

BOARD OF INVESTMENTS
THE GOVERNMENT OF THE PHILIPPINES

Study on the Supply Chain of Electronics Industry in the Philippines

Final report

October 2010

Japan International Cooperation Agency

Nomura Research Institute, Ltd.

Preface

In response to the request from the Government of the Philippines, the Government of Japan decided to conduct the technical assistance on Study on the Supply Chain of Electronics Industry in the Philippines and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team consisted of Nomura Research Institute, Ltd. and Institute of Information Technology, Ltd to the Philippines from April 2010 to October 2010. Meanwhile, the Board of Investment (BOI) formed a project team headed by Executive Director Mr Efren V. Leño and set up a steering committee comprised of representative of private sector and relevant organizations. All findings and recommendations made in this project were discussed and shared with all the steering committee members. To implement the recommendations, alliance and cooperation among committee members are expected.

The team conducted discussion interviews with companies of electronics sector in the Philippines to understand the current state and issues of the supply chain of the sector. They made a judgment that it will be difficult to expand the supply chain only with existing sectors. Hence they extended the scope of study to new generation industry including Photovoltaic Power Generation, its current state, issues and the possibility of investments.

The results and recommendations were reported not only to the steering committee, but also to the Philippines Investment Priorities Plan (PIPP) meeting, and will be utilized as the implications on investment promotion activities of the sector. Upon returning, to Japan, the team duly finalized the study and delivered this report.

I hope that this report will contribute to the enhancement of efficiency and effectiveness of investment promotion of the Philippines through more strategic approach, which will, in turn, lead to the industrial development of the country.

Finally, I wish to express my sincere appreciation to the concerned officials of the Government of the Philippines for the valuable assistance extended to the team.

October 2010

Norio Matsuda
Chief Representative
JICA Philippine Office

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Currency Exchange Rate

Philippine Peso (PHP)
Japanese Yen (JPY)

1 PHP = 2.20 JPY (as of 30th of March, 2010, TTS rate)

List of Abbreviations

ABB	Asea Brown Boveri
AFTA	ASEAN Free Trade Area
AGC	ASAHI GLASS CO., LTD.,
Al	Aluminum
AOC	Admiral Overseas Corporation
ASEAN	Association of South - East Asian Nations
ASTAR	Agency for Science, Technology and Research
AV	Audio/Visual
BEV	Battery Electric Vehicle
BOI	Board of Investments
BPO	Business Process Outsourcing
CAD	Computer Aided Design
CCFL	Cold Cathode Fluorescent Lamp
CDC	Clark Development Corporation
CD-ROM	Compact Disc Read Only Memory
CMP	Chemical Mechanical Polishing
CPBI	Census of Philippine Business and Industry P6
CRT-TV	Cathode Ray Tube-Television
CSP	Concentrating Solar Power
Cu	Copper
CVD	Chemical Vapor Deposition
CY	Calendar Year
DEC	Digital Equipment Corporation
DNA	Deoxyribonucleic acid
DSC	Digital Still Camera
DVC	Digital Video Camera
DVD	Digital Versatile Disc
DVR	Digital Video Recorder
EL	Electroluminescence
EMS	Electronics Manufacturing Service
EU	European Union
EV	Electric Vehicle
EVA	Ethylene-Vinyl Acetate
FA	Factory Automation
FDI	Foreign Direct Investment
FIT	Feed in Tariff
FPC	Flexible Printed Circuits
FPD	Flat Panel Display
GDP	Gross Domestic Product
GE	General Electric
GPS	Global Positioning System
HCMC	Ho Chi Minh City
HDD	Hard Disk Drive
HEV	Hybrid Electric Vehicle
HGA	Head Gimbal Assembly
HGST	Hitachi Global Storage Technologies, Inc.
HP	Hewlett-Packard Company
HSA	Head Stack Assembly

IBM	International Business Machines Corporation
IC	Integrated Circuit
ICT	Information-Communication Technology
IDEMA	The International Disk Drive Equipment and Materials Association
IGBT	Insulated Gate Bipolar Transistor
IIT	Institute of Information Technology, Ltd.
IPA	Information-Technology Promotion Agency, Japan
IPP	Investment Priorities Plan
IR	Infrared
IT	Information Technology
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JTS	Jugi Tandon Storage
JVC	Japan Victor Company
LCD	Liquid Crystal Display
LCO	Lithium Cobalt Oxide
LCR	Inductance, Capacitance, Resistance
LED	Light Emitting Diode
LFP	Lithium iron phosphate
LiB/LIB	Lithium-ion rechargeable battery
LMO	Lithium Manganese Oxide
LNG	Liquefied Natural Gas
LNO	Lithium Nickel Oxide
MERALCO	Manila Electric Company
METI	Ministry of Economy, Trade and Industry
MOCVD	Metal Organic Chemical Vapor Deposition
MP3	MPEG Audio Layer-3
MPU	Micro Processing Unit
MW	Megawatt
NiCd	Nickel-Cadmium rechargeable battery
Nidec	Nippon Densan Corporation
NIES/ NIEs	Newly Industrializing Economies
NiMH	Nickel Metal Hydride
NMC	Nickel-Manganese oxide-Cobalt
NRI	Nomura Research Institute, Ltd.
NSO	National Statistics Office
ODM	Original Design Manufacturer
OEM	Original Equipment Manufacturer/ Manufacturing
OLED/ OLEDs	Organic Light-Emitting Diodes
PC	Personal Computer
PCB	Printed-Circuit Board
PCBA	Printed Circuit Board Assembly
PEZA	Philippine Economic Zone Authority
PSEC	Panasonic Shikoku Electronics Co., Ltd.
PSIA	Philippine Software Industry Association
PV	Photovoltaics
R&D	Research and Development
R&D&D	Research and Development and Design
RFID	Radio Frequency Identification
RM	Malaysia Ringgit
RoHS	Restriction of Hazardous Substances
SAE	SAE Technologies Development (Dongguan) Co., Ltd.
SBMA	Subic Bay Metropolitan Authority

SEMCO	Samsung Electro-Machinery Corp.
Si	Silicon
SiC	Silicon Carbide
SMEs	Small-and-Medium-sized Enterprises
SSD	Solid State Drive
SUV	Sport Utility Vehicle
TI	Texas Instruments
TPV	TPV Technology Limited
TSST	Toshiba Samsung Storage Technology Corporation
UAE	United Arab Emirates
US/U.S./USA	United States of America
VCM	Voice Coil Motor
WD	Western Digital Corporation
WSTS	World Semiconductor Trade Statics

1. Purpose of project

1.1 Project objective

To attract investments into the Philippines, it is needed to understand profoundly the target sector and narrowly focus on specific subsectors. This project analyzes the supply chain of electronics industry and focusing on missing link in the Philippines, then considers how the country can attract investments from those sectors.

1.2 Project outcomes

The project is designed to produce the following four outcomes:

- (1) Listing of companies (foreign affiliated and local) involved in manufacturing key components and parts for electronics products considered important to the Philippines
- (2) Identification of missing links in supply chains in the Philippines that should be targeted for priority investment and human resource development given the state of supply chains in the Philippines and the global marketplace
- (3) Listing of overseas suppliers to attract to the Philippines
- (4) Strategic recommendations on FDI based on a comparative analysis with the Philippines' neighbors

1.3 Geographical scope of project

The region to be surveyed for the project shall consist mainly of the Greater Manila Area, Calabarzon region, Subic Bay Freeport, and Clark Special Economic Zone.

2. Project approach and selection of target sector

2.1 Development of Electronics Industry in the Philippines

2.1.1 Foreign Direct Investments have seen a steady growth

As shown in the table below, inward FDI into the Philippines has been a healthy US\$2.0-3.0 billion a year, with the exception of 2001, 2003, and 2004, when investment was only around several hundred million U.S. dollars.

The main sources of investment by country are the U.S. and Japan. Though only US\$12 million in 2003, investment from the U.S. has amounted to several hundred million U.S. dollars in recent years, and came to US\$660 million in 2007. Investment from Japan was US\$830 million in 2007 and US\$740 million in 2002. In weaker years, the amount comes to around several tens of millions of U.S. dollars. Other significant sources are Hong Kong and Korea.

A breakdown by industry shows significant investment in manufacturing, which accounts for around one third of total inward FDI. The electricity, gas, and water supply sectors have also recently attracted significant investment.

These past trends indicate the importance of investments from the U.S. and Japan in manufacturing sector. As the foreign direct investment creates jobs and earns foreign currency, it is one of the growth factors for developing countries. The Philippines should continue to attract investments from those countries as it did in the past.

Table 2-1 Inward FDI in the Philippines by country (BOP net flow by year)

Unit: mil\$

		1999	2000	2001	2002	2003	2004	2005	2006	2007	
World		1,247.00	2,240.00	195.00	1,542.00	491.00	688.00	1,854.00	2,921.00	2,928.00	
Equity		1,178.00	1,333.00	556.00	1,607.00	249.00	750.00	1,181.00	1,324.00	2,020.00	
E q u i t y	Japan	118.97	107.35	133.84	738.39	40.28	43.59	60.64	54.60	827.07	
	NIES total		86.69	48.70	3.31	4.93	10.51	2.35	258.10	2.94	17.84
	NIES	Korea	13.14	0.00	0.43	0.94	1.17	-0.13	0.02	3.01	14.46
		Taiwan	9.00	3.36	1.57	0.38	1.69	0.85	0.03	1.02	0.09
		Hong Kong	64.55	45.34	1.31	3.61	7.64	1.63	258.05	-1.09	3.29
	ASEAN (10) Total		108.92	66.50	62.55	22.54	194.73	116.18	12.69	-42.87	2.89
	Other Asia		65.48	0.00	0.08	0.63	0.99	1.41	0.95	3.47	0.78
	Other Asia	China	64.93	0.00	0.08	0.00	0.02	-0.18	-0.17	2.27	-0.12
		India	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00
		Other	0.00	0.00	0.00	0.63	0.97	1.58	1.12	0.50	0.91
	Oceania		2.04	0.41	0.26	0.32	9.65	1.55	-0.37	-1.07	1.28
	North America		356.08	155.39	154.88	391.71	12.27	119.02	276.89	224.93	665.55
	North America	USA	355.88	155.43	154.93	391.67	12.24	118.70	276.19	219.00	664.65
		Canada	0.19	-0.04	-0.05	0.04	0.03	0.31	0.71	5.93	0.90
	South-middle America		3.81	0.00	38.94	0.02	0.00	0.00	9.57	2.24	0.00
	EU		303.31	581.27	111.19	19.59	-473.04	-10.40	46.23	423.71	71.88
Other		132.72	373.37	50.96	428.86	453.62	475.96	514.93	656.04	432.71	
Return		449.00	-334.00	-258.00	235.00	168.00	141.00	140.00	485.00	567.00	

Source: Institute for International Trade and Investment, "Sekai Shuyo-koku no chokusetsu-toshi Toukei-shu" (2009)

Table 2-2 Inward FDI in the Philippines by industry (BOP net flow by year)

unit: mil\$

	1999	2000	2001	2002	2003	2004	2005	2006	2007
All industries	1,247.00	2,240.00	195.00	1,542.00	491.00	688.00	1,854.00	2,921.00	2,928.00
Total equity	798.00	1,333.00	556.00	1,607.00	249.00	750.00	1,181.00	1,324.00	2,020.00
Agriculture, coursing and forestry	16.91	0.00	0.00	0.00	0.00	0.00	0.18	0.05	3.71
Fishery	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Mining	30.75	80.45	0.00	21.47	-7.15	0.22	0.35	32.44	154.56
Manufacturing	-23.13	237.54	275.09	744.38	89.45	83.63	531.63	408.70	545.64
Electricity, gas and water	290.42	0.00	0.00	0.00	0.00	8.60	-6.30	200.39	699.18
Construction	4.46	16.17	13.51	21.47	19.39	-15.25	-2.91	8.74	49.36
Trade and Commerce	0.00	31.33	1.83	5.53	0.03	18.56	3.58	8.34	4.09
Hotel and Restaurant	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.11
Logistics, warehouse and communication	12.06	360.00	103.98	0.00	0.00	1.60	-32.40	-8.49	13.13
Finance	291.05	38.58	67.80	68.84	-35.85	6.77	199.51	-20.11	94.88
Real estate	0.00	2.62	6.74	0.00	27.49	54.76	111.93	120.49	137.61
Service	0.00	0.00	16.52	316.24	-307.23	89.94	17.13	-119.46	22.83
Others	175.48	565.31	70.53	429.07	462.87	501.17	358.30	692.90	292.90
Reinvestment	449.00	-334.00	-258.00	235.00	168.00	141.00	140.00	485.00	567.00

Source: Institute for International Trade and Investment, "Sekai Shuyo-koku no chokusetsu-toshi Toukei-shu" (2009)

2.1.2 Attractive investment environment

The Philippines offers attractive incentives to encourage foreign firms to locate in the country. As well as the BOI, incentives are provided by agencies including the PEZA, the CDC, and the SBMA, and export-oriented industries (i.e., industries with an export ratio of at least 70%) are offered incentives such as exemption from income tax for a certain period and additional deductions for personnel expenses.

Table 2-3 Examples of incentives in the Philippines

Under Book I of the Omnibus Investments Code, BOI-registered enterprises are given a number of incentives in the form of tax exemptions and concessions. These are:

(1.1) Fiscal Incentives

1. Income Tax Holiday (ITH)
 - Six (6) years- new projects with pioneer status
 - Four (4) years- new projects with non-pioneer status
 - Three (3) years- expansion/ modernization projects
2. Six (6) years- new or expansion projects in less developed areas or 30 poorest provinces in the Philippines.
3. Duty Exemption on Imported Capital Equipment Spare parts and accessories
4. Exemption on Wharfage Dues, Export Tax, Duty, Impost and Fees
5. Tax Exemption on Breeding Stocks and Genetic Materials
6. Tax credits (for export producers only)
7. Tax credit on tax/duty portion of domestic breeding stocks and genetic materials
8. Tax credit on raw materials and supplies
9. Additional Deductions from Taxable Income
10. Additional deduction for labor expense
11. Additional deduction for necessary and major infrastructure works

(1.2) Non- Fiscal Incentives

1. Employment of foreign nationals
2. Simplification of customs procedures
3. Tax and Duty-free Importation of Consigned Equipment for a period of ten (10) years
4. Privilege to operate a Bonded Manufacturing warehouse

(1.3) Incentives for Regional Headquarters and Regional Operating Headquarters in the Philippines

Source: BOI

Geographically as well, the Philippines is attractive. It borders on the Pacific Ocean and occupies an intermediate point between Japan, China, and ASEAN countries such as Vietnam. Taking advantage of its location features, it has developed extensive air and sea services.

The Philippines also has an abundance of cheap labor, and its population of 90 million makes it the second largest in ASEAN after Indonesia. It has a young population, giving it a large labor force. Wages for workers are low compared with coastal areas in China, Thailand, and Malaysia, and about level with those in major cities in India. Wages for managers are about level with those in Vietnam.

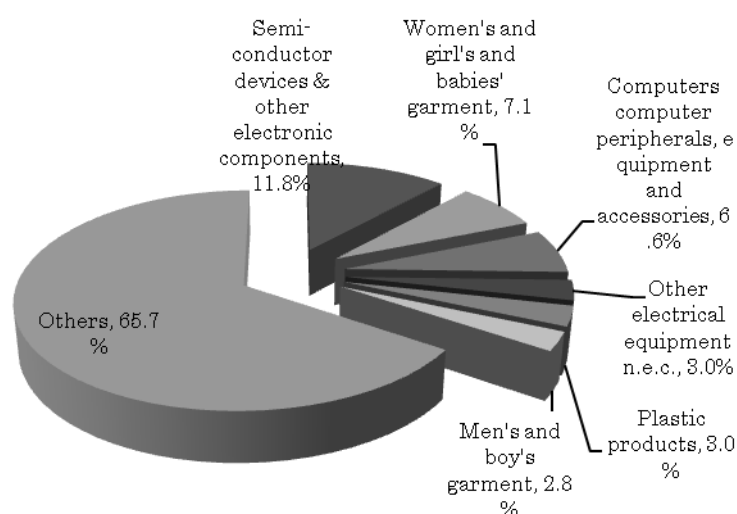
Table 2-4 Labor costs in selected Asian cities (2008)

city	unit	Manufacture			Service sector	
		worker	engineer	manager	staff	manager
Manila	us\$	194.8	314.8	850.1	332.4	969.8
Hanoi	us\$	95.8	270.4	798.0	353.2	945.4
HCMC	us\$	95.8	270.4	798.0	353.2	945.4
Kuala Lumpur	us\$	290.5	759.4	1,500.0	752.7	1,748.6
Bangkok	us\$	241.1	576.7	1,391.3	521.4	1,427.8
Jakarta	us\$	131.3	257.4	705.5	258.9	748.9
Shanghai	us\$	249.4	609.7	966.8	695.8	1,451.4
Shenzhen	us\$	204.1	485.9	1,158.2	714.6	1,815.9
New Delhi	us\$	187.4	460.2	1,021.5	518.2	1,371.2

Source: JETRO

2.1.3 Electronics sector is leading the industry of the Philippines

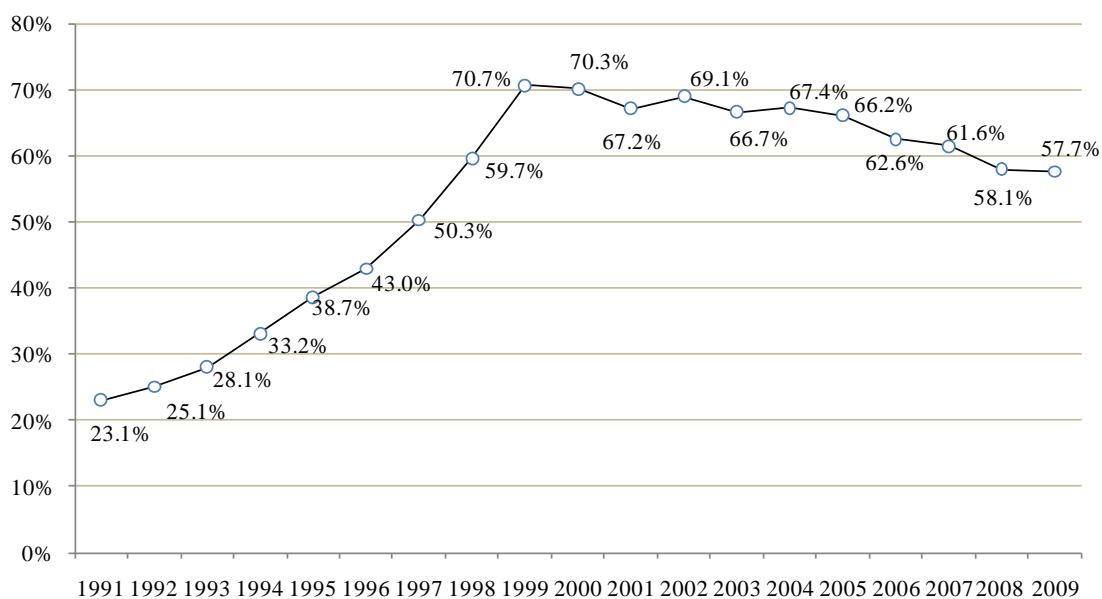
Electronics sector is one of the most important industrial sectors in the Philippines. In terms of the employment, “Semiconductor devices and other electronic components” count 11.8% of total employment of manufacturing sector, followed by “Women’s, girl’s and babies’ garment” (7.1%), “Computers, computer peripherals, equipment and accessories”(6.6%), “Other electrical equipment n.e.c” (3.0%) and “Plastic products” (3.0%) (see figure II-1).



Source: NSO, CPBI 2006

Figure 2-1 Employment share by Manufacturing sub-sectors

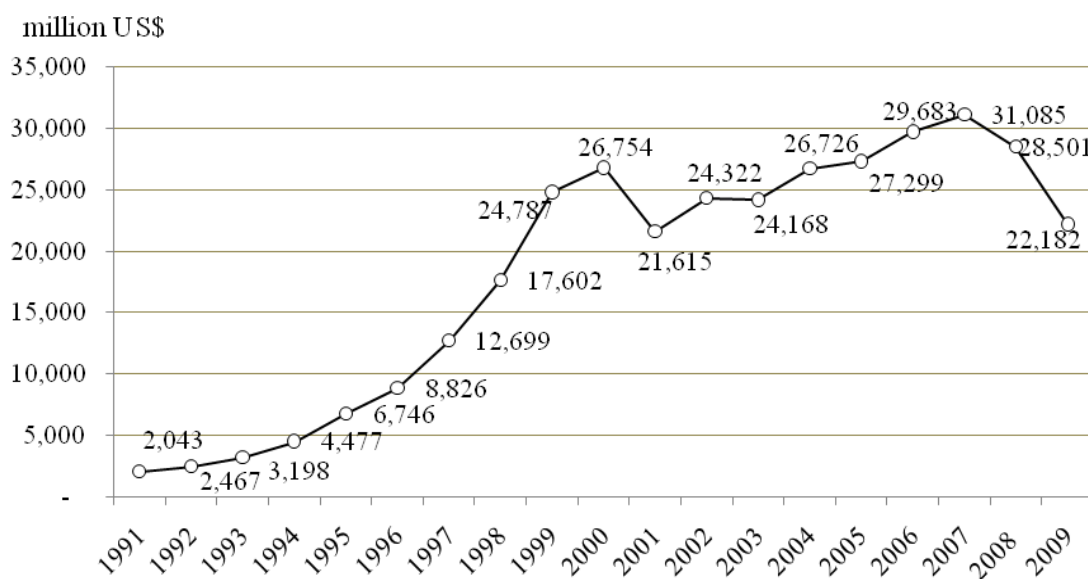
Electronics sector is leading the Philippines’ export. Although the share of electronics sector to the total exports has been decreasing, but it still counts 57.7%.



Source: NSO

Figure 2-2 Share of electronics industry to the total exports from the Philippines

The value of exports of electronics sector has been soaring until the year 2000. It decreased in 2001 when “IT bubble” burst, but then increased gradually. However, after it reached its peak in 2007, it is again falling down in 2008 and 2009.



Source: NSO, CPBI 2006

Figure 2-3 Exports value of electronics industry

2.2 Target sectors for the next generation industry

2.2.1 Comparison with neighboring countries

While investment in the Philippines is buoyant, it is not particularly so in comparison with neighboring countries, and is an order of magnitude smaller than in Indonesia, Vietnam, and

Thailand, etc., where investment is worth over a billion U.S. dollars a year compared with the US\$100 million level in the Philippines. Investment in manufacturing is low in comparison with other countries.

The Philippines is dependent on the electronics industry, which accounts for around 68% of the machinery industry. This indicates that the electronics industry in the Philippines should be competitive. Otherwise, it will be difficult to survive in the fierce regional competition.

