators made significant inroads into the rural markets, a trend that is expected to gather further steam in the next two years. As per statistics from Telecom Regulatory Authority of India (TRAI), the total telecom subscriber base at the end of 2010 was 787.28 million, growing from 562.21 million in 2009. Mobile phone connections totaled 752.15 million while the land line connections constituted to 35.09 million. The number of broadband subscribers jumped to 10.92 million as compared to 7.83 million in 2009.

Some of the following major trends were seen in 2010:

- Entry of new operators in the mobile space
- Proliferation of smart phones and increased appreciation for applications like those offered on the i-store and Android platforms
- Auction and allocation of 3G and broadband spectrum, which relieved the fiscal deficit a lot of strain
- Launch of 3G services
- Government's tightening of norms on usage of imported Chinese telecom equipment

The new telecom policy, anticipated to be unveiled by the end of 2011, is proposing a preferential treatment to indigenous manufacturers of telecom equipment. This move has been prompted by the soaring import bill of telecom equipment riding on the telecom sector's growth in recent years. The industry imported telecom equipment worth \$8,070 million in 2007-08, \$10,400 million in 2008-09, and \$9,400 million in 2009-10, while the indigenous production of telecom equipment stood at \$11,300 million in 2009-10.

The Telecom Regulatory Authority of India, TRAI, in its most recent recommendations for the new telecom policy has proposed investments to the tune of \$22 billion encompassing investments for setting up of a telecom R&D park, a telecom R&D corporation, and fund for telecom equipment manufacturing. TRAI's recommendations are expected to be included in the telecom policy call for a \$660 million manufacturing fund to be used as seed money for encouraging Indian product manufacturers. These recommendations shall provide the much needed impetus for local manufacturing. The highlight of the recommendations is reiteration for setting up of semiconductor fabs in the country. TRAI points out that the growth in telecom sector and specifically indigenous manufacturing shall necessitate the need for local fabs and encourages the government to provide assistance for setting up of at least two semiconductor fabs in the country. These recent developments help in keeping alive the expectations from the telecom policy and the much awaited thrust it shall provide to the TAM revenues from the telecom sector.

For the purpose of this study, the following product segments are considered for estimating semiconductor usage in the telecom industry:

- Modems
- Routers
- BTS (GSM and CDMA)
- DSLAM
- Carrier Ethernet
- IP PBX
- Media Gateway
- DWDM
- GPON

This research has estimated the TM for the communication segment for 2010 to be \$1,245.67 million with TAM to be \$632.26 million. The forecast for 2012 TM is expected to have CAGR of 24.0 percent growth and is projected to be \$1,915.32 million and TAM to be \$1,411.61 million with a CAGR of 49.4 percent growth.

The semiconductor TM and TAM revenue forecasts in the communication segment for the period from 2009 to 2012 is as shown below in Chart 3.4.

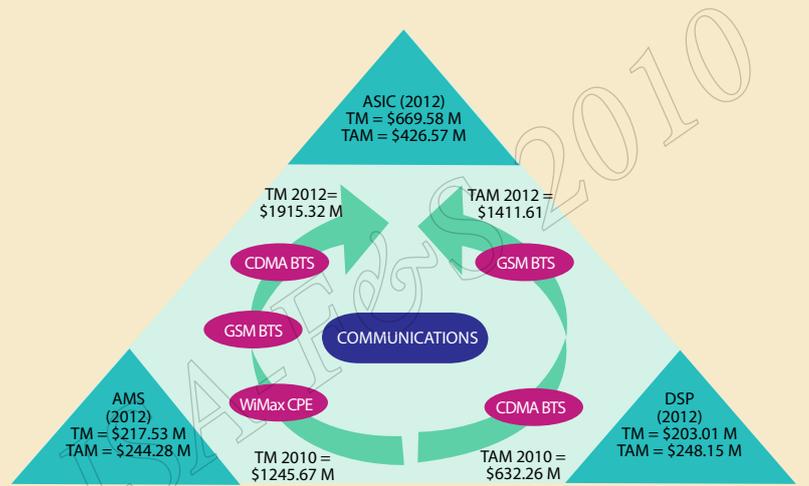
Chart 3.4: Indian communication semiconductor market: TM and TAM revenue forecasts, 2009-2012



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Chart 3.5 illustrates the key revenue generating application and semiconductor product segments within communications for the period from 2010 to 2012.

Chart 3.5: Communications: Key semiconductor and product segments, 2010-2012



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Table 3.3 provides the share of different end user products in the communication segment semiconductor market revenues (in \$ millions).

Product	2009		2010		2011		2012	
	TM	TAM	TM	TAM	TM	TAM	TM	TAM
Modems	2.85	1.76	6.18	4.01	12.58	7.26	20.93	13.08
STM 4 and 16	63.93	36.50	75.21	41.54	77.73	44.42	79.95	49.97
STM 64	5.33	1.07	8.12	3.05	8.14	4.58	8.12	7.73
BTS GSM	308.57	154.29	432.00	540.00	635.58	866.70	834.63	1236.49
BTS CDMA	139.31	27.86	173.40	21.68	211.90	42.38	227.88	62.15
WiMax BTS	1.04	0.00	4.96	0.99	9.42	1.88	8.95	1.79
WiMax CPE	3.93	0.00	11.24	3.75	14.99	7.49	14.24	7.12
DSLAM	4.67	0.33	7.00	0.64	15.90	1.59	22.26	3.18
IP-PBX	26.63	0.00	31.70	0.00	37.64	0.00	46.49	0.00
Media Gateway	0.067	0.000	0.109	0.011	0.414	0.104	0.531	0.138
Routers	356.46	0.00	475.00	0.00	532.20	0.00	583.45	0.00
PON and GPON ONT	18.428	0.000	0.000	0.000	2.565	0.000	24.368	0.000
PON and GPON OLT	4.586	0.000	0.000	0.000	0.638	0.000	6.064	0.000
DWDM	4.358	3.486	20.750	16.600	27.598	22.078	37.454	29.963

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Table 3.4 provides the different semiconductor products TM and TAM revenue forecasts (in \$ millions) in the communications segment for the period from 2009 to 2012.

Year	2009		2010		2011		2012	
	TM	TAM	TM	TAM	TM	TAM	TM	TAM
Discrete	45.42	9.65	57.33	19.74	71.44	32.67	80.80	46.59
Sensor	9.37	0.00	1.20	0.40	2.86	0.79	13.38	0.75
Analog-Power	52.85	9.24	62.16	15.64	75.13	24.73	87.16	34.23
Analog-Mixed Signal	91.63	34.37	126.09	108.23	172.85	172.05	217.53	244.28
MPU	71.07	4.39	106.83	5.13	139.26	7.42	173.09	9.77
MCU	0.33	0.18	0.39	0.21	0.40	0.23	0.41	0.27
DSP	83.07	33.21	113.41	107.78	160.28	173.97	203.01	248.15
Memory	73.83	18.10	95.38	56.10	124.62	89.33	152.21	127.29
Logic / FPGA	111.06	53.90	148.18	119.17	187.32	174.40	223.09	239.28
ASIC	382.25	57.85	509.00	185.00	611.86	298.70	699.58	426.57
ASSP	19.29	4.41	25.69	14.87	41.27	24.21	65.06	34.43

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

After having conquered the urban markets, the mobile revolution has now undertaken its journey to the semi urban and rural markets. Rural markets will be driving the next growth wave as rural tele-density stands at 25 percent compared to the saturated urban market with a tele-density of nearly 120 percent. Service providers are expected to offer innovative and affordable tariff plans or schemes with a focus on adding rural consumers. This rural invasion and the expected mass proliferation of the 3G services are creating a huge demand for BTS. GSM and CDMA base station market TM are expected to grow by 40 percent and 25 percent respectively. Nokia Siemens Networks indigenous manufacturing of BTS in India gives the much desired impetus to the TAM revenues. The highlight of telecom TAM growth is the indigenous manufacturing of BTS by EMS companies whose production volumes have witnessed a 100 percent increase. This remarkable increase in local production is propelling telecom TAM CAGR in excess of 50 percent. ASIC being a critical component in base stations has its TAM fortunes closely tied to the growth in local manufacturing of BTS. Apart from ASICs, other semiconductor components benefiting from the rapid rise in local BTS manufacturing are analog mixed signal, memory, and logic and FPGA.

The 3G and BWA auctions that concluded in Q2 2010, have paved the way for the roll out of 3G services. India is witnessing the mass roll out of 3G, 10 years after its first global entry in Japan in 2001. However, it

is expected that India will rapidly traverse the path from 3G to 4G (LTE) sooner than expected. Equipment manufacturers are already working on the next generation equipment and there is a firm belief that by 2014, 4G will contribute immensely to telecom TM and TAM. The current roll out of 3G is expected to usher a whole new suite of VAS applications and new revenue streams covering m-education, m-governance, and telemedicine.

The National Broadband Plan envisages the enhancement of the broadband network in the country. The plan entails taking wireless broadband connectivity to over 30,000 village panchayats by 2014. WiMAX being the technology touted to take broadband wireless access (BWA) to the remotest of Indian villages, the National Broadband Plan is built on exploiting the mobile WiMAX. Thus, the forecast period is likely to witness a surge in demand for WiMAX BTS and CPE. Semiconductor TM is expected to benefit from this trend as the limited local manufacturing of these products renders a negligible impact on semiconductor TAM.

The enterprise network equipment market has also been demonstrating a strong growth fueled by the ever-increasing bandwidth needs of the enterprises. The market grew by around 30 percent in 2010 with switches, routers, WLAN, and network managed services witnessing the highest growth. The migration to low cost IP networks and introduction of BWA in enterprises is expected to keep the demand for network equipment buoyant during the forecast period. However, high-worth telecom products like routers that have an average semiconductor BoM of \$200 per product have no local manufacturing. This opportunity loss for TAM can accentuate in the ensuing years as the demand for these products continue to strengthen.

Overall, the telecom equipment market in India is likely to remain on a growth tide. Telecom equipment manufacturers are observed to be increasing their footprint in the country to address this evolving demand. The government's tightened security norms on import of telecom equipment are also instrumental in drawing manufacturing investments in the country. Major telecom vendors such as UTStarcom and Alvarion have initiated plans for local manufacturing. Another interesting trend observed is the proposition by Chinese telecom equipment vendors to set up manufacturing facilities in the country through partnerships with local firms. Though this is seen as an effort to alleviate the security concerns voiced by the government, it has a long term positive impact on the semiconductor TAM for the telecom segment and is hence a welcome move.

