

Philippines: Electronics Equipment Production and Manufacturing

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Executive Summary

1. Electronics equipment production amounted to \$26.64 billion dollars in 2004 and constituted the largest export from the Philippines accounting for almost 70 percent of all exports from the Philippines. This industry employed over 376,000 people in 2004 and after a couple of depressed years is poised to grow again. Electronics production in the Philippines forms a very small percentage of the worldwide electronics industry revenue of over \$1.3 trillion in 2003. Majority of the Philippine electronics industry production was in the semiconductor assembly, testing and packaging. Discussions with the various industry participants revealed that the linkages within the Philippine electronics industry appear to be working adequately with minor room for improvement.

2. From an end user standpoint, the Philippine Electronics Industry manufactures products for a wide range of end-user segments such as computers, telecommunications and automotive products. It also participates in diversified geographic markets, such as the United States, Japan and Europe. However, from the viewpoint of participation in the electronics industry value-added chain, the Philippine electronics industry primarily operates in a very narrow range. Its principal participation is in the semiconductor assembly, packaging and testing (APT), constituting about 5 percent of the total electronics industry manufacturing value chain. It peripherally participates in printed circuit board assembly (EMS) and enclosures (plastics, sheet metal, etc.) accounting for another 10 percent of the value chain. Thus, it would be fair to suggest that the Philippines' participation in the electronics industry value-added chain is less than 15 percent. This very narrow participation leaves the Philippines very vulnerable to eroding participation in the worldwide electronics industry and stagnation even in the major segment that it participates in, the semiconductor APT.

3. The Philippines is already a major participant in the worldwide semiconductor APT accounting for maybe 20-percent market share in this activity. Further gains in this market share would be very difficult to achieve. Take for example China. It is very actively increasing its participation in worldwide semiconductor fabrication and would not need the Philippines' APT services. Thus, any significant growth in semiconductor APT would be difficult for the Philippines to achieve. Therefore, for the electronics industry to grow in the Philippines, it has to look at other segments of the electronics industry value-added chain.

4. The printed circuit board assembly and electronics manufacturing services (EMS) segment offers significant potential for the Philippine electronics industry to grow. EMS as a segment is growing worldwide, and the Philippines already has some experience in this segment. This can be leveraged as an engine of growth for the country's electronics industry. Once significant activity is attracted in this segment, other potential areas that can be grown include printed circuit boards, passive components, connectors, displays, batteries, other design services.

5. For these sectors to grow and attract potential investments to the Philippines, the Philippine government with the support of the country's electronics industry must significantly scale up its promotion and support activities. Currently there are only four individuals supporting the promotion and the growth of this industry – this is woefully inadequate. Promotion, development and support of these sectors will require a gigantic effort of a staff that is well qualified, internationally connected and with a deep technical and market understanding. Therefore, it has been recommended that the Philippine government seriously consider the development of an agency solely entrusted with promotion, support and development of this very important segment of the Philippine industry. An agency similar to that supporting the information industry in Taiwan, Institute for Information Industry, should be considered.

6. In summary, we can make the following observations:

- The electronics industry in the Philippines is a very large and important industry generating the largest exports and significant employment.
- The focus of the Philippine electronics industry remains very narrow and is predominantly confined to the semiconductor assembly, packaging and testing where the prospects for significant future growth remain slim.
- Electronics manufacturing services (EMS) offer a good potential for the Philippine electronics industry to grow as it has some experience in this area, and there are good prospects of this industry continuing to migrate to the developing countries. This sector can also act as demand pull for other segments of the electronics industry value-added chain, such as printed circuit boards, displays, batteries, design services, etc.
- The task of promoting these newer segments cannot be handled by the current government staff as they are very inadequate in numbers and training.
- The government would have to launch a major effort and possibly create a new agency staffed with well qualified people of technical knowledge and international connections to promote these segments.
- If these actions are not taken in a timely manner and with adequate resources – people and funding -- the Philippine electronics industry would be in danger of stagnation or reverse slide.

1. Introduction¹

7. The global electronics equipment market is one of the world's largest markets. According to the Electronics Business Magazine, this market was worth some \$ 1,337 billion in 2003. . The electronics equipment market has been relatively flat in the last several years beginning with the dot-com bubble in 2001, compared to market's performance in the late 1990s. In 2004, the worldwide electronics equipment market is expected to reach \$1, 431 billion with the top 10 consuming nations expected to account for about 78 percent of the total consumption. The United States, Japan and China are the three largest consumers of electronics equipment accounting for a total of 55 percent of the total electronics equipment markets. The other large consumers of electronics equipment are the United Kingdom, Germany, Korea, France, Mexico, Italy, Taiwan and Singapore.

8. In 2002, the worldwide electronics production was worth roughly the same as consumption that same year, at about \$ 1,247 billion with United States, Japan and China being the largest producers. The three accounted for roughly 53 percent of the total electronics equipment production, leaving these largest electronics producing nations as net importers.

9. Among the top 11 producers of electronics equipment, only South Korea, Taiwan, Singapore and Malaysia are net exporters. All the remaining seven major electronics producing nations – the US, Japan, China, Germany, United Kingdom, France and Mexico are net importers. The Philippines, also a major electronics equipment producer, is also a net exporter of electronics equipment with the surplus being about \$6 billion in the first quarter of 2005.

10. The worldwide electronics industry fell into what some call a “depression” after the dot-com burst of 2001. The volumes of electronics production simply fell off the cliff starting in the first quarter of 2001; the situation continued until very recently. The industry was left with tremendous amount of excess inventory, estimated in excess of \$ 22 billion, and with tremendous amount of excess capacity, by as much as 50 percent. The only exception to this situation was China, where production continued to increase and additional capacity kept being added.

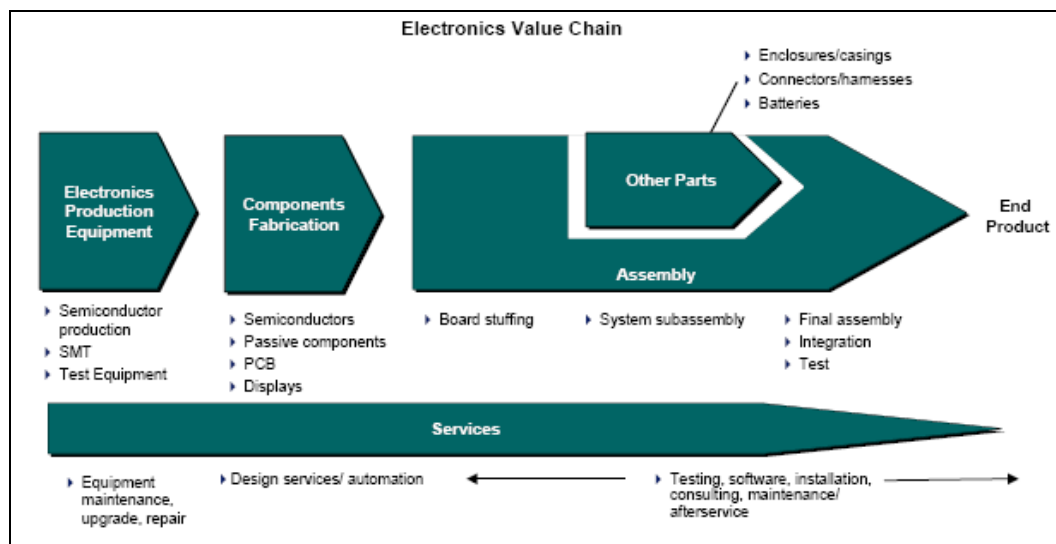
11. With the economic growth resuming worldwide, electronics equipment demand indicators have continued to strengthen worldwide over the past year, i.e. 2003. In the US, GDP growth was around 3.1 percent in 2003, but the total demand for electronics equipment rose 7.8 percent including inventory withdrawals. Similar trends were noticed in China, Japan, India and Europe at varying economic growth rates and corresponding growth in the demand for electronics equipment.

12. The stronger demand has begun to appear in electronics industry sales reports throughout the major producing nations. In Korea, semiconductor production rose 37 percent in September 2003 and electronics equipment exports soared in the last quarter of 2003. Taiwanese October 2003 export orders for electronics equipment were 27 percent more than a year earlier. Also, industrial production has jumped sharply throughout Asia, mostly in electronics. September

¹ The industry data for this section was derived from the Booz Allen and Hamilton study done for IFC while the findings and conclusions were primarily drawn from the industry executive and industry association meetings in the Philippines. A list of the industry executives interviewed for the study is included as Appendix A.

production increased 3.2 percent in Thailand and 3.0 percent in Japan. Compared with the previous year, electronics production was up 36 percent in Taiwan and up 16 percent in China in 2003. This suggests that electronics production and consumption are very tightly related to the growth and decline in the worldwide economic activity.

13. The electronics industry can be segmented in two primary ways – first along the electronics value chain and second along the end user segments (see Annex 1 for end use segments). As seen in the figure below, this study uses the value chain approach as it provides a better basis to analyze linkages with local economy. Value Chain defines the value added to the basic materials along the production cycle and does not total to the value of the electronics revenues worldwide because the remaining value is added through sales, distribution and service of products. The following major segments and sub-segments can be defined along the electronics value chain.



Source: IFC/Booz-Allen-Hamilton, 2003

1. Electronics Production Equipment

- Semiconductor production equipment
- Surface Mount Technology Equipment
- Test Equipment

2. Component Fabrication

- Semiconductors
- Passive Components
- Printed Circuit Board
- Displays

3. Custom and Other Fabricated parts

- Enclosures and Casings
- Connectors and harnesses
- Batteries

4. Assembly

- Board Level Assembly
- System Sub Assembly
- Final Assembly
- Integration
- Testing

5. Electronics Production Services

- Equipment Maintenance, Upgrade, and Repair
- Design Services/Automation
- Testing, software, installation, consulting, maintenance/after service

2. Overview of the Global Electronics Industry

14. This study is primarily concerned about the linkages and spillover effects of the electronics industry in the Philippines. In that regard, the analysis will focus primarily on the value added segmentation. As seen in the following table, value added in different segments of the electronics industry varies significantly. Even within the specific industry segment, value added in different steps of the value chain differs significantly. Within this framework, it is critical to understand in which steps of the value chain a country's electronics firms operate to be able to judge opportunities to develop linkages with the local economy.

Table 1. Value Added in Worldwide Electronics Equipment Production (2001)

<u>Value Added Activity</u>	<u>\$ Value in Billions</u>	<u>% Value Added</u>
Production Equipment	30.0	7.0
Semiconductors	147.0	35.0
Passive Components	23.0	5.5
Printed Circuit Board	31.0	7.5
Displays	46.0	11.0
Connectors/Cables	25.5	6.0
Batteries	45.0	11.0

Enclosures	30.0	7.0
Assembly Services	26.5	6.5
Other Services such as Design Services	14.0	3.5
Totals	418.0	100.0

Source: IFC - Booz Allen and Hamilton , 2003

Note: OEM in-house Assembly and other value added steps like marketing, distribution, etc. add the remaining value in the electronics industry food chain.

2.1. Production Equipment

15. The production equipment category is further classified by technology type; however, two broad classifications are along two major component types: semiconductor production equipment and circuit board assembly equipment.

16. Worldwide production of semiconductor equipment like those used in wafer processing, semiconductor assembly and testing, etc. was about \$25 billion in 2001. Very little of this market – worth less than \$1.5 billion -- was in developing countries including Korea, Taiwan and Singapore. Most major players in this market are from the United States, Japan and some from Europe. Some smaller players in this market are from Taiwan and China. These players are specialized by equipment type.

17. Worldwide production of circuit board assembly equipment like high speed assembly machines, flexible fine pitch pick and place equipment, printers, ovens, etc. was about \$5 billion in 2001. Less than half a billion dollars worth was sold in developing countries such as Korea, Taiwan and Singapore. Like the semiconductor equipment producers, most players in this market are from the United States, Japan and Western Europe who specialize by equipment type.

18. Over 95% of the production of such equipment is in the developed countries because of the huge expenditures required for research and development and specialized technology knowledge required. However, some companies are setting up production facilities in China due to cost pressures and the need to be closer to the customer base developing in China. The 5% of the equipment produced in the developing countries are primarily mechanical equipment – test handling/feeders, etc.

19. Based on the above profile, according to our opinion, there is very little opportunity for the Philippines to participate in this marketplace except in the servicing of such equipment, which will be discussed later. Though some production of such equipment is likely to shift to East Asia, they are likely to be in Taiwan and South Korea because of the greater development of the capital goods industry in those locations. This is because the design, development and production of “production equipment” requires significant investments in research and development, proximity with the customers to continuously develop and improve on technologies, and a very deep understanding of both the end-product being produced and the process for producing it. Since these capabilities do not exist in the Philippines, we have

concluded that it is not possible for the Philippines to position itself in this segment of the electronics value chain.

2.2 Semi-conductors

20. The three major types of value-added players in the semiconductor markets are:

- Semiconductor Foundries such as TSMC and UMC in Taiwan, Chartered Semiconductors in Singapore and Anam/Dongbu in South Korea. Foundries are mainly located in Asia – Taiwan, South Korea, Singapore and China -- although there are several in the United States and Eastern and Western Europe. These foundries produce commodity semiconductors used in virtually all end markets, particularly for the consumer electronics market.
- Integrated Design and Manufacturing Companies (IDMCs) such as Intel, Motorola, Texas Instruments in the United States, Infineon and SMT in Europe and Toshiba and NEC in Japan. IDMCs are primarily located in North America, Japan, South Korea and Western Europe. IDMCs produce both commodity semiconductors and more specialized semiconductors for particular end markets such as automobiles, communications, etc.
- Assembly, Packaging and Testing (APT) Companies such as Amkor, ChipPac based in the United States but with assembly plants in Asia. ASE Group in Taiwan and Carsem in Malaysia primarily have their plants in Asia and some in the North and Central America. Few have assembly operations in Western Europe such as Philips in Malta and others in Ireland.