The neighbouring countries have well organized system for attracting investments from foreign countries and grow faster. As AFTA is in progress, barriers of country border lowered and the location selection of foreign investments tend to concentrate on one or two countries.

Table 2-5 Inward FDI in neighboring countries

	2000			2005			2006			2007		
	total	manufacture		total	manufacture		total	manufacture		total	manufacture	
		value	%		value	%		value	%		value	%
China	40,715	25,844	63%	72,406	42,453	59%	69,468	40,077	58%	83,521	40,865	49%
Indonesia	15,413	10,703	69%	13,579	6,028	44%	15,624	8,308	53%	40,146	27,210	68%
Malaysia(RM)	19,849	19,849	100%	17,883	17,883	100%	20,228	20,228	100%	33,426	33,426	100%
Malaysia(US\$)	5,223	5,223	100%	4,731	4,731	100%	5,730	5,730	100%	10,098	10,098	100%
Philippines	2,240	238	11%	1,854	532	29%	2,921	409	14%	2,928	546	19%
Thailand	2,813	1,811	64%	6,503	3,430	53%	10,480	4,069	39%	10,199	3,651	36%
Vietnam	2,839	1,804	64%	6,840	4,818	70%	12,004	8,271	69%	21,348	10,883	51%

Source: Institute for International Trade and Investment, “Sekai Shuyo-koku no chokusetsu-toshi Toukei-shu” (2009)

Table 2-6 Output and share of machinery industries

Unit: mil \$

Output	China	Indonesia	Malaysia	Philippines	Thailand	Viet Nam
	2005	2005	2005	2005	2005	2005
General Machinery	109,168	1,054	2,615	1,400	6,153	867
Machine tool	18,528	115	585	-	-	-
Other special machine	96,285	525	1,488	-	-	-
Electric machine	80,148	2,122	2,290	2,283	2,692	2,086
Electronics machine	288,505	1,352	32,523	5,525	7,580	2,190
Electronics components	95,930	1,734	22,416	8,601	24,744	-
Presision machinery	32,875	102	1,639	849	799	155
Automotive	91,862	4,536	4,772	2,370	13,335	1,791
Auto parts	49,303	1,979	1,384	-	-	-
Motor cycle	16,329	3,107	438	-	1,937	-
Other transportation machinery	31,395	495	1,498	1,005	95	2,784
Total	910,328	17,120	71,647	22,035	57,336	9,874

Unit: %

Share by sub-sectors	China	Indonesia	Malaysia	Philippines	Thailand	Viet Nam
	2005	2005	2005	2005	2005	2005
General Machinery	12.0	6.2	3.6	6.4	10.7	8.8
Machine tool	2.0	0.7	0.8	-	-	-
Other special machine	10.6	3.1	2.1	-	-	-
Electric machine	8.8	12.4	3.2	10.4	4.7	21.1
Electronics machine	31.7	7.9	45.4	25.1	13.2	22.2
Electronics components	10.5	10.1	31.3	39.0	43.2	-
Presision machinery	3.6	0.6	2.3	3.9	1.4	1.6
Automotive	10.1	26.5	6.7	10.8	23.3	18.1
Auto parts	5.4	11.6	1.9	-	-	-
Motor cycle	1.8	18.1	0.6	-	3.4	-
Other transportation machinery	3.4	2.9	2.1	4.6	0.2	28.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Japan Society for the Promotion of Machine Industry, "Higashi-Asia kikai kanren tokei no hikaku, setsugo ni kansuru chousa kenkyu"

2.2.2 Policy measures for development of next generation industry

Since the Global economic crisis in 2008, businesses and governments alike have increasingly focused on new “industries of the future” to replace conventional electronics industries whose center of gravity has shifted from developed to emerging markets.

The following sections describe industrial policies in other countries as reference, which will indicate policies for the Philippines.

2.2.2.1 Industrial Policy in Japan

Led by the country’s Ministry of Economy, Trade and Industry, moves are accelerating in Japan to actively invest in and nurture infrastructure, next-generation energies, next-generation vehicles (such as HEVs and EVs), environmental services, and similar industries.

METI’s Industrial Structure Vision

In order to formulate what has been provisionally named an “Industrial Structure Vision” outlining Japanese industry’s future shape in line with the Basic Policy on Growth Strategy unveiled in December 2009, METI established a body called the Industrial Competitiveness Committee. This vision discusses “what will drive Japan’s revenues and employment in the future,” and focuses in particular on the following five themes.

Infrastructure development in emerging economies

Next generation energies

Services to solve social challenges

Leader in aesthetic/culture industries

High-tech

Specific industries and themes are show in the table below.

Table 2-7 Japan's priority industries of the future

Priority fields	Specific industries and themes
Infrastructure development in emerging economies	Power generation and transmission/distribution networks Water business Information and communications Urban development and industrial estates Railways Nuclear power generation Waste disposal and recycling
Next-generation energies	Smart grids, smart communities, and smart houses Storage cells Next-generation vehicles Solar power generation Clean IT (LEDs and organic EL devices, etc.)
Services to solve social challenges	Health (medical services and equipment, medical supplies, nursing care) Childcare and parental support Residential and consumer infrastructure (shopping assistance, crime prevention services) Digital government Recycling industry ("urban mines," etc.)
Leader in aesthetic/culture industries (market exploitation of local aesthetic and cultural resources)	Content Agricultural and food products Fashion and design Overseas expansion of SMEs Overseas expansion of distribution providers Ordinary and medical tourism Daily commodities (including traditional craft products)
High-tech	Space Aviation Rare metals Robots Advanced IT (cloud computing, etc.) Functional chemistry Nanotech Superconductors

Source: Compiled by NRI based on information published by METI.

2.2.2.2 Industrial Policy in China

In its Eleventh Five Year Plan, China similarly clearly identifies high-tech industries for priority development and industries whose growth should be maintained at current levels, and it is taking steps to promote the development of industrial clusters and expand industrial scale. Notably, even in China, where market growth is tremendous, interest in industries of the future in environmental and energy-related fields is increasing in the private sector as well at the government level.

Table 2-8 Beijing's Eleventh Five Year Plan

<p>High-tech industries for priority development</p>	<ol style="list-style-type: none"> 1) Software industry 2) R&D industry 3) Information services 4) Mobile communications 5) Computers and networks 6) <u>Optoelectronics and displays (development of industrial clusters driven by leading firms, promotion of joint innovation and R&D by leading firms, SMEs, and R&D institutes, and development of clusters of firms in cutting-edge optoelectronic and display technology industries, with a particular focus on developing LCD, OLED, LED, and similar products)</u> 7) Modern biotech industries (promotion of research on DNA processes, bio chips, animal vaccines, and other bio-process technologies and new products, and development of bio-medicine, bio-agriculture, and bio-environmental conservation industries, etc.) 8) In addition to the above, active development of digital TVs, car electronics, new materials, new energy sources, and similar industries
<p>Industries maintaining current growth</p>	<ol style="list-style-type: none"> 1) Automobile industry (accelerated restructuring in the industry focusing on rationalization of structure and harmonization of resources placing a priority on the development of passenger cars, commercial vehicles and SUVs for military and civilian use; promotion of related industries, such as auto parts manufacturing and the auto services trade, through development of the auto industry; acceleration of innovation, brand development, and import and absorption of advanced key technologies; improvement of competitiveness) 2) Equipment manufacturing 3) New petrochemical materials (active development of high added-value chemicals industry materials and micro-chemical manufacturing causing low levels of environmental pollution and resource depletion led by Yanshan Petrochemical Co., Ltd.) 4) Pharmaceutical industry (placing priority on development of traditional Chinese medicines and natural drugs and modernization of production of the former; enhanced discovery and R&D on chemical agents; balanced development of the four fields of chemical drugs, traditional Chinese medicine, bio-medicine, and medical equipment; development of industrial structure; construction of top-class nationwide bio-processes and new medical industry hubs) 5) Urban industry 6) Construction 7) Management of industrialization of agriculture

Source: Compiled by NRI based on information published by the Chinese government.

Table 2-9 Summary of Chinese policy on development of LED industry

Policy type		Details
Development plans and policy		<ul style="list-style-type: none"> ■ “General Work Plan for Energy Conservation and Emission Reduction” (announced June 2007) <ul style="list-style-type: none"> ● Promotion of 10 key energy conservation projects and installation of 50 million high-efficiency lights ■ “Electronic Communications Adjustment and Development Plan” (announced by the State Council in April 2009) <ul style="list-style-type: none"> ● Improvement of capacity for R&D in areas such as semiconductor lighting and development of industries on the value chain ■ “Opinion on Development of the Semiconductor Lighting and Energy Conservation Industries” (announced October 2009) <ul style="list-style-type: none"> ● <u>Approx. 30% annual increase in annual value of output of semiconductor lighting industry by 2015</u> ● <u>Improvement of firms’ ability to innovate targeting shift to domestic production of large-scale MOVCD systems, key raw materials, and LED chips; target of attaining 70% domestic production of LED chips</u> ● <u>Development of standard semiconductor lighting systems</u>
Means	Subsidies	<ul style="list-style-type: none"> ■ National 893 Plan <ul style="list-style-type: none"> ● Provision of special-purpose LED project funds and financial support of business applicants every year ■ “Provision Measures on Administration of Publicly Subsidized Funding of High-efficiency Lighting Products” (announced 2008) <ul style="list-style-type: none"> ● Vigorous promotion of high-efficiency lights placing priority on public subsidies for replacement of low-efficiency lights with semiconductor (LED) lights ■ “Flat Display and Color Television Industry Rolling and Molding Processes” (announced by the Electronic Communications Promotion and Planning Department, February 2009) <p>Technological improvement and industrialization of set products placing priority on supporting technological improvements to drive circuits, LED backlights, glass substrates, liquid crystal materials, and special-purpose facilities, and provision of 500 million yuan of support by central government</p>
	Large projects	<ul style="list-style-type: none"> ■ “LED Street Lighting Project” (announced by the Department of Science and Technology in May 2000) <p>Implementation of project to introduce LED street lighting in 21 cities, including Tianjin and Shijiazhuang in Hebei Province</p>

Source: Compiled by NRI based on information published by the Chinese government.

2.3 The targeting sector of this project

This is to identify missing links in the Philippines’ electronics industry in order to supplement and reinforce where necessary. In order to enhance the competitiveness of the semiconductor (assembly process) and hard disk product and part sectors, which are either considered strengths of the Philippines or which account for large chunks of the Philippine economy, it needs to be confirmed whether there exist any missing links. If any are discovered, they should be thoroughly studied from a variety of angles to determine whether plugging them would help strengthen the electronics industry.

2.3.1 Enhancing existing industry

Select electronics products from which production already exists in the Philippines. Among products, the project will select those have large scale productions globally and higher growth potential.

Table below shows our assessment of individual products for existing electronics industry in the Philippines. Based on the assessment, the project team selected HDD, Semiconductor and LED as study objects in this project. Photovoltaic cell also exists in the country (SunPower), but the team regarded this product as a new generation products.

Table 2-10 Assessment of existing electronics products in the Philippines

Products	Manufacturers	Production value size	Potential	Assessment for the Philippines
CRT-TV	Sharp	M	M	
DSC	HOYA	M	H	
Car audio	Clarion, Fujitsu-Ten	M	M	
A/C	Panasonic	M	M	
Refrigerator	MELCO	M	M	
Washing machine	Japanese companies	M	M	
Printer	Epson	M	H	P
Portable Navigation Device	Foreign companies	M	H	
HDD	Toshiba, (incl. ex-Fujitsu)	VL	H	HP
CD-ROM / Combo	TSST, Panasonic	M	M	
Optical pickup	Mitsumi	M	M	
LED	Lite-on	L	VH	HP
Switching supply	Mitsumi, Lite-on	M	M	
IGBT	Fairchild	L	M	
PV cell	SunPower	M	VH	P (as a new generation product)
Semiconductor	TI, Intel, Philips	VL	H	HP

Note:

Production value size in 2020:

- Very Large (VL) several hundred billion dollar
- Large (L) approximately one billion dollar
- Medium (M) approximately a half billion dollar

Growth potential:

- Very High (VH) more than 10% per annum
- High (H) around 5% per annum
- Medium (M) around 2% per annum

Assessment

- Highly promising (HP)
- Promising (P)

Source: Japan International Cooperation Agency, Study Team

2.3.2 Creating a new industrial cluster

This is an action in fields in which the Philippines does not presently have an advantage but which should be strengthened for the sake of the electronics industry as a whole, and fields that are expected to experience rapid market growth.

An extremely effective strategy in view of the global division of labor in electronics manufacturing is to attract brand-name manufacturers and electronics service providers that have a strong presence in parts and finished products. If, for example, brand-name manufacturers and electronics service providers of printers and cellular phones, which require numerous electronic parts and materials, can be attracted, the many parts and materials manufacturers that they need will cluster around them, and there are many examples of major industrial clusters having developed in this way.

While the Philippines is free to choose whether to focus on the parts and products category or the brands and electronics service category, it needs to focus on one or the other and adopt a strategic approach to attracting the companies that are expected to become core players by offering them overwhelmingly advantageous conditions.

In view of the above and the present state of its industrial clusters, the Philippines should focus on developing the following industries.

- Photovoltaics

One of the leading solar cell module manufacturer SunPower of the U.S. has operations in the Philippines, and further major additional investment is planned. Development of a major photovoltaic industry cluster with these operations at its hub should therefore be considered. In neighboring countries, U.S.-based First Solar is injecting significant additional investment in Malaysia, while in Thailand, module makers such as local manufacturer Bangkok Solar are emerging. With demand for photovoltaics rapidly growing in Southeast Asia, U.S. and European manufacturers also actively investing in Asia, the Philippines has the potential to attract firms and develop industrial clusters by marketing its low labor costs and experience of the electronics industry.

- LEDs

Lite-on of Taiwan has already established a presence in the Philippines, and domestic manufacture of high-luminosity LEDs and expansion of semiconductor operations is being pursued. Downstream, Hikari Systems and Sharp subcontractor Fujimoto Electric of Japan have established operations in export processing zones and are manufacturing and exporting LED lighting equipment. Elsewhere, LED lamp manufacturer Sanken Electric, automobile backlight manufacturer Kuroda Electric, LCD backlight manufacturer IMES, and others have already established operations in the country, creating the potential for industrial clusters to be developed around them.

- Rechargeable Batteries

Rechargeable batteries such as LIB, NiMH, and NiCD batteries are used in next-generation vehicles such as HEVs and EVs as well as in mobile digital devices, and the market has grown rapidly in size in recent years. Although mobile set makers and auto parts industry clusters are not particularly well developed, firms in these fields are worth attracting for their strategic significance as industries of the future.

- Next-generation energy infrastructure

The power supply situation in the Philippines is not particularly efficient. In urban areas, moreover, atmospheric pollution caused by traffic congestion is increasing, and environmentally friendlier energy supply sources are needed. As most of the country consists of small islands, there is no large-scale power grid, and the country is intrinsically suited to distributed

generation. Given this situation, the Philippines should pursue the development of industries that produce renewable energy systems, such as photovoltaic, wind, and geothermal power generation systems. Because, for better or worse, electricity costs in the Philippines are extremely high, there is little difference in cost between grid power and power produced by renewables, thus lowering the barriers to commercialization of renewable energy sources. Development, incorporation, and standardization of renewable energy systems taking advantage of these conditions should therefore be pursued at the national level, with consideration also being given to plans to export to neighboring ASEAN countries and emerging economies.

Some manufacturers of parts and modules used in photovoltaic and wind power generation have, as noted above, already established operations in the Philippines. The key to whether the Philippines' next-generation energy infrastructure can grow significantly thus lies in whether activity can be further expanded to include the systems industry.

The project team evaluated next generation products of electronics sector by the market size in 2020, growth rate up to 2020 and any relevance to the current state of the Philippines (relevance with existing companies and/or public policy). As a result, the team selected Photovoltaic cell, Rechargeable battery and LED as highly potential products. In addition to these, the team also included the embedded software development and Research, development and designing based on the motivation of local private sector.

Table 2-11 Assessment of next generation products in the Philippines

Products	Market size	Growth rate	Potential in the Philippines	Assessment
Photovoltaic cell	VL	VH	VH	HP
Fuel cell	L	VH	M	P
Rechargeable battery	VL	VH	M	HP
Electronic Book (e-Book)	M	L	H	P
Smart phone	L	VH	H	P
Car navigation	L	M	M	N
Electric Vehicle	VL	L	M	N
LED	VL	VL	H	HP
Flat Panel Display	VL	L	M	P

Note:

Production value size in 2020:

- Very Large (VL) several hundred billion dollar
- Large (L) approximately one billion dollar
- Medium (M) approximately a half billion dollar

Growth potential:

- Very High (VH) around 30% per annum
- High (H) around 20% per annum
- Medium (M) around 10% per annum

Potential in the Philippines, i.e. government's commitment and/or existing companies:

- Very High (VH) : very active
- High (H) : active
- Medium (M): moderate

Assessment

- Highly promising (HP)
- Promising (P)
- Not Promising (N)

Source: Japan International Cooperation Agency, Study Team

3. Supply chain analysis for the major sub-sectors in Philippines

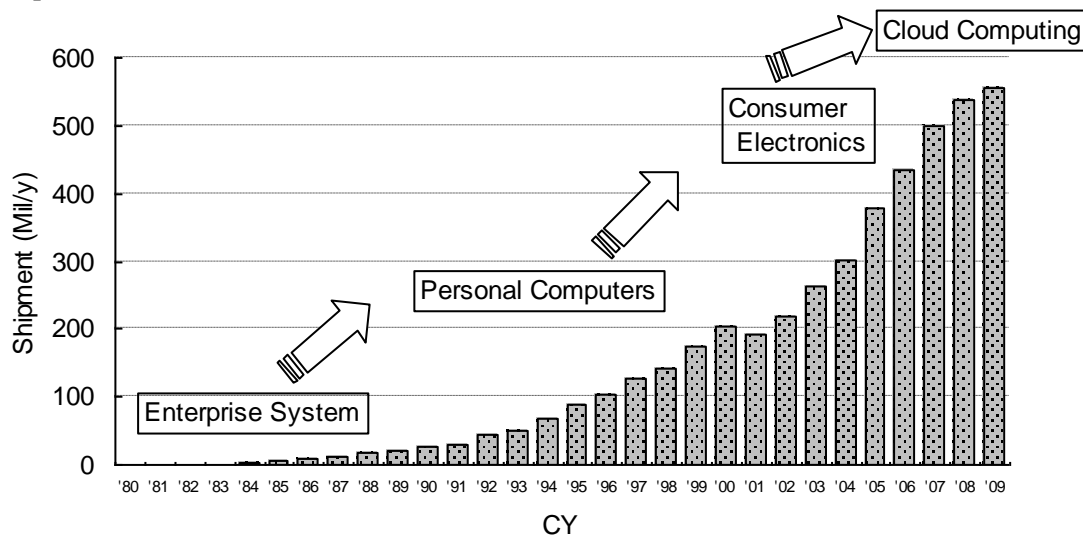
Below we summarize and explain the present state of the HDD and semiconductor industries, which play a core role in the Philippine electronics industry, and shed light on the supply chain.

3.1 HDD

3.1.1 HDD industry

The HDD market has grown as applications have developed. The hardware that underpins IT consists of the following three elements: information processing (MPUs and memory), information transmission (input/output and network), and information storage. The relative importance of these three elements is shifting from primarily information processing, as in the past, to information transmission and thence to information storage as IT evolves and develops. The bulk of the computers referred to as servers are file servers, and playing the core role of information storage in these are HDDs. Video, images, and music have of late become digitized, and HDDs are being increasingly used in a variety of applications in the consumer electronics.

HDDs first appeared in 1956. From then until around 1990, they were employed as key storage devices in computer systems used mainly in enterprise system. From the beginning of the 1990s, they began to become a standard part of PCs and the market exploded in size. In the following decade, they began to be used in Digital Video Recorder (DVRs) and MP3 players as the market expanded further, and the market is certain to continue to grow as cloud-computing developments.



Source: Institute of Information Technology, Ltd.

Figure 3-1 History of development of the HDD industry

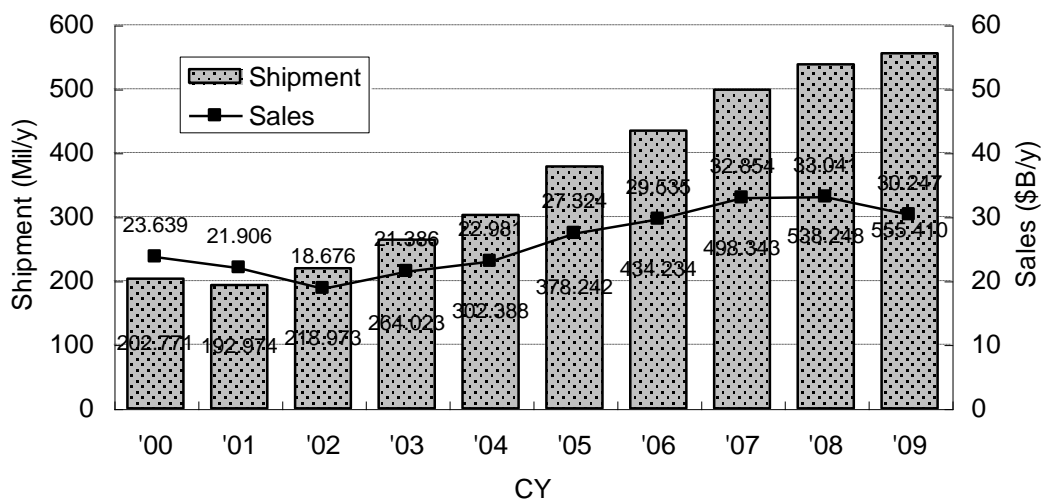
3.1.2 Current state of the HDD industry

The figure below shows the number of units and value of shipments of HDD. Early in the 2000s, the collapse of the IT bubble pushed the market into the doldrums. During the middle of the

decade, however, there was sustained stable growth. In 2008, conditions in the market temporarily deteriorated due to the impact of the Global economic crisis, but quickly recovered again. In 2010 through 2011, strong growth is projected.

The annual average growth rate of the HDD market in the 2000s was approximately 15% in terms of units and 6% in terms of value. This exceeds that of PCs, which are the main application for HDDs. This is due to their increased use in DVRs, game consoles, MP3 players, car navigation systems, DVCs, and others such devices that did not previously exist. In the 2010s, the effect of factors such as the impact of their use in such consumer electronics applications will fade. However, the anticipated rapid spread of PCs in emerging markets and increase in the proportion of high value-added HDDs used for applications such as data centers with the development of cloud-computing are expected to drive continued stable growth.