Consumer Electronics

Upgradation of CRT with FPD TVs, increasing penetration of Set Top Boxes (STB), and a tremendous consumption of whitegoods, are making their contribution to the semiconductor revenues. --This contribution accorded a growth of 12.09 percent in 2010. Key influences have been the increasing affordability of middle class families and the growing rural economy. Sporting events such as the Commonwealth games also served to boost select product market sales in 2010.

The Total Market (TM) and Total Available Market (TAM) for semiconductor products in the consumer electronics segment were estimated to be \$386.65 million and \$160.23 million in 2010. The TM and TAM are expected to grow at a CAGR of 22.1 and 29.0 percent respectively, thus amounting to revenues of \$576.86 million and \$266.82 million by 2012.

The following products were considered while estimating the semiconductor market in the consumer electronics application segment :

- Television – CRT, LCD, and LED
- Set Top boxes
- Digital cameras
- Camcorders
- Refrigerators
- Washing machines
- Air conditioners
- Portable media players
- Water purifiers
- Microwave ovens
- DVD and Blu ray disc players
- Induction cooktops

Chart 3.6 illustrates the semiconductor TM and TAM revenue forecasts in the consumer electronics segment for the period from 2009 to 2012.

Chart 3.6: Indian Consumer Electronics semiconductor market: TM and TAM revenue forecasts, 2009-2012



Chart 3.7 illustrates key revenue generating applications and semiconductor product segments within consumer electronics for the period from 2009 to 2012.

Chart 3.7: Consumer Electronics: Key semiconductor and product segments, 2010-2012

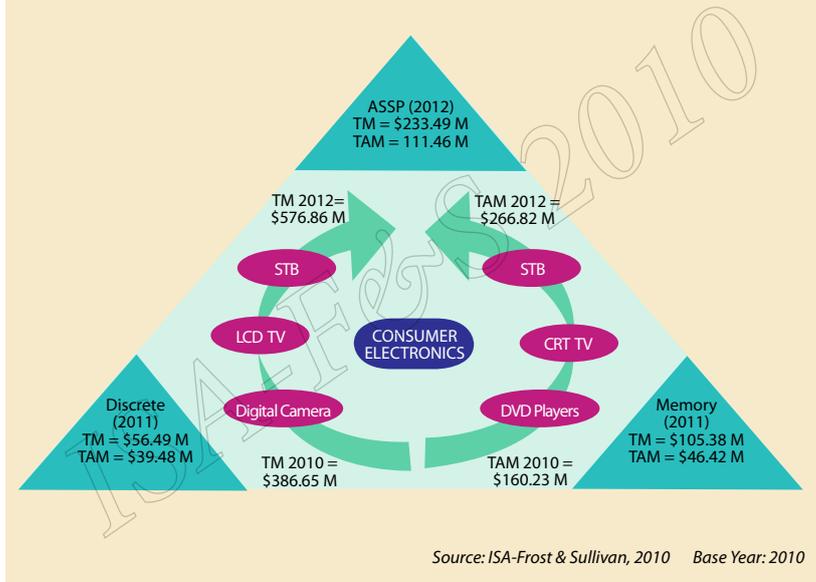


Table 3.5 provides the TM and TAM of semiconductor products (in \$ millions) by different end-user product segments within the Consumer Electronics segment for the period from 2009 to 2012.

Product	2009		2010		2011		2012	
	TM	TAM	TM	TAM	TM	TAM	TM	TAM
Color TV CRT	58.21	58.21	42.53	42.53	35.91	35.91	26.44	25.59
LCD TV	25.72	11.39	39.55	22.97	70.30	43.63	115.14	97.87
LED TV	2.65	0.00	4.73	1.58	7.48	2.54	13.50	4.26
Digital Camera	47.33	0.00	56.40	0.00	70.87	0.00	85.26	0.00
Camcorder	23.41	0.00	30.59	0.00	35.97	0.00	40.39	0.00
Refrigerators	4.51	4.08	5.59	5.24	6.93	6.77	9.00	8.72
Washing Machines	5.77	5.15	7.25	6.53	9.09	8.27	10.99	10.21
AC	4.99	3.77	6.08	4.75	7.04	5.78	8.57	6.86
PMP Player	4.50	0.00	5.39	0.00	6.72	0.00	8.00	0.00
Water Purifier	1.70	1.51	1.94	1.66	2.12	1.73	2.23	1.83
Microwave Ovens	1.83	1.16	1.91	1.19	2.07	1.51	2.26	1.79
STB - Cable	20.22	1.35	24.08	1.61	28.59	1.98	33.95	2.45
STB - Satellite	108.53	31.99	127.68	47.04	154.81	63.88	187.71	86.75
STB - IP	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.00
DVD Players	27.72	23.52	23.60	20.00	19.00	17.10	15.52	14.08
Blu ray Disc Players	0.80	0.00	1.98	0.00	4.70	0.00	9.83	0.00
Induction Cooktops	7.06	4.94	7.36	5.15	7.66	5.75	8.03	6.42

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Table 3.6 provides the TM and TAM of different semiconductor products (in \$ millions) in the Consumer Electronics segment for the period from 2009 to 2012.

Year	2009		2010		2011		2012	
	TM	TAM	TM	TAM	TM	TAM	TM	TAM
Discrete	45.82	34.53	44.08	31.30	49.37	33.60	56.49	39.48
Sensor	14.39	0.00	17.67	0.00	22.09	0.00	26.45	0.00
Analog-Power	25.68	12.90	29.04	14.24	37.03	18.07	48.12	27.20
Analog-Mixed Signal	27.47	4.78	33.70	7.18	43.07	10.43	54.47	16.97
MPU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MCU	9.42	7.75	11.32	9.53	13.44	11.80	16.28	14.41
DSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memory	62.39	22.07	71.29	26.90	85.90	33.74	105.38	46.42
Logic / FPGA	6.83	3.69	8.63	5.18	11.38	7.22	15.30	10.89
ASIC	12.11	0.00	15.82	0.00	18.60	0.00	20.89	0.00
ASSP	140.85	61.34	155.11	65.90	188.41	80.00	233.49	111.46

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Digital Set Top Boxes (STB), Digital Camera, and LCD TVs with respective Y-o-Y growth rates of 25, 30, and 70 percent respectively represented the top three contributors to the semiconductor TAM in 2010. Declining CRT TVs, which have a unity manufacturing index, digital STB, and the increasing indigenous manufacturing and assembly of LCD TVs, accord these products the status of leaders in semiconductor TAM. Continuing expansions and new investments for indigenous manufacturing of washing machines and refrigerators are also expected to bolster the semiconductor TAM.

The entire CE segment (except CRT TV) continued on the growth path throughout the year despite the price increases on account of a surge in input costs. Apart from the tremendous volume growth, other imperative trends in the market include the widening product portfolio and maturing technology denoting the shift to smarter appliances. Washing machines, digital cameras, high definition STB, refrigerators, and air conditioners witnessed significant technological developments spanning the areas of digital control, data capture and storage, and transfer technologies. This trend bodes well for the semiconductor market in 2011 and beyond as it deepens the electronics content in each product. For product categories such as portable media player (PMP), STB IP, DVD, and Blu-ray players, the semiconductor consumption is poised to increase with the introduction of Wi-Fi and 3G features in them.

Apart from technological advancements that are driving transition to newer products, sporting events such as Commonwealth Games, the ICC Cricket World cup, and the IPL tournament are influences for higher sales. CE companies are observed to offer price discounts to capitalize on the incremental demand that arise during such sporting events. TAM growth prospects for the CE segment remain robust riding on the proposed massive expansion plans of all major vendors. Even erstwhile vendors who had

long exited the market are contriving a rejuvenated relaunch for their products to capitalize on the humongous untapped markets in semi urban and rural India.

Some of the prominent expansion announcements in 2010 include:

- Over \$120 million worth of investments proposed collectively by the consumer electronics majors of Samsung, Panasonic, and Haier for their manufacturing facilities.
- Panasonic's entry into indigenous LCD TV manufacturing at Noida.
- Samsung's \$15 million investment in the LCD TV manufacturing plant
- Haier's proposed \$22 million investments on their manufacturing facility in Ranjangaon to manufacture televisions, washing machines, and refrigerators.
- LG proposes to double its production capacity in India by 2012. It has earmarked investment of \$175 million for plant expansions in 2011 alone.
- Godrej's proposed new manufacturing facilities for its AC, washing machine, and refrigerator product categories in Tamil Nadu or Karnataka.
- Panasonic's decision to advance manufacturing plans from the Jhajjar plant in Haryana to 2010 from the initial plan for 2012. The investment of \$300 million to set up R&D and manufacturing facility and marketing initiatives is directed to their home appliances sector.
- Videocon is setting up a TV manufacturing unit at Manamadurai in Tamil Nadu with an investment of \$335 million.
- Daikin's entry in the home AC market in India with its FTE brand of 0.75-1.8 ton ACs. The company is ramping up its manufacturing unit at Neemrana, Rajasthan, which currently has a capacity of 3 lakh units per year for this purpose.
- Kent RO 's additional manufacturing facility at an investment of \$4.5 million in Noida to increase its manufacturing capacity to 7 lakh units per year.

For 2011, regulations on fuel costs, interest rate revision, corrections in the MFI industry, and duty exemptions for locally assembled products are needed to insulate the industry that is plagued from rising input costs and increasing exchange rates of the Chinese Yuan. This will help the suppliers overcome price volatility and also help in enhancing the buying power of the consumers.

DVB tuner, transceiver, and video tuner chips are integral in consumer electronic products of TV and STB. Apart from this, ASSP used in imaging products ensure its emergence as the major semiconductor component. ASSP TAM is expected to witness strong growth trends during the forecast period. On the contrary, ASSP TAM has little to rejoice as most of the high growth CE products with significant ASSP content have low manufacturing index rendering the ASSP TAM to TAM ratio to be less than 50 percent.