21. Worldwide production is dominated by the IDMCs who added more than \$133 billion of value in 2001. Most of the consumption of these semiconductors was in the developed countries with the developing countries accounting for less than 10% of consumption. Foundries added the next greatest value to semiconductors with a worldwide market of about \$9 billion where primary consumption, over two-thirds of the total, was in the developing countries including Korea, Taiwan and Singapore. The value added by semiconductor assembly, packaging and testing was about \$6.5 billion where over two-thirds came from the developing countries like Malaysia and the Philippines and, increasingly, China.

22. As seen in the table above, semiconductors add over a third of the value added to electronics equipment production. This is a very capital-intensive and technology-intensive segment of the value chain with new fabrication facilities likely to cost upwards of two billion dollars. It appears that other than China, no new locations in semiconductor fabrication are likely to emerge during the next several years. Thus, opportunities for semiconductor fabrication for the Philippines in this sector seem to be very limited. Further, semiconductor fabrication requires a very strong supporting infrastructure for rare gases, pure chemicals, semiconductor equipment servicing and a host of other services. This infrastructure has to be created simultaneously with the development of the semiconductor fabrication facilities. This does not seem feasible in the current environment in the Philippines.

2.3. Passive Components

23. The value added by the passive components to the electronics equipment production is divided roughly into two categories – commoditized passive components such as Tantalum Capacitors, Ceramic Capacitors, Aluminum Capacitors which are used in almost all end-user segments of the electronics industry and account for roughly two-thirds of the value added worth about \$15.5 billion in 2001. Roughly half of the market for these is in the developing countries and they are produced generally in all regions of the world. Primarily, global players specializing in discrete semiconductors and passive components participate in this segment.

24. Less commoditized/specialized passive components such as Super Capacitors, Electromechanical Capacitors, Resistors, Transformers, etc. which are also used in almost all the end-user segments of the electronics industry account for roughly a third of the value added in this category or about \$8 billion in the electronics value chain. A third of these markets today is in the developing countries.

25. About a third of the production of the passive components is already in the developing countries. Many passive component manufacturers are moving to Asia, primarily to be close to their customers and to reduce costs. Mexico still remains an important production center for the production of passive components. According to our opinion, this is a value-added segment of the electronics industry in which Philippines can position itself to get a larger share of production in the region. Investments in passive component production are not extremely high and can be afforded by Philippine entrepreneurs. Compound annual growth rate in the passive components segments from 2001 to 2005 is projected to be between 17% to 22%, according to Global Industry Analysts Inc. and Passive Components Magazine.

2.4. Printed Circuit Boards

26. The segments of the printed circuit manufacturing are differentiated by the layer count and degree of complexity on the circuit. There are four different segments of the printed circuit board industry:

- i. **Microvia** characterized by circuit boards which are populated by extremely small holes for component insertion – holes in the range of 0.1 mm to 0.25 mm. These printed circuit boards are primarily used for the production of handheld equipment, mobile telephones, miniaturized consumer products, telecom products and the like. Most of these microvia products are used in the Asia-Pacific, Japan, US and Europe. Typically, global PC board manufacturers participate in this segment and have an increasing number of production facilities in China and some in Thailand. Value of the worldwide production of these microvia boards are in the range of about \$2.5 billion and a third of its markets are in developing countries mostly in Asia.
- ii. **Low Complexity, One to Eight Layer Boards** require lesser skills to produce and are primarily used for the production of computers, PCs, Consumer Electronics and Automotive Electronics. These are generally produced all around the world by a large number of fragmented players. There are very few global players in this

segment of the market, which constitutes the bulk of the printed circuit board market – about \$ 18 billion in size, constituting 58% in 2001. The consumption of these boards is primarily in the developing countries like China, the Philippines, South Korea, Taiwan, Thailand and others in the region. They are likely to grow at a compound annual growth rate of between 10% to 15% from 2001 to 2005.

- iii. **Mid Complexity with Eight to Fourteen Layers** require greater skills to manufacture and are used in more complex products like LAN Routers, Servers, Telecom/Datacom Infrastructure and complex computers including notebook computers. They are generally produced in North America, Europe and Asia Pacific. This segment constitutes the second largest among printed circuits, accounting for about \$7 billion in sales in 2001 and representing about 22.5% of the market in 2001. Only a third of the consumption of these boards is in the developing countries with the rest being in the United States, Japan or Europe. This market is expected to grow at an annual compoun rate rate of 13% to 15% from 2001 to 2005.
- iv. **High Complexity with Fourteen Plus Layers** require sophisticated technology and skills to produce and are generally used in very high-end electronics products such as telecom switches, high-end computing, backplanes for defense and other applications. The end-market segments in which they are used include Telecom/Datacom infrastructure and Computers. They are produced in North America and Europe and increasingly in Asia-Pacific. This segment is mostly dominated by global players and account for about 13% of the worldwide market and is likely to grow between 12% to 14% compound annual rate from 2001 to 2005. Most of the consumption of these products today is in the United States, Japan and Europe.

27. Increasingly, the production of printed circuit is shifting to China and may reach 16% to 20% percent of the world production by 2005. Thailand is also a strong player in this market because of inexpensive labor and other tax incentives. While the Philippines theoretically is considered an ideal place for production of Printed Circuit Boards, it is puzzling to see some of the PCB companies move out of the Philippines in recent past.

28. When the Free Trade Zone Authorities were questioned as to why the PCB companies had stopped production in the Philippines, the FIAS Team did not get any satisfactory answers. One possible explanation could be that, since the current electronics production in the Philippines is so concentrated within the semiconductor APT, little demand exists for PCBs from the other sectors of the electronics industry. As a result, the PCB production in the Philippines cannot be done competitively at these scales. However, if the contract manufacturing and assembly segments in the Philippines grew, significant new demand for PCBs can be generated and manufacturing of PCBs could be competitive in the Philippines. The Indian PCB industry has been growing at the rate of 20% in the past two years and is likely to accelerate or continue this rate in the near future. This is an area where the Philippines certainly has significant opportunities as explained earlier. Production of PCBs is labor-intensive and this will play to the strength of the Philippines. In addition, there has been a history of successful PCB

production in the Philippines and can be reinvigorated with focus on and the development of local demand.

2.5. Displays

29. The two segments in the Electronic Display area are differentiated by technology – the older traditional display technology involving picture tubes and the newer display technologies of the flat panel kind.

- **Traditional Display Technologies** like Cathode Ray Tubes (CRTs) or the Color Picture Tube (CPTs), are primarily used today in computing technologies and consumer electronics. These display devices are currently produced in Asia or Latin America, primarily in Mexico. This is a consolidated market comprising of large Asian and West European players. There are few regional players in China and Thailand. The worldwide production of the traditional displays account for about \$28 billion in production, representing about 61% of the total display market. However, the market is rapidly moving towards the newer display technologies and growth in this market is expected to be less than 10% in the coming years. The major consideration for production of the traditional displays is proximity to the market because of the significant transportation costs.
- **Emerging Technologies Displays/Flat Panel Displays** like Thin Film Technology Liquid Crystal Displays (LCDs) Plasma Displays for HDTV, Organic Light Emitting Diodes (OLEDs) and others. These displays are primarily used in computing particularly mobile computing, handheld devices, automotive displays, and, to a lesser extent, in other applications. Japan, Korea, and Taiwan are the major producers of these displays and the production of these flat panel displays is increasingly moving to China. This is a consolidated market of large global players mostly headquartered in Asia and some newer players in China. The worldwide production of flat panel displays was about \$18 billion in 2001, accounting for less than 40% of the total display market. However, this segment is likely to grow faster in the coming years, increasing at a rate of over 20% and the production of these is likely to grow much faster in the developing countries.

30. Currently, the manufacturing of displays is concentrated in South Korea and Taiwan, which account for more than 95% of the total production. China is expected to produce over \$5 billion in displays by 2005. The Philippines would have a good opportunity to participate in this segment, particularly the flat panel displays. The market for traditional displays, particularly computer displays, is under tremendous price pressure due to over-capacity and technology obsolescence, which caused the shutdown of 33 production lines in developed countries in 2001. Present manufacturers of traditional displays are moving capacity to China (18 lines), Thailand (1 line) and Mexico (2 lines) and Eastern Europe (2 lines). The Philippines would be a good target location for the production of displays due to the increasing demand and extreme price pressures. With the trend of these production lines moving to other locations like China, Thailand, Mexico and Eastern Europe, there is no reason why the Philippines cannot position to get its share of the display production business.

2.6. Connectors

31. The two segments of the connectors/cables are also differentiated by technology types—the commodity connectors and the non-commodity connectors.

- **Commodity Connectors** are generally used in consumer electronics, handheld devices except those with cutting edge input/output and radio frequency connections, telecommunications and lower end computers. These are generally produced in East Asia (most notably in Malaysia and China), in Eastern Europe and in Latin America (most notably in Mexico). The market is dominated by large global players such as Molex, Tyco, FCI and others. Additionally, a large number of medium-sized and small local players also participate in the commodity connector marketplace. Over 70% of the connector market in 2001 was for the commodity type connectors and they were generally consumed in the developing countries.
- **Non-Commodity Connectors** are generally used in industrial electronic products, aerospace, automotive electronics applications, higher end handheld devices using cutting edge input/output connections or radio frequency connections, and high-end computing applications such as servers. They are generally produced in Japan, the USA and Western Europe; however, the production recently has begun shifting to the developing countries. This market is dominated by the global players mentioned above and very few medium-sized local players. These non-commodity connectors account for less than 30% of the market in 2001 and were consumed mostly in the developed nations such as the USA, Japan and Western Europe. The non-commodity connectors market is likely to grow faster than the commodity connector market place at about 15% compound annual growth rate.

32. With the connector production shifting increasingly to the developing countries, Philippines certainly stands a good chance of attracting such production. Development of production capacity for the connector production within the electronics value chain is not extremely high and can be promoted by the Philippine entrepreneurs. Additionally, some of the backward linkages required for successful connector production like tool and die making exist in adequate quantity in the Philippines to get connector manufacturing started in the Philippines.

2.7. Batteries

33. The segmentation in the battery market is based upon dual criteria – technology and end-use market. There are segments within the battery market – single use zinc carbon/alkaline batteries, rechargeable lead acid batteries, rechargeable nickel or lithium based batteries.

- **Single use zinc-carbon or alkaline batteries** are used in consumer electronics, handheld devices, and medical and industrial electronics equipment. Production of zinc-carbon batteries is very heavily concentrated in the developing countries, while the production of alkaline batteries is heavily concentrated in the developed countries. Major locations for the production of alkaline batteries are Japan, Europe, the US and increasingly China. These batteries constitute over a third of the total battery market with a production value

of about \$16 billion in 2001. The growth rate for this category of batteries is not expected to exceed 10 percent.

- **Rechargeable lead acid batteries** are generally used in automotive application; however, they are also used for standby power applications for computers as battery backup power devices. These are produced all around the world, close to the consumption centers because of their weight. The market is dominated by some large global players, many of which are automotive OEMs like Johnson Controls and Delphi. These batteries also constitute over a third of the battery market, a third of which are produced in the developing countries. This is a low-growth battery segment, where growth rates are expected to be less than 7 percent.
- **Rechargeable nickel or lithium batteries** are used in almost all consumer electronics like digital cameras, handheld devices like mobile phones and PDAs and notebook computers. The market is dominated by some global players and local players. Production takes place generally in Japan, Europe, Asia Pacific and China. This is an area of high growth, with growth rates expected to be more than 30 percent.

34. China is likely to emerge as a major global player in the production of batteries, with more than 30 percent of the market share by 2005. Compound annual growth rates for China are projected to be over 13 percent, as against 5 percent in the developed nations. Mexico has sizeable battery exports, and so does the Czech Republic in Eastern Europe. The Philippines can certainly participate in this growth market for rechargeable batteries by attracting production of major battery manufacturers. Continuous growth and price pressures would be the reasons for such companies to look for alternate locations. If local demand for rechargeable batteries could be developed in the Philippines through the creation of a contract manufacturing business, then it would become an attractive location for the production of rechargeable batteries.

2.8. Enclosures

35. The segmentation of the market in the enclosures is based upon technology type – low volume non-commodity customized enclosures and high volume commodity enclosures.

- **Low volume non-commoditized/customized enclosures** are generally used in aerospace electronics devices, industrial electronics devices and automotive electronics devices. The production of these devices is primarily in the developing countries such as Russia, Eastern Europe and Latin America, most notably Brazil. Some specialized global players dominate this market such as Pentair Inc. and Tesla in the Czech Republic. The consumption of these enclosures is generally in the developed countries. It is a moderate-growth market with growth rates projected to be around 8 percent.
- **High volume commodity enclosures** are generally used in almost all end-user segments of the electronics industry. The production of the high volume commodity enclosures is dominant in East Asia, most notably in China, Philippines, and Malaysia, Eastern Europe and Latin America, particularly Mexico. Global players like Flextronics and some local players like Plastronics Enclosures, Inc. operate in this market. There are numerous technologies like plastic injection molding,

aluminum die casting, and sheet metal forming that are involved in the production of these enclosures. The total market size for such enclosures is large and stood at over \$28 billion in 2001. The growth rates projected for this segment are between 8 to 10 percent compound annual growth rate between 2001 and 2005.

36. There will be a growing demand for low-volume high margin customized enclosures. Such enclosures have complex mechanical/physical properties – temperature/pressure controls, EMI Shielding. Manufacture of these often requires skilled manual operations. There may be significant opportunities for Philippines in the manufacturing of such enclosures. Today the Philippines has the skills and capabilities to produce these enclosures as we have seen during our visits to various units in the country. Significant further growth is constrained by the lack of local demand. This demand can be created through development of local contract manufacturing industry.

2.9. Assembly Services

37. The market segmentation for PC Board Assembly Services is based on end-use markets and volume of production. The segments in this value-added activity with the electronics value chain are: High Volume Low Mix Assembly, High/Medium Volume Medium Mix Assembly, and High Mix Low Volume Assembly. Value added in this segment of the Electronics Value Chain is moderate and expected to grow significantly in the future. The total value added for Contract Electronics Manufacturers in 2001 was about \$26.5 billion excluding the value added by the in-house operations of OEM. The Assembly Services Value Added of in-house OEM operations was twice that of the assembly contracted out at \$51.4 billion.