While the SSDs which use flash memory are forecast to eat into the HDD market, the five- to tenfold difference in price per bit between HDDs and SSDs leads the IIT to project only a very slight decrease as a result.



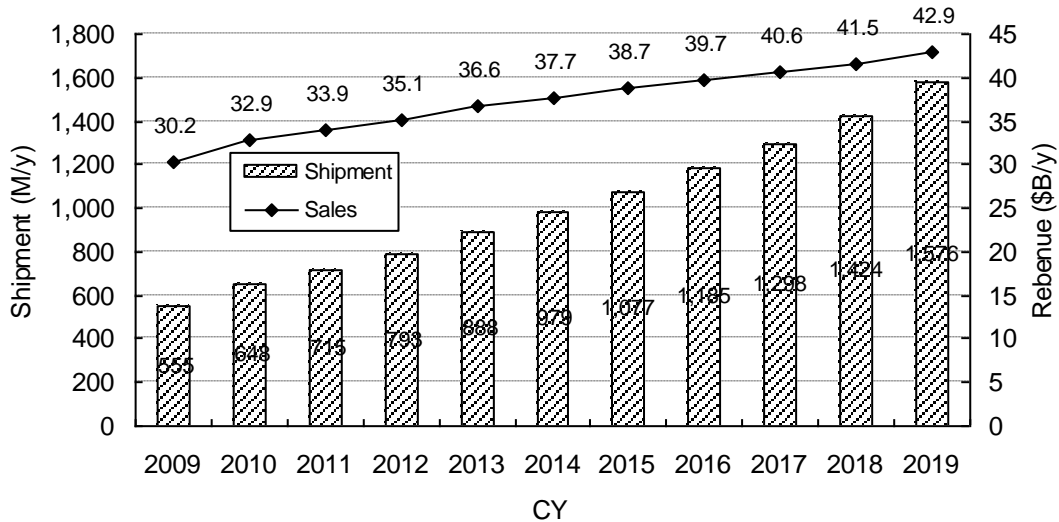
Source: Institute of Information Technology, Ltd.

Figure 3-2 Unit shipments and value of shipments of HDDs (2000-2009)

From the end of 2008 through 2009, the HDD market was turbulent. It had returned to robust growth by the beginning of 2010, however, leading some commentators to make exceedingly bullish market projections for 2010 through 2011, with some even projecting continued growth in excess of 20% during that period. The IIT expects strong growth as the market rebounds from a lackluster first half in 2009, followed by a return to stable growth from 2011. In the mid-term, a combination of computer and non-computer demand will propel stable growth.

A breakdown by size shows 2.5” HDDs’ share of shipments to be growing, and they will form the mainstay of the market from the second half of 2010. This does not mean, however, that 3.5” HDDs are on the way out, and demand will continue driven mainly by applications requiring large capacity. This is because, despite the advantages of miniaturization of HDDs, the range of applications where the advantage of compactness outweighs the demerit of lower capacity is limited. Super-small-size HDDs of 1.8” or less will see the loss of their mainstay use in MP3 players, making it crucial to again seek out new applications.

Broken down by application, demand for non-computer applications is unlikely to grow as rapidly as over the past five or six years. Computer demand, on the other hand, is likely to continue to grow at around the same level. Looking ahead, non-computer applications' share of total HDD demand will hold steady at around 10%.

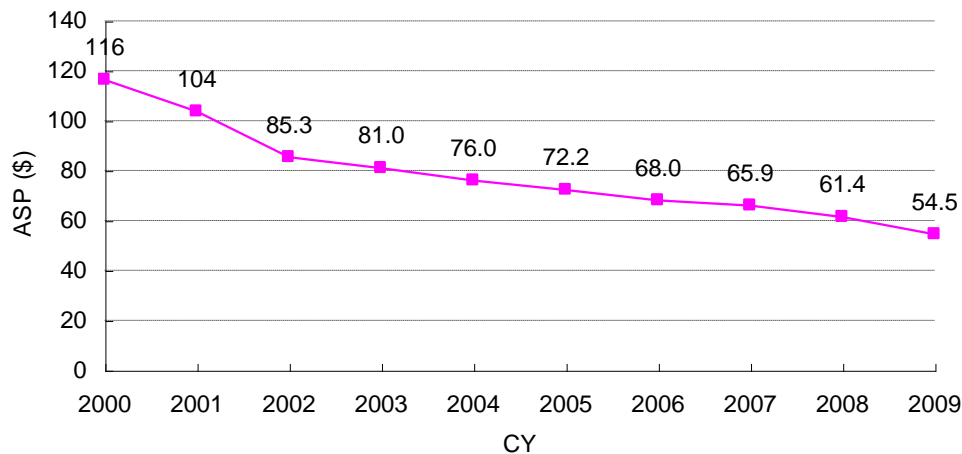


Note: Actual figures for 2009 and forecasts for 2010 onward.

Source: Institute of Information Technology, Ltd.

Figure 3-3 HDD market outlook

Competition between companies in the HDD arena is fierce. The figure below shows movements in the average selling price of HDDs, from which it can be seen that it has roughly halved over the past decade or so. On an annualized basis, this represents a fall of around 6.6%. Since they began to be used in PCs in particular, the equipment price of HDDs has fallen significantly, and the decline is expected to continue at around the same rate.



Source: Institute of Information Technology, Ltd.

Figure 3-4 Average selling price of HDDs (2000-2009)

As the table below shows, there has as a result been a series of withdrawals, assimilations, and mergers among players in the industry. The number of companies entering the market has consequently steadily declined. The number of entrants was over 50 at its peak in around 1985,

a figure that had fallen to around 20 in the mid-1990s, and to 10 in 2000. Assimilations and mergers have continued thereafter, and there are now only 5 left.

The same trend is apparent among parts and materials manufacturers as well. Hoya recently sold its media business to Western Digital, as a result of which the only two independent media manufacturers left are Showa Denko and Fuji Electric. There is also now only one independent head manufacturer left, TDK, upon whom all manufacturers who do not manufacture their own heads in-house are now solely dependent. The industry, including the parts and material segments, is growing increasingly and noticeably oligopolistic, with the only two manufacturers of aluminium blanks now being Kobe Steel and Furukawa Electric.

Table 3-1 Changes among players in the HDD market

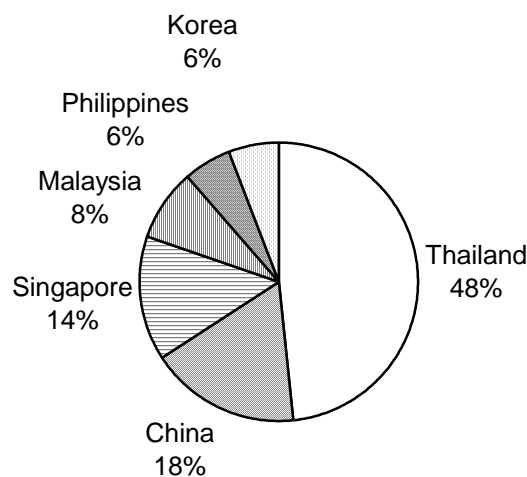
	CY93	CY94	CY95	CY96	CY97	CY98	CY99	CY00	CY01	CY02	CY03	CY04	CY05	CY06	CY07	CY08	CY09	CY10	
# of Company	23	21	18	16	14	13	10	10	10	10	9	9	9	9	7	6	6	5	
Seagate	9,922	12,877	16,690	28,853	29,424	30,005	36,571	44,162	40,796	64,476	75,464	82,269	107,896	131,820	175,542	170,478	175,215		
Conner	9,380	10,852	11,983	Merged by Seagate															
Maxtor	4,875	4,738	7,122	5,674	8,367	16,163	23,502	27,461	25,075	39,640	55,242	53,698	53,039	27,612	Merged by Seagate				
Quantum	10,456	15,863	19,558	23,261	25,956	25,185	29,776	32,678	27,831	11,760	Merged by Maxtor								
DEC	366	1,003	Merged by Quantum																
Western Digital	5,170	8,819	12,318	19,359	24,051	19,504	19,632	21,459	23,387	35,039	44,862	54,780	66,324	85,172	113,020	144,604	165,098		
Hitachi	119	202	496	894	1,337	2,670	3,497	4,200	6,113	8,065	43,484	46,570	58,352	69,893	89,389	91,127	91,188		
IBM	4,949	7,817	10,399	10,824	14,238	17,789	24,159	28,663	32,257	28,133	Merged by Hitachi								
Toshiba	1,049	2,260	3,021	4,994	5,344	7,780	5,676	6,318	8,861	11,112	15,149	22,194	32,522	41,417	37,424	46,456	54,730		
Fujitsu	915	1,049	2,240	5,536	11,478	17,306	21,294	26,951	18,116	8,125	11,286	17,566	24,211	29,963	36,209	39,320	18,971	Merged by Toshiba	
Samsung	769	1,349	2,092	1,640	4,232	5,376	9,723	10,750	8,365	12,623	15,508	23,031	34,950	47,642	46,659	46,263	50,208		
Cornice											317	1,108	670	685	100	BR			
GS Magicstor											346	1,172	278	30	BR				
Calluna	3	6	17	8	52	108	110	130	45	0 BR									
NEC	385	503	876	1,503	979	227 WD													
Integral	42	91	287	262	236	6 BR													
JTS			83	716	1,188	394 BR													
Micropolis	366	366	203	277	363 WD														
HP	724	910	1,092	335 WD															
Areal	148	205	91	18 BR															
MiniStor	13	46	18 BR																
Alps	344	9 WD																	
Fuji Electric	259	103 WD																	
TEAC	14	13 WD																	
Daeyoung	42 WD																		
JVC	15 WD																		

BR=Bankruptcy
WD=withdrawal

Source: Institute of Information Technology, Ltd.

3.1.3 The Philippines' position in the HDD industry

The figure below shows HDD production broken down by country. While HDD demand exists worldwide, production is concentrated entirely in Southeast Asia. At the center of global HDD production is Thailand, where top maker Seagate has operations and Western Digital, HGST, and Toshiba also have major plants. Seagate, HGST, Toshiba, and Samsung recently expanded production in China, whose share has risen considerably. While Singapore used to be at the heart of HDD production, it is now assuming more the role of production controller in Southeast Asia. Elsewhere, Western Digital, Samsung, and Toshiba each have only one production facility in Malaysia, Korea, and the Philippines respectively.



Note: Based on total unit output in 2009. Each HDD is counted as a single unit regardless of differences in size and price.

Source: Institute of Information Technology, Ltd.

Figure 3-5 Breakdown by country of HDD production

While the Philippines' HDD industry is one of the country's foremost industries, its importance to the HDD industry as a whole is minor. However, Toshiba, which has key production operations in the Philippines, sees HDDs as one of its core businesses, as evidenced by its recent acquisition of Fujitsu's HDD business, and it is likely to continue investing to expand its operations. To assist in this, manufacturers of key parts, such as heads, printed circuit boards, and motors, are also establishing production operations in the Philippines.

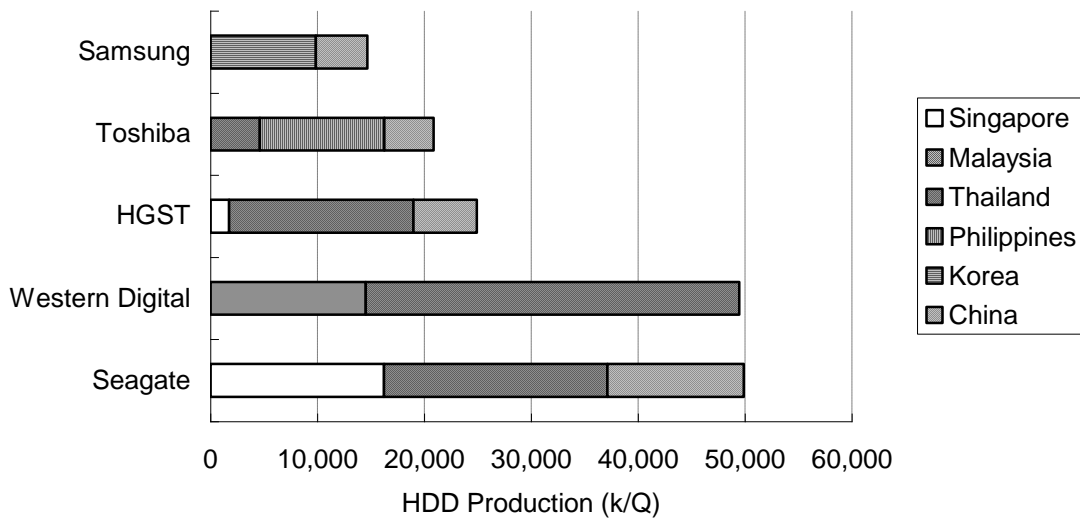
The figure below shows the volume of production of all manufacturers broken down by country. Top manufacturer Seagate was historically the first to commence production in Southeast Asia when it established operations in Singapore. Singapore continues to make HDDs, primarily for high-end systems, and some final inspection work on HDDs made in Thailand and China is also carried out there. Singapore is also the location of other media production operations, and production in Asia as a whole is overseen from there. All recent increases in production capacity have occurred in China.

Western Digital was one of the first to commence production in Singapore, but subsequently transplanted all production to Thailand and Malaysia. HDD production control functions are located in Malaysia. Recent increases in production capacity have been concentrated in

Thailand, as in the case of its acquisition of the former Fujitsu plant there.

Several years ago, HGST consolidated plants around the world that used to be operated by IBM and Hitachi. Presently, HDDs for high-end systems are produced in Singapore, and the remainder are made in Thailand and China. HGST also used to make HDDs in the Philippines (at the former Hitachi plant), but now only carries out slider processing there.

Toshiba used to make HDDs in the Philippines and China (contracted out to SAE) and, following its purchase of Fujitsu’s former operations in the Philippines and Thailand, now produces them in three locations. In the Philippines, Toshiba has a former Fujitsu plant and its two original operations there.



Note: Based on volume of output in 4Q 2009. Each HDD is counted as a single unit regardless of differences in size and price.

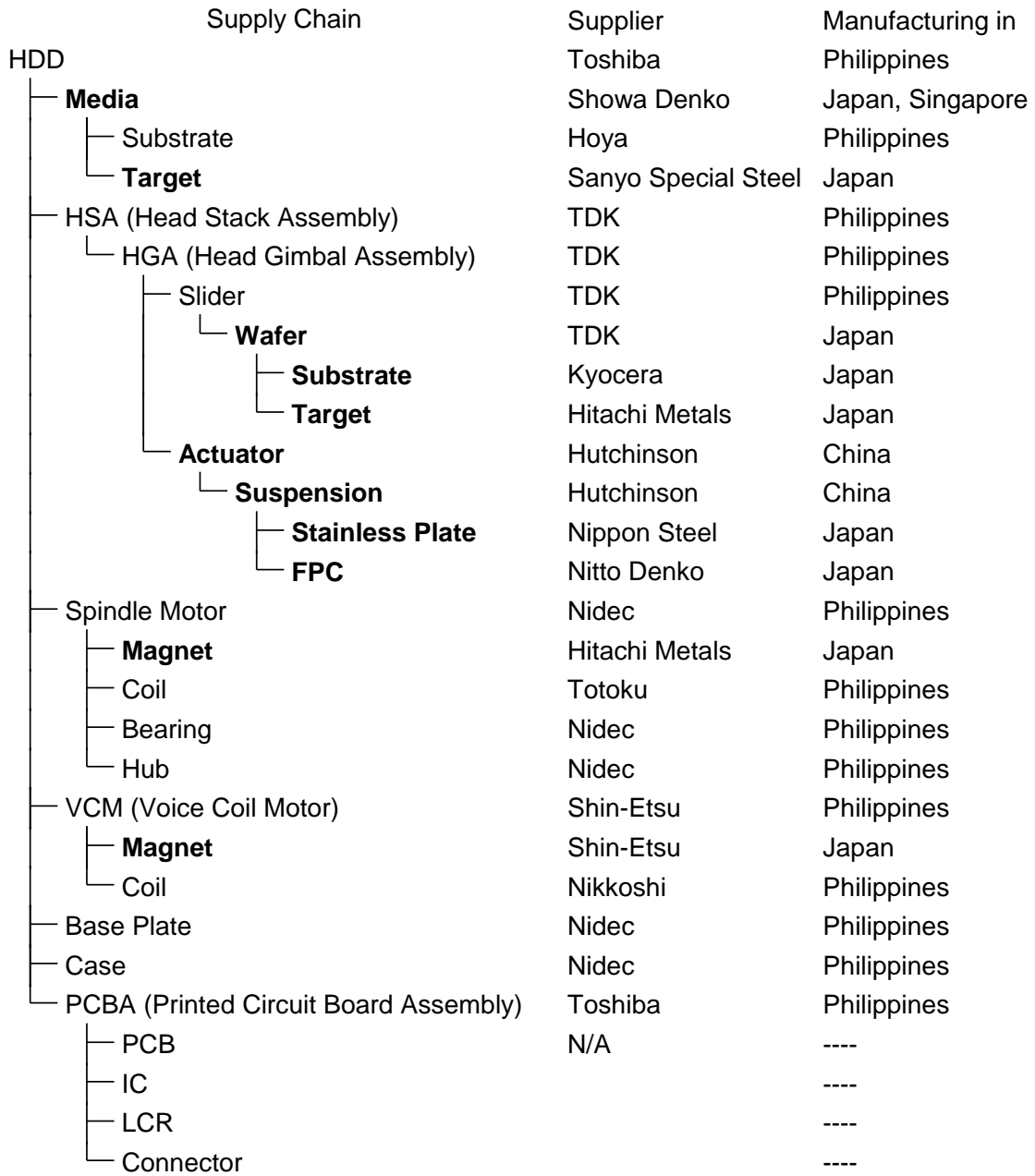
Source: Institute of Information Technology, Ltd.

Figure 3-6 Volume of production of HDD manufacturers by country

3.1.4 Supply chain of the HDD industry in the Philippines

The figure below shows the HDD production supply chain in the Philippines. In the figure, the bolded text indicates items that are not produced in the Philippines, i.e., the “missing links” in HDD production there. Most of the key parts required to produce HDDs are made in the Philippines, but not all. Key parts such as media and Heads in particular all have to be imported.

For the companies that fill these missing links, new investments into the Philippines enables them to strengthen relations with existing clients and build ties with new clients, and so they might be exceedingly interested in investing in the country.



Note: Items in bold indicate missing links in the Philippines.

Source: Compiled from interviews. Some estimates by IIT.

Figure 3-7 Supply chain for HDD production in the Philippines

However, from discussions with related companies in the Philippines, it is found that existing parts suppliers for HDD industry are struggling from two major reasons. One is that HGST has quitted from HDD production. The other is that Fujitsu has merged to Toshiba and their total production number has declined. Therefore, the suppliers who had supplied to those three HDD manufacturers cannot fill up their capacity and are compelled to find new products so that they can survive.

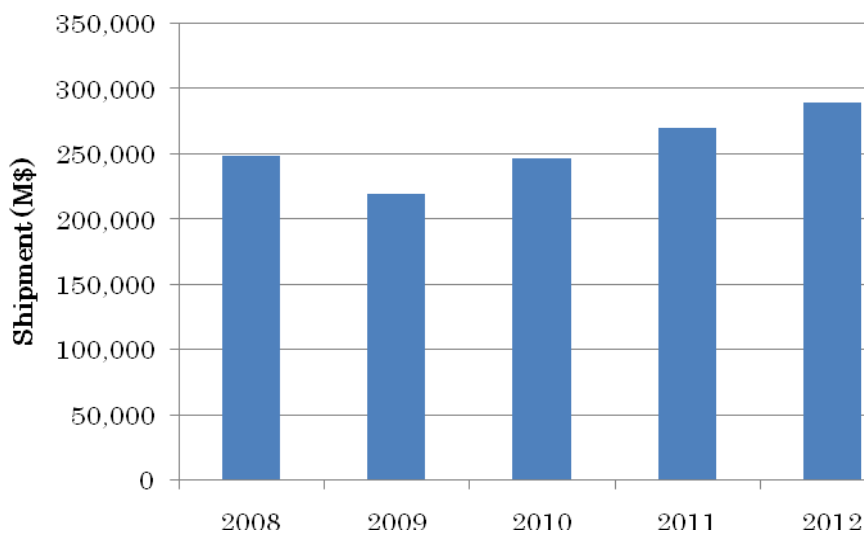
Half of the HDDs in the world are manufactured in Thailand and HDD manufacturers will expand their production capacity mainly in China. Toshiba will expand their capacity in China and will keep the Philippines capacity as it is now. For the other HDD manufacturers, there is also no reason to build a new factory in the Philippines. Under this circumstance, it is almost impossible to find a new supplier who will invest in the Philippines only for Toshiba.

We recommend to find potential investors in new industries which will be developed from now on such as PV, LED and others.

3.2 Semiconductor

3.2.1 Overview of the semiconductor industry

According to the WSTS, the global semiconductor market in 2009 was worth US\$248,602 million, down 11.5% from the previous year due to the Global economic crisis in the fall of 2008. However, due to active demand in emerging markets including China, the market is expected to expand by about 10% per annum from 2010 to 2012 in spite of financial uncertainties in Greece and other European countries.



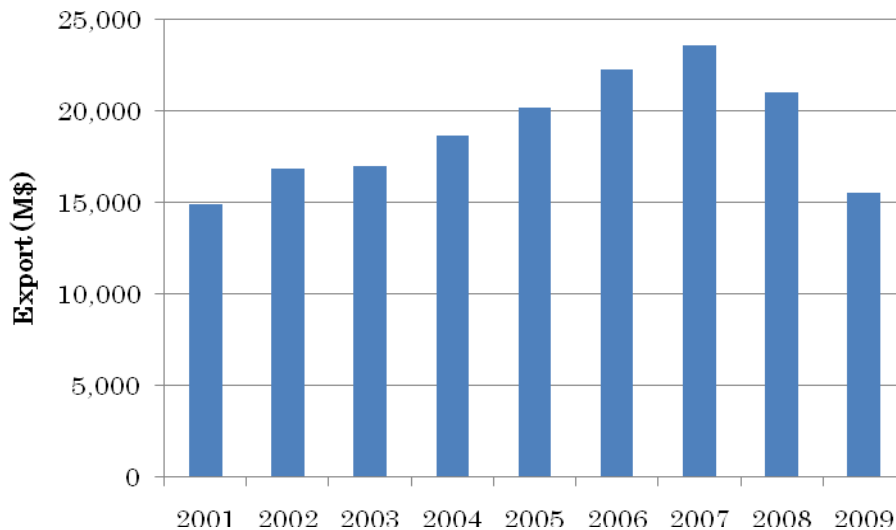
Source: WSTS2009 Autumn

Figure 3-8 Global Semiconductor Market Forecast

3.2.2 Semiconductor industry in the Philippines

Electronics is a vital industry for the Philippines. Although the amount fell for two consecutive years due to the Global economic crisis from a record-high of US\$23,624 million in 2007, the country exports electronics worth US\$15,582 million. The amount fell by almost 20% from

2008 to 2009, but rose by 8% per annum from 2001 to 2007, and is expected to grow by about 10% in 2010 and beyond.