India has evolved to be the biggest market for all major CE MNCs. Interestingly, the sales growth indicates that by 2015, India would contribute more to the revenues of CE MNCs than their home country itself. India is thus gaining prominence as the potential manufacturing hub and therefore is expected to attract manufacturing investments. As capacities for indigenous production of all the different CE products expand, the character of CE manufacturing index is likely to undergo a transformation and the CE segment is expected to boast a manufacturing index similar to the industrial segment by 2015.

Automotive electronics

In the last decade, India has transformed itself to be the seventh biggest automobile producing nation and accounted for 5 percent of the overall automobiles produced globally in 2010. The Indian automotive industry has acted as the magnet for investments attracting multinational and domestic companies alike. During this period, India has positioned itself as a major manufacturing hub in South Asia with global majors like Ford, Hyundai, Skoda, BMW, DaimlerChrysler, Toyota, Renault, Volkswagen, and Fiat setting up their manufacturing units. Gaining competitive advantage in the domestic market and tapping export opportunities were the key factors behind the investment decision. Today, the revenue contribution and employment generation have catapulted the automotive sector to be a key contributor to the overall economic growth of the country.

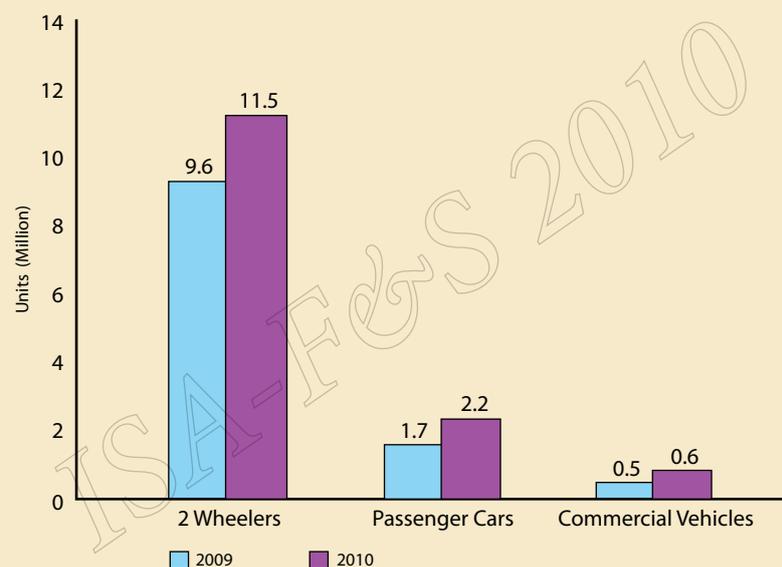
Passenger cars segment within automotive, by virtue of its widespread impact, is the most significant sub-segment. Capitalizing on India's low penetration of passenger cars, auto manufacturers are focusing on the effervescent small car segment. Majority of the car sales is in the small car segment where the average per unit price is under \$9,000. Increasing affordability of the middle class as well as the growing prosperity among the rural populace is driving the demand for the small cars. Besides the increase in disposable income, availability of easy finance options ensures upgradation of 2-wheelers owners too.

2-wheelers market in India is also on a high growth trajectory. The desire for enhanced safety and comfort features is riding high even in the 2-wheelers segment. There is a pronounced shift from smaller to higher capacity engines. Features adding greater safety and ride comfort warrant the inclusion of more electronic controls that increases the value offering per vehicle. Entry of new players and renewed marketing efforts is expected to sustain the excitement in this market during the forecast period.

The commercial vehicles market has hitherto remained the unsung hero in the automotive market. This scenario underwent a change during the period of economic slowdown when efforts were made to expand the infrastructure and thus maintain growth. The investment in infrastructure coupled with urban development policies led to resurgence of demand for commercial vehicles. The impact of this move led to a plethora of manufacturing investment announcement by many OEMs. The commercial vehicles manufacturers have started to focus on the safety and comfort features thus increasing the electronics consumption in this subsegment.

Chart 3.8 illustrates the production details for 2-wheelers, passenger cars, and commercial vehicles for the period from 2009 to 2010.

Chart 3.8: Indian Automotive market: Production Volumes of 2 Wheelers, Passenger Cars and Commercial Vehicles (2009, 2010)



Source: Society of Indian Automobile Manufacturers

As market volumes increase, features that were earlier limited to premium vehicles are becoming an integral part of mid and low-end vehicles. Partially mandated through regulation and the growing awareness of safety is driving the inclusion of features such as Anti-Lock Braking System (ABS), Electronics Brake Distribution (EBD), Traction Control (TC), and Air-Bags in many 4-wheelers, and not just the premium category. Inclusion of these electronic systems in the passenger and commercial vehicles segment has a direct impact on the semiconductor TM revenues. Although the current level of indigenous activity in these products is negligible, the increasing adoption rates are expected to create a favorable environment for local manufacturing. This is expected to directly aid the semiconductor TAM revenues in the forecast period.

The semiconductor TM and TAM revenues from the automotive segment were estimated to be \$175.16 million and \$108.40 million respectively in 2010. The TM and TAM are expected to grow to \$300.92 million and \$159.29 million respectively by 2012 growing at a CAGR of 31.1 and 21.2 percent respectively.

The following automotive components were considered for the estimation of the semiconductor market:

- Capacitor Discharge Ignition (CDI)
- Flashers
- Regulators
- Instrument clusters (2-wheelers)
- Instrument clusters (4-wheelers)
- 2-wheeler body electronics (electronic switching and lighting)
- 4-wheeler body electronics (power windows, ABS, remote keyless entry, immobilizers)
- Electronic Control Unit (ECU)
- Engine Monitoring System (EMS)
- Electric vehicles (cars)

Chart 3.9 illustrates the semiconductor TM and TAM revenue forecasts in the automotive electronics segment for 2009-2012.

Chart 3.10 illustrates the key revenue generating application and semiconductor product segments in automotive electronics for the period from 2010 to 2012.

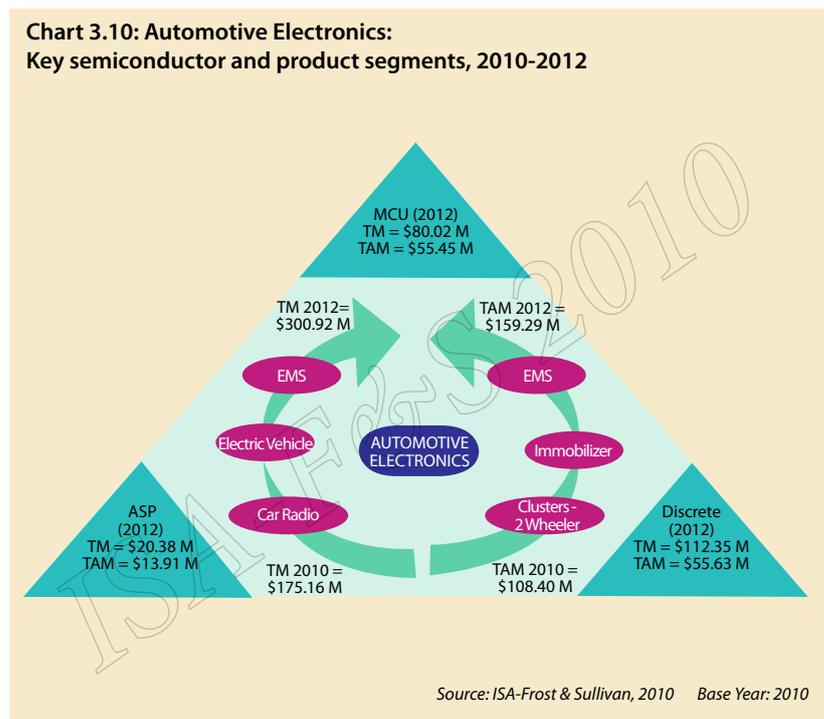
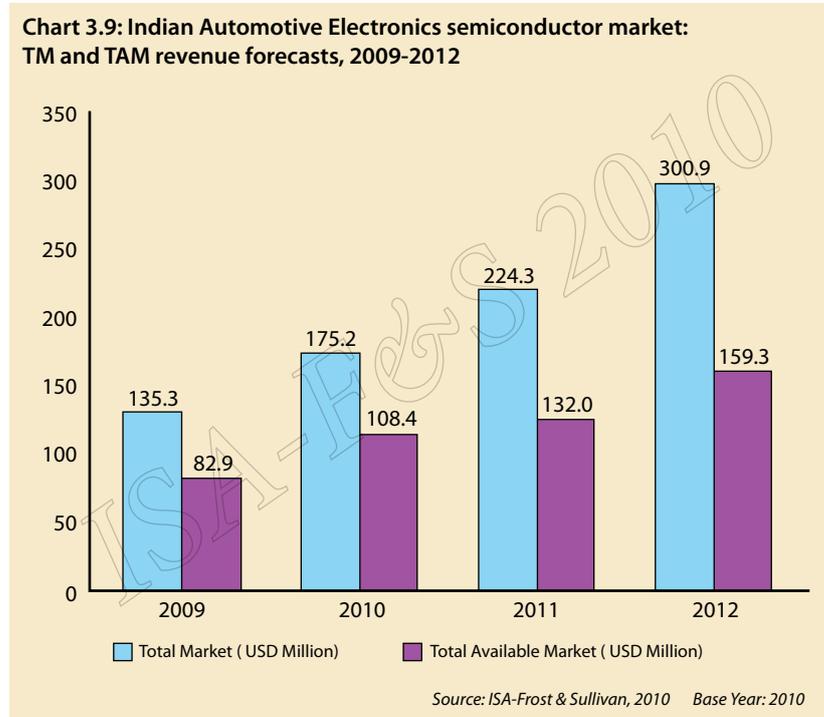


Table 3.7 provides the share of different end-user products in the automotive electronics semiconductor market revenues (in \$ millions) for the period from 2009 to 2012.