- **High Volume Low Mix Assembly** is generally done for computers and peripherals, handheld devices, and consumer electronics. The production of these types of devices is concentrated in the developing countries like China, East Asia like Taiwan, Malaysia, Indonesia, and some in Philippines, Latin America most notably in Mexico and Brazil, and Eastern Europe most notably in Hungary and the Czech Republic. A large mix of players are participating in this segment including major global players such as Flextronics, Taiwanese original design manufacturers such as Quanta and Inventec, Asian contract electronic manufacturers such as WKK and Global and Local OEM's. More than two thirds of such assembly takes place in low labor countries as mentioned above. This activity in the developing countries was at a level of about \$16.5 billion for CEM's and about \$ 51.4 billion for the in house operations of OEM's. It is expected to accelerate and grow at the rate of between 22 to 30 percent during the 2001 to 2005 period.
- **High/Medium Volume and Medium Mix Assembly** generally applies to Telecom/Datacom Infrastructure Equipment and Automotive Electronics Equipment. The lower end products are primarily assembled in China, East Asia such as Taiwan, Malaysia and Eastern Europe such as Hungary. The higher end products are assembled in the developed countries such as the US, Japan and Western Europe. The same set of players operates in this market as in the category above. In 2001 this market was at a level of \$7 billion for CEM's and a level of \$18.6 billion for in-house operations of OEM's. It is seen to grow at very high growth rates in the developing countries in the next few years.

- **High Mix Low Volume Assembly** generally applies to Medical Electronics Equipment, Aerospace/Defense Electronics Equipment, and Industrial/Utilities Electronics Equipment. These are generally produced in the developed countries like the US, Japan, Western Europe and some in Taiwan. Global CEM's and specialized CEM's such as Plexus and OEM's and Tier one suppliers participate in this segment. Worldwide CEM production value-added in this segment in 2001 was about \$3.5 billion and the OEM production value-added was \$16 billion. Growth in this segment in the developing world during the next years is likely to be very robust and range between 22 to 26 percent compound annual growth rate.

38. Because of price pressures and mounting competitiveness, the Assembly Services segment is likely to move to the low-cost regions of the developing countries. The Philippines certainly has very good opportunities in this segment of the electronics value chain as more and more companies seek lower cost assembly services. The Philippines can position itself in this segment through offering lower cost manufacturing with English-speaking workers—the production documents of large multinationals do not have to be translated in Chinese or any other language to be understood by the workers. The Philippines can also position itself to offer better intellectual property protection than others in the region. Finally, the Philippines can offer better supply chain support to the customers because of the presence of major supply chain majors in the Philippines. These would be three distinct advantages that the Philippines can offer to a potential Assembly Services Customer.

2.10. Other Electronics Value Chain Services

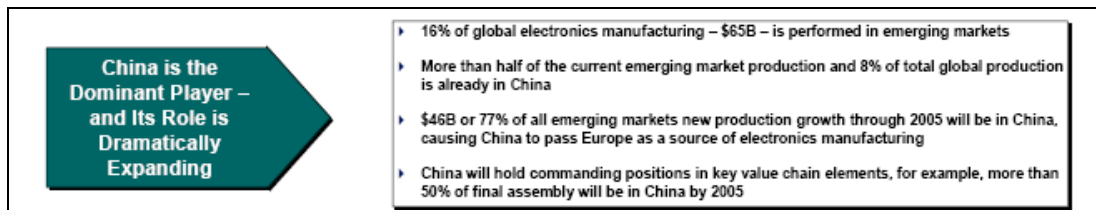
39. This area covers semiconductor and component design services, maintenance, system engineering, product design and other support services such as fulfillment services. The segmentation in this services market is along two lines – components/semiconductor design and automation services and system engineering, product design, and fulfillment services.

- **Components/Semiconductors Design and Automation Services** are used by all segments of the electronics end-user markets. These are mostly provided by companies in the US, Western Europe, Japan, East Asia such as Taiwan, Malaysia and Singapore, India and China. These services are provided by Electronic Design Automation/Services Companies (EDA/EDS), and by Intellectual Property Houses. Generally they are smaller boutique shops with very high value-added content. Worldwide value added by this segment in 2001 was about \$7 billion and likely to grow in the developing countries by 33 to 45 percent during the 2001 to 2005 time period. A lot of this activity is migrating to lower cost countries because of time to market, cost and availability of talent reasons.
- **Systems Engineering, Product Design and Fulfillment Services** are also used by all end-user market segments of the electronics industry. In addition to the locations mentioned above, these services are also available in Eastern Europe most notably Hungary and Czech Republic. These services are provided increasingly by CEM's, ODM's and global semiconductor equipment manufacturers. The worldwide value added of these activities in 2001 was about \$6.6 billion and is expected to grow at the rate of 32 to 39 percent in the developing countries.

40. These are very high value-added activities and for all the reasons mentioned above, they are moving to the developing countries. The Philippines has a good opportunity to capitalize on this market because of the availability of good, English speaking and well trained engineers. While some companies in the Philippines are making efforts to position themselves in this segment, they require more marketing and sales support to create a critical mass of companies that are well recognized in the world market.

2.11. Implications of Global Electronics Industry Trends on Philippines Electronics Industry/Linkages

41. The electronics industry is a global industry with intense competition, rapidly declining prices, rapid technology development, cyclic customer demand and constrained material supplies. The search for better margins leads to a continuous stream of new products, each able to command a premium price for a short period before becoming commoditized. This challenging cycle requires firms to be continually innovative, more flexible and efficient in order to compete effectively globally.



Source: IFC/Booz-Allen-Hamilton, 2003.

42. Many original equipment manufacturers (OEMs) have outsourced elements of their manufacturing to Electronics Manufacturing Services (EMS) providers in order to gain economies of scale, and share R&D costs across product lines. These EMS providers themselves have moved manufacturing activity to low-cost locations. A similar trend has occurred in semiconductor manufacture. Distributors currently source most of their component purchases from key locations globally. This increase in globalization and off-shoring over the past few years has led to disaggregation of the electronics supply chain, and put significant pressure on the industry and the SME community in particular.

43. Major parts of the supply chain do not reside in the Philippines and, unless a technology is developed in the country that makes it commercially viable to bring these elements of production to the Philippines, they will continue to remain outside the country or locate to the most competitive country in the region, China. Analyses of the information provided about the structure and developments in the global electronics equipment production industry, several observations as follows can be safely made:

- After a couple of years of negative growth and stagnation, the growth in the worldwide electronics industry has resumed. This growth will continue at brisk pace at least for the next couple of years.
- Not all segments and sub-segments of the electronics industry value chain offer opportunities for the developing countries. There are some in which production is likely

to continue to be prevalent in the developed countries, while for others the potential would exist for substantial delocalization to developing countries.

- There are several segments and sub-segments of the electronics industry value chain that offer substantial growth opportunities for developing countries.
- Labor costs alone will not be the sole criteria for companies to locate new plants or expansions of production in the electronics value chain. Proximity to the other elements of the value chain, access to local and regional markets, availability and trainability of the labor force, and ease of operations would be the other criteria for companies to select one location for production over others.

Engineering and Design Labor Costs Drop by 60-90% In Emerging Markets

- ▶ Developing countries, particularly India, China, and Russia, have an abundance of highly trained technically qualified labor
- ▶ Labor for higher order functions, such as design services and engineering have begun to migrate to developing countries
- ▶ The migration will accelerate, driven by much lower salaries (up to 90% below developed world), benefits and recruiting costs
- ▶ Driven by compelling economics, engineering and design functions will increasingly move to developing countries over the next five years, although the transition will trail the more rapid shift in production


- While China is certainly a major destination for various segments and sub-segments of the electronics value chain, it is not the only destination for growth and new investments. Opportunities will exist for other developing nations to participate in these segments and sub-segments of the electronics value chain.

44. Within this framework, the following segments and sub-segments of the electronics equipment production value chain offer the greatest opportunity for developing nations seeking to attract electronics manufacturing to their shores. These same segments also represent the greatest possibilities for the Philippines to participate in and explore greater opportunities to develop spillovers into the local economy. These observations are based on a review of the Philippine electronics industry, investment requirements within the sub-segment and the capabilities of the Philippine entrepreneur to handle these opportunities, trends towards offshoring these sub-segments and the demand and price pressures in these sub-segments.

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1. Assembly, Packaging and Testing of Semiconductors
Passive Components
 - Commoditized
 - Less Commoditized/SpecializedPrinted Circuit Board
 - Microvia
 - Low Complexity One to Eight Layers
 - Mild Complexity Eight to Fourteen Layers
 - High Complexity Greater than Fourteen Layers
 2. Displays
 - Flat Panel DisplaysConnectors
 - Commoditized
 - Non Commoditized/Specialized

- Batteries
 - Rechargeable Nickel/Lithium Batteries
- Enclosures
 - Low Volume Non Commoditized/Customized
 - High Volume Commoditized
- Printed Circuit Board Assembly Services
 - High Volume Low Mix Assembly
 - High/Medium Volume Medium Mix Assembly
 - High Mix Low Volume Assembly
- 3. Other Electronic Value Chain Services
 - Component/Semiconductor Design Automation Services
 - Systems Engineering, Product Design and Fulfillment Services

45. Growth for developing countries in the various segments of the electronics industry value chain is expected to be about \$60 billion a year representing a compound annual growth of over 18 percent. These estimates exclude Korea, Taiwan and Singapore; however, they include China. More than 75 percent of this growth will come from China, and only about 12 percent or about \$7 billion in additional production will come from Asia Pacific, primarily Malaysia, Thailand and the Philippines. The rest will come from Eastern Europe and some parts of Latin America. ²

 <p>Source: Booz Allen Hamilton</p>	<ul style="list-style-type: none"> ▶ Production at the lowest cost is required to survive in hyper-competitive electronics markets ▶ Over time, developing countries gain the ability to perform higher value added services (for example: design, testing, customer care) , which are also beginning to follow the same pattern --- countries like China are also now increasingly important end markets ▶ Low cost production bases are used both for exports and to serve indigenous markets ▶ As suppliers become more plentiful, both the ability to serve local customers and the ability to reduce costs is increased creating competitive advantages that are difficult to duplicate in countries with lower end user demand levels
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46. China is expected to evolve into a major hub of manufacturing for electronics equipment in the coming three years growing at the rate of 24 percent compound annual growth rate. This growth will be driven by the following:³

- Assembly of Printed Circuit Boards
- Manufacturing of Displays
- Fabrication, Assembly, Packaging and Testing of Semiconductors

47. Assembly of Printed Circuit Boards and Assembly, Packaging and Testing of Semiconductors could be the engines of growth for the Philippines electronics industry. Once these segments of the value chain are in place, they would provide impetus for other segments to locate there as they provide the demand pull for the other segments. For example, if a location begins major Semiconductor APT operations, it would lead to demand for lead frames, enclosures, etc. If another location starts assembly of printed circuit boards, it naturally give rise to the demand for printed circuit boards, semiconductors, passive components, enclosures, displays, connectors, batteries, and a host of other services.

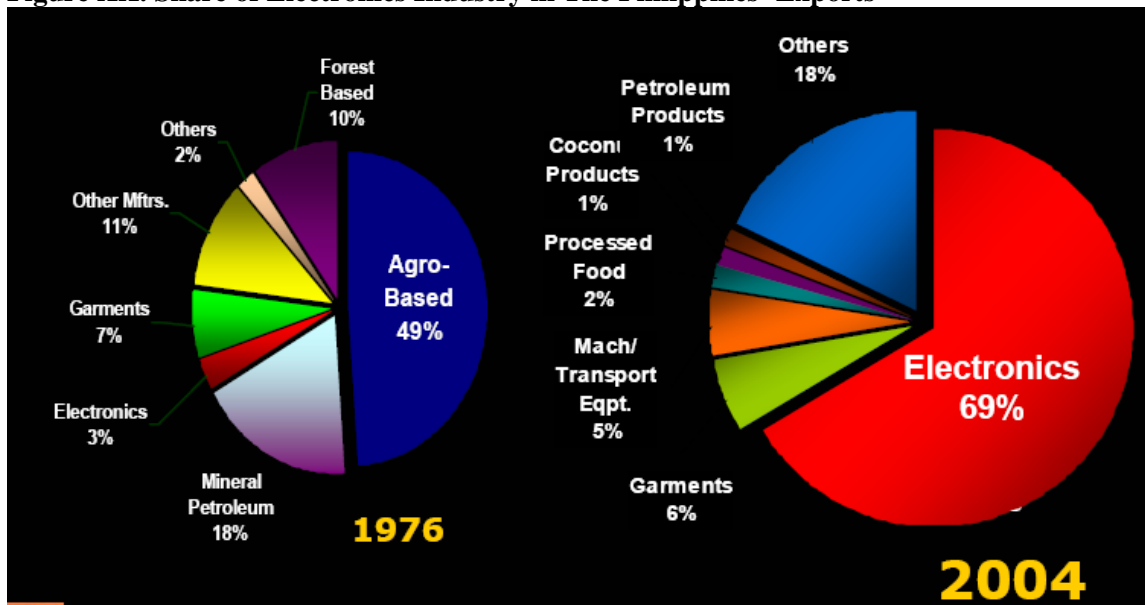
² International Finance Corporation, Booz- Allen-Hamilton, 2003