Source: Trade Statistics Office, NSO

Figure 3-9 Export Value of the Philippines' Semiconductor Industry

The semiconductor industry in the Philippines is an outsource of the packaging process, or the assembly and testing process in the semiconductor industry, which means the country plays a key role in the value chain. Philippine companies import processed semiconductor wafers and chips from developed countries, package and inspect them, and export them to the destinations where application devices are assembled.

The following figure shows the value added by the semiconductor industry in the Philippines, which is equal to the value of exports minus imports, in other words the value added by processing in the Philippines. After a sharp drop in 2004 (unknown causes; under investigation), the value added gradually recovered and is now as high as that in the first half of 2000.

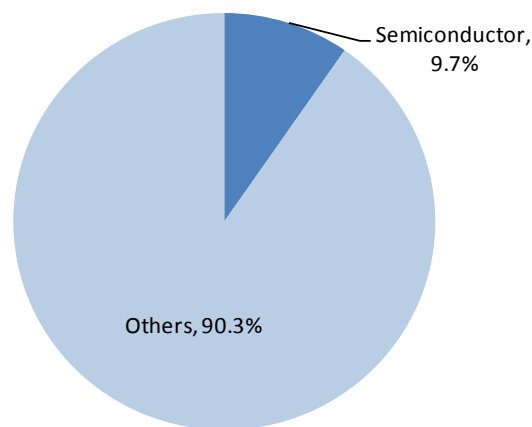


Source: Trade Statistics Office, NSO

Note: Added Value = Value of Exports – Value of Imports

Figure 3-10 Figure Added Value of the Philippines' Semiconductor Industry

The semiconductor industry (export base) accounted for about 10% of the nominal GDP of the Philippines in 2009. Although the semiconductor industry plays a key role in the Philippines, its growth potential is not so high because it is only a part of the value chain, that is, the inspection and packaging process within the assembly and testing process.



Source: Trade Statistics Office, NSO

Figure 3-11 Proportion of semiconductor industry in the nominal GDP of the Philippines

The semiconductor industry started developing in the country as early as in the 1970s when major semiconductor players including TI, Intel, and Philips started operations in the Philippines. Although Intel (except for the memory division) and Philips have already withdrawn, many parts manufacturers which came with the majors still contribute greatly to the development of the semiconductor industry in the country. However, because of the worldwide reorganization of the semiconductor industry and global relocation of semiconductor manufacturers, the large semiconductor manufacturers no longer have their plants concentrated in the Philippines. Therefore, parts makers and unit makers in the semiconductor industry no longer come to the Philippines.

3.2.3 Supply Chain of the Semiconductor industry in the Philippines

Process	Material & Parts	Equipment	Supplier & Manufacturing in
Design / Mask			
	Design	CAD	
	Mask		
	Mask		
	Quartz Substrate		
	Blanks		
	Cr Target	Sputter	
	Photo Resist	Stepper	
	Pelicle		
Wafer			
	Silicon Wafer		
	Silicon Ingot	Melting Pot, Growth Furnace	
	Poly Silicon		
	Wire	Wire Saw	
	Abrasive	Polishing Machine	
	Fumed Silica		
	Polysilicate Anion		
	Abrasive Pad		

Source: Japan International Cooperation Agency, Study Team

Figure 3-12 Supply chain for semiconductor production in the Philippines (1)

Wafering Process							
	Oxidizing Wafer					Diffusion Furnace	
	Coating					Coater	
		Photoresist					
		├ Base Resin					
		└ Photosensitive material					
	Patterning					Developer	
	Etching						
		Etching Gas (Dry Etching)				Etcher	
		Conditioner (Wet Etching)				Etcher	
	Oxidizing / Diffusion / CVD / Ion Implanting						
		Target					
	CMP						
		CMP Slurry				CMP	
		├ Abrasive Grain					
		├ Dispersed Material (PEG)					
		├ Anticorrosion Material					
		├ Complexer					
		├ pH Controller					
		└ Oxidant					
		CMP Puff					
	Electrode Formation					Sputter	
		Metal Target					Heraeus Electronic Materials Philippines, Inc.
		Inactive Gas					
	Wafer Testing						

Source: Japan International Cooperation Agency, Study Team

Figure 3-13 Supply chain for semiconductor production in the Philippines (2)

Assembling Process						
	Dicing					Dicer
		Dicing Tape				
		Diamond Dicing Brade				American Resources Group Phils., Inc., Toyo Adtec, Inc.
	Chip Mounting					Chip Mounter
		Lead Frame				Globaltech Automation, Inc.
		Die Attach Film				AMKOR Technology Philippines, Inc., Gotoh Philippines Corporation, L & K Industries Phils., Inc., PHCP, Inc., Testech Incorporated
		Die Adhesive Die Attach Epoxy				Amertron, Inc., Aurotech Corporation, RNM Dynamics Philippines inc., GMV Corporation, Romma Electronics Industry Corp., Henkel Philippines, Inc.
						American Resources Group PHILs., Inc.
	Wire Bonding					Wire Bonder
		Bonding Wire				American Resources Group PHILs., Inc., Heraeus Electronic Materials Philippines, Inc., Nittetsu Micrometal Corporation Philippines, Matsuda Sangyo Phils. Corp.
	Molding					Molder
		Molding Compounds				GMV Corporation. Rohm Mechatech Phils., Inc., American Resources Group Phils., Inc., Gennex Solutions Phils Inc., Technomotion Controls Int'l, Inc.SPI Semicon Asia, Inc, Henkel Philippines Inc, Waste and Resources Management Inc.
		Solder Ball				Nittetsu Micrometal Corporation Philippines, American Resources Group Phils., Inc., Qualitek-Delta Philippines, Inc, Autronix Systems Incorporated, Wings Technology Enterprise, Inc.
		Solder Paste / Flux				GMV Materials Inc., GMV Corporation, Heraeus Electronic Materials Philippines, Inc., Qualitek-Delta Philippines, Inc., American Resources Group Phils., Inc., Takachiho Philippines, Inc.
		Solder Bump				Minami machineries & Electronics Technology, Inc.
		Dry Film Resist				
	Burn-In					Burn-In Oven
						Fit In Trade & Services, Inc., American Resources

Source: Japan International Cooperation Agency, Study Team

Figure 3-14 Supply chain for semiconductor production in the Philippines (3)

4. Candidates for Next Generation Industry

4.1 Industrial field

The Philippines has depended largely on two industries: semiconductors including assembly, and HDD. To strengthen and vitalize the industrial structure of the Philippines, there are those who search for the missing link in the value chain of these two industries and seek to overcome the weakness.

However, the wafer process of the semiconductor industry tends to be concentrated in certain countries such as the US, South Korea, Taiwan, and Japan which have excellent development technologies and quality control in the manufacturing process and have sufficient funds for large capital investment. The assembly and testing process tends to gather near where final products are assembled. So these processes are clearly shifting from Japan, South Korea, and Taiwan, which dominate wafer processing, to China, the world's assembly plant. In addition to China, ASEAN countries such as Thailand, Malaysia, and Vietnam have established the so-called "China +1" position for assembling final products, but have not been successful in attracting assembly and testing process companies.

The HDD industry has recently undergone a rapid restructuring; only five companies now remain (Seagate, Western Digital, Toshiba, HGST, and Samsung Electronics). Like other electronics products, HDD companies are working hard to lower production costs to offset the steep decline in price, such as by consolidating production bases. Most companies have production plants in only three countries (Singapore, Thailand, and China) and their investment plans are mainly for expanding existing bases.

In view of these circumstances, strengthening the semiconductor and HDD industries, both of which used to be crucial for the Philippines, may not succeed in building up the electronics industry in the Philippines.

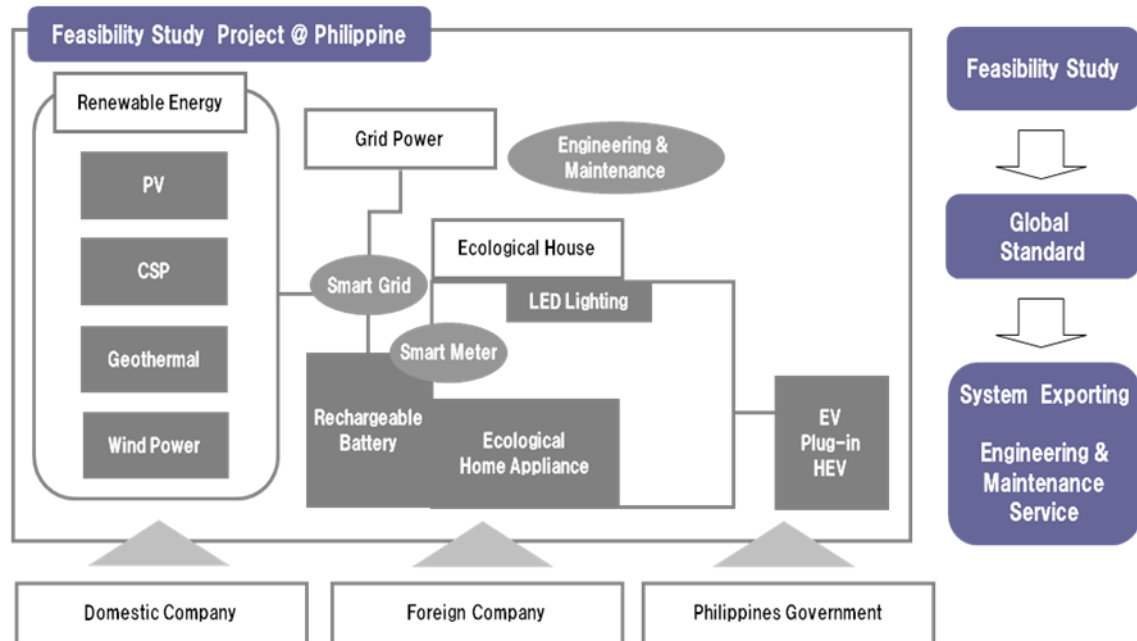
To revitalize the electronics industry in the Philippines, it is necessary to invest in and invite promising renewable energy industries such as photovoltaic power generation, LEDs, and rechargeable batteries. Although these are currently hot industries in the world, the system is neither integrated nor standardized yet and costs must be reduced if the industries are to grow fully.

Let's look at the potential of photovoltaic power generation. The Philippines consists of many islands, so it is not suitable for constructing large-scale electric power networks; it needs distributed power supplies. In addition, electricity rates are much higher than in all other ASEAN nations. These seemingly hostile conditions, however, are actually advantageous for feasibility studies on solar power generation, which is currently too expensive to spread dramatically.

Systems need to be developed for using energy effectively while creating renewable energy through photovoltaic power generation, wind power generation, geothermal power generation, etc. Because it is not safe to directly connect these energies with their unstable output to the existing electric power grid, these forms of energy could be stored in rechargeable batteries and then stably output.

Renewable power can be effective for new devices including LED lighting, EVs and HEVs. LEDs are highly efficient, consuming just one-tenth the power of incandescent bulbs and one-third that of fluorescent lamps. EVs and HEVs, driven by electric power, produce no

emissions while moving, and so help improve the roadside environment. Metropolitan Manila suffers severe air pollution due to chronic traffic congestion. A feasibility study would help to solve such environmental issues.



Source: Japan International Cooperation Agency, Study Team

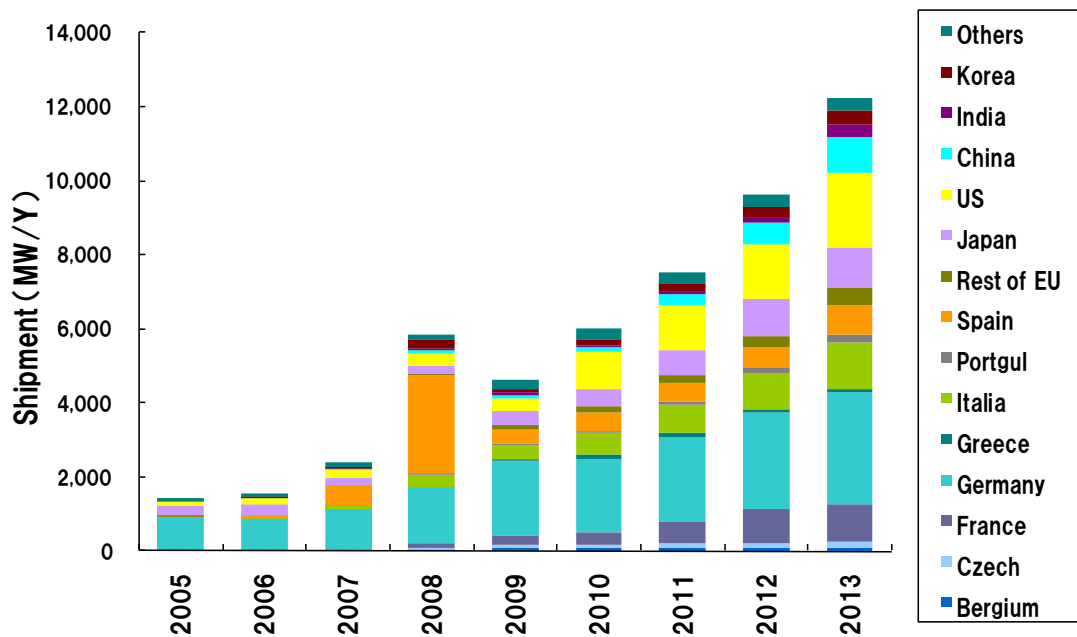
Figure 4-1 A scheme to promote promising industries

4.2 Photovoltaic Power Generation

4.2.1 Overview

Photovoltaic power was invented long ago and was used in calculators as early as in the 1970s. However, it was not widely used as a power source for general electric power. From the 1990s to the early 2000s, commercial photovoltaic power was small-scale in Japan. Then, in 2005 Germany adopted the FIT system which caused the market to mushroom in Europe.

The market shrank in 2009 because of the financial crisis in 2008 and the fiasco in Spain which over-adopted the FIT system, but the market is expected to grow strongly again in 2010 and beyond. The market will expand not only in Germany but also in Southern Europe such as Italy and France, and in the US and China. In ASEAN countries including the Philippines, the potential for market growth is still unknown, but it may flourish if each government demonstrates active commitment.



Source: NRI forecast based on data from IEA, PVPS, and EPIA

Figure 4-2 Global shipments of PV systems (installation base)

SunPower Corporation has already set up a large production base in Laguna, the Philippines, and industrial clusters could develop around this plant. SunPower Corporation is the world's fifth largest photovoltaic cell module manufacturer (as of the end of 2009), and manufactures and sells high-efficiency photovoltaic cells based on mono-crystal silicon wafer. In addition to the Laguna plant, the company is constructing a large photovoltaic cell factory in Batangas.

As for slicing silicon wafers, which is a vital process before the cell process in the photovoltaic power generation industry, First Philec Solar Corporation and Opti Solar International Corporation are scheduled to do work for SunPower. Other raw materials can be supplied by existing semiconductor companies.

The module process is labor-intensive and the Philippines is qualified for such work. However, this process is not likely to accumulate in the country in the mid or long term. For example, SunPower, which used to manufacture most of its cells and modules in the Philippines, has recently raised the proportion of module process outsourcing to EMS outside the Philippines. The geographical conditions for photovoltaic cell module manufacturers to set up production bases are low labor costs and proximity to markets. The Philippines has a low-cost, excellent assembly workforce, but the market remains undeveloped. Therefore, the process tends to accumulate in China where the market has rapidly expanded, or in Mexico, which is located next to a large market, the US.

To establish the Philippines as a major base for the photovoltaic cell industry, it is important to inform leading companies of the geographical superiority of the country in order to capture the expanding ASEAN market, and to attract them. To achieve this, it is necessary to create a certain size of market in the country, establish a standard for solar photovoltaic systems that matches ASEAN nations, and then expand the system throughout the region.

The Philippines has the worst electric power environment and highest power costs among ASEAN nations. However, these high costs actually mean a lower barrier to expansion of

photovoltaic power generation. The country is a suitable place for installing photovoltaic power generation systems to verify the profitability.

Installing solar photovoltaic systems and subsequently generating and delivering power will yield massive opportunities. Installing systems requires a large low-cost workforce of certain quality. Maintenance after installation also requires well-trained staff. If personnel who can handle emergencies are trained in the Philippines and can be immediately dispatched worldwide, the country will have a great advantage.

Process	Material & Parts	Supplier & Manufacturing in
PV Cell	<ul style="list-style-type: none"> PV Cell <ul style="list-style-type: none"> Wafer Substrate <ul style="list-style-type: none"> Ingot Poly Silicon Photo Resist Metal Target Bulk Chemical 	<p>Renewable Energy Corporation, Q-Cells, Solar World, PV Crystalox Solar, Sovello, Kyocera, Schott Solar, SUMCO, Mitsubishi Material, JFE Steel, LDK Solar Hightech, Renesolar, Solargiga, SAS, Green Energy Technology</p> <p>Hemlock Semiconductor Corp., Wacker Chemie AG, Renewable Energy Corporation, Elkem Solar, MEMC, Tokuyama, Mitsubishi Material, mstek, JFE Steel, Shin-Nihon Solar, Osaka Titanium, Solar Silicon Technology, OCI, Hankook Silicon, Woongjin Polysilicon, GCL Poly Energy Holdings, Daqo Group, Emei Semiconductor Material Factory & Institute, LDK Solar</p> <p>AZ Electronic Materials, Tokyo Ouka, JSR</p> <p>AGC Ceramics, ULVAC Material, Mitsubishi Material, Sumitomo Metal Minings, Hitachi Metal</p>

Source: Japan International Cooperation Agency, Study Team

Figure 4-3 Supply chain for Photovoltaic Power Generation in the Philippines (1)

Process	Material & Parts	Supplier & Manufacturing in
PV Module	<ul style="list-style-type: none"> PV Module <ul style="list-style-type: none"> Cell Glass Substrate Electrode Paste EVA Back Sheet Aluminum Frame Terminal Box 	<p>Q-Cells, First Solar, Suntech, Sharp, Sunpower, Kyocera, ...</p> <p>Saint-Gobain, Asahi Glass Corporation, NSG Group, CSG Solar Glass, Xinyi Glass</p> <p>Dupoint, Noritake, Cermet</p> <p>STR, ETIMEX, Mitsui Chemical Fabro, Bridgestone, Sanbic, C-I Kasei, Kurabo, Dai Nippon Printing, Solusia, Sekisui, Kuraray</p> <p>Isovolta, Rintec-Madico, Krempel, Coveena, Toyo Aluminum, MA Packaging, Toppann Printing</p>

Source: Japan International Cooperation Agency, Study Team

Figure 4-4 Supply chain for Photovoltaic Power Generation in the Philippines (2)

Process	Material & Parts	Supplier & Manufacturing in
PV System	<ul style="list-style-type: none"> PV System <ul style="list-style-type: none"> PV Module Power Conditioner Cable Mounter Tracker 	<p>SMA, Fronius, Kaco, Xantrex, Siemens, Matervolt, Solar Power, ABB, Daihen, Omron</p> <p>ABB, Sumitomo Cable, Fujikura Cable,</p>

Source: Japan International Cooperation Agency, Study Team

Figure 4-5 Supply chain for Photovoltaic Power Generation in the Philippines (3)

4.2.2 Possibility of new investment

The photovoltaic power generation market is growing rapidly worldwide. Especially in Europe, it doubled annually since the FIT system was introduced in Germany in 2005, before slowing down following the bursting of the PV bubble in Spain triggered by the Global economic crisis in 2008. Nevertheless, annual growth remains at 50% or more. In addition to the strong European market, the North American, Chinese, and Japanese markets are also expected to grow. In Southeast Asia including the Philippines, governments are becoming increasingly interested in introducing photovoltaic power generation, but it will take time for the market to grow because of limited national budgets among other reasons.

Against this backdrop, major solar panel manufacturers in Europe and the US are now moving to invest in large-scale production bases in Asia. The reasons for investing in Asia, such as China or Southeast Asia, are: (a) to reduce logistics costs by manufacturing photovoltaic panels, which are heavy and large, near areas with strong demand; (b) to take advantage of the cheap, stable, high-quality workforce for assembling solar cells into photovoltaic modules; and (c) to improve the brand image, etc. by setting up production bases in Asia, which is also a major market.

First, consider the recent investment information on major manufacturers of solar panels (cells and modules). As the table below shows, many of the major manufacturers have cell and modular production bases overseas in addition to in their own countries. In particular, cell and module manufacturers in Europe and North America tend to locate their production bases in Asia for geographical reasons. The Malaysian government has recently been actively seeking to invite solar battery manufacturers; the country first attracted investment from First Solar, one of the largest solar battery companies, and then from Q-Cells, by providing large incentives.

**Table 4-1 Overseas investment by major manufacturers of solar batteries
(cells and modules)**

Share Rank	Manufacturer		Destination of investment	Year
1	First Solar	USA	Malaysia	2008
2	Suntech Power	China		
3	Sharp	Japan	Italy	2009-2010
4	Q-Cells	Germany	Malaysia	2008
5	Trinar Solar	China		
6	Yingli	China		
7	Canadian Solar	Canada		
8	Solarfun	China		
9	Kyocera	Japan		
10	Sunpower	USA	Philippines Malaysia	2009 2010

Source: Japan International Cooperation Agency, Study Team

Component suppliers for solar cells and modules are moving full-scale into Asia. When setting up production bases in Asia where demand is high, cell module manufacturers in Europe or the US tend to procure lower-cost materials locally, therefore related materials manufacturers follow their customers into such countries. In many cases, materials manufacturers start overseas operations at the request of their customers.

Table 4-2 Overseas investment by major parts manufacturers related to cells or modules

Product	Manufacturer	Destination of investment
Glass	Saint-Gobain	Has only a main factory in Luxemburg. Aims to consolidate its position in the European market.
	AGC	Has sales bases in Japan, Taiwan, China, South Korea, North America, and Europe. Has production bases in the United States, Belgium, and the Philippines. Will have a production base in Suzhou, China.
Back Sheet	Madico	Has production bases in Japan and the United States. Plans to invest in Asia to improve cost competitiveness.
	Isovolta	Has close relations with companies in South Korea. May set up a production base in South Korea.
Poly Silicon	Tokuyama	Has a production base in Sarawak, Malaysia. Emphasizes incentives of cheap power such as hydraulic power, etc.