Product	2009		2010		2011		2012	
	TM	TAM	TM	TAM	TM	TAM	TM	TAM
CDI	12.04	12.04	14.31	14.31	16.18	16.18	18.40	18.40
Flashers	4.24	4.24	5.11	5.11	5.91	5.91	6.83	6.83
Regulators	6.58	6.58	7.62	7.62	8.82	8.82	10.19	10.19
Analog Instrument clusters – 2-wheelers	1.98	1.98	2.34	2.34	2.67	2.67	2.97	2.97
Digital Instrument clusters – 2-wheelers	10.68	10.68	12.69	12.69	16.17	16.17	21.39	21.39
Digital Instrument clusters – 4-wheelers	7.35	7.04	9.20	8.74	11.24	10.86	13.61	13.15
ECU - 2 wheelers	3.17	0.00	3.62	0.00	4.30	0.00	5.24	0.00
EMS – 4-wheelers	33.37	14.68	39.72	17.87	49.18	22.13	63.23	28.45
Electric Vehicles (only the power supplies component)	1.09	0.00	5.91	0.00	16.39	0.00	44.10	0.00
Immobilizers	7.34	4.98	9.97	7.98	12.40	10.17	15.10	12.98
Power Windows	4.60	4.18	7.87	7.71	8.63	8.47	9.65	9.54
ABS	2.79	0.00	4.19	0.00	5.91	0.00	8.58	0.00
Remote keyless entry	2.13	1.92	3.21	2.89	4.09	3.68	5.13	5.05
Body Electronics - 2 wheeler(electronic switching and lighting)	14.61	14.61	21.20	21.12	27.01	26.91	30.44	30.32
Car Radio (low cost)	21.75	0.00	25.94	0.00	32.12	0.00	41.27	0.00
Car Radio (high end)	1.64	0.00	2.25	0.00	3.22	0.00	4.78	0.00

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Table 3.8 provides the different semiconductor components TM and TAM (in \$ millions) in the automotive electronics segment for the period from 2009 to 2012.

Product	2009		2010		2011		2012	
	TM	TAM	TM	TAM	TM	TAM	TM	TAM
Discrete	38.20	29.68	54.58	39.90	75.12	48.05	112.35	55.63
Sensor	9.66	3.53	11.66	4.30	14.53	5.32	18.80	6.84
Analog-Power	11.71	5.87	14.68	7.51	18.46	9.29	23.70	11.31
Analog-Mixed Signal	10.42	1.09	12.60	1.35	15.72	1.68	20.28	2.03
MPU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MCU	41.89	29.22	52.52	37.53	64.21	45.41	80.02	55.45
DSP	0.20	0.00	0.27	0.00	0.39	0.00	0.58	0.00
Memory	4.87	3.61	5.88	4.40	7.41	5.59	9.61	7.28
Logic / FPGA	8.03	3.53	9.56	4.30	11.83	5.32	15.21	6.84
ASIC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ASSP	10.37	6.39	13.42	9.10	16.60	11.30	20.38	13.91

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

The Indian automobile industry has had its share of impact from the continuing volatility in the international crude oil prices. A significant trend has been the increasing preference for diesel powered passenger vehicles. The number of new car launches on the diesel platform is a testimony to this trend. It has been observed that sales of diesel power train vehicles witnessed a growth of 24.2 percent from 2009 to 2010 and this is estimated to further grow at the rate of 46.8 percent from 2011 to 2012.

Chart 3.11 illustrates the automotive power train trends outlook for passenger car production for the period from 2009 till 2014.

Chart 3.11: Automotive Powertrain Trends Outlook for Passenger Car Production (India), 2009-2014



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

The Indian government's initiative in mandating Bharat Stage IV norms has defined the permissible emission levels for all vehicle categories. This initiative has influenced manufacturers to discontinue or modify their older engines to suit the new norms. Apart from the emission norms, the government has furthered the cause of electric vehicles by offering them full exemption from central excise duty. Hybrid cars and electric cars thus are anticipated to witness significant growth following the favorable tax structure. Innovation in the energy solutions for automotive industry has paved way to newer technology like fast-charging Lithium Composite Phosphate (LCP) battery. This in turn is expected to act as stimulant for the prospects of Electric Vehicles and Plug-in Hybrid Electric Vehicles (PHEV) market in India. Discrete components comprising of power transistors, IGBTs, and MOSFETs are the premium semiconductor components in electric vehicles. With per product BoM as high as \$150, the discretized market TM for electric vehicles alone is expected to rise to \$42 million by 2012. In contrast, an equivalent opportunity loss for discretized TAM is expected due to the lack of indigenous manufacturing of these electric vehicles.

IT/OA

The power of information technology has moved from an apparent factor to one that touches human lives in multiple ways. IT/OA hardware, comprising of multiple products, has had a multiplier effect riding on the IT network and applications growth. Technology dynamism and product development have been the hallmarks of this industry sustaining an incomparable excitement. The government is striving to achieve higher penetration of broadband in the country, as also the ongoing initiatives for e-Governance are propellers for the IT/OA growth engine. The IT/OA products market is favorably impacted by the investments in rural and higher education, banking, and other private sector investments in the IT infrastructure enhancement.

Smart mobility being the next level of innovation, auto manufacturers are concentrating more on the telematics provided in their vehicles. Networking majors and auto manufacturers are increasingly collaborating to design the right solutions for the Indian market. Transformation of analog instrument clusters to digital instrument clusters and the inclusion of audio controls in the steering column are the other trends driving the growth of electronic content in automobiles.

India being the second largest market for 2-wheelers in the world, the increasing electronic content in 2-wheelers has a positive impact on the semiconductor TM and TAM revenues. The migration from AC CDI units to DC CDI units has had a positive impact on the consumption of semiconductors. This is further foreseen to be taken over by the incorporation of ECU in the 2-wheelers segment. The inclusion of electronic switches, digital instrument clusters, and more recently ABS in the 2-wheelers segment has added to the demand for semiconductors from this segment. The expected surge in demand for high performance bikes, which uses a substantial amount of body electronics, is likely to act as the growth driver over the next two to three years.

The increasing number of manufacturers and the need to maintain profitability has forced manufacturers to continue the localization of majority of the components thereby increasing the scope for indigenous manufacturing. Maruti, Tata and Renault-Nissan in the passenger cars and Volvo-Eicher, Ashok Leyland, Mercedes-Benz, and Mahindra and Mahindra, in the commercial vehicles segment have lined up investment plans totaling \$500 million. Addressing the key factors of value based products and designs for global markets, Indian automotive industry will continue to take strides towards achieving a leadership position thus driving growth of semiconductor TM and TAM.

From an overall semiconductor stand point, MCUs are the critical semiconductors that find application in all the control units found in automobiles. The growth in each of the individual product markets thus has a favorable impact on the MCU TM. The continuing manufacturing investments and expansions by OEMs and Tier I and Tier II suppliers serve to boost the MCU TAM that shall grow at a CAGR of 21 percent till 2012.

Broadband Wireless Access (BWA) spectrum will be pivotal to the development of broadband services in the country, as Internet access speed is severely limited. For a population of about 1.2 billion, India has only 11.2 million broadband lines. The planned investment of \$16,700 million for broadband roll out by 2015 is expected to generate a huge demand for IT/OA products. The expected roll out of LTE services in the second half of 2011 besides the ongoing WiMAX network expansion has an immense potential to create a demand for IT/OA products. The creation of higher bandwidth is a stimulating introduction of heavier applications in the devices that in turn calls for a higher semiconductor value per product.

The enterprise segment demand for IT/OA products continues to register significant demand, while education and Government are the other key demand drivers. Education sector annual outlay in budget witnessed an increase of 24%, which is expected to fuel demand for IT/OA products during 2011.

The TM and TAM for semiconductor products in IT/OA segment were estimated to be \$2,052.93 million and \$596.19 million, respectively, in 2010. The TM and TAM are expected to grow at a CAGR of 20.0 and 11.5 percent, respectively, thus amounting to revenues of \$2,958.15 million and \$741.75 million, respectively, by 2012.

The following product segments were considered while estimating the semiconductor market in the IT/OA segment:

- Printers
- Multifunction devices
- Notebooks and Netbooks
- Tablets
- Desktops
- Servers
- Monitors - CRT and LCD
- Storage USB memory and cards
- CCTV

Chart 3.12 illustrates the semiconductor TM and TAM revenue forecasts in the IT/OA segment for the period from 2009 to 2012.

Chart 3.13 illustrates key revenue generating applications and semiconductor product segments within IT/OA segment for the period from 2010 to 2012.

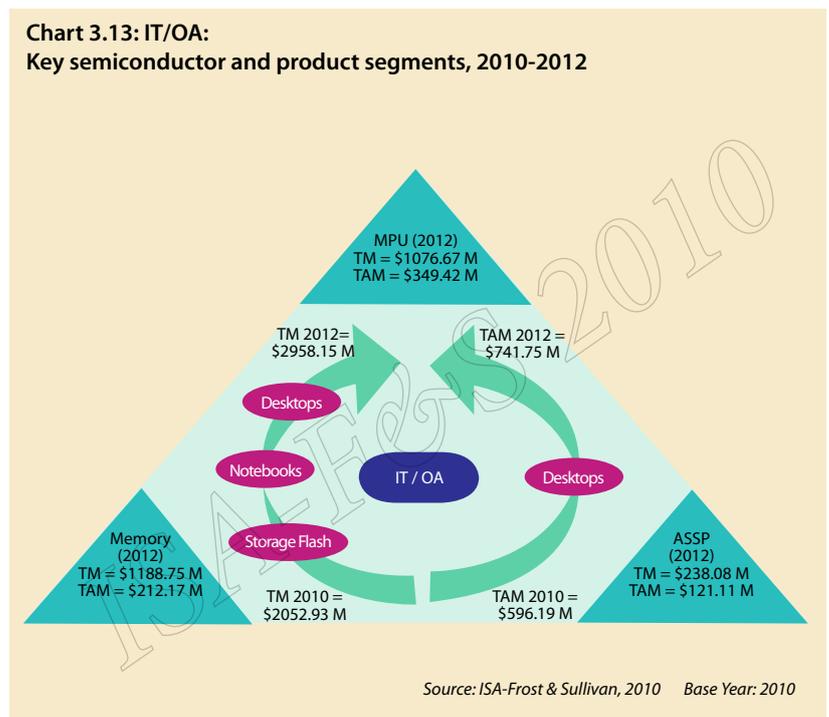
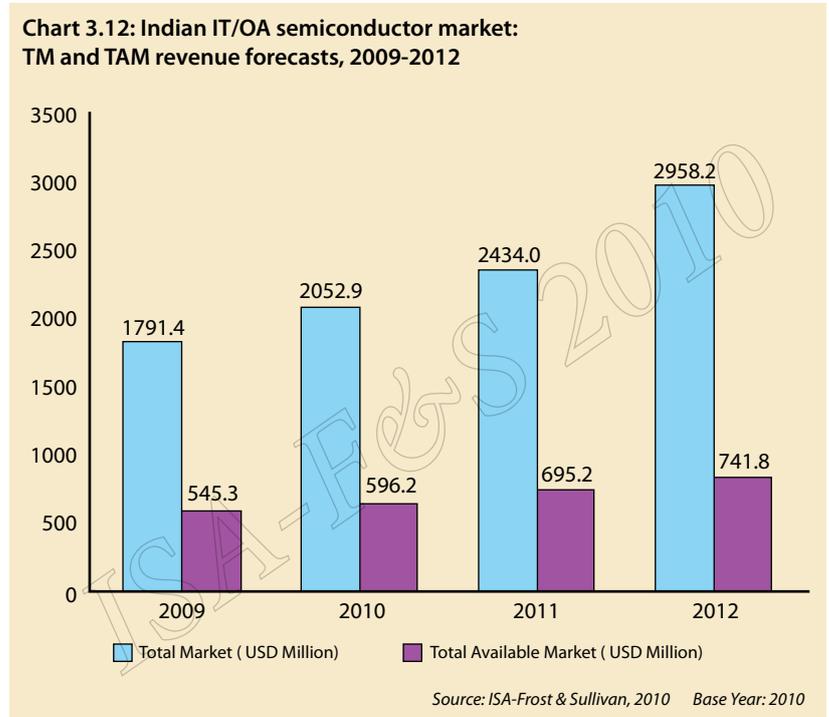