³ *ibid.*

3. The Philippines electronics industry structure

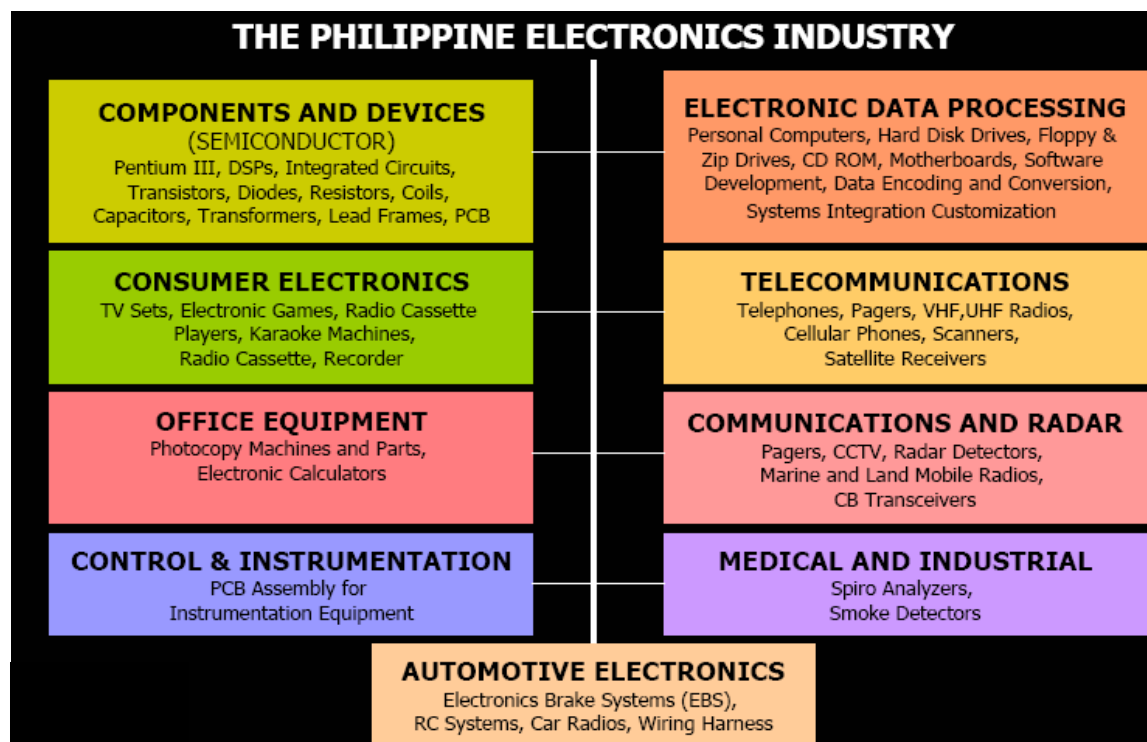
48. The Philippine Electronics Industry is the driver of the Philippine economy accounting for almost 70 percent of its total exports with a value of US\$26.64 billion in 2004. It is expected to grow by 5 percent in 2005. The sector employs over 376,000 people showing remarkable growth since 1995 when the employment in the sector was less than 100,000. As of 2004, there were 860 firms operating in the sector, 72 percent of them foreign owned. Japanese companies account for 30 percent of the foreign firms. Korean, American, and European companies each constitute roughly about 7 percent of the electronics companies. There is a sizeable number of Taiwanese, Singaporean and Malaysian owned firms and the rest, about 28 percent, are all Filipino owned firms.

Figure XX. Share of Electronics Industry in The Philippines' Exports



Source: SEIPI, 2005

The Philippine electronics industry is essentially engaged in assembly and test manufacturing of a range of electronics goods. They are generally very labor intensive and technical in nature. The industry is primarily export oriented, dominated by multinational companies, producing high quality products with global productivity levels and with a growing base of local component suppliers.



Source: SEIPI, 2005

49. The largest concentration of the electronics firms in the Philippines is in the Calabarzon area with 342 companies, followed by Metro Manila with 303 firms. Cebu has 24 companies, and Northern and Central Luzon had 21 companies as of December 2001.

50. The Electronics Industry within the Philippines is very heavily weighted towards Semiconductor Assembly, Packaging and Testing – over 70 percent of the revenues of the electronics industry come from this sector. The following Table gives the breakdown of the percentages contributed by the various end user segments of the electronics industry.

3.1. Breakdown of Philippines Electronics Production by End User Segments in 2001

<u>End User Segment</u>	<u>Total Dollar Value(B) 2001</u>	<u>Percentage of Total</u>
Semiconductor APT	15.500	70.7
Computers and Peripherals	3.810	17.5
Office Equipment	1.400	6.4
Communications & Radars	0.530	2.4
Consumer Electronics	0.380	1.7
Telecommunications	0.220	1.0
Medical and Instrumentation	0.005	0.2
Controls and Instrumentation	0.002	0.1
Totals	21.900	100.0

Source: SEIPI, Philippines

51. Recognizing that the Philippines Electronics Production is very much biased in favor of semiconductor assembly, packaging and testing, SEIPI has rightly suggested in its strategy for growth that the future driver of the Philippine Electronics Industry has to be Contract Electronics

Manufacturing, which starts out with Printed Circuit Board Assembly. The good news is that many Filipino Electronics firms have recognized this and are moving in that direction—there is already a base of such manufacturing in the Philippines that may be leveraged.

52. The major strength of the electronics sector in the Philippines comes from the fact that there is a labor force of 32 million people in the Philippines with about 100,000 engineering, IT and technical graduates every year. This labor force is cost competitive, trainable and technically capable and flexible. Above all, a large number of these workers speak English.

53. A typical electronics company in the Philippines is ISO certified and generally practices well known quality programs and adopts best known methods in manufacturing such as JIT, TQM, 5S and QPIC. Their capabilities range from Integrated Circuit (IC) packaging, Printed Circuit board assembly and testing to full product assembly. They generally operate in essentially all end user segments of the electronics industry such as the following:

- Components and Devices such as Integrated Circuits (IC's) and semiconductors
- Consumer Electronics such as TV sets electronics games, etc.
- Office Equipment such as calculators, copying machines, etc.
- Controls and Instruments
- Electronics Data Processing such as personal computers, disk drives, etc.
- Telecommunications such as telephone handsets, cellular telephones, pagers, etc.
- Communications and Radar Equipment such as CB radios, radar detectors, etc.
- Medical and Industrial Electronics Products such as smoke detectors, etc.
- Automotive Electronics such as Electronic Brake Systems, car radios, wire harness, etc.

54. Generally the companies work three shifts and provide better compensation packages than the rest of the Philippine industry. For the most part, the labor is non-unionized and has low turnover rates. Most of these companies are located in the Economic Zones or are registered with the Board of Investments. Many operate with Clean Room technologies and generally have integrated manufacturing facilities.

55. There is a critical mass of global electronics companies operating in the Philippines such as Intel, Texas Instruments, Analog Devices, Toshiba, NEC, Cypress Semiconductor, AMI, Ionics, Fujitsu, Hitachi, Mitsumi, and Remec. Largest revenues are generated in the Semiconductor Assembly Packaging and testing segment followed by Printed Circuit Board Assembly Services. These companies are adequately supported by availability of local components and other inputs required for production.

56. Foreign companies have been increasing their investments in the Philippines, growing from a small base of \$40 million in 1992 to a level of over \$2 billion in the year 1995 after which it stabilized at around a billion dollars for the next five years. Since 2002, investments have dropped due to the decline in the global electronics industry.

3.2. The Philippines' Position in the Global Electronics Value Chain

57. As large as the Philippine Electronics Industry is and as important a sector as it is the Philippine economy, a closer look at the activities that the Philippine electronics companies engage in will reveal that they operate in a very narrow spectrum of the electronics equipment production value chain. The following Table summarizes the activities within the Electronics Industry Value Chain that Philippine companies engage in.

3.3. Philippines' Participation in the Electronics Value Chain

<u>Value Added Activity</u>	<u>% Value Added Globally</u>	<u>Filipino Philippine Participation</u>
Production Equipment	7.0	None
Semiconductors	35.0	5% of 35% only APT
Passive Components	5.5	Minimal
Printed Circuit Board	7.5	Minimal
Displays	11.0	Minimal
Connectors/Cables	6.0	Minimal
Batteries	11.0	None
Enclosures	7.0	6% Yes
Assembly Services	6.5	6% Yes
Other Services such as Design Services	3.5	Minimal
Totals	100.0	<15%*

** These estimates are not scientifically derived. They are the author's estimates based on interviews with individual associations and companies.*

58. This table is supported by an analysis of the "Buyer's Guide" published by the Semiconductor and Electronics Industries in the Philippines, Inc. (SEIPI). This analysis showed the following:

- There were 27 manufacturing Equipment Suppliers listed and none was producing manufacturing equipment locally.
There were three suppliers listed for passive components; none of them produced passive components locally. All the components were imported.
There was one producer for printed circuit board listed. Very few circuit boards are locally produced at this time.
There were six suppliers of Lead Frames used in semiconductor packaging operations.

There were several companies listed which provided support services and packaging materials. The support services provided, while very important, are lower value added services compared to the design services.

59. The Table above and an analysis of the SEIPI Buyer's Guide clearly illustrates that the Philippine Electronics industry operates in a very narrow spectrum of the electronics industry; its participation represents less than 15 percent of the total electronics equipment production value chain. Unless the Philippines increases its participation in other segments of the value chain, it would be difficult for it to significantly increase its profitable participation in the global electronics industry.

3.2. Main Findings⁴

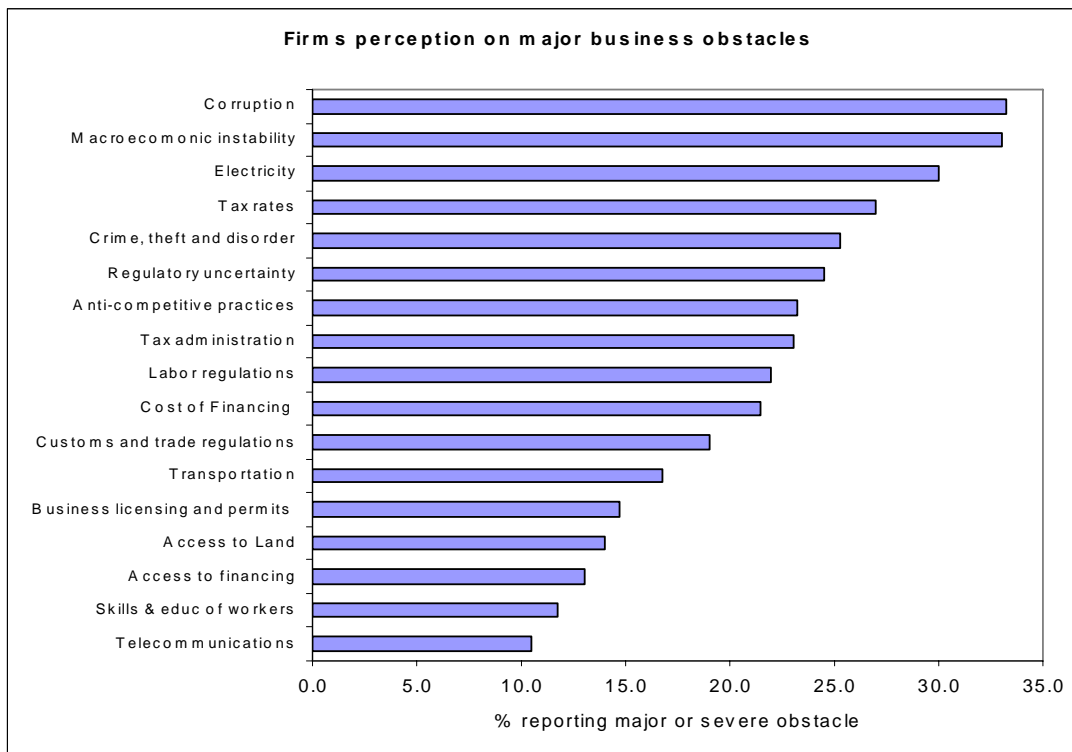
From an end user standpoint the Philippines Electronics industry produces goods for a wide range of end user segments such as computers, telecommunications, automotive, etc. However, analysis of the Philippines Electronics Industry from the point of participation in the Electronics Industry Value Added Chain indicates that it primarily operates in a very narrow range of the industry. Its principal participation is in the semiconductor Assembly, Packaging and Testing (APT) which constitutes about 5% of the total electronics industry manufacturing value chain. It peripherally participates in printed circuit board assembly (EMS) and Enclosures (plastics, sheet metal, etc.) accounting for another 10% of the electronics industry value-added chain. Thus, it would be fair to suggest that the Philippines' participation the electronics industry value-added chain is less than 15%. This very narrow participation leaves the Philippines very vulnerable to eroding participation in the worldwide electronics industry and stagnation even in the major segment that it participates in, semiconductor APT. It also limits opportunities for spillovers into the local economy. Within this framework, the following represent the key findings of this study:

There is a need for immediate focus on microeconomic constraints in the investment climate. The three biggest problems in doing business in the Philippines, in descending order, are corruption, inefficient bureaucracy and inadequate infrastructure. In all six corruption-related categories, the Philippines scores significantly below the other 10 East Asian nations. Additionally, with only a couple of exceptions, with Vietnam and Indonesia at the same level or worse, the Philippines had the worst indicators for bureaucratic procedures and contract enforcement and law. It also did badly in terms of business costs associated with petty crime and extortion-oriented organized crime.

According to the recent ADB-World Bank investment climate survey (2005), "costs relating to unreliable infrastructure, contract enforcement, crime and security, bribes and regulatory compliance add up to as much as 26% of sales, considerably higher than in Indonesia or China. Poor infrastructure imposes the biggest costs, with power and transport being the key cost drivers. Concerns of firms regarding costs, complexity and uncertainty in contract enforcement are also supported by the World Bank's doing business indicators – Philippines was

⁴ Team findings are based on a two week field visit to the Philippines as well as an interim workshop to discuss preliminary findings, several meetings with Government Officials, Industry Associations and several multinational and domestic companies in the electronics sector, and overview of the currently available reports and studies done on the sector,

viewed as providing a less certain environment in comparison to Indonesia, Thailand, China and Malaysia. The survey showed that small firms were more severely affected. As a percent of sales, these unproductive costs were twice that of large firms”. The figure below shows enterprise perceptions on business costs in the Philippines.



The Philippines also performs poorly in infrastructure. It ranks last, joint last or second last on all indicators of infrastructure quality, railroad development, port quality, air transport, infrastructure supply and availability of new telephone lines for business. These deficiencies are reflected in data on utility costs – particularly the cost of electrical power and Internet use (Table 3.4). Its electricity costs are the highest in the region⁵; transport costs are relatively high because of poor roads. In general, “infrastructure expenditures (at 2.8 percent of GDP in 2002) are well below the 5 percent benchmark, and also low compared to other countries” (ADB, 2005). High electricity costs are particularly important for the development of the electronics sector, the most important area of MNC activity in the Philippines.