Source: Japan International Cooperation Agency, Study Team

Meanwhile, manufacturers of system components like inverters often go to where there is a large solar photovoltaic system market. The current largest markets in Asia with strong growth momentum are Japan and China. European and American manufacturers find it difficult to enter the Japanese market because there are many strong rivals, and as a result, makers choose to set up in China rather than Japan. The markets in Southeast Asia including the Philippines have not yet grown sufficiently, so firms have not considered setting up production bases there.

Table 4-3 Situation of foreign investment by major manufacturers related to photovoltaic power generation (system components)

Product	Manufacturer	Destination of investment
Inverter	Siemens	Has sales bases in China, South Korea, and Malaysia. Is considering establishing an assembly factory in China.
	Fronius	Is establishing sales bases. Has no production base. Concentrates in Malaysia. Has some business in the Philippines because of its relation with SunPower.
	ABB	Has a Chinese base to control the Asian region. Distributes products from China to other Asian markets.

Source: Japan International Cooperation Agency, Study Team

4.3 LED

4.3.1 Outlook for the LED market

LEDs have long been used as optical communications devices, but then the invention of the blue LED and its combination with existing red and green ones led to the white LED, which

dramatically expanded the market.

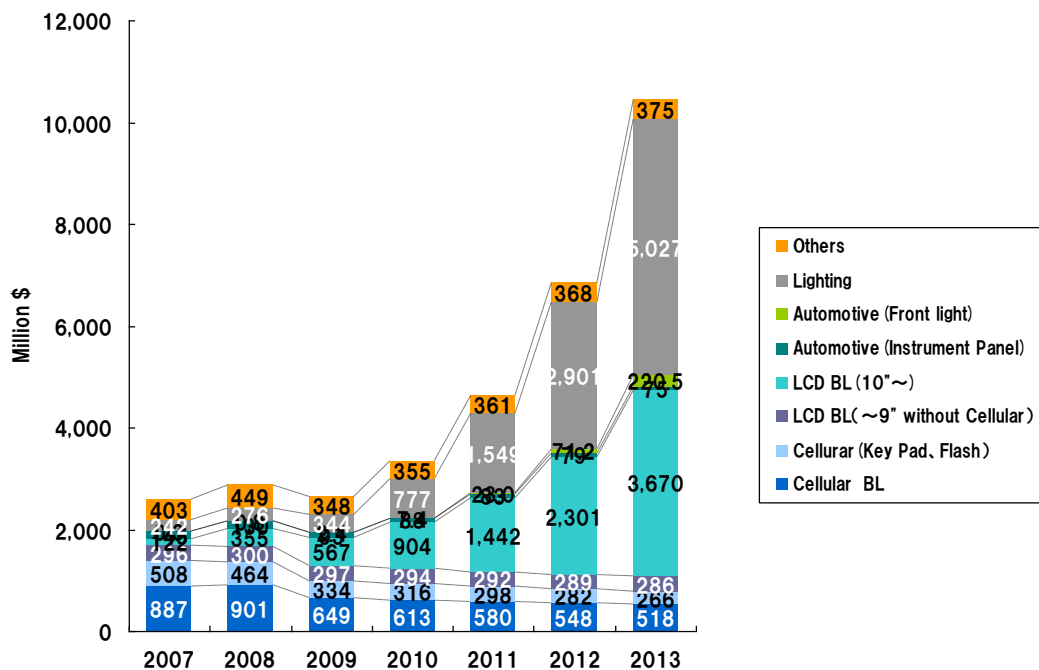
The market scale of the white LED package as of the end of 2009 is about 2.6 billion dollars. Promising applications include backlights for notebook PCs and LCD TVs, tail/headlight modules for cars, and general lighting. The market could grow in two ways: by about 10% a year if LEDs replace the conventional CCFLs in the backlights of notebook PCs and LCD TVs; or by about 30% a year if LEDs replace conventional incandescent and fluorescent lamps for general lighting.

In the early 2000s, LEDs were used in mobile phones and the market surged. However, the market is now saturated at about two billion dollars because the rapid growth in demand for this application was offset by the sharp decline in unit prices. From 2010, new applications such as LCD backlights, general lighting, and tail/front lights of cars will expand.

The market for mobile devices equipped with 10 to 15-inch LCD panels (notebook PCs and tablet PCs) is expanding. Compared with conventional CCFL, LCD panels make these devices far thinner and reduce power consumption to about one-third. Furthermore, LEDs offer excellent color reproducibility and can express more colors than CCFL.

As for large-scale applications, high-end LCD TVs using LEDs were released in 2010. Samsung Electronics (South Korea) has been the most active in using LEDs for LCD TVs, with this type of TV accounting for about 30% of total shipments. Sharp and Sony (Japan), whose production of LED-backlit LCD TVs now accounts for about 10% of total shipments, are rapidly catching up with Samsung. Because the supply of LED backlight modules for LCD TVs is still limited, the share of these TVs may not rise dramatically, but could exceed 70% within three years.

LED lighting is also expanding globally. China and some other countries have introduced subsidies for installing LED lighting in offices and homes to encourage their use. The large amount of electricity consumed by incandescent lighting is now being questioned, especially in Europe where incandescent lighting is widely used, and the switch to more efficient fluorescent lighting or LED lighting is being considered. However, fluorescent lights are not expected to spread in Europe because they contain mercury, which is restricted by the RoHS Directive and other regulations. Thus, LED lighting may spread more rapidly in Europe than Asia where fluorescent lights are widely used.



Source: Forecast by Nomura Research Institute

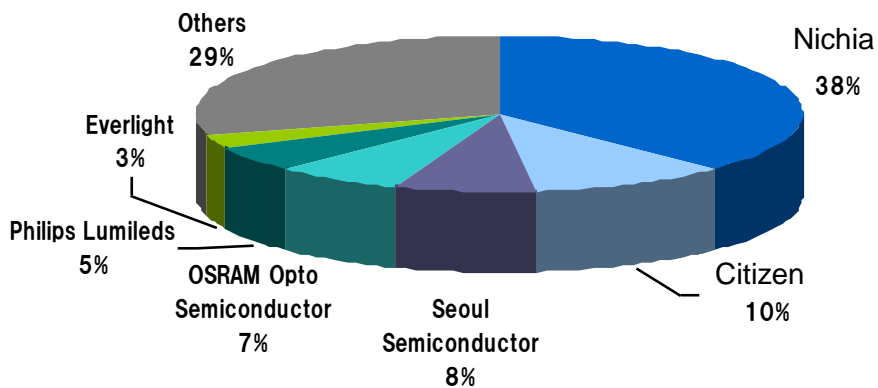
Figure 4-6 Outlook for the white LED package market

4.3.2 Structure of the LED market

The global lighting market is dominated by the Big Three of OSRAM (Siemens), Philips, and GE, plus light bulb manufacturers in Japan such as Panasonic, Toshiba, and Mitsubishi Electric or MELCO. The markets in Asia, Africa and Latin America are dominated by products from these manufacturers and OEM products by local manufacturers.

The major light bulb manufacturers have enjoyed a monopoly of the lighting market and thus have been reluctant to introduce innovative technologies such as LEDs which could destroy the industry structure and make their businesses less profitable.

New manufacturers with innovative LED lighting technologies are challenging this closed market. Nichia Corporation, which owns the key patent for the blue LED, opened up the white LED market and now has a 40% market share. Citizen Electronics, Seoul Semiconductor, OSRAM Opto Semiconductor, and others are pursuing Nichia. Although Nichia has adopted an exclusive patent strategy, this patent will expire in 2010; other companies which have basic patents such as OSRAM and Philips are following a more open strategy. Therefore, semiconductor manufacturers in Taiwan and South Korea are expected to begin manufacturing inexpensive LED chips soon.



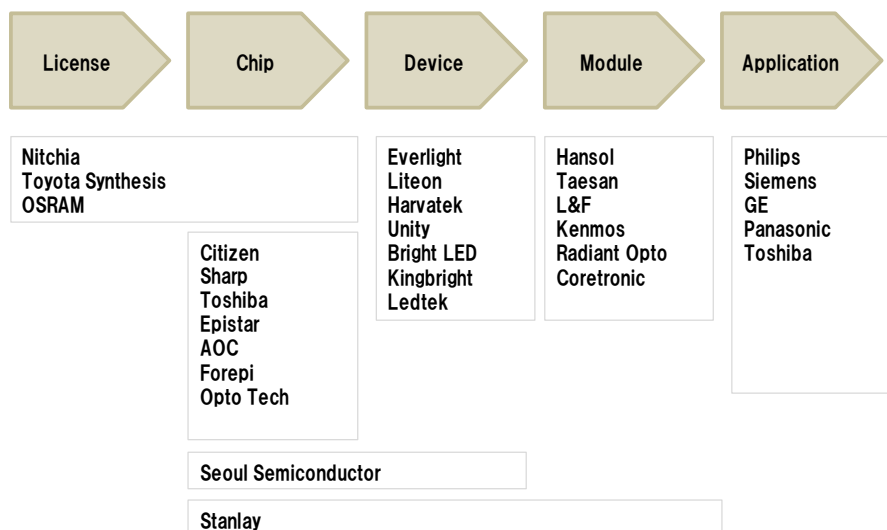
Source: Estimate by Nomura Research Institute

Figure 4-7 Shares of white LED package market (based on value in 2008)

4.3.3 Structure of the LED industry

The value chain of the LED industry is as follows: License, Chip, Device (Packaging), Module, Application. Nichia Corporation, Toyoda Gosei, OSRAM Opto, and Cree are licensors as well as chip makers. Seoul Semiconductor (South Korea), AOC (Taiwan), Forepi (Taiwan), OptoTech (Taiwan) manufactures chip licensed basic patent out from licensors mentioned above.

Everlight (Taiwan), Lite-on (Taiwan) and Harvateck (Taiwan), mostly those Taiwanese companies, manufacture packaging device using sealant. Hansol (South Korea), Taesan (South Korea), L&F (US) and Kemos (Taiwan) produce the module of back light of LCD using the packaged device and provide to large LCD panel and TV manufactures.



Source: Nomura Research Institute

Figure 4-8 Major players of LED sector

Since LEDs use fewer components and materials, the LED industry tends to be much smaller than the semiconductor and LCD industries, so the effect of attracting companies to create an industrial cluster may be small.

LED chips need sapphire, ingot wafers of SiC, and Cu and Al for fluorescent materials and wiring, as well as bulk chemicals such as sulfuric acid, hydrochloric acid, and ammonia. The LED module (packaging) process needs only bonding wire, heat sinks, seal materials, etc., so a large industrial cluster may not be created.

Process	Material & Parts	Supplier & Manufacturing in
LED Chip	<ul style="list-style-type: none"> Chip — Wafer Substrate <ul style="list-style-type: none"> — Ingot — Phosphor — Metal Target — Bulk Chemical 	<p>Opto Tech, Epistar, Arima, Forepi, VPEC, Huga, Tekcore, GPI, Cree, Sharp</p> <p>Kyocera, Namiki, Shinkosha, Cree, Sicrystal, Sumitomo Electric, Mitsubishi Chemical</p> <p>Sumitomo Electric, Freiburger, AXT, Hitachi Cable, Mitsubishi Chemical, Shinetsu Semiconductor, Sumitomo Metal Minings, Showa Denko,</p> <p>Nichia Chemical, Toyoda - Gosei, Osram, Intematix, Mitsubishi Chemical</p>

Source: Japan International Cooperation Agency, Study Team

Figure 4-9 Supply chain for LED Production in the Philippines (1)

Process	Material & Parts	Supplier & Manufacturing in
Packaging	<ul style="list-style-type: none"> LED Module <ul style="list-style-type: none"> — Chip — Bonding Wire — Heatsink — Molding Material 	<p>AOT, Bright LED, Edison, Everlight, Harvatek, Kingbright, Ligitek, Lite-On, Opto-Proflight, Opto Tech, Taiwan Oasis, Unity Opto</p> <p>Henkel, Kyocera Chemical, Pernocks, Shietsu Chemical</p> <p>Kyocera, Sumitomo Metal Electronic Device, Tokuyama</p> <p>Nittodenko, Henkel, Pernocks, Fine Polymers, Shinetsu Chemical, Toray - Dow coming, Momentive, Nusil, Nye</p>

Source: Japan International Cooperation Agency, Study Team

Figure 4-10 Supply chain for LED Production in the Philippines (1)

4.3.4 Possibility of new investments

The LED market will expand quickly as LED products replace incandescent and fluorescent lighting and are used as the backlights for LCDs. To meet the demand, the capacity for producing LED chips and devices (packaging) must be increased. Therefore, LED companies will continue to invest heavily.

Concerning LED chips, manufacturers in Taiwan and South Korea will expand low-cost mass production, thanks to the expiration of basic patents or licensing or cross-licensing from licensors. The production of LED chips needs a build-up of the semiconductor production industry (wafer process) in the peripheral areas and most of the chip manufacturing process is automated and carried out in a vacuum system. Meanwhile, the industry does not require a skilled workforce with reasonable wages, which is a strong point of the Philippines. Therefore, existing manufacturing bases are unlikely to be transferred from Taiwan and South Korea to the Philippines.

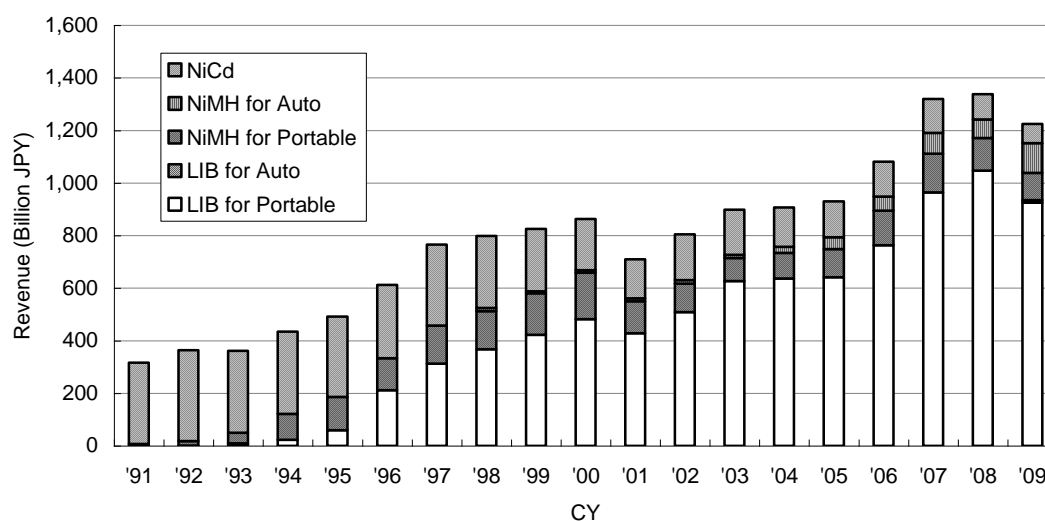
New investment is expected in LED devices as well. LED devices are manufactured by wiring LED chips and sealing them. Thanks to recent technology development, wafer units are sealed in batches. LED devices are often of uneven quality such as the quantity of light, etc., so all devices are visually inspected. For this reason, Taiwanese manufacturers with inexpensive labor costs have monopolized the market. To lower costs further, these manufacturers have set up production and inspection facilities mainly in southern China, but are now considering transferring them to other countries because of frequent labor problems and sharply rising wage costs.

LED modules are made by combining LED devices and other components into lighting modules, such as backlight modules of LCD panels or tail/front light modules of automobiles. LEDs are increasingly incorporated into these parts. As the demand for these modules expands, new investment in this field is expected to grow dramatically. This module process is performed manually, and the acceptance inspection of LEDs and pre-shipment inspection of products after assembly are also done visually. We believe that the Philippines has a competitive advantage in this area.

4.4 Rechargeable Battery

The LIB market has expanded as applications continue to develop rapidly. This cell is indispensable for all types of portable equipment, and lightweight and large-capacity types are always needed. New sources of demand-led growth are for HEV and BEV.

Until the early 1990s, most rechargeable batteries were NiCd, which were used mainly in power tools and shavers. When laptop PCs appeared, the demand for NiCd cells increased rapidly. Then, higher-density Ni-MH batteries expanded the market, replacing NiCd cells for PCs. Cell phones, which emerged in the mid 1990s, boosted the market for these cells, and much higher density LIB batteries soon appeared. In the late 1990s, Toyota started the world's first mass production of HEVs using NiMH cells. The HEV market is expanding thanks to growing environmental awareness worldwide. LIBs were first used in HEVs in 2009. High-density LIBs will drive this field.

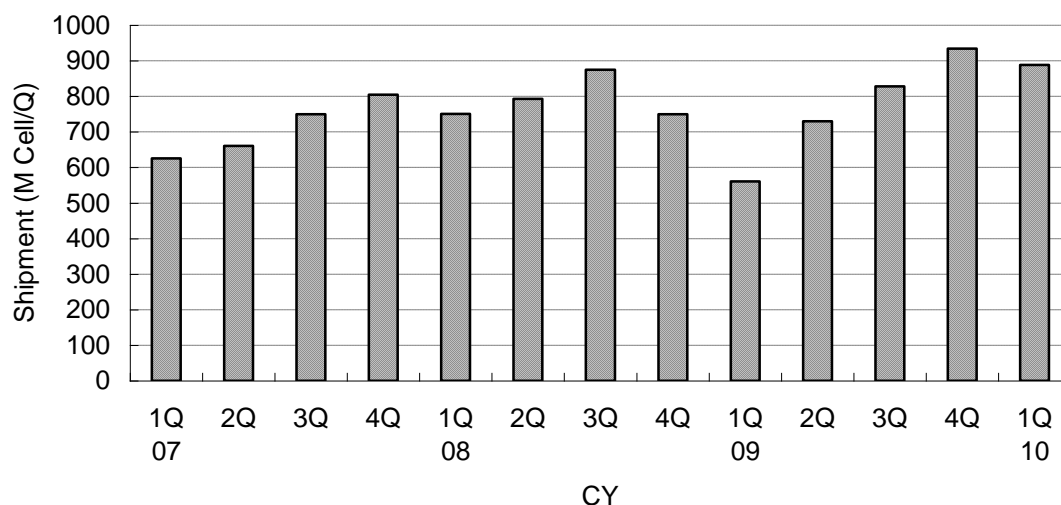


Source: Institute of Information Technology, Ltd.

Figure 4-11 History of the secondary battery industry

4.4.1 State of the LIB industry

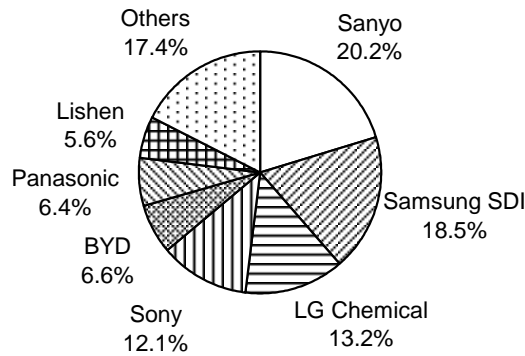
The LIB market slumped temporarily after the Global economic crisis, but the market for laptop PCs soon recovered, followed by cell phones and DSC. The market has now fully recovered and is strong in the second quarter of 2010.



Source: Institute of Information Technology, Ltd.

Figure 4-12 Changes in LIB shipment (1Q 2007 to 1Q 2010)

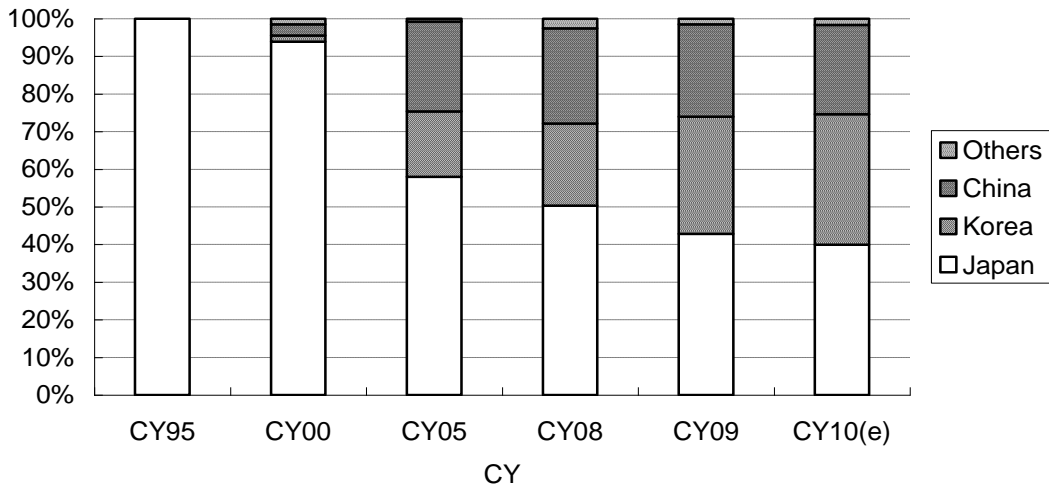
In this market, Sanyo Electric Group and Samsung SDI are the two leading companies, followed by LG Chemical Ltd. and Sony Corporation. These four major players in the industry account for about two-thirds of the market. Behind them are Japanese manufacturers (Panasonic Corporation, Hitachi Maxell, Ltd., GS Yuasa Corporation, and NEC Corporation) and Chinese manufacturers (BYD, Tianjin Lishen Battery, Amperex Technology Limited, and China BAK Battery). In the US, E-One Moli Energy and A123 Systems are expanding thanks to the automobile market.



Note: Based on the number of cells shipped in 2009
 Source: Institute of Information Technology, Ltd.

Figure 4-13 Market share of LIB

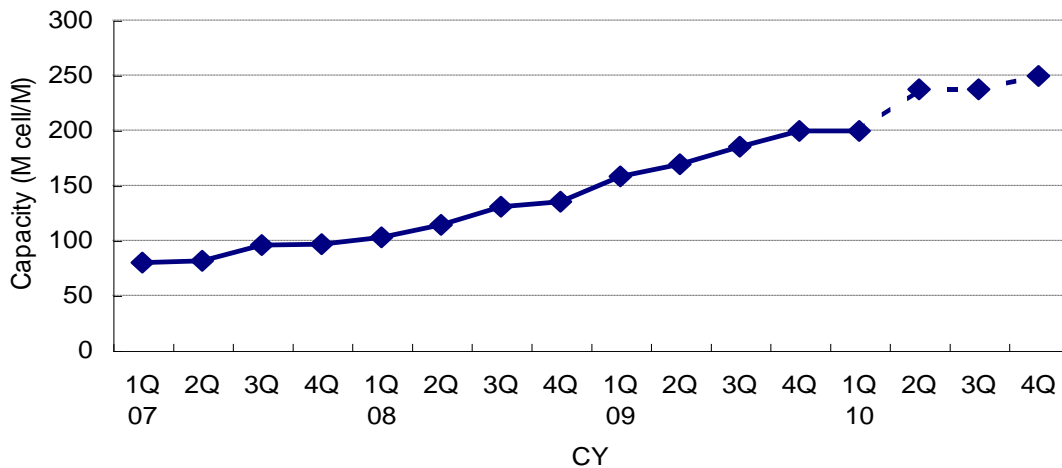
As shown in the figure below, Japanese manufacturers started up and then nearly dominated the LIB market. Recently, however, a South Korean manufacturer occupies a corner among the Top 4, and Chinese manufacturers are also growing stronger, ramping up production mainly for automobiles in the US.