Table 3.9 provides the TM and TAM of semiconductor products (in \$ millions) by different end-user product segments within the IT/OA segment for the period from 2009 to 2012.

Product	2009		2010		2011		2012	
	TM	TAM	TM	TAM	TM	TAM	TM	TAM
Printers	1.08	16.15	1.42	18.61	1.86	0.24	3.21	0.32
MFD	4.59	0.00	6.59	0.00	7.84	0.00	9.53	0.00
Netbooks	0.00	0.00	52.48	0.00	89.09	0.00	135.80	0.00
Notebooks <\$500	58.17	0.00	79.54	0.00	142.90	0.00	241.90	0.00
Notebooks >\$500	427.98	0.00	487.55	0.00	605.08	0.00	728.59	0.00
Desktops <\$400	284.85	242.39	299.83	259.31	329.09	294.78	337.61	275.72
Desktops >\$400	398.93	256.57	405.43	279.37	411.51	302.47	426.69	341.45
Servers single processor	17.42	10.85	18.96	12.15	22.30	14.89	25.50	16.05
Servers multi processors	16.00	6.80	19.60	8.33	30.73	13.06	41.41	16.00
CRT Monitor	7.10	5.53	5.57	4.34	3.82	2.98	2.25	2.04
LCD Monitor	61.81	22.25	63.21	31.61	66.08	40.26	68.80	45.53
Storage USB Flash Memories	61.14	0.00	80.92	0.00	107.05	0.00	141.63	0.00
Storage Flash Memory Cards	400.18	0.00	456.20	0.00	511.40	0.00	583.00	0.00
CCTV	2.13	0.00	2.68	0.00	3.50	0.00	4.29	0.00
Thin client and Net tops	39.45	0.00	46.39	0.00	60.61	13.27	74.25	19.51
Tablets	0.00	0.00	14.08	0.00	26.82	12.04	118.30	23.59

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Table 3.10 provides the TM and TAM of different semiconductor products (in \$ millions) in the IT/OA segment for the period from 2009 to 2012.

Year	2009		2010		2011		2012	
	TM	TAM	TM	TAM	TM	TAM	TM	TAM
Discrete	53.55	17.90	63.14	19.87	77.18	23.71	97.59	25.60
Sensor	13.93	7.16	16.24	7.72	19.69	9.21	25.67	9.88
Analog-Power	77.39	6.62	88.10	8.55	104.06	10.30	126.01	11.37
Analog-Mixed Signal	58.52	0.00	67.62	0.00	82.10	0.00	103.07	0.00
MPU	615.37	259.21	709.67	280.93	862.43	326.63	1076.67	349.42
MCU	12.88	3.29	13.92	3.97	15.33	4.56	16.91	4.94
DSP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memory	749.94	159.22	861.19	172.37	1001.38	200.41	1188.75	212.17
Logic / FPGA	15.51	3.93	17.78	4.75	21.21	5.68	26.95	6.32
ASIC	25.79	0.00	32.31	0.00	42.96	0.48	58.44	0.94
ASSP	168.49	87.93	182.95	98.04	207.64	114.18	238.08	121.11

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

The printers and MFD market (clubbed to reflect convergence of functions) continues to post modest Q-o-Q growth figures growing at around 10% on a Q-o-Q basis during Q4 of 2010. Primary drivers continue to be the SMB sector and Government. 2011 is expected to augur well for both B2B as well as B2C segments. MFD's have made a significant contribution towards taking the concept of 'Office Next' to the higher level. As this market matures, mono lasers are expected to decline while 'Color laser MFDs' are expected become popular thus providing users color solutions at effective price points.

Notebooks are expected to grow by 38-40 percent in 2011 and reach sales of 4 million units. The overall ASP for notebooks is expected to drop by 5 percent in 2011. The demand for Netbooks is likely to sustain in India in contrast to its flat growth rates globally as Netbooks become substitutes for low end Notebooks. Emergence of Tablet PCs, whose acquisition costs are comparable, makes threat to Netbooks look real. IT OEMs are reworking their

strategies for Netbooks in face of the increasing uncertainty of this market.

2011 shall see Tablets overshadowing Netbooks as a potential substitute. As competitive offerings begin to emerge in Q1 2011, price wars are expected to intensify in the tablet PC segment during Q3 of 2011 leading to a price decline of up to 20 percent. Emergence of Media tablets will also impact this category in the long run. Some companies such as HCL Infosystems are planning to enter the Tablet PC market by April 2011. There is a strong possibility of HCL establishing a SKD unit for Tablet PCs in Puducherry.

Market for desktops is being driven by rural education programs and ongoing computerization of government departments. The ASP for Desktop units is expected to come down by 13 percent during 2011. Data virtualisation is the primary driver for the spike in demand for single processor server units. Also companies do not necessarily have a captive capacity thereby increasing reliance on external data centre resulting in 14-15 percent cost savings. This leads to increased demand for server units.

Declining prices of LCD monitors coupled with increased consumer awareness is leading to a spike in demand for LCD monitors against the conventional CRT monitors. Continued degrowth of CRT monitors shall eventually lead to LCD monitor demand overtaking CRT monitors' sales by the year 2012. Prominent industry names such as Sony and Samsung have already exited the CRT monitor segment and switched over to LCD monitor manufacturing. Key Taiwanese panel manufacturing company, BenQ, has already set shop in India besides attracting many more to follow suit. These companies include Amtran Technology, AUO (AU Optoelectronics), Chimei Innolux, Chungwa Picture Tubes, and Hannstar Display Corporation.

The highest growth segments for storage are in Smartphones, iPads, and Tablets. These three user categories are expected to influence growth of storage in India till 2012. The year 2011 shall see the launch of products with higher capacity, higher data transfer rates, and lower failure rates. Key trends in the USB market include an increase in storage capacity from the present 256 GB capacity to the 500 GB capacity and beyond. The anticipated introduction of USB 3.0 shall help a multifold increase in the bandwidth between a PC and an external hard drive.

Memory cards shall continue to witness significant growth on account of

continued demand from mobile phones as well as digital cameras. Demand for higher memory shall lead to a preference for SDHC cards (32 GB capacity) thereby leading to major shift from the current standard 2-4 GB memory capacities.

The CCTV market is expected to grow at a CAGR of 30-35 percent per annum until 2012. Decline in prices and greater product capabilities like people counters, video PoS, and retail video analytics is driving a major shift towards IP cameras. IP devices are also being preferred in public infrastructure, where the investment is significantly high.

Technology dynamism, increase in market volumes, and competitive pressure have contributed to a continuous erosion of IT/ OA products prices. Increase in the product features does result in an increase in semiconductor BoM, but this is observed to be a temporary phenomenon. The mass market products continue to put pressure on semiconductors prices but professional segments help achieve a better realization for semiconductor vendors.

Industrial Electronics

Industrial segment, because of its high manufacturing index, is the most valuable segment from the perspective of semiconductor TAM. The less prominence enjoyed by this segment is partly on account of the fragmented nature of product categories and the B2B channel of distribution. Hence, industrial segment has always remained in the shadow of prominent segments like automotive, mobile handsets, or IT/ OA. However, recent developments have ensured the spotlight on industrial segment. These developments include the rising popularity of solid state technology in applications of metering and lighting driven by the clamor for energy efficiency and the ongoing transition from mechanical to electronic controls. The advent of solid state and energy efficient technologies has been the key influencer for the growth of the industrial segment TM.

The demand for some of these advanced products is not satiated through local manufacturing alone, rendering the manufacturing index to decline negligibly. However, as increasing volumes continue to enable indigenous manufacturing, the TM to TAM ratio is expected to regain its past glory within the next three to five years.

The TM and TAM for semiconductor products in the industrial product lines was estimated at \$284.42 million and \$215.45 million respectively in 2010 and this is expected to increase to \$415.77 million and \$316.98 million in 2012, growing at a CAGR of 20.9 percent and 21.3 percent respectively.

The following major products are covered in the study under the industrial electronics segment:

- Inverters
- UPS – online and offline
- Energy meters – single and poly phase
- Stabilizers – domestic and industrial
- Weighing scales
- CFL lighting
- LED lighting
- Power supplies
- Variable Frequency Drives

Chart 3.14 illustrates the semiconductor TM and TAM revenue forecast in the industrial electronics segment for the period from 2009 to 2012.