Communications between major manufacturers and their local suppliers is improving. During our Mission to the Philippines, the FIAS Team discovered that adequate linkages exist between the manufacturing companies and suppliers of the custom components and services in the value chain segments in which the Philippine electronics industry participates. This was based on interviews with the companies and through discussions with the Industry Associations. The private sector, Philippines Electronics Industry, is recently doing a credible

⁵ According to the ADB (2005), these are due to “inefficient over-investments in generation, insufficient expansion of transmission, and lack of investment in distribution [that] have caused excess generation capacity in the Luzon grid but sporadic shortages in the Visayas and Mindanao grids.” Setting the price of power below costs has led to ballooning deficits in the power suppliers.

job of bringing major buyers and suppliers together. A significant credit for this effort goes to the Semiconductor and Electronics Industries in the Philippines (SEIPI),; Department of Trade and Industry (DTI); and several other smaller industry associations such as the Electronics Industry Association of the Philippines (EIAPI). One example of recent efforts to strengthen communications between multinational and local suppliers was the jointly organized (DTI and SEIPI) “Industry Link”, a Trade Fair in Manila in April 2004. The two-day event brought buyers and supplier within the electronics value chain together to exchange information on the needs of buyers and on what is available locally. The event was well organized with several seminars scheduled to discuss various issues in buying and selling, logistics, etc.. Many companies exhibited their products during the fair and there was very lively interchange of ideas between buyers and suppliers. The findings during the exhibit suggest that improved interchange and exchange of ideas between the buyers and suppliers enhances opportunities for linkages development.

The study team was also present at the Annual General Meeting of the Electronics Industries Association of the Philippines, Inc. (EIAPI). At this meeting, in addition to the general membership of EIAPI, presidents of many other associations linked to the electronics value chain like the Integrated Telecommunications Suppliers Association of the Philippines (ITESAP), Philippine Die and Mold Association, Industrial Automation Association and others were invited. During this meeting, the FIAS Team witnessed a fruitful discussion among the various industry participants and came back with a distinct feeling that the communication between the various participants of the electronics value chain was very open, frequent and meaningful.

However, discussions with various Government Agencies and some industry groups suggest a quite different perception-- that there are limited linkages with the local economy in the country. While it may have been true in the past that there were limited spillovers from the electronics industry, linkages with the local economy have strengthened in the last 5 years in many of the segments within which the Philippines electronics industry participates. Another explanation for the varying perception could be that there is not enough clarity that suppliers would follow demand and global production chains of firms. Within this perspective, the following sections note these different perceptions and contrasts them with our findings:

- **Local Materials Are Not Available** -- Interviews with firms and associations suggest that most of the local manufacturers were generally satisfied with the availability of the customized components, primarily enclosures and some assembly services that they are buying locally. In many instances, the companies that could increase their local purchases were restricted by headquarters because the parent company had a global buying program requiring them to import from certified global suppliers even those items that were locally available. In some cases, corporate buying strategies rather than the local availability of many components and services is the main constraint in increasing the linkages within the Philippine Electronics Value Chain. This situation can be improved only if the Philippine suppliers could become global suppliers for these MNC’s. Several of these Philippine suppliers have started to position themselves to become global suppliers to these companies operating in many locations; however, the process of getting approved as global suppliers for these MNC’s is painstakingly slow and costly.

The Philippine's participation in the electronics value chain, however, is not optimal in many segments, such as semiconductors, passive components, printed circuit boards, displays, connectors, and batteries. SEIPI is well aware of this and has plans to address this issue in their roadmap for world competitiveness. However, this is an issue that needs to be addressed at the highest level of the Government by identifying the key variables and investment climate issues in order to develop a competitive environment for areas that could be attracted to the Philippines for production, as well as for local firms to enhance their capabilities. The question is which of these segments mentioned above could Philippines attract and in what order and what should be the strategy to attract them to the Philippines? Based on our interaction with the Industry and the Government officials, it seems that the major focus at this time is to attract semiconductor fabrication to the Philippines. Such a strategy should be very carefully designed and reviewed, and other alternatives should be fully explored before moving forward. These alternatives have been mentioned in the discussions above.

- **Local Suppliers are Difficult to Find** – Our findings are contrary to this. Generally we found a high degree of satisfaction among the manufacturers that knew of the local suppliers; the recent work done by organizations such as SEIPI and EAAPI is commendable in bringing suppliers and manufacturers together. In addition, there seems to be a great deal of interaction going on between the supplier and buyer associations. However, our meetings with smaller firms suggest that there exist information gaps especially for smaller suppliers on buying behavior of large and multinational firms. This information gap can be filled with supplier development and linkage programs modeled on good practice experience such as the Irish National Linkage program.

Box 9: Ireland's National Linkage Program

Ireland's National Linkage Program (NLP) was launched in 1995 and upgraded in 1998. It is currently staffed by around 15 people. The program was originally envisaged as a brokerage service with the aim of increasing the extent of local sourcing by foreign multinationals. It soon became apparent however that local companies (LCs) faced problems with respect to deficiencies in technical competence and a low scale of production, making it difficult to meet the volume requirements for sub-supply.

The early NLP involved six key elements:

- Mobilisation of goodwill and specific resources in MNCs to assist targeted companies
- Identification of target LCs with the potential to trade with MNCs and to export
- Coordination between MNCs and state development agencies to support the chosen LCs
- Identification of targets for the designated LCs
- Provision of resources by MNCs and state agencies to address these issues
- Coordination of the overall programme by Ireland's Industrial Development Agency (IDA).

The programme was initially headed from outside the industrial development agency structure by a private sector entrepreneur who was seen as having market credibility. The other staff members were seconded from the IDA and other state agencies. To avoid the possibility of political controversy over the policy of focusing on a small number of firms, the NLP established and maintained a database of potential supplier firms, on which any firm in Ireland was eligible to be included.

The programme began by surveying SMEs to identify the constraints and problems they faced in working with multinational companies. It then proceeded to identify LCs with sub-supply potential. The most important criterion employed was the attitude of the firm's management team. Specifically, the NLP looked for management that was forward thinking, ambitious, and dynamic. The main support methods used were intensive development plans for suppliers, close cooperation with selected SMEs and detailed and continuous surveys of MNC requirements.

On the MNC side, the communications building approach taken was to engage MNCs in the process of linkage development by assisting them in building their *European* sub-supply chains generally, and within that context, identifying potential within Ireland. This European rather than national approach meant that the MNCs did not see the programme as constraining them, but rather as providing further support for them, reinforcing their willingness to become involved with it. A further advantage of the approach was that it allowed contact to be made and information to be collected on MNC requirements as Irish LCs were building up technical capability.

Target industries included electronics, engineering, health care, and metal and plastic components. On the issue of scale, NLP executives, emphasising the need for metal and plastic component suppliers to co-operate, played a role in 'marrying' specialised supplier companies, to create single companies with a range of capabilities.

Setting up partnerships between SMEs and MNCs required milestones and targets. It was important to find out the purchasing specifications of MNCs planning investments in Ireland. Enterprise Ireland (until recently a branch of the main Industrial Development Agency) was instrumental in gathering this information, which became crucial inputs for supplier audits and supplier training. A crucial element was trial orders that helped SMEs to work with MNCs and to follow them as they entered other markets.

Since the program was established, foreign affiliates have increased their local content substantially. Suppliers in turn have seen their sales rise by 83%, productivity by 36% and employment by 33%.

Outsourcing by TNCs has grown significantly of course since the 1990s and linkage policies have developed in tandem with the increased globalisation of the sub-supply industry and the changing capacity and capability of local companies.

By 1997, with the advanced globalisation of the electronics sector, policy makers were led to question the precise meaning of local linkages. Various different strategies have since been used to assist in the globalisation of the local sub-supply industry, to help it to achieve the capacity for survival:

- Assistance for LCs in finding global partners to assist them in meeting scale targets
- Procuring international owners to purchase LCs that could not succeed under (i), so that the local plants can continue to operate in Ireland
- Assistance for LCs engaged in electronic sub-supply finding international markets for their outputs, often piggy-backing on the parents of affiliates who purchase locally
- Assistance for LCs successfully, currently engaged successfully in sub-supply, in finding/building cheaper sub-supply sources, e.g. in Central and Eastern European (CEE) countries where their Irish cost base is under threat
- Assistance for successful LCs in becoming sub-assemblers rather than sub-suppliers, drawing on sub-supplier outputs produced in Ireland and/or CEE countries.

Moreover, Enterprise Ireland keeps abreast of new FDI projects in Europe to help its client companies develop linkages with these new projects. Such data enable SMEs to better understand developments internationally as well as locally.

Thus the approach is moving increasingly towards the building of supply networks and supply chains rather than direct MNC-LC linkages. Local linkage formation is now seen as just the first step in the process of MNC/LC relationships.

Enterprise Ireland also has a program for high-potential start-ups, where the Agency invests equity and provides other crucial inputs. It plans to develop some 300 high-potential exporters over the next few years. It has launched a global OEM linkage program to link Irish SMEs with SMEs from other countries. In 1999, for example, 22 Irish SMEs were given the opportunity to visit Penang and establish links with Malaysian companies with the objective of selling in Asia and providing market outlets for Malaysian companies in Europe.

Source: Crone (2001), Ruane (2001).

- **Unreliability of Local Suppliers** – Our interviews suggest that most manufacturers were generally satisfied with the level of support they received from the local suppliers. In many instances the manufacturers suggested that the level of support from the Philippines suppliers was a lot better than that received from suppliers in China and other parts of the world.
- **Local Materials are More Expensive** – The major manufacturers that the team visited during its mission to Philippines actually expressed the opposite about the costs. Most cited that for parts that can be procured locally, the total costs of procurement were generally lower than the same parts that have be imported. They cited cost savings for these items in the neighborhood of 10 to 30 percent. Here we are talking about parts that can be sourced in the Philippines and not those that have to be imported. These cost savings result from savings of the logistical costs such as transportation, customs clearances, etc. If these same parts were to be exported to other places they would become more expensive because of the logistical and other supply chain costs.
- **Local Materials Do Not Meet the Required Quality Standards** – Here also we did not find complaints from the manufacturers. In many instances they cited that the Philippine quality was as good or better than that of the materials procured from China and other places. Some of the manufacturers have very active programs to support the local supplier in upgrading their quality. However, in some cases in which multinationals' supply chain decisions were made globally and contracted to very large suppliers, local firm capabilities in volume as well as (in some cases) technical capabilities did not meet the global sourcing requirements.
- **Industry Local Requirements are Not Known to Many Suppliers** –This perception is generally not true as we witnessed a high level of interaction between the suppliers and the manufacturers at least at the association level. What we witnessed was a lack of appropriate marketing capabilities and information gaps between the needs of the multinationals and capabilities of prospective suppliers. In this regard, **marketing efforts of the smaller players in the electronics value chain require strengthening.** The FIAS Team met several smaller companies supplying to the larger manufacturers and learned that they supply their products only to a handful of companies and in many instances only

to one company as a captive supplier. It was also learned that in many such cases, they are even unable to sell into similar operations of their existing customer in other global locations. In another instance, the Team discovered that the smaller industry associations are seeking assistance from other Foreign Governments to establish their website for marketing and information dissemination purposes, since such assistance is not easily forthcoming from the Philippine Government. In general, the Team found that the smaller electronics related companies in general and in many instances the larger companies lack the appropriate marketing skills to be able to leverage their skills and capabilities. This is an area that could be strengthened significantly in the short-term, a quick win, as it does not require long-term policy efforts but rather a well organized effort such as the Irish or the Czech supplier development programs discussed in this document

The dynamic and complex nature of the electronics supply chain demands up-to-date cost and associated information to aid strategic “make-or-buy” decisions. Even getting access to this information can be a major challenge. The rapidly changing nature of the industry also complicates the decision making process – as new products quickly reach a level of maturity and volume production, followed by obsolescence problems. Unless local suppliers are aware of the ongoing changes and strategies of global firms, their ability to adjust their strategies to supply to multinationals will be constrained.

Many multinational OEMs and large EMS companies have models and resources to manage supply chains. However, this is an impossible task for SMEs with limited resources. As a result, local suppliers are often disadvantaged in the strategic decision-making process as they lack the tools and resources to address the supply chain as a whole. They operate with significant information gaps. SMEs are usually driven by customer specifications, designer preferences, and the knowledge of their procurement groups (which are often home-grown and trained). Their decisions tend to be part cost-driven rather than landed cost-driven, and often respond reactively to issues, such as flexibility, inventory, geography implications, transport, service and repair. **In this framework, it is critical to develop a program and/or strengthen ongoing programs to provide information exchange to local firms to make strategic linkages with multinationals.**

The Government of the Philippines has recognized this shortcoming and instituted a program to assist the marketing and management efforts of the industry; however, these programs appear to be too broad and not deep enough to be able to offer any significant value to the constituents. For these programs to be effective, they need to be restructured to provide more in-depth assistance almost on a one-to-one basis. A commitment of this type would mean hiring more qualified staff, increasing their numbers and making them available to the smaller companies when they need them.

From the above findings what we can conclude is that the Philippine suppliers are in tune with the requirements of the market and are serving them adequately. Given that there are linkages exploiting the possibilities in an industry segment that has limited opportunities for local linkages, *the issue is not only how to improve the existing linkage*, it is also *how to start participating in the other segments of the electronics value chain* that provide broader opportunities for spillovers into the local economy. If Philippine companies are given an opportunity to participate in newer segments of the electronics value chain, they could create

successful new linkages within the electronics industry. The segments that offer opportunities for the Philippines have been discussed above. A more detailed study to define the segments that could be attracted immediately and the specific strategy to attract them is not within the scope of this study. Such a study should be conducted jointly between the Government and the Industry Associations.

- **The Government of the Philippines under the Department of Trade and Industry and the Board of Investments has developed a program to provide significant boost to the selected priority industries including electronics. While this is a good first step, the program needs strengthening.** The Government of the Philippines through DTI has instituted a very good program in principle to assist certain priority sectors including electronics. The program aims to provide guidance to the companies in selected sectors about future technologies, attracting new investments, guiding policy formulations in the sector and essentially act as a one-stop-shop for problems related to that sector. The program as designed may be very effective; however, the implementation of this program needs to be significantly strengthened. First, the program is very thinly staffed. The FIAS team was given to understand that the Electronics Team has less than five people involved in the entire sector that provides over 68 percent of the country's export. This is extremely inadequate.