Note: Actual results up to 2009, forecasts for 2010
 Source: Institute of Information Technology

Figure 4-14 Production share of LIB by country

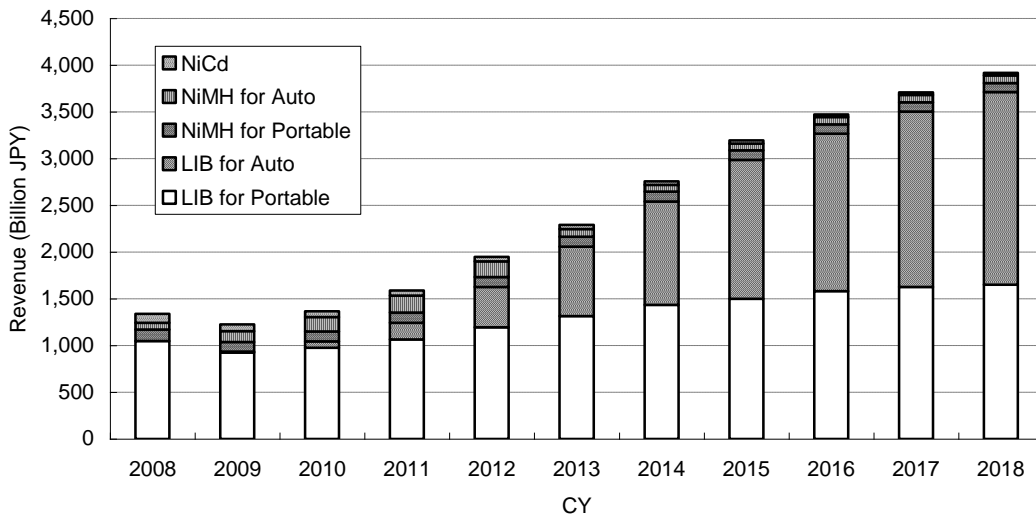
Each company is continuing to increase production capacity. Among the leading companies, Sanyo has no major investment plans for the near future, but is focusing on starting up expanded plants in Kaizuka, Nantan Mihara, and Sumoto. Samsung SDI started up the Cheonan factory in the fourth quarter of 2009. It has also decided to set up a factory in Pusan, its second plant in South Korea, which will manufacture more than 10 million cells a month. In addition to two plants in Orchang, LG Chemical has built two plants: one for consumer products, the other for automobiles. Panasonic, which already has its Wakayama factory, will build a new factory in Suminoe in the second quarter of 2010.



Note: Actual data until 1Q of 2010; estimates based on each company's plan after 2Q of 2010
 Source: Institute of Information Technology

Figure 4-15 Changes in LIB output

The LIB market exceeded one trillion yen in 2006. Although stagnant in 2009, it is expected to continue to expand rapidly to four trillion yen around 2020. Applications such as laptop PCs and mobile phones will steadily increase and LIBs will become much more widely used in automobiles. LIBs for automobiles are expected to exceed the market for other products around 2015. Setting their sights on this promising market, manufacturers are working hard to develop dedicated LIBs for automobiles.



Source: Institute of Information Technology, Ltd.

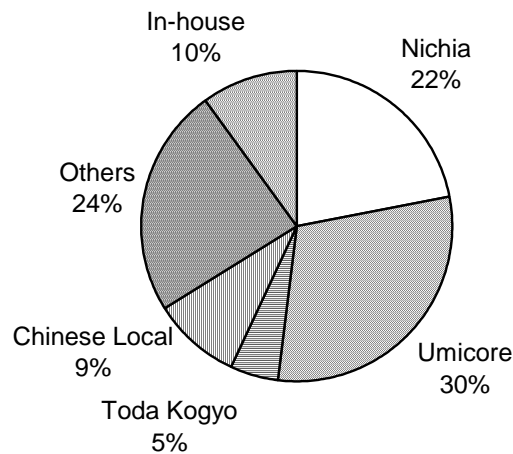
Figure 4-16 Outlook for the LIB market

4.4.2 Supply chain in the LIB industry

In lithium-ion batteries, a long strip of aluminum foil, both sides of which are coated with active materials such as lithium cobalt oxide, is used for the positive electrode, and a long strip of

copper foil coated with carbon materials is used for the negative electrode. The positive electrode is actually called the cathode and the negative electrode the anode because an anode reaction occurs at the negative electrode during discharge. A separator, which is a porous insulating film through which ions can move, is placed between the cathode and the anode. The electrodes and the separator are rolled into a spiral or cylindrical Swiss roll shape, then this assembly is put into the case, electrolyte is injected, and then the case is sealed. The supply chains for these key materials are described below.

The following figure shows the shares of cathode active material suppliers. The cost of manufacturing cobalt-based materials is mostly for the metal containing lithium, and at least 70% of the cost is for cobalt. Mine strikes in Canada and rising demand in Japan and China have caused the international price of cobalt to continue rising. Thus, many suppliers have proposed alternative materials for cathodes and are developing inexpensive, efficient materials by trying to remove expensive cobalt from conventional LCO.



Note: Weight shipped in 2009

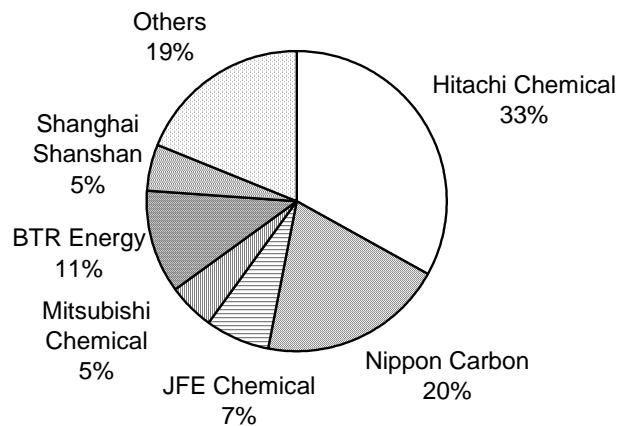
Source: Institute of Information Technology, Ltd.

Figure 4-17 Shares of cathode suppliers

LCO still accounts for about half of consumption, with NMC, accounting for about one third. LNO, LMO, and LFP, etc. have also been used. There are more than 50 suppliers in total.

Toda America Inc., the American subsidiary of Toda Kogyo Corporation, decided to invest US\$70 million in total to boost its cathode material business for lithium-ion batteries in the US. The company will receive US\$35 million in subsidies from the Department of Energy, backed by the Obama Administration which is financing next-generation cell businesses and the manufacture and introduction of electric cars to boost the economy. In the cell and material sector, Toda America is the only Japanese company to have won a subsidy.

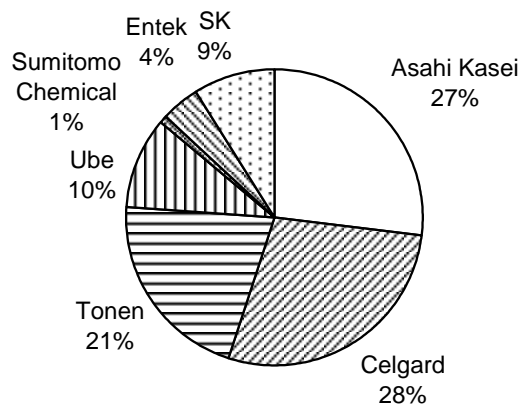
The following figure shows the shares of anode active material suppliers. The anode material of LIBs is made of synthetic spherical graphite with numerous pores in particles. Carbon fiber has recently been introduced. Sony and Panasonic have begun to produce a new Si-based anode material, and Shin-Etsu Chemical and other companies are also preparing for mass production.



Source: Institute of Information Technology, Ltd.

Figure 4-18 Shares of anode material suppliers

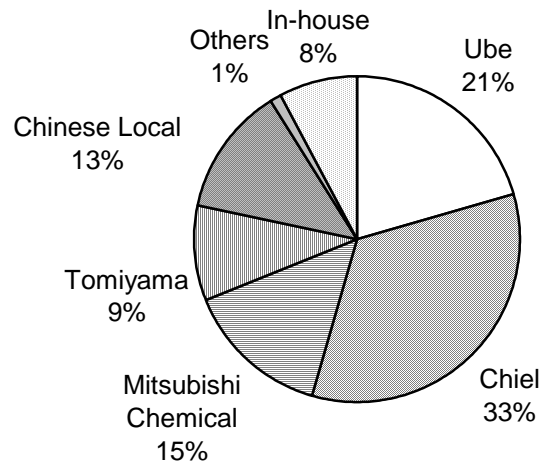
The figure below shows the shares of separator suppliers. Currently, polyolefin-based materials (polyethylene and polypropylene) are the most popular. However, many separator suppliers are also seeking new materials to lower costs, including unwoven cloth, cellulose (paper), etc. The top-three companies have three quarters of the market, but other companies are seeking to expand their share by developing new materials, such as Hitachi Maxell (ceramic layer), Teijin, Toray Industries, Mitsubishi Chemical (polyolefin-based dry/wet type), Nippon Kodoshi Corporation, Hirose Paper, and Japan Vilene Company (unwoven cloth).



Source: Institute of Information Technology, Ltd.

Figure 4-19 Shares of separator suppliers

The following figure shows the shares of electrolyte (formulated electrolyte) suppliers. This market is dominated (more than 90%) by the top five suppliers. There is no change in supply and demand; only Chiel has expanded its share by supplying Chinese and South Korean manufacturers that have increased production.



Source: Institute of Information Technology, Ltd.

Figure 4-20 Shares of electrolyte suppliers

4.5 Embedded Software

4.5.1 Actual conditions of the embedded software industry (particularly those in Japan)

The embedded software is used in almost all electronics products such as printer, mobile phone and electric apparatus. This is a part of supply chain of electronics industry.

The size of the embedded software industry in Japan is ¥4.2 trillion. The total development cost of the embedded software in Japan increased rapidly at an average annual rate of 15.2% from 2004. With respect to the number of companies in the embedded software-related industries in Japan, which are classified by the number of employees, companies with 1 to 9 employees account for the majority (58%) of the all companies. The ratio of the SMEs is high.

The number of the embedded software engineers in Japan is 258,000, with a shortage of 69,000. The shortage in fiscal year 2009 decreased compared to a shortage of 88,000 in fiscal year 2008.

Table 4-4 Actual conditions of the embedded software industry in Japan

Classification	Item	FY2009 results
Market Size	Embedded-related industry production	¥69.6 trillion
	Embedded product development cost	¥8.6 trillion
	Embedded software development cost	¥4.2 trillion
Number of Employees	Number of employees in the embedded software-related companies	4.75 million
	Number of embedded software engineers	258,000
	Development cost per embedded software engineer	¥16.4 million
	Shortage of embedded software engineers	69,000

Note: The embedded software-related industries include general tools and machinery manufacturers, electric machinery and appliance manufacturers, information communication equipment and device manufacturers, electronic component and device manufacturers, transportation machinery manufacturers, precision equipment manufacturers, and other manufacturers, as well as information communication and software companies.

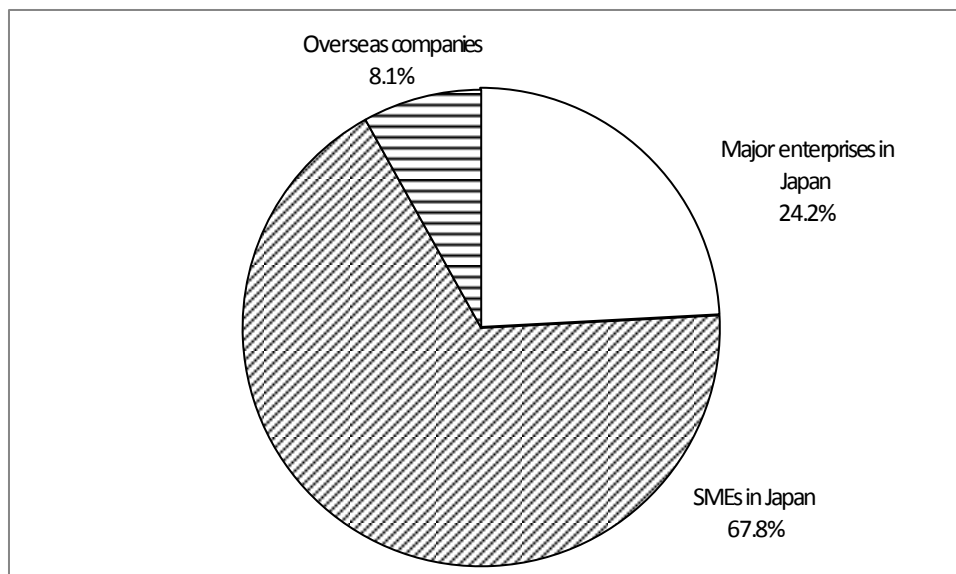
Source: Report on a Survey on the Actual Conditions of the Embedded Software Industry in 2009

4.5.2 Outsourcing of embedded software in Japan

The ratio at which the embedded software companies outsource is 69%. Out of which, 67.8% is outsourced to the SMEs in Japan, followed by 24.2%, which is outsourced to the major companies in Japan, and 8.1%, which is outsourced to the overseas companies.

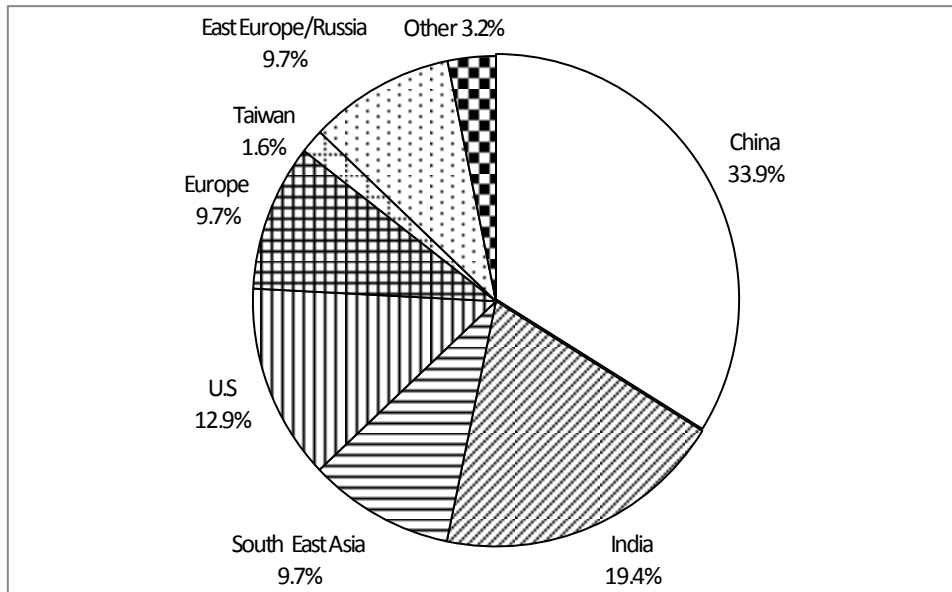
With respect to the overseas outsourcing, 33.9% is outsourced to China, followed by 19.4%, which is outsourced to India, 12.9% which is outsourced to the U.S., and 9.7% which is outsourced to the South East Asian countries. With respect to the criteria for selecting the outsourcing contractor, “outsourcing unit price” comes top, followed by “high skills of engineers.”

With respect to the problems with overseas outsourcing, “communication (language barrier)” comes top, followed by “difficult to manage quality” and “difficult to share the requirement and design specifications.”



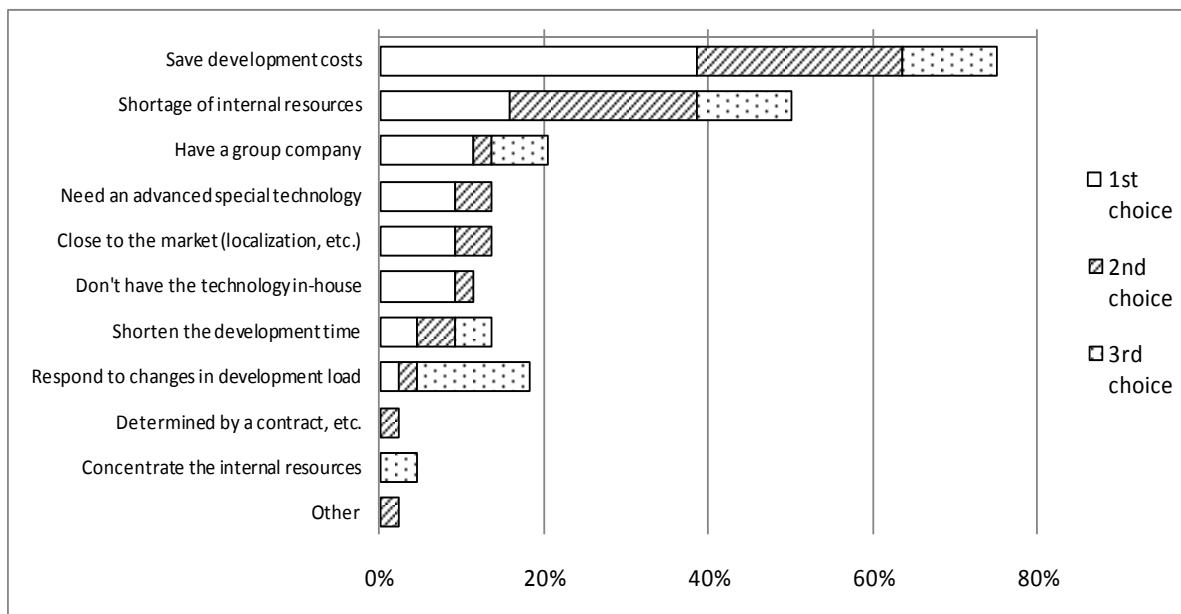
Source: The Report of embedded software industry (IPA)

Figure 4-21 Ratio of outsourcing contractors by size



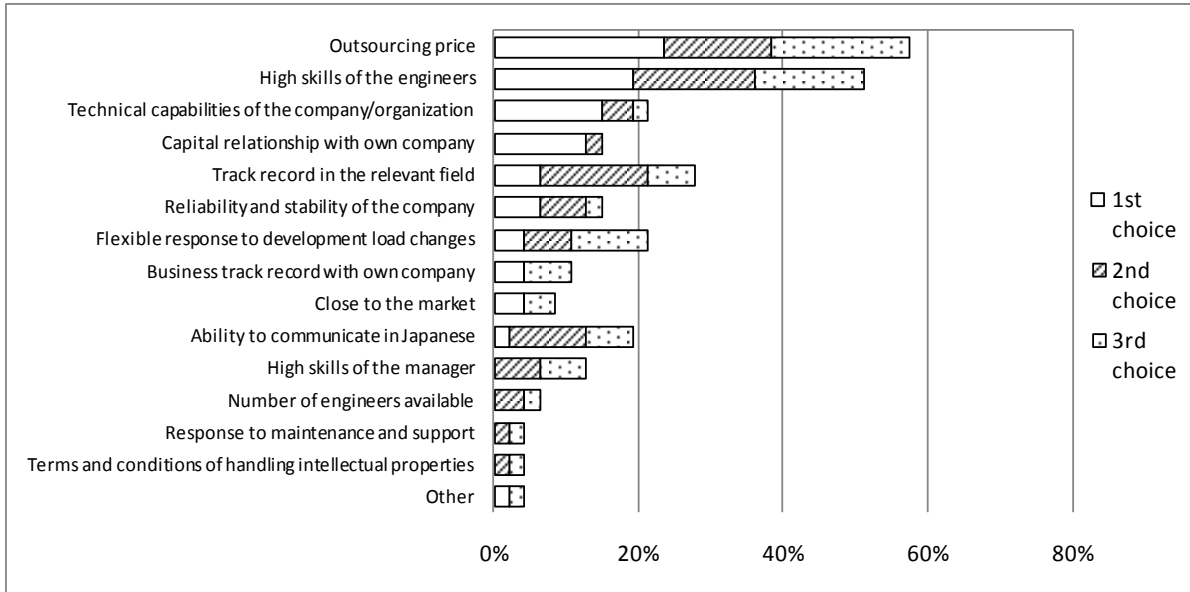
Source: The Report of embedded software industry (IPA)

Figure 4-22 Outsourcing contractor distribution by overseas region



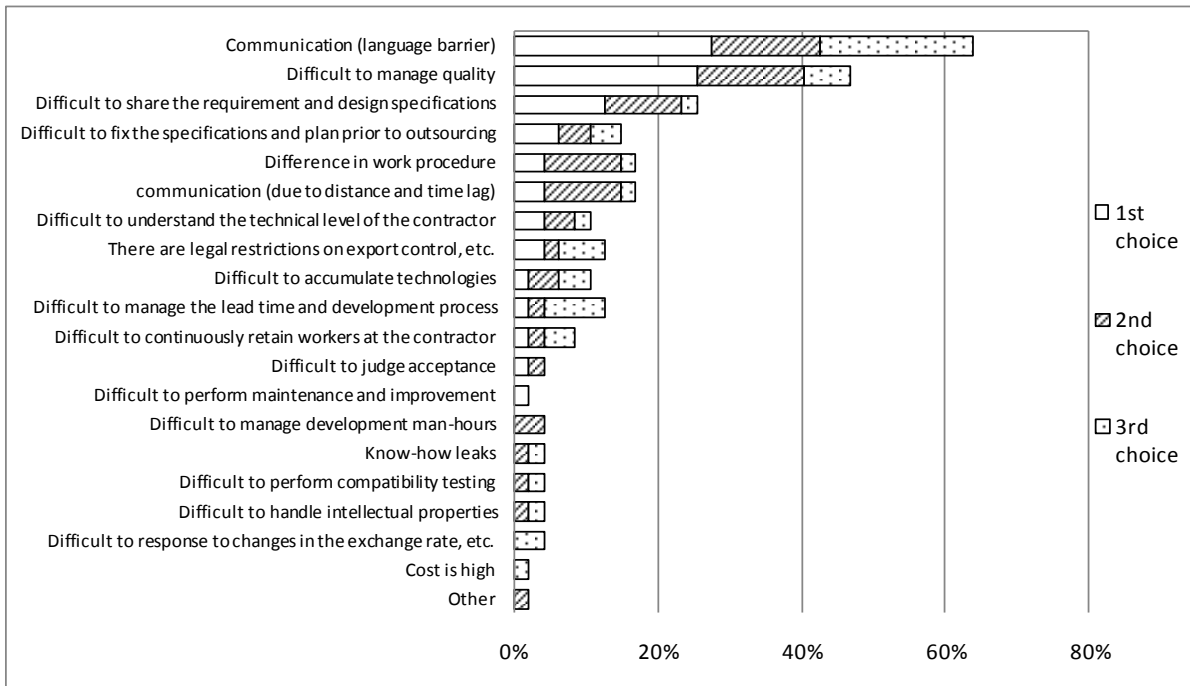
Source: The Report of embedded software industry (IPA)

Figure 4-23 Reasons for outsourcing (Contractor: overseas company)



Source: The Report of embedded software industry (IPA)

Figure 4-24 Criteria for selecting the outsourcing contractor (Contractor: overseas company)



Source: The Report of embedded software industry (IPA)

Figure 4-25 Problems with outsourcing (Contractor: overseas company)

4.5.3 Situation of overseas operations in the embedded software industry in Japan

Since many of the embedded software companies in Japan are SMEs and they often do not go overseas but instead rely on outsourcing for overseas, there are only limited cases where they

operate overseas themselves.