Chart 3.14: Indian Industrial Electronics semiconductor market: TM and TAM revenue forecasts, 2009-2012

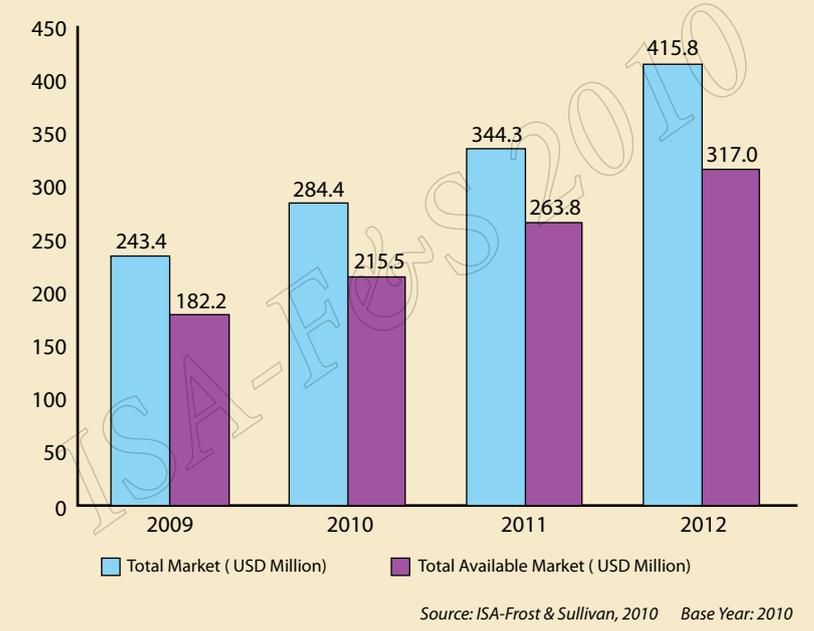


Chart 3.15 illustrates the key revenue generating application and product segments within industrial electronics for the period from 2010 to 2012.

Chart 3.15: Industrial Electronics: Key semiconductor and product segments, 2010-2012

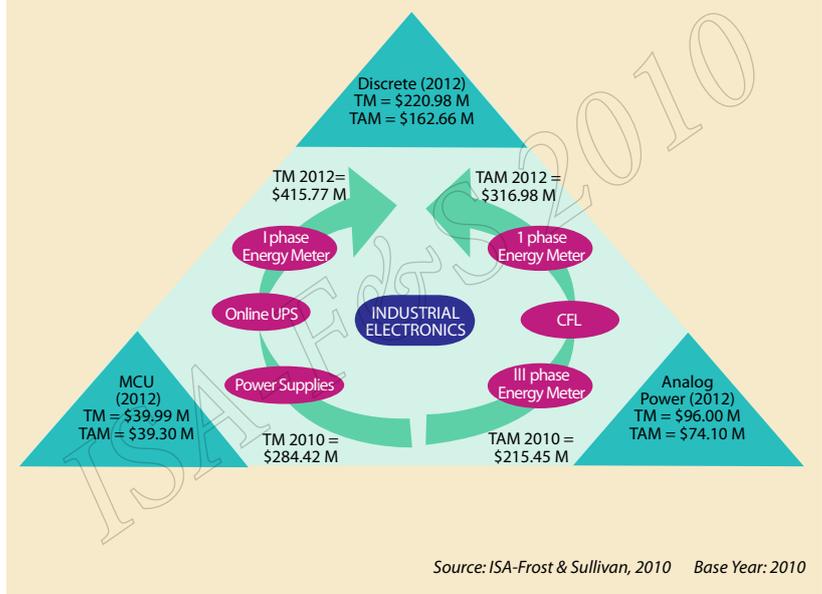


Table 3.11 provides the share of different end-user products in the industrial electronics segment semiconductor market revenue (in \$ millions) for the period from 2009 to 2012.

Product	2009		2010		2011		2012	
	TM	TAM	TM	TAM	TM	TAM	TM	TAM
Inverter	8.82	7.88	10.35	9.60	11.63	10.83	13.03	12.14
UPS Offline	11.47	11.47	12.56	12.56	18.70	18.70	21.00	21.00
UPS Online	14.73	11.78	17.15	13.72	19.97	16.51	23.26	20.03
Energy Meter I Phase	40.24	40.24	43.80	43.80	46.81	46.81	49.41	49.41
Energy Meter Poly Phase	13.42	13.42	14.82	14.82	16.19	16.19	17.69	17.69
AC Drives	51.01	15.55	58.86	19.44	67.92	24.30	78.36	30.38
Weighing Scale low end	1.19	1.00	1.35	1.13	1.44	1.23	1.48	1.30
Weighing Scale High End	4.25	3.56	4.95	4.16	5.59	4.72	6.01	4.70
DC Drives	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CFL	34.65	29.40	46.78	41.16	65.49	57.62	91.68	77.79
LED Lighting	3.36	1.54	4.98	2.07	7.62	2.95	12.20	4.28
Power Supplies	60.22	46.37	68.82	52.99	82.96	63.88	101.62	78.25

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Table 3.12 provides the different semiconductor component TM and TAM in the industrial electronics segment for the period 2008 to 2011.

Year	2009		2010		2011		2012	
	TM	TAM	TM	TAM	TM	TAM	TM	TAM
Discrete	114.13	79.69	138.60	99.89	173.80	127.87	220.98	162.66
Sensor	0.79	0.63	0.95	0.76	1.12	0.92	1.31	1.13
Analog-Power	60.46	47.67	69.07	54.26	80.90	63.16	96.00	74.10
Analog-Mixed Signal	8.39	6.17	9.48	7.01	15.19	12.47	16.88	13.84
MPU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MCU	31.73	31.14	34.61	34.02	37.39	36.78	39.99	39.30
DSP	18.13	7.49	20.87	9.01	24.01	11.00	27.64	13.49
Memory	4.28	4.04	4.78	4.51	5.24	4.94	5.60	5.16
Logic / FPGA	1.04	0.97	1.19	1.11	1.36	1.28	1.55	1.48
ASIC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ASSP	4.41	4.41	4.87	4.87	5.32	5.32	5.81	5.81

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

The investments in augmenting power generation capacity in the country have reached stratospheric levels. However, the rapid pace of economic growth has led to perpetual demand-supply gap in the electricity scenario in India. The uncertainty over uninterrupted and clean power supply has aided the growth in demand for power back-up devices. While commercial establishments opt for industrial power back up systems, the residential and SOHO segment has been driving the demand for inverters. The inverters market has a manufacturing index of almost 92 percent, indicating the high level of indigenous manufacturing activity. The import of inverters is attributed to meet the increasing demand from the residential and SME segment. During the forecast period, this demand is expected to be addressed by some of the major market participants who propose to increase their manufacturing capacity. The inverter industry is highly

fragmented with 20-25 branded suppliers controlling nearly 60 percent of the market. There are numerous small players who offer entry level products and are likely to be targets for acquisition in the next few years.

The preference for notebooks over desktops by the SOHO and SME segment is impacting the market for offline UPS that hitherto witnessed strong growth trends. Various government initiatives such as computerization of all its offices and government schools are expected to sustain the demand for the otherwise declining offline UPS market. The online UPS market, on the contrary is riding on a growth tide. Continuous expansion of the bank ATM networks in the country, increasing usage of information kiosks at public locations as well as the increasing installation of automatic ticket vending machines are driving the need for online UPS systems for uninterrupted operations. Discretes form a major junk of the online UPS market and it enjoys strong growth in both TM and TAM.

The insistence of state regulatory commissions supported by the Ministry of Power, to use energy meters for all power supply connections, has driven the demand of energy meters in the country. This coupled with increasing rural electrification programs, high replacement rate of the meters, and the rising infrastructure boom, has catapulted the demand for energy meters in the last few years. This trend is expected to further amplify in the next two years. Ongoing reforms in the power sector is expected to influence widespread usage of energy meters by utility companies in various stages of distribution, transmission, and monitoring. MCUs are critical to the functioning of energy meters and are the highest priced semiconductor component in an energy meter. The growth in the single and poly

phase energy meter market is anticipated to result in an addition of \$31 million to the overall MCU market in 2012.

The Indian CFL market has shown tremendous growth driven by the increasing awareness and adoption. There are numerous programs initiated by the Government of India that have influenced CFL penetration. Notably is the Bachat Lamp Yojna (BLY), under which incandescent bulbs using 60 and 100 watts of power are replaced by 11-15 watt CFLs, at subsidized rates of INR 10-15, making it on par with the price of incandescent bulbs. The BLY is a private-public partnership between the Government of India, private CFL makers, and electricity distribution companies, which expect to make about 50 lakh replacements in the next few years. This scheme, which is executed under the Kyoto Protocol, ensures that the subsidy of INR 80-90 provided on each bulb is borne by developed nations to meet their carbon reduction targets. This singular scheme of BLY is estimated to usher power savings of 20,000 MW annually, thus demonstrating the energy efficiency of CFLs and influencing its further penetration. Further PSUs such as the Indian Railways are observing 2011-12 as the 'Year of Clean Energy' and have embarked on distributing CFLs, free of cost, thus expediting the phasing out of incandescent bulbs.

With a majority of India's rural population still reeling under lack of electricity, development of products using renewable energy sources are a boon to rural India. Solar powered LED lights have emerged as one such technology that enables lighting of many rural households. The enormous power savings accorded by LED lights in applications such as street lighting and factory lighting among others and their longer operational life are further encouraging their adoption. Discretes and analog power are the major components of semiconductors in both CFL and LED lights. Thus, the enormous growth in both these product segments will turn advantageous to the discretes and analog power semiconductor market. Apart from the contribution to TM, the increasing local manufacturing of CFLs, credits it with being a significant TAM contributor. The past year has witnessed enormous capacity addition by all the major CFL companies in India. This trend coupled with the increasing incidence of contract manufacturing of CFLs in the country is expected to contribute for the sustenance of the manufacturing index in the industrial segment.

The power supplies associated with mobile and notebook chargers, along with other charging devices, forms the major contributor to the overall TM. The sheer size of the wireless handset market and their chargers makes this a large volume segment. All chargers for handsets manufactured or assembled in the country are also locally manufactured in India, adding to the TAM revenues for this segment.

The industrial segment has historically been and continues to remain one with a high manufacturing index as most of the products find indigenous manufacturing base. The manufacturing index has remained as high as 75 percent or more. The impetus should now be to raise this further and position the industrial segment as the truly self reliant segment by having 100% TAM. It is imperative for decision makers to adopt the necessary measures to influence greater local manufacturing of high growth products like online UPS, LED lighting, and notebook chargers. While policy initiatives such as subsidies to local manufacturing can help in improving the scenario, fiscal and tax incentives such as higher duties on Completely Built Unit (CBU) imports and low duties on component imports, encourage investments in local manufacturing.