Second, the FIAS Team met with some of the members of the electronics team at the Board of Investments under DTI and found that while the "Brand Managers" were well intentioned, there is a need to strengthen the capacity and available resources to provide the needed assistance to the sectors. This staff also lacked the necessary international network of contacts to be able to bring in any significant new investment. There is also a need for an in depth understanding of the electronics value chain to be able to identify the areas where the industry needed support and where linkages can be encourage further.

The FIAS Team feels that **for such an initiative to bear fruits, the program needs to be adequately funded, significantly expanded with appropriate talent in place and that the programs needs to be given adequate clout in policy formulation for the sector.** In the interim, the program may be strengthened by providing more training and exposure to the current staff that is working this sector.

- **Industry Associations need strengthening in creating appropriate marketing programs and developing an appropriate technology road-map for the industry to be prepared to meet the continuing demands of the electronics industry.** The FIAS Team had an opportunity to meet several smaller companies and several large companies during the mission to the Philippines. In discussions with these firms, the Team discovered that while the multinational customers of these Philippine suppliers found their products, pricing, quality and delivery effective, they were still not getting 100 percent of their orders. This was so because while the customer had moved on to production of newer technology products, the supplier was still not capable of producing the parts for the newer technology products. An example of such a situation was found at a semiconductor lead frame supplier where the supplier was still producing lower pin count lead frames while the customer had moved on to higher pin count lead frames.

Participating in the electronics industry value chain requires keeping up with the latest technology developments. Not doing so significantly jeopardizes the chances of future participation. While very effective in supporting the existing requirements, Philippine electronics suppliers need to keep abreast of the technology developments to gain their rightful share in the market.

To create this awareness, understanding and ability, the various industry organizations have to be supported in a manner where they are enabled to understand the future technology requirements, create a technology road-map, intelligently discuss them with their customers and are able to muster enough investment capital to be able to keep up with the future technology requirements of their customers. One example of this support is the Institute for Information Technology in Taiwan. (See Box 1).

Box 1: Institute for Information Technology (III), Taiwan

The Institute for Information Industry (III) started from an idea that was commonly shared by the Ministry of Economic Affairs and several private enterprises. The concept of integrating resources from government and private sectors gave birth to the III.

Since its inception in 1979, III has been the backbone of research and development for Taiwan's information industry sector, with the aim of improving the productivity and competitiveness of all industries through the use of IT. III's extensive network of resources and decades of experience has made it Taiwan's one-stop IT development and promotion source.

III is chartered to assist the government in developing the local information industry. This strategic mission has been carried out by deploying effective information technology applications and cultivating a growth environment for IT industry development, with the strengthening of national and industrial competitiveness as one of its primary goals.

III's Missions are to

- Serve as a think-tank for the government in fostering the development of the information technology industry and moving towards a knowledge-based economy.
- Provide strategic and technical support to the government in forming and improving Taiwan's information technology infrastructure.
- Promote information technology applications and training in various fields to further increase the productivity of domestic industries.
- Develop and transfer innovative and advanced information technologies to generate opportunities for the creation of new industries and the development of new products; reinforce the competitiveness of Taiwan's information industry in the global market.

III's Bard is composed of prominent members from the government, industry, and academia and focused on Taiwan's vision of a knowledge-based economy. As Taiwan's premier IT institute, its members come from multidisciplinary backgrounds. Executives have backgrounds in the corporate, government, and research sectors carry out III's mission and vision. Supporting them is a 1,300-strong force of researchers, engineers, technicians, computer programmers, statisticians, market analysts, management and technology consultants, legal experts, and a highly educated support staff. A key component of this team is the Market Intelligence Center which tracks global technology developments and disseminates this information throughout the industry to enable

them to keep pace with technology, develop strategic marketing plans, and allow companies to develop programs to remain competitive in the ever changing technology world.

The Institute for Information Industry collaborates with major companies and institutions through technological cooperation, international exhibitions and conferences, certification and training programs, strategic alliances and trade promotions, and other pacts to boost the competitive edge of Taiwan's IT industry.

III works with organizations worldwide with respect to technology transfer for the purpose of developing advanced technologies used by domestic industries. III has helped develop and promote key technologies and components such as interoperability testing with Cisco, third-generation (3G) chip sets with Analog Devices, a mobile Internet service platform (iRAMP) with Mobile ID, pervasive computing with IBM, and communication systems with Sony.

- **Great entrepreneurial talent exists in the Philippine Electronics Industry; however, to leverage this talent fully, these entrepreneurs require local market support.** The FIAS team visited several companies during their mission to the Philippines where entrepreneurs had migrated back from the United States. These entrepreneurs created significant local operations for exports of their products and were growing organically with their overseas partners and/or customers. These companies have a significant opportunity to boost their growth if they were given local market support.

A case in point is that of a company that designs, fabricates and supports wireless infrastructure equipment – very sophisticated high technology gear required for development of wireless networks. While this company has been growing very briskly exporting their products to many developed nations and employing hundreds of very talented Filipino engineers, the company is unable to get access to the local companies for sale into the Philippine market. This is primarily an issue where the major local companies do not consider the locally made equipment to be good enough, and they have no incentive to procure locally. To jump-start some of these sectors, some incentives could be designed to use locally produced products instead of imports, thus removing some of these artificial barriers. If they were able to get access to the local market, they could leverage this local sales for a larger share of the global market with their parent or their customer. (See Box 2) The FIAS Team recognizes that these are simply temporary measures; however, they are pointed out to illustrate the “chicken-and-egg” problem of these companies.

Box 2: Integrated Microelectronics, Inc., Philippines

Integrated Microelectronics Inc. (IMI) is a one stop electronics manufacturing services (EMS) company offering seamless operations from product development, prototyping, plastic injection, metal stamping, electronics assembly operations, supply chain management to complete box build solutions. Located south of Metro Manila, IMI was founded in 1980 through a joint venture between Ayala Corporation and Resins, Inc. What started as a company engaged in the packaging of integrated circuits has evolved into a leading EMS companies in the Philippines with over 11,000 employees. EAZIX is a subsidiary of IMI which is engaged in the design and development of complete products and sub-systems to assist original equipment Manufacturers (OEM's) in product realization.

IMI has diversified its portfolio into EMS from Semiconductor Assembly Testing and Packaging recognizing the great potential of the Philippines within the electronics value chain. One of the senior executives at IMI said the “Philippines electronics manufacturing capability is the best kept secret in the world”. From IMI’s point of view Philippines has to offer many advantages to the electronics manufacturing industry worldwide. It feels that Philippines has the following advantages:

- Most of the overseas customers of IMI feel that the Philippines is an easy place to do business with.
- Most people with whom the customers interact speak English and thus IMI’s overseas customers do not feel threatened. They are also spared the expense and headaches associated with translating process manuals into some other foreign language
- The logistics out of the Philippines are competitive and is supported by the Asian hubs of UPS and Fedex in the Philippines. This compares very favorably with China.
- Many of the customized components such as enclosures, to a lesser extent printed circuit boards are available locally at competitive prices and of good quality. This particularly true for enclosures of all types.
- The recent decision of Arrow Electronics to develop distribution center in the Philippines is a very welcome decision as it would ease availability of components not currently produced in the Philippines.
- The general perception is that the Chinese products are cheaper; per se this may be true but when you add logistics costs, costs of clearances and other related costs, the economics of Chinese procurement are questionable.
- Philippine companies have the ability to support their customers with quality design services at very competitive costs. That is reason for the development of EAZIX subsidiary.
- Many of IMI’s customers have complained about the protection of intellectual property in China; they feel a lot more comfortable with IP protection in the Philippines.
- For all practical purposes, Philippines is the only “western country” in Asia Pacific. This makes the US, European and Israeli customers very comfortable in dealing with the Philippines.

Based on these premises, IMI has started a very aggressive program of recruiting a global management team and working with local suppliers to increase the local part count in their production. In doing so, IMI has encountered the following difficulties:

- Many of the suppliers of the components are Japanese owned and they are not necessarily geared to serve the local market. They are geared to serve their Japanese parent or its affiliates. A good case in point is their procurement of the printed circuits. They are working with three foreign owned companies – one Korean and other two Japanese. In all cases IMI had to approach them to partner with them; neither came forward to sell to IMI. Each did not know which business model to follow and some expressed capacity constraints. What can be done for Japanese suppliers to supply to non-Japanese firms? The same holds true for the Korean and Taiwanese supplier companies.
- Sometimes, the Philippine suppliers are at a disadvantage as many Chinese companies are subsidized by the Chinese Government through underwriting tooling costs.
- If more components of the electronics value chain such as passive components, displays, connectors/cables, and batteries were available locally, then Philippines would be a very competitive location for manufacturing.

Chinese firms are progressively seeking increased market access in several countries including the Philippines. Chinese owned companies currently operate about 900 bonded warehouses in the Philippines to support supply of components to the EMS industry. Their business practices are sometimes questionable.

- **Many companies who were earlier primarily Semiconductor Assembly, Packaging and Testing Companies are now looking at Contract Manufacturing Services as their future. Government may want to encourage this trend as it provides larger market opportunities for local suppliers.** The FIAS Team met with several large Philippine-owned companies who were earlier engaged in the Semiconductor Assembly, Packaging and Testing (APT). These companies over the last several years have transitioned to become Electronic Manufacturing Services very successfully. This transition was brought about by the Company's own strategic vision and without much support from the local MNC's. Some of these companies have gone very aggressively to develop a base of local suppliers for the various elements of the electronics value chain like enclosures. This is a very good first step. Some in fact have also started providing design services in addition to the manufacturing services. A further encouraging sign is that they not only participate in design from a manufacturability standpoint, but some of them have started participating with their customer on design for the supply chain. Such a trend will encourage development of larger and deeper linkages within the electronics industry and should be supported.

A Philippine Electronics Industry more skewed towards the Electronics Manufacturing Services (EMS) focusing on printed Circuit Board Assembly will encourage development of broader and deeper linkages with the electronics value chain. We have seen evidence of this already with some these Philippines owned EMS companies are very actively scouting for and supporting local vendors for printed circuit boards, enclosures and other sundry parts. As this industry gets a foothold in the Philippines, broader linkages extending to other segments of the electronics value chain such as passive components, printed circuit boards, displays, connectors/cables, and batteries will be sought. Such a move will increase local demand for these other elements of the electronics value chain and push new investments in that direction.

Therefore, the EMS sector should be more deeply studied and analyzed to determine what factors can lead to its accelerated growth. Currently, this sector accounts for less than 25 percent of the total revenues of the electronics sector and probably even lesser of the percentage of the local value added. Maybe a new goal for the share of the EMS in total electronics industry revenues should be raised to 50 percent or more where the local value added content percentage could be a very significant number. This will happen through creation of new enterprises to support the increased breadth of the electronics value chain. (See Boxes 3 and 4)

- **The Department of Trade and Industry has numerous programs to assist the SME's within the electronics sector; however, these programs lack depth and coordination.** DTI's ongoing SME support programs are laudable and are much needed to fully support the SME's in the electronics sector. However, these SME programs of the DTI seem to

lack depth and broad coordination among all agencies concerned. For example, there is a program for SME financing whereby the DTI officers assist SME's to prepare appropriate business plans to qualify for government backed financing. In principle this is a good program and should be continued; however, questioning in the field revealed that the support provided by the DTI staff in the field is not adequate for the companies to make sound business judgments. The programs are also directed to micro enterprises more than medium- sized enterprises which is where bulk of the linkage industries are likely to exist.

The overall impression of the FIAS Team was that it would be best for DTI to develop programs to assist SMEs in a manner such that some very targeted elements within the electronics value chain could be supported at any one point in time and moved along. For example, the Electronics Manufacturing Services would certainly require the use of printed circuit boards and that the Philippines does not have many good suppliers of printed circuit boards. If this element of the electronics manufacturing value chain were encouraged and supported, a new sector of the electronics industry could be created and significant local value added could be developed. This is not a question of picking winners and losers; it is matter of filling in the gaps in the electronics value chain. Electronics production is already a major industry, and they are the largest exporter from Philippines. The question is now about improving its competitiveness and enhancing the value added from this sector.

- A lot of attention within the Philippine Electronics Industry is currently **focused on discussing development of a semiconductor fabrication industry within the country** as a way to enhance competitiveness of its Electronics Industry. **The subject should be studied extremely carefully but not in a manner that excludes participation by the Philippines in the other segments of the electronics value chain.** During its mission to the Philippines, the FIAS Team encountered an active debate on the subject of creating a semiconductor fabrication facility in the Philippines. The idea behind the subject is good and is rooted in the thought that if semiconductors form 35 percent of the value chain in electronics, production of semiconductors in the Philippines will certainly enhance its local value added within the industry. However, the semiconductor fabrication is not as simplistic. A single semiconductor fabrication facility will not do the trick – it will require several lines of these to make any significant dent. Each semiconductor fabrication line today costs more than \$1 billion in investment and a very large supporting infrastructure to make it productive. Finally, countries such as Singapore, Taiwan and South Korea and now China that have actively developed this capability have mixed results from the creation of such facilities.

Based on the analyses of the current electronics industry in the Philippines, it is quite evident that the Philippines today participates in less than 15 percent of the electronics industry value chain. Semiconductors form 35 percent of the value chain. The remaining 50 percent of the value chain is comprised of segments like passive components, printed circuit boards, displays, connectors/cables, batteries and other design and fulfillment services. It is the opinion of the FIAS Team that in addition to participation in the semiconductor fabrication, the Philippines should also look at participation in other

segments of the electronics value chain because semiconductor production is complex, expensive and competitive requiring development of a major support infrastructure. It may be easier to penetrate these segments, require less investments and may be more synergistic in the short term with printed circuit board assembly operations.

- **Understanding of the Electronic Manufacturing Value Chain needs strengthening.** A lot of attention has been paid to the end-user market segments, as opposed to focusing on manufacturing activities that cut across many end-user segments. For a country seeking a manufacturing base, segmentation along the electronics manufacturing value chain is more relevant.