There are some cases where the overseas subsidiaries of major electric companies or major embedded software companies such as Fujisoft are operating overseas; for example, in China. There are only a few examples where Japanese companies outsourced to or operated/operate in the Philippines

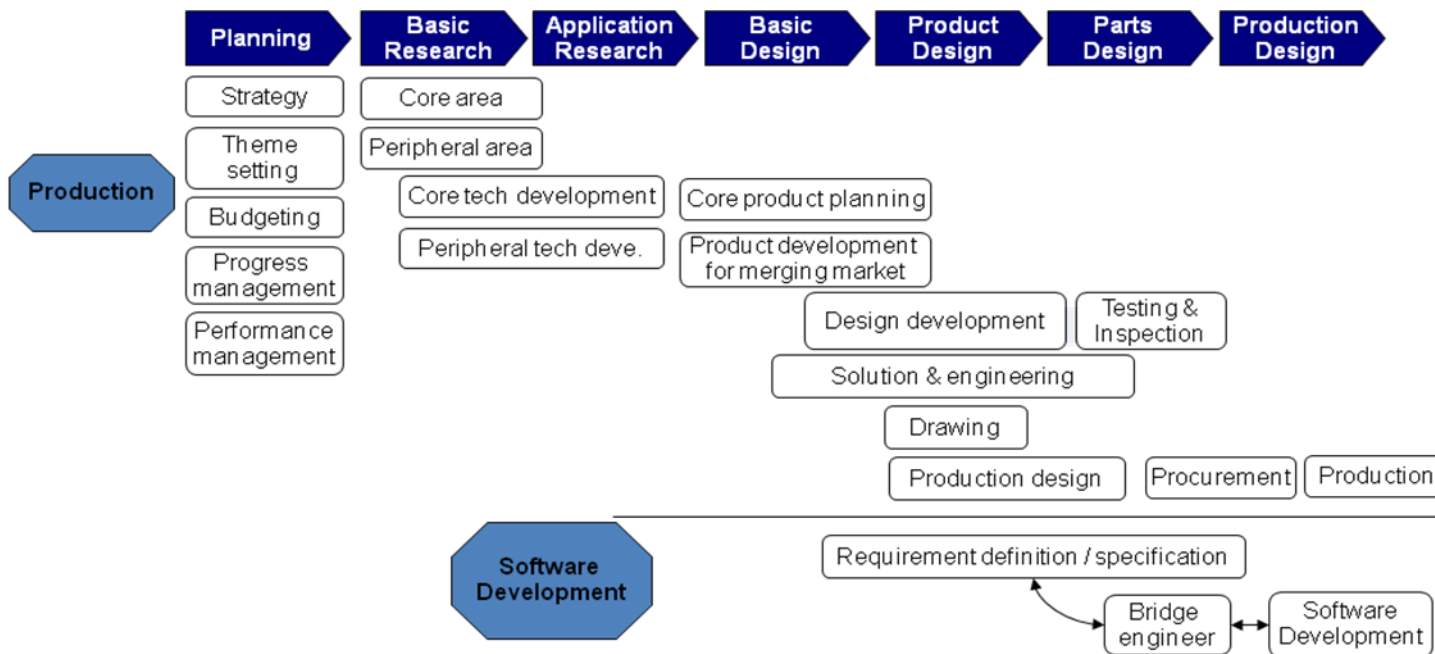
Table 4-5 Foreign affiliated companies of embedded software development

Type	Company	Scale	Oversea Office
Big Group	Fujitsu B.S.C	Capital JPY1.97bil Sales JPY33.8bil Employee 1,877	Hong Kong Beijing
	Toshiba Solution	Capital JPY23.5bil (Toshiba100%) Employee 5,200	USA(Silicon valley)
	NEC Software	Capital 8.7bil Sales JPY109bil Employee 4,947	Taiwan, China, Vietnam, Singapore
	Canon ITec	Capital JPY10mil Employee 600	Philippines
	NEC System Technology	Capital JPY6.8bil Sales JPY87bil Employee3,940	China, India
	NTT Data MSE	Capital JPY0.2bil Employee 1,061	China
Independent	Fuji Software	Capital JPY26.2bil Sales JPY82.2bil Employee6,058	Taiwan
	AWS	Capital JPY268mil Employee600	Philippines
	Tsukiden Software	Capital JPY26mil Sales JPY1.2bil Employee120	Philippines
	Aplix	Capital JPY0.01bil Employee 312 Sales JPY3.5bil	China(Bejing Shanghai), Taiwan, Seoul, USA, London
	Sunnygiken	Capital JPY0.05bil	Vietnam(HCMC),China

Source: Japan International Cooperation Agency, Study Team

4.6 R&D&D

“Research and development” is a wide concept for private companies. It practically includes not only basic and application research but also product development process such as designing. Sometimes, software development could be also a part of R&D. The following figure shows “R&D” activities of Japanese companies.



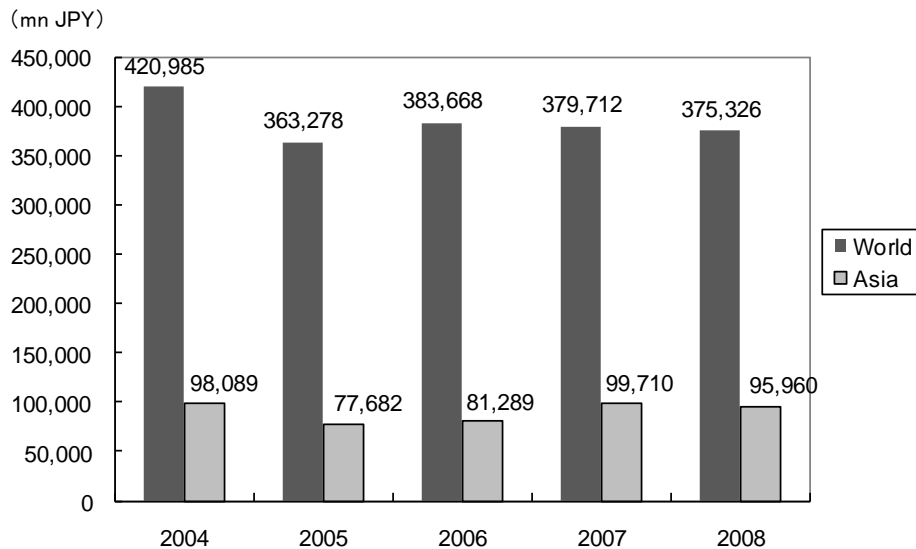
Note: Core tech development, application development, algorithm development, demonstration test etc.

Note: Solution & engineering includes kitting and combination of products.

Source: Japan International Cooperation Agency, Study Team

Figure 4-26 Process of research, development and design

Research and development function is spreading out to the global world. Looking at Japanese manufacturing sector, they spend 375,326 million Japanese yen (approximately 4,035 million US\$) all over the world. R&D expense in Asia is about one fourth of total expenses. The amount decreased in 2005 but it recovered from 2006 and stays rather stable.



Source: Ministry of Economy, Trade and Industry, GoJ, “Wagakuni Kigyo no Kaigai Jigyo Katsudo (Foreign business activities of Japanese firms)” (2004 to 2009)

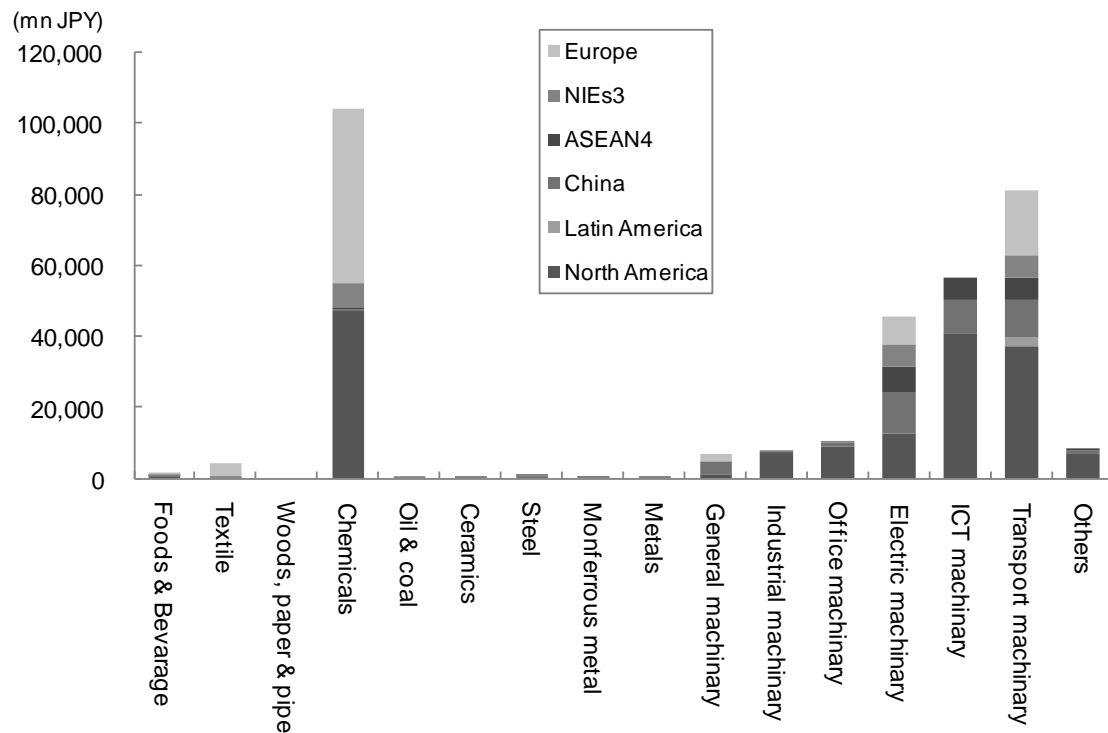
Figure 4-27 R&D expense in foreign countries by Japanese manufacturing sector (2004-2008)

Among sub-sectors of manufacturing, Chemicals, Transport machinery, ICT machinery and Electric machinery are the leading sectors in terms of globalization. Their R&D expenses in foreign countries are higher than other sectors.

For Chemicals, most of expenses are in North America and Europe. This sector contains pharmaceutical which conduct R&D in large markets to conduct clinical test for new products and to obtain approvals from the government. This is why they are spending much money into North America and Europe, the world’s two largest markets.

For Transport machinery, their R&D activities abroad are mostly designing to fit to local markets. Naturally, in North America and Europe, the two largest markets, their R&D expenses are high. As China and other Asian countries are also becoming important as markets, their R&D activities expand into those areas.

As North America is advanced in ICT, the large portion of ICT sector’s R&D is spent in that region. On the other hand, Electric Machinery sector spends R&D evenly in North America, Europe, China, ASEAN 4 and NIEs 3 countries.

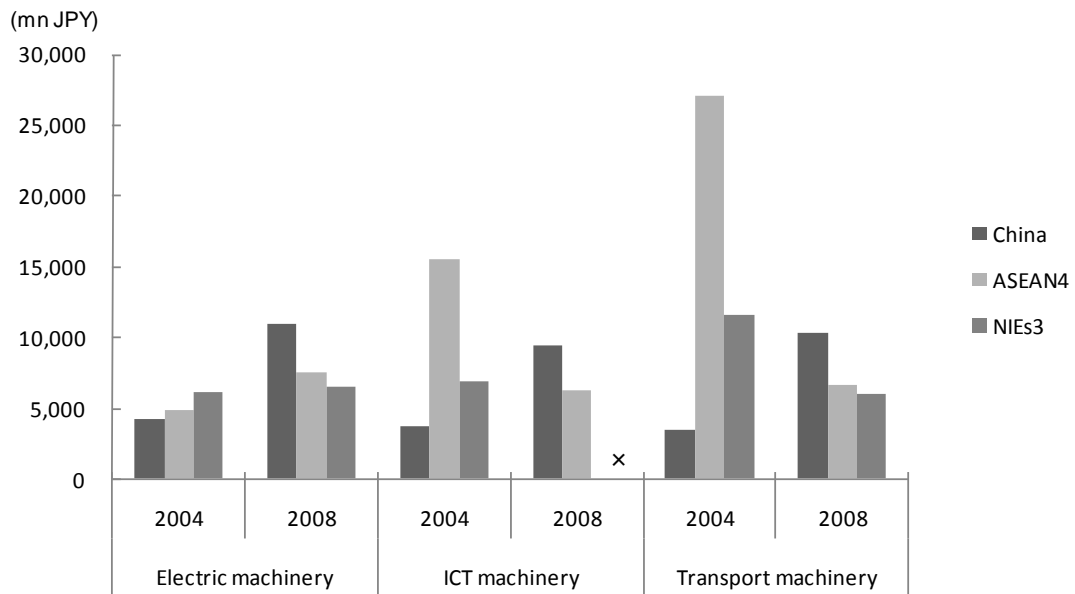


Note: ASEAN 4 are Malaysia, Thailand, Indonesia and Philippines, NIEs 3 are Singapore, Taiwan and South Korea.

Source: Ministry of Economy, Trade and Industry, GoJ, “Wagakuni Kigyo no Kaigai Jigyo Katsudo (Foreign business activities of Japanese firms)” (2009)

Figure 4-28 R&D expense in foreign countries by Japanese manufacturing sub-sectors (2008)

Compared to the year 2004, R&D in China has increased whereas R&D in ASEAN 4 has decreased for ICT machinery and transport machinery. China is becoming one of the most important markets in the world and R&D is also becoming more active. Major reasons for R&D in China by Japanese companies are application technology development, adapted technology development, product development and designing. In addition to the market orientation R&D, Chinese government is trying to change policy orientation from labor intensive manufacturing to knowledge based economy.



Note: ASEAN 4 are Malaysia, Thailand, Indonesia and the Philippines, NIEs 3 are Singapore, Taiwan and South Korea.

Source: Ministry of Economy, Trade and Industry, GoJ, “Wagakuni Kigyo no Kaigai Jigyo Katsudo (Foreign business activities of Japanese firms)” (2009)

Figure 4-29 R&D expense in foreign countries by Japanese manufacturing sub-sectors (2004, 2008)

5. Situation of attracting the investments by surrounding countries

5.1 Industries on which the Philippines and neighbouring countries place emphasis

The table below shows the growth industries on which the Philippines and neighboring countries place emphasis. Some countries place emphasis on the development of advanced industries in manufacturing, biology and health care industries, environment industry, and service industries, such as software and tourism.

Table 5-1 Growing industries on which major Asian countries place emphasis

Country	Growth industries on which emphasis is placed	Country	Growth industries on which emphasis is placed
Philippines	New energy industry BPO Tourism industry Internet casino Port and harbor projects	Taiwan	Cloud computing industry Environmental and energy-related industries New energy industry Biotechnology industry Casino industry
Thailand	Environmentally friendly automotive-related industries Bioplastic industry Electronics industry Textile and fashion industry Health care Business event industry Software industry	Singapore	High-tech industry Urban solution industry Knowledge-intensive industry High-speed communication projects Creative industry Environment-related industries Energy industry Biomedical industry
Vietnam	10-year Socio-economic Strategy, (1) Strengthen the conventional industries, such as textile, shoemaking, marine products, and food processing, (2) Develop the heavy and chemical industries, such as petroleum refinery, iron manufacturing, fertilizer manufacturing, drug manufacturing, and machine processing, (3) Change industrial structure to high-tech industries, such as electronics, communication, and information technology, (4) Strengthen the development capabilities, such as those of new energies and software, and place emphasis on environmental measures	South Korea	Nuclear industry Software industry IT industry Robot industry Environment industry New and renewable energy industry
Indonesia	New energy industry LNG Coal liquefaction projects	Malaysia	Environmentally friendly automotive-related industries Biofuels Biotechnology industry Palm industry Islamic finance industry

China	Premier Wen Jiabao declared at the Third Session of the 11 th National People's Congress, "In 2010, we place emphasis on the development of strategic new industries. We promote industries, such as new energies, new materials, energy conservation and environmental preservation, bio-medicine, information network, and high-end manufacturing. Furthermore, we speed up the progress of new energy vehicles and integration of communication, television broadcast networks, and Internet, speed up the practical use of research and development of the Internet of things (intelligent recognition and management by combining the Internet with information technologies, such as RFID/IR sensor, GPS, and laser scanner and by connecting objects with objects), allocate resources in strategic new industries, and strengthen policy support."	India	High-tech electronic component industry Mineral resources Communication industry Textile industry Petrochemical industry
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Source: Japan International Cooperation Agency, Study Team

5.2 Renewable Energy Programs in Malaysia

5.2.1 Introduction of FIT Program

The Ministry of Energy, Green Technology and Water announced on May 4, 2010, that it is to consider implementing a feed-in-tariff (FIT) program, which purchases all renewable energy generated by solar panels, during the next year.

The announcement is expected to start discussions on the Renewable Energy Act in the Parliament, and at present, the tariff system for the FIT program is being considered. The purchase prices in the FIT program are subject to change before the bill is passed. The electric energy purchase prices in the FIT program that have been released are as follows.

Table 5-2 Purchase Prices in FIT Program in Malaysia

Power Sources	Purchase Prices (per 1 kWh)	Purchase Periods
Photovoltaic generation	1.25 to 1.75 ringgit	21 years
Biomass/biogas generation	0.24 to 0.35 ringgit	16 years
Solid waste generation	0.30 to 0.46 ringgit	21 years
Micro-hydraulic generation	0.23 to 0.24 ringgit	21 years

Data: Malaysian government

When the bill is passed by the end of 2010, the act is likely to be enforced in the April to June period of the next year. The government wants to promote power generation by renewable energy by enforcing the new act.

The Malaysian government has initiated a Malaysian Building Integrated Photovoltaic (MBIPV) National Project Team under the authority of the Ministry of Energy, Green Technology

and Water, which is an organization to promote renewable energy. The organization predicts that use of the five renewable energy sources, including sunlight, will be expanded to 5.5% of the total energy generation of the nation by 2015. The limits to the fixed purchase prices by energy source are as follows.

Table 5-3 Maximum amount of Purchased Energy by Source

Unit: MW

	2011	2012	2013	2014	2015	2020	2030
Biomass	110	150	200	260	330	800	1340
Biogas	20	35	50	75	100	240	410
Micro-hydraulic	60	110	170	230	290	490	490
Photovoltaic	9	20	33	48	65	190	1370
Solid waste	20	50	90	140	200	360	390
Total	219	365	543	753	985	2080	4000

Data: MBIPV National Project Team, Ministry of Energy, Green Technology and Water

The government purchases energy through a private equity fund. This private equity fund is expected to be placed under the umbrella of the Sustainable Energy Development Authority (SEDA) which is an organization responsible for renewable energy. The purpose of the private equity fund is to manage the fund effectively to ensure the purchase at fixed prices is performed in the long run, and maximize the potential of the renewable energy.

5.3 Demonstration Projects on Renewable Energy in Japan

Besides the ASEAN countries, Japan is conducting a demonstration experiment project on renewable energy. The experiment in Japan is a state-of-the-art research and development project with a huge budget. If a similar project is implemented in the Philippines, it is assumed that the budget will be smaller. However, some parts of the project could be applied.

In April 2010, the Ministry of Economy, Trade and Industry (METI) of Japan selected four areas for the demonstration experiment from a total of 20 areas that applied for participation in the demonstration experiment; the selected areas are Yokohama City, Kanagawa Prefecture; Toyota City, Aichi Prefecture; Kita-Kyushu City, Fukuoka Prefecture; and Kansai Science City (Keihanna) which is located in an area that extends across three prefectures, Kyoto, Osaka, and Nara.

A five-year demonstration experiment project costing a total of about ¥100 billion is to be launched. The METI allocated a budget of ¥5.4 billion for the project for this fiscal year and plans to request a budget of ¥22 billion for the next fiscal year.

The project budgets for each area are estimated to be ¥74 billion for Yokohama City; ¥22.7 billion for Toyota City; ¥13.9 billion for Keihanna; and ¥16.3 billion for Kita-Kyushu City.

Table 5-4 The National Experimental Project of Renewable Energy System, Candidate Cities

Region	City	Region	City
Hokkaido	Sapporo City	Kansai	Kyoto City
Tohoku	Aomori Prefecture		Keihanna (awarded)
Kanto	Tsukuba City		Osaka Prefecture
	Kashinoha	Kobe City	
	Koto Ward	Kyushu	Kita-Kyushu City (awarded)
	Otemachi, Marunouchi, Yurakucho		Fukuoka City
Yokohama City (awarded)	Goto City		
Chubu	Toyota City (awarded)		Minamata City
	Gifu Prefecture		
	Nanto City		

Note: (awarded) means the city was awarded the budget of the project.

Data: METI

5.3.1 Yokohama Smart City Project

5.3.1.1 Facts of Area for Demonstration Experiment

- Population: about 420,000
- Number of households: about 170,000
- Area: about 60 km²
- Number of cars owned: about 150,000
- Total amount for 5-year demonstration project: about ¥74 billion
- Area and implementing bodies: Yokohama City, Kanagawa Prefecture (Yokohama City, Accenture, Toshiba, Nissan Motors, Panasonic, Meidensha, TEPCO, Tokyo Gas)

5.3.1.2 Proposal Outline

- Gather knowledge of companies and create a new social system in Yokohama, and apply it overseas, in order to reduce CO₂ emissions and increase national wealth. For that purpose, maximize use of the assets of Yokohama, such as the power of citizens, varied geographical features, APEC, as well as opportunities.
- Create the system in the urban district where citizens are living, in order to pursue the sustainability of the project.
- Set up an implementing body for making an overall decision, investments, public relations, and education, and create an organization system for promotion consisting of energy companies and users.
- Target of CO₂ emission reduction of 30% compared to 2004 by 2025.