Other Electronics

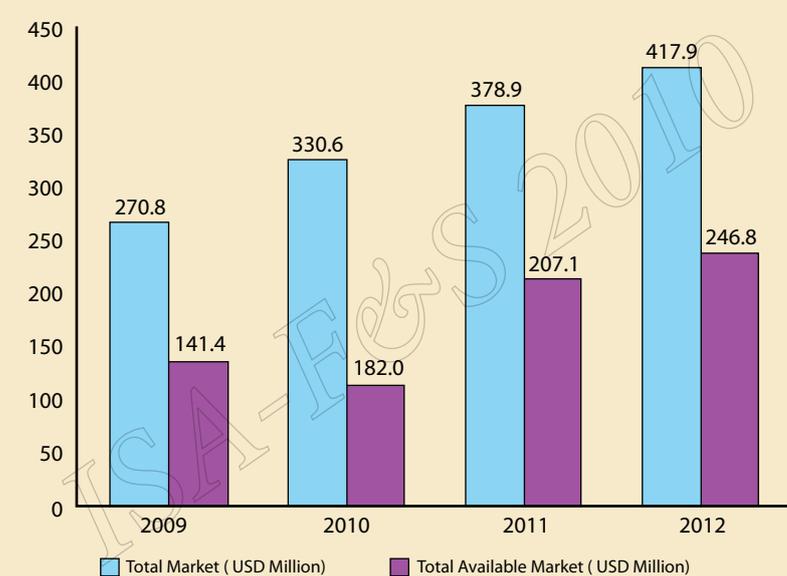
The other electronics market category comprises of the following end-user segments:

- Smart cards
- Aerospace and defense
- Medical electronics

The TM for semiconductors from the above end-user products aggregated \$330.64 million in 2010. This market is expected to generate revenues of \$ 417.90 million by 2012 growing at a CAGR of 12.4 percent. The TAM for semiconductors was \$182.04 million in 2010 and the same is expected to grow to \$246.77 million in 2012 growing at a CAGR of 16.4 percent.

Chart 3.16 illustrates the semiconductor TM and TAM revenue forecasts in the Other Electronics segment.

Chart 3.16: Indian Other Electronics semiconductor market: TM and TAM revenue forecasts, 2009-2012



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Table 3.13 provides the share of different end user products in the Other Electronics segment semiconductor market revenues (in \$ millions)

Product	2009		2010		2011		2012	
	TM	TAM	TM	TAM	TM	TAM	TM	TAM
Smart Cards	88.00	48.00	112.00	70.00	117.37	72.60	122.05	85.44
A and D	167.63	85.17	201.16	102.20	241.39	122.64	272.74	147.17
Medical	15.20	8.20	17.48	9.84	20.10	11.81	23.12	14.17

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Table 3.14 provides the different semiconductor components TM and TAM (in \$ millions) in the Other Electronics segment.

Year	2009		2010		2011		2012	
	TM	TAM	TM	TAM	TM	TAM	TM	TAM
Discrete	22.03	17.27	26.38	20.72	31.59	24.86	37.83	29.84
Sensor	5.00	0.00	6.00	0.00	7.20	0.00	0.00	0.00
Analog-Power	21.40	10.70	25.51	12.84	30.42	15.41	36.27	18.49
Analog-Mixed Signal	44.20	22.10	52.83	26.52	63.15	31.82	75.51	38.19
MPU	6.63	3.50	7.92	4.20	9.47	5.04	11.32	6.05
MCU	6.18	1.10	7.34	1.32	8.73	1.58	2.09	1.90
DSP	6.20	3.10	7.38	3.72	8.79	4.46	10.47	5.36
Memory	25.80	12.90	30.87	15.48	36.94	18.58	44.21	22.29
Logic / FPGA	29.40	14.70	35.21	17.64	42.17	21.17	50.51	25.40
ASIC	16.00	8.50	22.00	13.00	27.57	16.20	30.69	19.76
ASSP	88.00	47.50	109.20	66.60	112.84	67.92	119.01	79.50

Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

The Indian smart cards market growth is scripted by the expansion of existing applications and development of newer ones. Smart cards technology offers security and versatility leading to its increased adoption across social and commercial applications. The annual shipment of smart cards in 2010 is estimated at 550 million units. The key application segments for smart cards are telecom, transport, Driving License (DL) and Registration Certificate (RC), access control, and government projects.

The mobile telephony market is the single largest consumer of smart cards. The explosive growth in mobile subscriber addition has been a great driver for smart cards in the telecom segment. Entry of many new operators and the ongoing tariff wars has influenced subscribers to change their subscriber identity module (SIM) on an average thrice every year. The youth population, which is constantly trying to migrate to the best available plan, are observed to change their SIM even 5-6 times in a year. These trends keep

the market for smart cards buoyant. The launch of number portability is expected to further increase the frequency of plan switches thus creating higher demand for smart cards in the ensuing years.

DL and RC (Driving License and Registration Certificate) and transportation are other application segments that show high growth potential in the coming years. Gujarat and Madhya Pradesh were the first states to upgrade from paper based licenses to the use of smart cards for DL and RC. Many other states like Maharashtra, Karnataka, and Tamil Nadu have followed suit. All the four major metros have introduced smart cards for ticketing applications in mass transit systems. The growth of public private partnership in transport infrastructure projects has brought in smart cards based toll collection. As of today, these programs have limited impact on the revenues but they exhibit high potential with an increase in adoption of smart cards.

The Government of India has adopted smart cards as the technology backbone for many social sector schemes like the National Rural Employment Guarantee Act (NREGA) and Rashtriya Swasthya Bima Yojana (RSBY) among others. Smart cards make the implementation of the schemes efficient and foolproof. NREGA program, which was one of the flagship schemes of the central government, crossed the hundred million cards mark in 2009. National UID project recently branded as Aadhaar is expected to be one of the largest smart card application projects. It proposes to provide the 1.2 billion citizens of the country with a unique identity number over a period of ten years and there are strong indications that smart cards would form the hardware for storing the UID numbers of citizens.

Indian aerospace and defense industries have been in the limelight for their indigenous space missions and advanced defense programs. Surrounded by volatile

neighbors and the recent multiple security breaches have heightened the emphasis on national security evident from the annual increase in defense budgets. More than the revenue allocation in the defense budget, the allocation for capital spending has been gaining prominence year on year. The capital budget has been utilized to run multi year advanced defense programs such as the Indian Ballistic Missile Defense Program aimed at creating advanced air defense missiles for the country. Establishments such as Bharat Electronics Ltd and Electronics and Radar Development Establishment, amongst others play crucial roles in these electronics intense missile development programs. The heavy amount of data compilation, computing, and control involved in these programs have augured well for the markets of analog mixed signal, memory, and FPGA and Logic that have benefited from the demand arising from the A and D segment. In attempts to make India's defense machinery self-reliant and

to encourage local vendor base, the defense offset policy was introduced that mandates 30 percent of local content in all defense procurement. This has started boosting local manufacturing for the defense segment creating newer and more potential markets for the semiconductor vendors too. The fact that all aerospace and defense programs are rich in electronics from communication devices, the opportunities and growth potential for semiconductor TM and TAM is large. The product segments expected to benefit the most will be analog power and mixed signal, memories, FPGAs, and ASICs.

The highly fragmented nature of the medical devices market in India makes it a very intriguing one and a hugely untapped market from the semiconductor perspective. The total Indian medical devices market was estimated to be about \$5 billion in 2010 emphasizing on the enormity of this growing market, which includes a high level of electronics. Driven by the increasing health consciousness of average Indians as well as the populist Government programs aimed at taking quality and affordable health care to the poorest of Indians, medical equipment manufacturers have been creating India-centric products that have export potential in other South East Asian countries as well. In lieu of this, there is heightened activity in the Indian design scene, with many of the medical equipment manufacturers involving their local design teams to design and develop products for the developing economies. The significant boost in design activity is driving increased demand for local semiconductor vendors and this trend is expected to amplify during the forecast period. Analog power and mixed signal are some of the semiconductor products with high BoM content in medical applications that are profiting from the new trend.

Total Indian Electronics Market

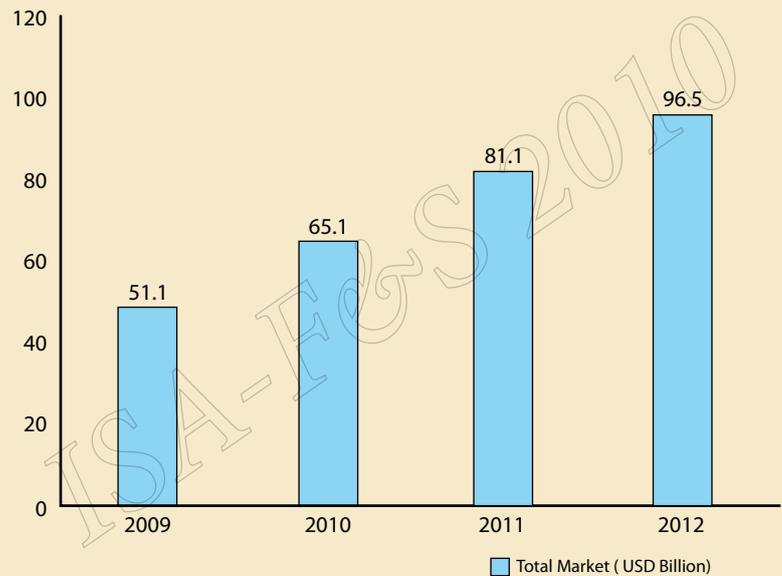
Indian Electronics Industry, 2010

India's electronics industry has traversed a long journey but is far from reaching its zenith. The industry has been characterized by an acute disparity between supply and demand. Despite the continuous increase in electronics consumption in the country, indigenous electronics manufacturing has not reached desirable levels. Electronics production accounts for less than 2 percent of the country's GDP. Also, locally manufactured electronics contributes to less than 1 percent of the global electronics industry pointing towards the need for immediate attention. Electronics manufacturing in the country currently accounts for less than 55 percent of the local consumption.