In our dealings with the industry and government representatives the FIAS Team noticed that most of the discussions regarding segments within the electronics industry were focused mostly on the end-user segments like consumer electronics, telecommunications, and computers. Little, if any, discussion was devoted to the manufacturing value chain within the electronics industry. Such scant attention bears upon the orientation of the industrial promotion efforts.

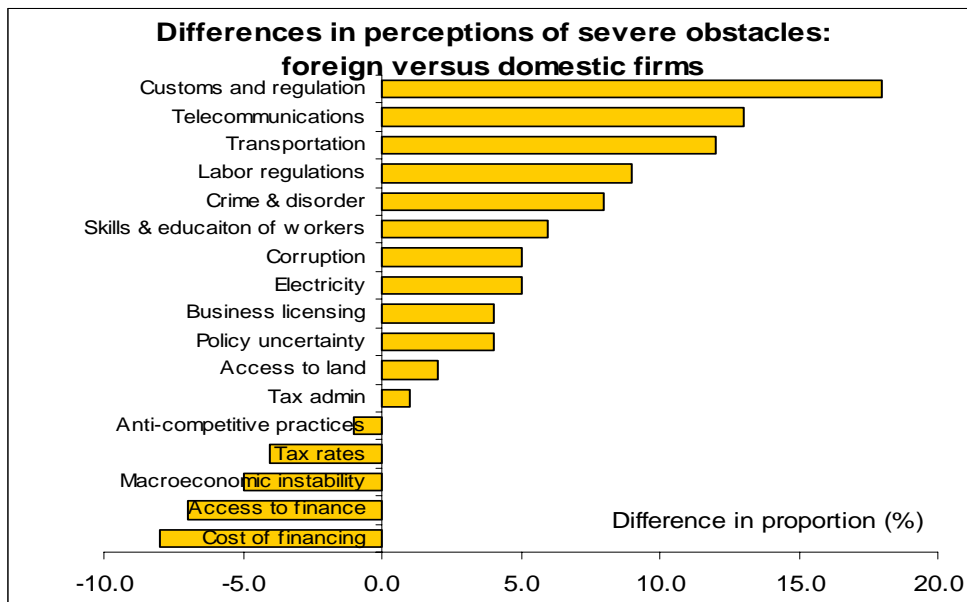
When the focus is vertical, promotion efforts are geared to bringing a certain type of end-user companies like computer systems companies, telecommunications companies and so on to produce in the Philippines. If the focus is horizontal, the efforts will be towards attracting printed circuit board assembly companies. If efforts to attract printed circuit board assembly companies are successful, then companies that will fill in the remaining parts of the value chain like passive components, semiconductors, batteries, and displays would be attracted. Such change in orientation will result in attracting companies producing varied products but with similar inputs and skills. Thus the industry would be less vulnerable to economic cycles.

3.4. Recommendations

60. Based on a detailed study and understanding of the global electronics production value chain and an understanding of the position of the Philippine electronics industry in this chain, the Government may want to consider the following recommendations that aim to improve the existing linkages and increase their depth and breadth in the future:

- **Improving the investment climate is key to enhance productivity in the industry.** The Philippines scores poorly on business climate issues such as corruption and contract enforcement. Small firms that will serve as suppliers to multinationals are as severely affected by these deficiencies as multinationals, limiting capabilities to enhance productivity. There is a need for a more concerted approach to recognize the constraints this places in the way of linkage development and engages more pro-actively to address these issues. Macroeconomic instability engenders uncertainty, which impacts adversely on FDI, dissuades the private sector from investing in the upgrading of technological capability and promotes speculative rather than innovative activities. It also encourages vertical integration at the sectoral level, reducing the potential for linkage development. The most efficient way to promote linkage development is to address these

issues at source rather than seeking simply to ameliorate their symptoms. One example is the customs operations. As seen below, exporting firms suggest that customs regulations are the most critical issue they face in their operations. This is a significant impediment for a country with electronics industry as its leading exporter. The Government is already working closely with the private sector to strengthen the customs clearance system that is critical for prompt delivery of products in the electronics sector (see Box 3). These efforts need to be given priority and broadened to other critical issues such as infrastructure, transportation, power, etc.



Source: ADB-World Bank Investment Climate Survey

Infrastructure: Poor infrastructure and high utility costs electricity also constrain the development of indigenous businesses as well as reducing the attractiveness of the Philippines as an FDI location. These issues can only be addressed by concerted government action.

Box 3. Customs to Run Export/Import Clearance System

The Bureau of Customs (BoC) is set to fully activate this month an export-import clearance processing system that proponents claim is the first of its kind to connect electronic transactions of private companies to the government.

The processing system is based on RosettaNet, a trade facilitation software used globally in conducting business-to business (B2B) electronic commerce, or transactions between and among private companies. It targets to help companies reduce inventory, lower transaction cost and speed up time to market.

To date, over 500 companies worldwide, representing \$1 trillion in revenues, are using RosettaNet as a trade facilitation standard. In the Philippines, however, the RosettaNet solution, dubbed as the eCustoms Declaration Process, has been customized to facilitate B2B and business-to-government (B2G) transactions. It works as a logistics software for the BoC, which aims to improve the cycle time and system efficiency of customs clearance, including the generation and processing of shipping information required to move products through customs. It is estimated that the automated export-import clearance process reduces the cost of doing business by over 50%.

Under the system, a BOC-RosettaNet affiliate company can now move its shipping information automatically from its computer system to its logistics forwarders and then to the BoC. RosettaNet is the global organization of companies in the information technology industry, which develops open standards for adopting and conducting B2B electronic commerce.

In the Asia region, the Philippines is the sixth country to launch a RoseattaNet initiative. It is also running in Japan, Korea, Taiwan, Malaysia and Singapore. The full roll-out of the system in the semiconductor and electronics industry, with around 800 companies, to happen in the next two years.

Source: Maricel E. Estavillo, "Customs to run B2G Export/Import Clearance System this month", *Business World Online, Inc.*, 6 April 2005.

- **Study the Global and Philippine Electronics Value Chain in Depth.** The Department of Trade and Industry in conjunction with the major industry groups such as SEIPI and EIAPI should develop a detailed understanding of the global electronics production value chain and the position of the Philippines electronics industry in this value chain. Based on this understanding and a detailed analysis, but the Philippine Industry leaders should identify additional segments of the electronics value chain that they are currently not participating in, and develop strategies to promote both local and global investments in these newer sectors to increase the breadth and depth of the linkages in the electronics value chain.

These additional segments would likely fall into the following categories as identified earlier: semiconductors, passive components, printed circuit boards, displays, connectors/cables, batteries and design/fulfillment services. Once these additional segments are identified, a detailed roadmap should be developed detailing the priorities for implementation of each segment, methods of mobilizing the resources required to create such segments within the Philippine economy and incentives and other mechanisms required to attract the first few pioneers in each segment.

The FIAS Team is fully aware that the last thing that it needs to recommend is another study that may take a lot of time and discussion. However, in this situation, the FIAS Team believes that a dramatic change in outlook is required for both the industry and the government officials to create long-term competitiveness for the Philippine Electronics Industry. If properly focused, such a study could be completed within ninety days and a consensus reached within short order thereafter.

- **Explore options to strengthen institutional support to the industry and enhance its linkages with the local economy through new institutions or by strengthening existing institutions.**

One option is to develop an agency dedicated to the support of the Electronics Industry in the Philippines very similar to the Institute for the Information Industry in Taiwan, but much smaller in size. In 1979 the Government of Taiwan created an Institute for the sole purpose of promoting the information technology industries in Taiwan. A more detailed discussion about Taiwan's III is given in Box 1. The main mission of the Institute for Information Technology (III) (www.iii.org.tw) in Taiwan are as follows:

- Serve as a think-tank for the government in fostering the development of the information technology industry and moving towards a knowledge-based economy.
- Provide strategic and technical support to the government in forming and improving Taiwan's information technology infrastructure.
- Promote information technology applications and training in various fields to further increase the productivity of domestic industries.
- Develop and transfer innovative and advanced information technologies to generate opportunities for the creation of new industries and the development of new products; reinforce the competitiveness of Taiwan's information industry in the global market.

Since electronics production accounts for over 68 percent of the Philippine's export earnings and is a main driver of the Philippine economy, the FIAS Team would suggest that the Philippine Government could consider a downsized version of this model for further development of the electronics. Creation of such an institution will allow the Philippine Government to focus its energy in further development of its very strategic industry, allow it to attract appropriate talent that can provide in-depth policy guidelines in a continually changing industry, allow it to develop and attract new segments of the electronics production value chain, and reinforce the competitiveness of the Philippine electronics industry in the global marketplace.

The FIAS Team certainly recognizes that setting up such an institution would compete for resources needed to address other critical issues in the development agenda of the Government. However, a much smaller unit with high-caliber technical capacity could be an effective way to address the issue. Development of such an Institute in the Philippines would ensure that there are no real disconnects between the Government and the Industry as regards their perception of the status of the electronics industry and its place in the global electronics value chain.

Development of such an Institute in the Philippines with a core group of top notch researchers, and even Filipino expatriates working in the developed nations, may ensure that the areas and segments identified for further development are well reasoned and grounded in realities and above major controversies. This would also create an ideal platform for addressing both marketing and technology needs of the Philippine Electronics Industry in a very focused and in-depth manner – something lacking today. The “Brand Manager” function for the Electronics Sector can reside here and can be

adequately and appropriately staffed here.

Such an Institute in the Philippines would be the focal point for the industry to communicate its needs and concerns in a more intelligent way to the Government. Development of such an Institution alone will not guarantee its success; it will also have to be guided by very strict and enforceable performance standards as is the case in Taiwan, Korea and Singapore. Government could also consider developing this Institute as public/private sector initiative that will ensure active private sector participation and hold the Institute's Management to strict performance standards. The structure of such an Agency would be similar to that for semiconductor research in the United States – SEMATECH in Austin, Texas. The ARCDI (Box 4) initiative by the private sector is an excellent starting point for such an initiative.

61. It could be argued that the Philippines has been able to develop a large electronics sector without much Government support, why then does it need it now? The answer lies in the fact that during the last decade, companies came to the Philippines seeking lower labor costs and a decent infrastructure for semiconductor assembly, packaging and testing and found the same. This industry segment has grown and now represents the bulk of the electronics industry exports from the Philippines. However, the market for this activity is near saturation and the new growth is primarily going to China. For the Philippine Electronics to grow from here on, it will have to compete with locations which in addition to lower costs also provide supply chain advantages, local availability of components, lower infrastructure costs, continuous supply of trained manpower, ability to keep up with technology trends and local market access. Direct Government support to the industry has now become crucial as Singapore, Taiwan, and Malaysia have found out.

- **The second option** in the institutional support arena is to focus efforts to strengthen existing institutions. This option would focus on **increasing the strength and caliber of the of the DTI Electronics Department staff and available resources to enhance the operating environment for electronics firms**. The FIAS Team had an opportunity to meet with and discuss the issues related to the Philippine Electronics Industry with the team at DTI/BOI's Electronics Division. The staffing of this department should reflect the size and importance of the Electronics Industry to the Philippine economy. The current strength of the Department is less than five. Without a detailed study, it is very difficult to pin point what would be an adequate strength of such a staff for the size of the Philippine electronics industry; however, the Team feels that it should be several times more than the current strength. Even while staff increases are studied, existing staff capabilities should be reviewed in detail and programs developed to strengthen their capabilities through training, larger exposure to the worldwide electronics production processes, better understanding of the worldwide electronics production trends and evaluation of the emerging technology areas. The DTI could consider re-allocating some of its resources to the electronics sector, as it is such an important sector for the Philippine economy.

Further, it is the opinion of the FIAS Team that the capabilities of the staff in this Division should be significantly upgraded to make them knowledgeable of the global

electronics production industry. They must have global connections in the electronics industry. They should preferably have spent some time in production areas of the electronics industry and be well versed in business and technical issues surrounding the electronics production industry.

Box: 4. The Advanced Research and Competency Development Institute (ARCDI)

In February 2004, the Advanced Research and Competency Development Institute began operations at Northgate Cyberzone (Alabang). ARCDI, a non-stock, non-profit foundation, was borne from work by PEZA, SEIPI, EIAPI and other SMEs, ASTI (of DOST), the EEE Department of UP, the Brain Gain Network (<http://www.BGN.org>), and various private individuals.

The vision of ARCDI is to make Philippine high-technology companies more globally competitive by providing a venue for world-class professional-level training, advanced research, development and engineering (RD&E), and new venture incubation.

Present activities at ARCDI include:

- Market focused high-quality Technical Training and Education; Courses for improved productivity, yield, and quality are available to engineers in electronics manufacturing companies. Technologists engaged in RD&E can study or review professional level courses on semiconductors, wireless and RF electronics, embedded systems, and software applications engineering.
- Collaborative Research, Development and Engineering (RD&E) activities relevant to member companies - The RD&E labs will support the continuing advancement of instructors themselves and provides hands-on lab training to student engineers. The first three labs will focus on wireless communications systems, computing systems and software, and microelectronics design.
- Sharing of Scarce Resources such as state-of-the-art laboratories with the required hardware and software, video-conferencing and communication facilities, seminar rooms, and an up-to-date library. Professors in the University of the Philippines-Diliman and other universities have expressed the desire to avail of equipment in other campuses or corporate labs. Corporate engineers are willing to share their resources and in turn use the tools and human resources of the academic institutions. Since these resources are relatively costly for Philippine entities, sharing while respecting intellectual property rights is a win-win proposition.
- An efficient, high-quality of life, physical Convergence Center for Synergistic Interaction between technopreneurs. One target is to promote the return of expatriate professionals, with the Brain Gain database to be used to tap these human resources.
- New Venture Incubation - One of the most desired side effects of the Institute will be similar to Stanford University's ability to be the Silicon Valley magnet for the best engineers from the country and worldwide, for the largest Venture Capital community, and for all other people and resources needed to create successful start-up ventures. It is envisioned that ARCDI will successfully anchor the limited number of business service specialists for high-technology such as venture capitalists, IP lawyers, product marketing experts, headhunters, IT infrastructure consultants, and IT cluster real estate developers.

The ARCDI Foundation is structured to be led by private sector stakeholders in partnership with a visionary group of government industry promoters and leading academic and RD&E institutions. Of course, the proper selection of principled visionaries and properly-compensated management is key to the successful execution of this vision. Furthermore, a well selected advisory board of Silicon Valley and Japanese high-tech leaders with impeccable credentials will help guide the Institute in using its limited resources to promote economically self-sustaining activities.

Source: SEIPI web-site.

- Encourage the shift of the Philippines Electronics Industry to a more balanced portfolio of semiconductor APT and Printed Circuit Board Assembly Services.** A shift towards Contract Manufacturing Services (CMS) or Electronic Manufacturing Services (EMS) would enable the Philippines to broaden and deepen its linkages in the electronics industry creating new sub-segments within the Philippine electronics industry. These promotional programs should emphasize the positive differences that the Philippines can offer to the international electronics manufacturing companies such as educated and trained English speaking workforce, a well established culture of electronics manufacturing within the semiconductor APT segment, ability to assist companies in designing products not only for manufacturability but also for supply chain considerations, protection of intellectual property, well established logistical and distribution infrastructure and proximity to semiconductor assembly operations. All of these factors are directly related to the cost of manufacturing in the electronics manufacturing sector and with efficiency of electronics manufacturing and distribution. The program should be jointly undertaken by the government and the private sector, projecting the Philippines as a location where hassle-free manufacturing could be undertaken by global EMS companies. This public-private sector initiative should develop an infrastructure that continuously monitors and understands the dynamics within the global electronics manufacturing industry, and formulate specific time-bound plans and programs to be successful.
- Rationalize the number of support programs for the SME's.** There are numerous programs that have been developed by DTI to support the SME's. The intention of these programs is good and valid; however, they overlap and are not coordinated. This recommendation aims at DTI conducting a detailed review of its programs to make them simpler to implement and follow-up – reduce the breadth and increase the depth. For example, there are numerous programs that are DTI-sponsored to support the SME's with financial support and financing. Yet again there are several programs to support the SME's technically and with research and development. There are several programs to support the SME's with sales and marketing. Finally, there are several programs to help SME's develop business plans. None of these programs seem to be in any great depth to be of much benefit to these entities. A detailed review of these programs would focus on elimination of overlaps, elimination of multiple agencies dealing with the same issues and development of an anchorperson to deal with particular SME's issues.

There are opportunities to strengthen these linkages through well-functioning supplier development programs based on good practices learnt from other countries such as the Czech Republic and Ireland.

Box 5: Czech Pilot Supplier Development Program

This is a backward linkages program for the electronics sector, introduced in September 1999 under the responsibility of CzechInvest, the foreign investment agency (a semi-autonomous arm of the Czech Ministry of Industry and Trade) and originally scheduled to run for 18 months. The project is run by 5 staff.

The strategic process was overseen by a newly established High-level Steering Group, which brought together the representatives of government, general managers of MNCs, presidents of business associations and managers from CzechInvest.

18 electronics MNCs and 45 Czech suppliers were selected to participate in the program (of which 80% were nominated by MNCs).

Auditors identified and agreed areas where domestic companies were failing to meet MNC audit criteria. During the second round of audits, the improvement of companies was assessed and 20 most successful, those with the highest potential, were invited to the final stage of individually tailored help.

Fifteen companies so far have gained new contracts through the program. The new business created was worth 17 million USD per year (in 2003), consisting of contracts renewable on a 12-month basis, and amounted to 45 million USD for the period 2000-2003. Ten of the selected companies were not supplying to MNCs prior to the program. Out of those ten, seven confirmed that they found their first new MNC clients through the program. The companies were selling typically 40 % of their production to MNCs in the Czech Republic. On average 26 % of their revenues from business with MNCs accounted for final products, 62 % were from selling parts or components and 12 % from selling the packaging materials. More than half of the companies saw the value added of their supplied products increasing (57 %).

Participating firms reported improvements in the areas of internal management, human resources management and client relationship management. Participation in the program was also reported to have improved their reputation and to have helped them to meet with MNCs and other companies from the sector.

Source: J. Malinska (2004): FDI-SME Backward Linkages Promotion Program: Promising Results in the Czech Republic.

ANNEX A. Selected Company Profiles

Box A1: REMEC Manufacturing Philippines, Inc.

After completing his degree in Electronics and Communications Engineering and obtaining a license in the same field, Mr. Domingo B. Bonifacio, left the Philippines for the United States in 1977. Through hard work and lessons learned from his US mentors, Mr. Bonifacio ended up working as the Director of Operations for Optical Microwave Networks, Inc. (OMNI), a US-Taiwan joint venture.

While working at OMNI, Mr. Bonifacio was inspired by the success story of MTI. This microwave company had been founded by eight Taiwanese engineers who moved back from Silicon Valley and used the education, training and experience gained there, and flourished in the Hsinchu Science Park. MTI is now listed in Taiwan and one of the most successful wireless communications companies in the Asia Pacific Region.

In 1994, Mr. Bonifacio decided to develop a company in the Philippines dedicated to pioneering development of RF and microwave equipment manufacturing. Wireless Communications required significant capital investment and the presence of support industry (linkages) to supply indirect materials and services. Mr. Bonifacio pre-selected a team of specialist from the United States and the Philippines to launch his company.

Mr. Bonifacio initially looked within the United States for financing to launch his new venture. All his efforts at raising initial funds from the US Venture Capital Funds in the United States were unsuccessful. He met with similar fate with the Philippines Venture Capitalists. Finally through the efforts of his friends in the Philippines, he was able to gather a group of Filipino businessmen who were willing to take risks with Mr. Bonifacio's business plan and the company was launched in late 1995 as the Pacific Microwave Corporation (PMC).

Through PMC, Mr. Bonifacio was able to transfer the RF and microwave manufacturing technologies to the Philippines based upon the experience that he had gained through his work in the United States. PMC steadily grew from 30 employees in 1995 to over 800 in 2000 and was serving over 50 customers in United States, Europe and Israel. In 1998, a US based venture capital group invested in PMC. In 2001, a REMEC, Inc. a NASDAQ listed company based in San Diego, California specializing in the development, design and manufacturing of voice, video and data traffic over wireless communications networks and in defense communications, acquired PMC. PMC now became REMEC Manufacturing Philippines.

REMEC Manufacturing Philippines now provides quality turnkey manufacturing and design services for the global wireless communications industry. The Philippines manufacturing currently competes with REMEC's other facilities in China, Costa Rica, Finland, Mexico and the United States. The Philippines facility is competing well with these other locations in spite of lower domestic content. This lack of local availability of components other than enclosures is currently offset by their productivity and an able design team.

REMEC Manufacturing Philippines' position its global family of manufacturing plant would be significantly enhanced if there was greater supply of local components from all segments of the electronics chain and/or a greater access to the local wireless market. REMEC Manufacturing Philippines' efforts to sell in the local market have been mainly unsuccessful as there is no system

which provides a break to the local suppliers and a prejudice in favor of global suppliers.

REMEC Manufacturing Philippines' experience with the local parts those are available locally have been very positive. They are 20 to 30 percent cheaper than those that are imported. They are of world class quality and have had no delivery problems. The company has also introduced some its local suppliers to its sister manufacturing companies in other countries.

REMEC Manufacturing Philippines feels that a plan to support local manufacturing of other components like passives, batteries, etc. will significantly enhance Philippines' position in global electronics manufacturing. Also support to sell its products in the local market as the Chinese plant does will certainly enhance its ability to gain more products to be manufactured in the Philippines.

Box A2: IONICS, EMS Inc., Philippines

Ionics EMS is the leading and most experienced electronics manufacturing services provider in the Philippines. Ionics EMS started as a semiconductor and hybrid assembly company in 1974. It has a proven track record in a broad range of services like design, engineering, manufacturing and logistics solutions for customers in the computing, telecommunications, consumer, automotive, industrial and medical fields.

Ionics' five (5) facilities are ISO-9002, QS9000, EN46002, and ISO 14001- certified and committed to excellence in quality, delivery and cost. Its services are geared to provide extensive time-to-market advantages and continuous competitiveness to our customers. Ionics' customers come from the United States, Europe, Israel and other Asian countries like Singapore and Thailand. In addition, Ionics also serves several Philippine based customers.

Ionics is a majority Filipino owned company with listing on the Singapore stock exchange. The company started in 1974 as a semiconductor assembly company and shifted to Electronics Manufacturing Services (EMS) in 1984, long before anyone else had done so in the Philippines. In the early phases of its development the company simply provided labor services; however, in the more recent times it has developed into a fully service operations providing full spectrum design services. Ionics is one of the few companies in the Philippines which not only provides "design for manufacturability" but also "design for the supply-chain" services. In this latter role, local procurement of the components is built into the design. Ionics also has subsidiary for plastic parts production in a joint venture with a Singapore based company called Iomni. The group employs design engineers in the Philippines who are supported by contractors in Europe.

Ionics procures about 30 percent of its parts locally and the rest are imported. The company finds the local suppliers of components competitive, with very good quality and delivery. Ionics is constantly striving to increase the local content. To make this possible, the Philippines has to attract companies in other segments of the electronics value chain such as passive components, printed circuit boards, displays, batteries, and connectors. It feels that if these suppliers were present in the Philippines, its competitive would increase significantly. Ionics also welcomed the decision by Arrow Electronics to establish distribution operations in the Philippines.

In general Ionics shares many of the views expressed by IMI and feels that the Philippines Government should work hard to counter the negative perceptions about Philippines and encourage development of the complete electronics value chain in the country. They are very confident that if such companies were attracted to the Philippines through various means, then these new companies would also be as competitive as the existing suppliers.

Box A3: Panasonic Mobile Communications Corporation of the Philippines

Matsushita Electric Corporation of the Philippines (MEPCO) is the maker and distributor of **Panasonic** brands of electric and electronics appliance in the country. Founded in 1967, MEPCO is the first Filipino-Japanese joint venture operation in the area of consumer electronics in the country.

MEPCO's history dates back in the early 60s when Mr. Jesus V. del Rosario established the Distributors and Manufacturers Corporation (DMC), producing radios and radio phonos at the living room of his house along San Luis Street in Pasay City with only a handful of workers. After a year, DMC's manufacturing department was made a separate company and was named Festival Manufacturing Corporation (FMC). Consequently, FMC changed to Precision Electronics Corporation (PEC) in 1965 to signify its no nonsense determination to produce products by ways no less than precision manufacturing.

The name PEC remained even after the joint venture between PEC and Matsushita Electric of Japan was formalized in 1967. However, on the occasion of the company's 25th Anniversary in 1992, the name Matsushita Electric Philippines Corporation was adopted.

Today Matsushita Corporation owns four manufacturing companies in the Philippines including Panasonic Mobile Communications Philippines (PMCP). The company employs about 1195 people in 2004 and has sales revenue of about \$650 million. The company started out in 1987 with the manufacturing of floppy disk drives which continued until 1999. After significant price erosion in the floppy disk drive market, it was no longer feasible to continue to produce floppy disk drives in the Philippines. The production of the floppy disk drives was transferred to China in 1999. Since that time, PMCP has shifted its production to mobile telephone production in this plant.

PMCP is one of the four plants in Matsushita's global production of mobile telephones. The others are in Japan, China and Czechoslovakia. PMCP produces GSM telephones for consumption in Asia, Australia and the United States.

The Company Bill of Materials accounts for over 70 percent of the revenues, with 8 percent going to labor and the rest if overhead. Of the 70 percent material costs, less than 5 percent is procured locally; the rest of the materials are all imported. Very few components such as chargers and packaging materials are procured locally. This is as per the corporate directives.

There have been several attempts by the local management to introduce local components to the corporate management; however, they have had limited success in introducing Philippine made components to the Matsushita family of companies. The limited success that the company has enjoyed is in the areas of printed manuals for the Philippines made products and another example is the springs used in the mobile phones. The local management has not been able to get enclosures approved at the corporate level even though the quality of Philippine made enclosures is good. Key reason is that the local suppliers do not have appropriate plastics coating technology to prevent radiation. Metal parts and pressed parts are also candidates for immediate substitution. The corporate approval process for getting local parts approved is lengthy, tedious and very complex at Matsushita as in any other multinationals.

Even though the local management felt that the quality rating of the China procured parts was not very good, there is a large hesitation on the part of the Corporate Management to invest in components in the Philippines. Given the mega competition in the industry for quality, timely delivery, and cost competitiveness, the Corporation requires guarantees of volumes before the

Corporation would even consider investing. In a fast changing environment that is sometimes not possible. Can the Philippine Government come up with some way to mitigate these perceived risks for the investor in newer parts of the electronics production value chain?

ANNEX B

The segmentation along the end user markets is as follows:

- 1. Computers and Peripherals, e.g.**
 - Desktop PC, Notebooks
 - Printers, etc.
- 2. Telecom/Datacom Infrastructure, e.g.**
 - Switches, Routers
 - Mobile Infrastructure, Terminals, etc.
- 3. Handheld Devices, e.g.**
 - Mobile Handsets
 - Personal Digital Assistants (PDA)
- 4. Consumer Electronics, e.g.**
 - TV, Set Top Boxes
 - Digital Cameras
 - DVD Players, etc.
- 5. Automotive Electronics, e.g.**
 - Engine Controls, Climate Controls
 - Brakes, Telematics
 - Car Entertainment Systems
- 6. Medical Equipment, e.g.**
 - Scanning/Ultrasound equipment
 - Bedside Monitors, etc.
 - Pace Makers, etc.
- 7. Aerospace/Defense, e.g.**
 - Avionics, Air Traffic Control Systems
 - Radar Systems
 - Transponders, etc.
- 8. Industrial, e.g.**
 - White Goods and Home Appliances
 - Automation and Power Control Systems
 - Security Systems, etc.

62. The geographical segmentation in the Electronics Industry is generally done along the following dimensions:

1. Japan
2. North America
3. Western Europe
4. Asia Pacific
5. China

6. Eastern Europe
7. Latin America
8. Mid-East/Africa