The total electronic products market, arrived at by aggregating individual product market sizes, indicates a size of (TM) \$65.1 billion in 2010. TAM for the same year was estimated to be \$36.0 billion. TAM includes not just pure-play manufacturing but assembly activity as well. It is interesting to note that the wireless handset segment is a significant part of this TM and TAM. The total electronics TM and TAM for 2009 after exclusion of the wireless handsets is estimated at \$49.1 billion and \$26.8 billion respectively. This highlights the contribution of wireless handsets to the electronics market in the country. It is worth mentioning that most of the activity in this product is in the form of low value-added assembling in the country.

Chart 4.1 and Chart 4.2 illustrates the TM and TAM revenue forecasts for the Indian electronics market respectively.

Chart 4.1: Indian electronics market: TM Revenues forecasts, 2009-2012



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Chart 4.2: Indian electronics market: TAM Revenues forecasts, 2009-2012



Source: ISA-Frost & Sullivan, 2010 Base Year: 2010

Challenges faced by Electronics Manufacturers

Many factors can be attributed to the lack of substantial electronics manufacturing activities in the country. The foremost are:

- An inadequate ecosystem.
- Absence of policy support and government incentives for indigenous manufacturers.
- Lower customs and import duties on raw materials needed for electronics manufacturing make trading a more attractive business proposition. The additional state level taxes, non-uniform duties, and inverted duty structure, all weigh against indigenous manufacturing.
- Physical infrastructure inadequacy and power shortages.
- Complex investment procedure - lack of simplified procedure for investing in the country - tedious documentation and bureaucratic delays.

Contribution and Future of Electronics Manufacturing Services (EMS)

The advent and growth of the EMS industry has been crucial to the improvement of indigenous production in the country. The EMS industry can be pronounced to be the chief contributor of locally produced volumes for certain high-growth product markets where OEM manufacturing in the country is quite contained. Communications is one such high growth, high-potent segment, where the contribution of EMS to total TAM is enormous. The fostering of the EMS industry is thus crucial for India's local electronics manufacturing to reach appreciable levels. India has been the home to all the major EMS companies including Flextronics, Foxconn, Elcoteq, Jabil Circuits, and Sanmina. There are also numerous homegrown EMS companies addressing multiple but niche application segments. India's EMS industry, which was worth \$1.2 billion in 2010, is expected to grow at a CAGR of 25-30 percent till 2015. The industry is expected to reach revenues of \$1.5-1.6 billion in 2011. Some pertinent growth drivers for India's EMS industry include:

- Strong and a growing domestic demand for mobile phones, medical, consumer, aerospace, and automotive electronics
- Increasing demand for telecom infrastructure equipment
- Highly talented workforce, especially for design and engineering services with good communication skills
- Inflation and rising costs of doing business in China
- Presence of global EMS majors and their plans for increased investments in India
- More outsourcing of manufacturing by both Indian and global OEMs that are increasingly focusing on R&D and other core competencies

The EMS industry currently faces challenges of inadequate supply chain, logistic connectivity and lack of government support. Initiatives taken to alleviate these, will pave way for an energized EMS industry in the country. In the ensuing years, India is expected to gain some of the EMS opportunities lost by China to other low cost destinations. India's EMS industry focus is expected to be on creating a solid ecosystem and supply chain for electronics manufacturing. Recent trends also indicate that an increasing number of engineering and design activities are being outsourced to EMS companies and are becoming ODMs (Original Design manufacturers). They also provide the final system integration and logistical support. EMS companies in India are expected to focus on tapping the evolving opportunities in consumer electronics, telecommunication infrastructure, defense, aerospace, renewable energy, and medical devices in the following years to grow their business.

The Road Ahead

Efforts facilitated through policy changes and incentives are needed to create an ecosystem for nurturing electronics manufacturing within the country. The existing strengths have to be positioned to attract manufacturing investments. Within electronics manufacturing, the growing segments of telecom infrastructure, aerospace, defense, automotive, and medical need to be given more emphasis. Apart from improving infrastructure facilities that pave the way for a faster growth for electronics manufacturing in the country, the Government needs to formulate a focused **National Electronics Development Plan (NEDP)** that provides the stimulus to grow all aspects of the industry.

Recognizing electronics to be a driving force in growing the economy and developing a national level mission can result in the Indian Electronics industry surpassing \$350 billion by 2020. The National Electronics Development Plan with its right constituents can produce the following results:

- Direct and Indirect employment of over 15 million
- Growth in India's IP strength
- Opportunities worth many billions for EDA and design companies
- Development of India's physical infrastructure to world-class levels

Thus making **Electronics an Enabler for GDP growth!!**

Research Methodology and Appendix

Sampling

- The leading manufacturers and suppliers of each end use product categories that were chosen to provide a larger representative sample.
- Purposive unit sampling was adopted for application segments such as automotive electronics and color TV, which were more organized and for which known participants were available in the industry. Purposive sampling was resorted to in order to elicit the appropriate inputs with regard to the qualitative growth aspects of the market. This was to get more accurate samples and hence attain the objectives of the research.
- A mix of purposive unit sampling and stratified probability sampling was carried out for application segments such as inverters and stabilizers, where there were a large number of participants.

Secondary Research

The research methodology that was carried out was desk research through various journals, association reports, and in-house databases to build a knowledge base on various application segment product categories and industry trends.

Primary Research

Surveys through personal face-to-face interviews with the end users of semiconductors were conducted. Projective and in-depth interviews were conducted across application segments. Individuals from technical, procurement, and marketing/sales department from each organization were interviewed to obtain technical, purchase, and market information. In all, interviews were conducted across organizations. In addition, interviews were conducted through personal interviews with semiconductors suppliers.

The analysis from demand side (end users) and qualitative inputs from supply side (suppliers of semiconductors) were used to arrive at the TM and the TAM values and forecasts.

Industry Information

It was essential to understand the current industry landscape, market dynamics and production, assembly, import, and sales data. To estimate the semiconductors TM and TAM forecasts, marketing, production managers, and procurement heads were interviewed.

Technical Information

In addition to the interviews with leading participants for industry-related information, Frost & Sullivan conducted interviews with research and development (R&D) and design and development (D&D) team to understand the current usage of semiconductors by product category and also to find out the emerging trends. Finally, interviews with suppliers were conducted to cross-check the validity of information and also to understand the emerging trends in end-user applications. The detailed methodology for primary research phase is outlined below.

Primary Interview Questionnaire Design

Frost & Sullivan developed a detailed questionnaire, which was used by the analysts as a guide for their discussions. This process ensured the collection of all necessary data. Frost & Sullivan also solicited inputs from the ISA Market Research Committee in the final stage of development of this questionnaire to assure proper content, focus, and context. The questionnaire was designed to elicit unbiased industry level data (production, assembly, sales, and others), that had check points (questions such as company level information and their position in the industry acted as check points) to ensure accuracy of the data. The questionnaire included the following sections:

- Industry level information – industry
- Characteristics and dynamics
- Company-specific information
- Semiconductor usage norm
- Purchase channel

Interview Questionnaire Test and Validation

Following the design of the questionnaire, Frost & Sullivan carried out some initial interviews to verify that the appropriate market and technology data was generated. Frost & Sullivan made some final ISA - Frost & Sullivan research service modifications to the research instruments to assure optimal project completion and success. After the final design of the questionnaire, Frost & Sullivan began full-scale primary research. Specific companies targeted for primary research interviews were selected based upon market participation. The higher the entity's profile, the more attractive the entity generally was. Specific individuals within selected targets were chosen based on existing Frost & Sullivan contacts, participant's market role, title, and area of expertise.

Interview Process

As participants respond in the course of an interview, Frost & Sullivan analysts are trained to move from lower priority and/or sensitive topics to increasingly key and/or sensitive topics in response to the interviewee's behavior. This responsive and reflective interview process, combined with the analysts' ability to discuss industry and technical issues in an open and sharing environment, allows Frost & Sullivan to probe for key data, operations, and competitive information. Multiple contacts within a single organization and with an individual are often planned and/or staged in order to optimize and complete the information gathering process.

Research Validation

At the point of the project where 20 percent of the research interviews and/or data collection had been completed, Frost & Sullivan consultants evaluated the preliminary findings to assure that up-to-date results are in line with project objectives. The analyst team analyzed the information from the interviews. Information and data were validated through a combination of the following information:

- Cross checking with other primary data and previously developed in-house research
- Review of secondary information, such as trade journals, annual reports, and industry directories

Appendix

A-1 Proposed Manufacturing Plans of Handset Companies, India

Company	Investment Plan	Capacity	Year of Commencement	Location
Winncom	\$110 million (2011)	1.2 M per annum	2012	Gagret, HP
Spice	\$22 million in 2010; to raise \$155 million in 2011	Currently 650 K per annum; Proposed is 6 M per annum	2010	Baddi, HP
MAXX	\$175 million	1.2 M per annum (proposed by 2014)	2012	Pune (Maharashtra), Gujarat
Airfone	N/A	4 M per annum	2012	Manesar (Haryana)- Makeshift plant; AP/TN – Final plant
Lava	\$22 million	6 M per annum (proposed by 2012)	2011	N/A

Source for the above information: Primaries with companies; Published secondary sources. Some of these plans might change depending on other factors.

Acronyms

ABS	: Anti Lock Braking System
ASIC	: Application Specific Integrated Circuit
ASSP	: Application Specific Standard Product
BTS	: Base Terminal Station
CBU	: Completely Built Unit
CDI	: Capacitor Discharge Ignition
CDMA	: Code Division Multiple Access
CKD	: Completely-Knocked Down
CPE	: Customer Premise Equipment
DLC	: Digital Loop Carrier
DSP	: Digital Signal Processor
DVD	: Digital Versatile Disc
eBoM	: Electronics Bill of Materials
ECU	: Engine Control Unit
EMS	: Engine Management System
GSM	: Global System for Mobile communications
IC	: Integrated Circuit
IP	: Internet Protocol
LCD	: Liquid Crystal Display
MCU	: Microcontroller
MPU	: Microprocessor
SKD	: Semi-Knocked Down
STB	: Set top Box
STM	: Synchronous Transfer Mode
UPS	: Uninterrupted Power Supply
WiMAX	: Worldwide Interoperability for Microwave Access

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