5.3.1.3 Details of Activities

Carried out in the major 3 areas, including Minato Mirai 21

- Large-scale introduction of renewable energy (27,000 kW photovoltaic generation)
- Construction of smart houses and buildings (4,000 households)
- Coordinated control of regional energy, including electric and thermal energy, in order to complement the large-scale commercial grid.
- Promotion of the next-generation traffic system (use of 2,000 next-generation vehicles)
- Lifestyle reform through visualization

- Strengthen the organization system for promotion by setting up an organization consisting of corporate members
-

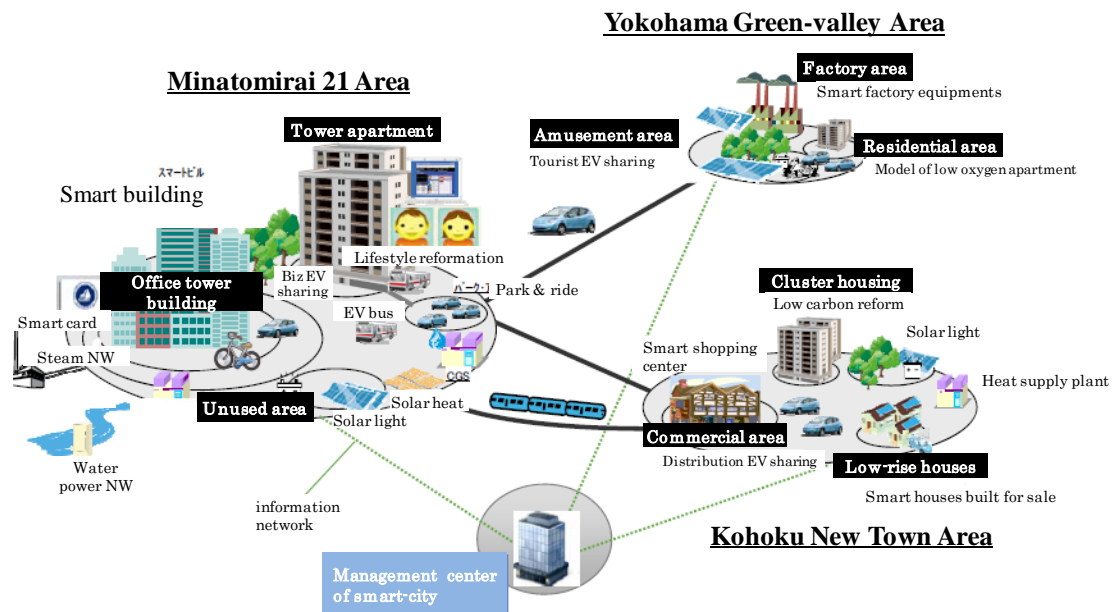


Figure 5-1 Illustration of YSCP Vision

5.3.2 Demonstration Project to Create City with Low Carbon Emissions from Home and Community in Toyota City, Aichi Prefecture

5.3.2.1 Facts of Area for Demonstration Experiment

- Population: 422,865
- Number of households: 164,040
- Area: 918 km²
- Number of cars owned: 366,065
- Total amount for 5-year demonstration project: ¥2.272 billion
- Area and implementing bodies: Toyota City, Aichi Prefecture (Toyota City, Toyota Motors, Denso, Chubu Electric Power, Toho Gas, Sharp, Toyota Home, Fujitsu, Toshiba, KDDI, Circle K Sunkus, Mitsubishi Heavy Industries, Toyota Industries, Dream Incubator)

5.3.2.2 Proposal Outline

- Global companies, local major companies, and local government collaborate with citizens to create a social system with less carbon emissions, with focus on the household sector (household + car).
- The demonstration project aims to keep the social costs low, maximize use of electric, thermal, and unused energy, create a low-carbon emission traffic system, and coordinate all the efforts.
- Conduct standardization activities while being aware of global competition.
- Target of CO₂ emission reduction of 20% for households and 40% for traffic.

5.3.2.3 Details of Activities

- Maximize use of energy at home (more than 70 projects)
- Maximize use of energy in the community
- Create a low-carbon emission traffic system (use of 3,100 next-generation vehicles)
- Reform the lifestyle by helping citizens change their behaviors and verify the effect of incentives (effect to reduce the social costs)
- Consider the strategy for global replication (global replication and global standard)

5.3.3 Keihanna City: Next-Generation Energy and Social System Demonstration Project

5.3.3.1 Facts of Area for Demonstration Experiment

- Population: 171,203
- Number of households: 63,870
- Area: 153.72 km²
- Number of cars owned: 80,313
- Total amount for 5-year demonstration project: ¥1.387 billion
- Area and implementing bodies: Kansai Science City (Kansai Research Institute, Doshisha Yamate Sustainable Urban City Council, Kyoto Prefecture, Kyotanabe City, Kizugawa City, Seika Town, Kansai Electric Power, Osaka Gas)

5.3.3.2 Proposal Outline

- Kansai Science City is used to study and verify the “science for sustainable society,” create new industries, visualize the energy flow in homes, offices, and via electric vehicles, and control energy (nano-grid).
- Control the demand fluctuations caused by unstable natural energy sources and human behaviors, implement a stable and efficient local energy system, and create new industries.
- Target of CO₂ emission reduction of 20% for households compared to 2005 and 40% for traffic by 2030.

5.3.3.3 Details of Activities

- Install a photovoltaic generation system in 1,000 households.
- Implement a nano-grid system in homes and buildings that uses energy information and intelligently controls the power generator (photovoltaic, fuel cell, etc.), and storage system.
- Actively use electric vehicles, and create a network of charging stations.
- Develop a local energy economic model using Kyoto Eco Points.
- Establish a Local Energy Generation and Local Energy Consumption Model by integrating the above efforts.
- Demonstration experiment of mutual complementation of the local nano-grid and national grid

5.3.4 Kita-Kyushu Smart Community Creation Project

5.3.4.1 Facts of Area for Demonstration Experiment

- Population: 600
- Number of households: 200
- Area: 1.2 km²
- Number of cars owned: about 600
- Total amount for 5-year demonstration project: ¥1.633 billion
- Area and implementing bodies: Kita-Kyushu City, Fukuoka Prefecture (Kita-Kyushu City, Nippon Steel, IBM Japan, Fuji Electric Systems)

5.3.4.2 Proposal Outline

- Yahata-Higashida area's smart grid network based on photovoltaic and hydrogen new energy infrastructure and community infrastructure developed by the public sector is used to implement area energy management involving all of the citizens in the community and create a community capable of reducing CO₂ emission by 50%.
- The results are incorporated into the policy of the city development and then replicated in the entire city and in Asian cities through the network with such cities.
- The demonstration project aims to reduce CO₂ emissions for the consumer and transport sector by 40% in 2030 and by 70% in 2050, and revise the target upward by 10% from 40% to 50% in 2030 and from 70% to 80% in 2050.

5.3.4.3 Details of Activities

- Maximize use of industrial energy to increase use of new energy to 10% of the total energy consumption in the urban area.
- Introduce an energy conservation system for the entire community (implement real-time management using a smart meter for 70 companies and 200 households).
- Implement energy management in the urban area through "local energy conservation stations."
- Create a local community and traffic community based on the energy infrastructure.
- Create a system to transfer the results to the Asian regions.

6. Direction of the Future Activities

6.1 Promoting the Attraction of Existing Industries

6.1.1 HDD

As already described, it is very difficult to attract new investments by taking advantage of the current concentration of the HDD industry in the Philippines. The HDD industry is a large industry in the Philippines. However, only one company (Toshiba) produces part of its HDDs in the Philippines and the production accounts for only 6% of the total production of HDDs around the world.

Therefore, the first step to attracting investments in the HDD industry is to make efforts to increase the HDD production. At the very least, a situation such as the withdrawal of HDD production by HGST from the Philippines must be prevented from occurring. The most important thing for that is to make active efforts to get Toshiba, the sole HDD manufacturer in the Philippines at present, to bring more production to the Philippines. Toshiba has two factories in the Philippines. One is the company's original factory and the other is the former factory of Fujitsu. Considering the current production scale of Toshiba, it is inefficient to have two factories in the Philippines. Therefore, it can be expected that Toshiba will streamline the two factories into one in the future. Accordingly, efforts must be made to prevent Toshiba from withdrawing production from the Philippines. If Toshiba decided either to withdraw from the Philippines or to close one of its factories and reduce production, many of the suppliers who have their factories in the Philippines and supply parts to Toshiba Philippines would surely consider withdrawal from the Philippines following the movement of Toshiba. In fact, when HGST stopped the HDD production in the Philippines, many of the suppliers considered withdrawal from the Philippines. Another reason why the suppliers considered withdrawal was a sharp decline in the production volume after the Global economic crisis. However, since the production volume recovered at a fast pace thereafter and the overall production capacity was about to fall behind demand, the suppliers decided to maintain the current production in the Philippines for the time being. One should recognize clearly that the operations of the suppliers in the Philippines will become the initial targets in streamlining and consolidation if no action is taken with regards to the current situation.

The following assesses the possibility and suggests ways to attract investments in the HDD and other industries according to the supply chain in the Philippines. Though U.S. manufacturers have large market share in HDD final product, Japanese manufacturers have large market share in its parts, materials area. Aside from internal manufactures (those who manufacture parts only for internal use), Japanese manufacturers have 100% of the market share in main parts such as media, head, and spindle motor. Therefore we describe about mainly Japanese manufacturer in the following.

6.1.1.1 Media

The HDD media business is a typical equipment-intensive industry, where the material cost of substrates and the depreciation cost of the sputtering equipment account for most of the manufacturing cost. Therefore, a large cost reduction effect cannot be expected even if production is transferred out of Japan.

Target company 1: Showa Denko (possibility of investment: very low)
Showa Denko supplies more than 80% of the media for Toshiba at present. Since HOYA

Corporation that supplies the rest is going to transfer its media business to WD, Showa Denko will supply 100% by the end of 2010. The company has factories, which are distributed widely, in Ichihara, Japan (main factory), Yamagata, Japan (former factory of Fujitsu), Singapore (former factory of Mitsubishi Chemical), and Taiwan (former factory of Trace Storage Technology). This is a result of acquiring the media business from Mitsubishi Chemical, Trace Storage Technology, and Fujitsu, and not a result of the company's active movement to transfer production abroad. As is evident from the manufacturing locations of these factories, large cost benefits cannot be achieved even by transferring the media business to the Philippines.

Target company 2: Fuji Electric Holdings (possibility of investment: very low)

Fuji Electric does not supply to Toshiba at present. Fuji Electric used to supply part of the HDD media for Fujitsu, but all of that is supplied by Showa Denko at present. Fuji Electric has factories in Matsumoto (main factory of Fuji Electric), Minami-Alps, Yamanashi, Japan, and Malaysia. Since Fuji Electric was supplying a lot of media to WD and has an aluminum substrate polishing factory in Malaysia, the company transferred part of the sputtering process to Malaysia. The company has lost a large market share due to lagging behind in technology and has no plan to construct a new factory.

Target company 3: HOYA (possibility of investment: very low)

HOYA has invested in the Philippines recently. HOYA originally had planned to construct a facility at the site of its factory in Vietnam to expand capacity. But because of an urgent request from a customer, the company bought a factory in the Philippines and converted to a substrate polishing factory. That is why HOYA started operation in the Philippines. There is no doubt that HOYA will make a small-scale investment such as an installation of equipment in the Philippines. However, the company will implement investment, including the construction of a new facility, at the site of its factory in Vietnam.

6.1.1.2 Heads

Like the semiconductor and HDD media, the wafer process of HDD heads is a typical equipment-intensive industry, where the material cost of substrates and the depreciation cost of the manufacturing equipment account for most of the manufacturing cost. Therefore, a large cost reduction effect cannot be expected even if production is transferred out of Japan. On the other hand, the subsequent slider manufacturing process and HGA process are labor intensive, so all production is already located in Southeast Asia.

Target company 4: TDK (possibility of investment: very low)

TDK supplies 100% of the heads for Toshiba. The front-end process of TDK is located in factories in Chikumagawa, Japan, Kofu, Japan, U.S. (Headway), and Dongguan, China. The overseas bases are a result of acquisition and not a result of the company's active movement to transfer production abroad. The slider process, HGA assembly, and HAS are located in the Philippines and China. Its wholly-owned subsidiary, SAE Magnetics in Hong Kong, is in charge of production in China. Factories in China are located in Shenzhen, Dongguan, and so on. SAE Magnetics is also in charge of the contract production of HDDs for Toshiba and Samsung. SAE Magnetics is a Hong Kong and China based company and basically plans to increase production capacity in its factories in China. The factory in the Philippines is a wholly-owned subsidiary of TDK. The subsidiary was established because Toshiba, Fujitsu, and Hitachi started production in the Philippines. The utilization of the factory is low at present. At one point, TDK considered closing the factory and concentrating production in China.

Target company 5: NHK Spring (possibility of investment: very low)

NHK Spring does not manufacture suspensions for Toshiba at present (Hutchinson manufactures 100% for Toshiba). NHK Spring has factories in Ina, Japan and Thailand. NHK

Spring was originally a manufacturer of automotive suspension coils and seats, and has a production base in Thailand for automotive manufacturers in Thailand. NHK Spring established a new HDD suspension factory in Thailand because its main customers, such as HGST, Seagate, and WD, manufacture HDDs in Thailand. At present, NHK Spring manufactures suspensions for Korea and China in Ina Factory and for Thailand, Malaysia, and China in the factory in Thailand. The possibility that NHK Spring will manufacture suspensions for Toshiba is not zero, but the possibility that the company will establish a new factory in the Philippines for that purpose is remote.

Target company 6: Hutchinson Technology (possibility of investment: very low)

Hutchinson supplies 100% of suspensions for Toshiba at present. Their factories are in Thailand, China and South Korea. They are losing their market share rapidly recently though it was proud of about 60% of the market share in this field before. Therefore, the expansion of the production capacity can't be expected for a while. Even if they make a new investment, Thailand or China will be a candidates, as their customers exist. Hutchinson supplies Toshiba Philippines from their factory in Thailand. The possibility to establish a new factory only for Toshiba is quite limited.

Target company 7: Nippon Steel (possibility of investment: very low)

Nippon Steel manufactures and processes stainless steel for suspensions for HDD manufacturers. All manufacturing and processing are performed in Kimitsu, in Japan. Nippon Steel manufactures stainless steel for HDD suspensions using stainless steel equipment for another purpose. Since stainless steel manufactured for HDD suspensions accounts for less than 1% of the total production of the company, Nippon Steel is unlikely to establish a factory for HDD suspensions outside Japan. In addition, considering the fact that the transportation cost of exporting processed suspensions is much lower than that of exporting steel sheets, and waste materials can be reused, Nippon Steel is unlikely to establish a new factory for HDD suspensions outside Japan.

Target company 8: Nitto Denko (possibility of investment: very low)

Nitto Denko manufactures FPC boards that connect a head mounted on a suspension to the circuit. All production is performed in Toyohashi, Japan. Since all the FPC boards are produced on a fully-automated manufacturing line, no cost reduction effect can be expected even if production is transferred out of Japan. In addition, since the FPC board line is also used for other products to achieve the benefit of scale, Nitto Denko has no plan to establish a new factory outside Japan.

6.1.1.3 Spindle Motors

Since HDD spindle motor manufacturing is labor intensive, all production has already been transferred to the Southeast Asia region.

Target company 9: Nidec (possibility of investment: very low)

Nidec is a major HDD spindle motor manufacturer that has a dominant market share of about 80%. Nidec operates the HDD spindle motor business according to the concept of manufacturing close to customers. This is because it enables the company not only to deliver products quickly, but also to respond to the feedback of customers appropriately and satisfy market needs carefully. Nidec has four factories in Thailand alone, as well as factories in China, Singapore, and the Philippines. If Toshiba Philippines increases production significantly, Nidec is likely to make an additional investment in the Philippines. However, the possibility of an additional investment is extremely low because there is enough capacity at present because of the withdrawal of HGST.

Target companies 10 to 13: Other spindle motor manufacturers (possibility of investment: very low)

The remaining 20% market share of the HDD spindle motors is owned by Minebea, PSEC (formerly Matsushita-Kotobuki Electronics Industries), Alphana Technology (formerly JVC), and SEMCO. These companies are having difficulty continuing their business because of price pressure from Nidec, which takes advantage of scale.

6.1.1.4 VCM

Since the HDD VCM assembly is labor intensive, all production has already been transferred to the Southeast Asia region.

Target company 14: Shin-Etsu Chemical (possibility of investment: very low)

Shin-Etsu Chemical has a worldwide HDD VCM market share of about 60%. The company started production in April 2000 in the Philippines. At the beginning of establishment, the factory specialized in the VCM assembly for the factories of Toshiba, Fujitsu, and Hitachi located in the Philippines. However, production decreased because Hitachi transferred the HDD production out of the Philippines and Fujitsu was acquired by Toshiba. To compensate for the decrease in production, the factory manufactures magnets for compressors, vehicles, FA, and AV equipment. As of 2010, production of VCM magnets decreased to 10% of the total production in terms of tonnage. Shin-Etsu Chemical operates the business according to the policy of manufacturing as close as possible to customers and manufactures HDD VCM in Thailand for Seagate, WD, and HGST, in Malaysia for WD, in Indonesia for Singapore HGST, and in China for Seagate, Toshiba, and Samsung. The factory in the Philippines has been forced to change course from the original purpose of establishment and an additional significant investment cannot be expected in the future.

6.1.1.5 Base Plates/Cases

Base plates/cases can be made using a simple metal processing technique; so many local companies manufactured them in the past. Unlike large HDDs, the base plate and spindle motor for the recent compact HDDs are manufactured and supplied as an integrated part in order to reduce the thickness. Therefore, Nidec which has a dominant market share of spindle motors has the same dominant market share in this field, too. For the target company and possibility of investment, see the section on spindle motors.

6.1.1.6 Other Electronic Parts, etc.

A HDD is manufactured by assembling many parts in addition to the parts described above. With respect to these parts, it is easy to imagine that the situation is the same as that of the key parts described above. Local surveys conducted in the Philippines and surveys conducted in Japan up until now have not found any company that is likely to make a new investment in the Philippines.

6.1.2 Semiconductor

Semiconductor companies tend to do the wafer processing in their own countries or subcontract it to foundries in Taiwan, and to carry out operations related to logic or discrete semiconductors, which are less value added, in ASEAN nations. Concentrating the semiconductor industry has not been so successful except for Hsinchu Science Park in Taiwan.

Targeting on Taiwanese Package manufactures

Wafer processing is unlikely to concentrate in the Philippines, although some companies may invest in wafer processing in the country such as Intel and TI in the past. The only way to attract manufacturers in this field is to continuously try to persuade them to invest.

As for the assembly and testing process, Taiwanese enterprises have focused their operations in Taiwan and China, but are now considering relocating their bases from China because of rising labor costs. These companies are delaying additional investment, closing existing production sites, and planning to move to Taiwan or ASEAN countries. There is a possibility that packaging (assembly and testing process) manufacturers in Taiwan could be successfully encouraged to invest in the Philippines.

Continuous approach to Taiwanese EMS

In addition to the semiconductor industry, another approach is to attract the assembly process of the electronics industry. As with the semiconductor assembly and testing processes, many Taiwanese electronics manufacturing service (EMS), OEM, or ODM companies expanded into China. However, as the Chinese risk emerges, they are considering relocating their production bases again. The first destination is Taiwan; the government should pitch the Philippines as an alternative site.

6.2 Strategy for attracting companies in next-generation industries

6.2.1 Next-generation energy industry

If the Philippines intends to create an industrial cluster as a world-class base for producing next-generation energy devices, it must create a substantial domestic market, attract key players, and gather a sufficient number of supporting industries.

As the photovoltaic cell market grows worldwide, production bases are being built in not only the three major areas of Europe, Japan, and China, but also in North America and ASEAN. Among ASEAN countries, Malaysia and Thailand are keen to gather firms and promote the photovoltaic cell industry.

Creating the domestic market

For the Philippines to outperform Malaysia and Thailand in attracting firms and growing the photovoltaic cell industry, it must create a domestic market of sufficient size and attract the attention of overseas manufacturers. In October 2010, Malaysia will introduce the FIT system for purchasing electric power. At the World Future Energy Summit held at Abu Dhabi in January 2010, the country declared that it would increase the output from renewable energy from 50 MW in 2010 to 2000 MW in 2020, and that it would expand the renewable energy market. This policy of promoting the domestic market is encouraging foreign companies to enter and invest in Malaysia.

Before this declaration, the country started offering incentives to individual companies related to renewable energy in 2006. As a result, Malaysia successfully attracted First Solar (US) and Q-Cells (Germany), the two leading photovoltaic cell manufacturers, and manufacturers including Tokuyama (Japan) of silicon, which is needed for manufacturing photovoltaic cells.

As the incentives offered by BOI, PEZA and other governmental institutions need condition of 70% or more export of produced goods. However, to create a domestic market, the government should consider to alleviate this condition.

Strengthening approaches to US manufacturers

Historically, the Philippines has had closer relations with the US than European countries, and American manufacturers have greatly contributed to the country's industry. Regarding next-generation energy, SunPower, an American photovoltaic cell company, has been operating the first and second plants in the Philippines and plans to build a fourth. SunPower has also set up First Philec Solar, a wafer maker, through a tie-up with Manila Electric Company (Meralco). To grow the industry, the government should use SunPower as the core and attract more material and device manufacturers.

In the United States, there are many venture companies related to next-generation energy including photovoltaic cells. The government should consider the possibility of incubating their technologies in the Philippines. Although it may be difficult for the government to take such an initiative, it would be possible to help a powerful financial group start a new business. For example, the UAE invested in a German photovoltaic cell manufacturer through the Masdar Foundation to establish a photovoltaic cell manufacturer called Masdar PV in its own country.

Approach to European manufacturers

European manufacturers are strong in next-generation energy. To create an industrial cluster in this field, it is essential to approach European manufacturers.

Generally, there is less information on the Philippines in Europe than in the US, which is a disadvantage for the Philippines. When planning to invest in ASEAN countries, many European manufacturers first consider Singapore, Malaysia, and Thailand. Why not the Philippines? Geographical disadvantage is one reason; there are no direct flights from many European countries. But the most serious problem is that European companies have little information on the Philippines.

Either the government or industry should send a mission for attracting investment and exchanging information with European manufacturers.

6.2.1.1 PV

For constructing an industrial cluster related to photovoltaic power generation in the Philippines, it is necessary to: (a) cultivate the domestic market and (b) attract major manufacturers of cells and modules. The Philippines should follow Malaysia which has been successful in this approach.

Follow the Malaysian policy of encouraging industrial growth

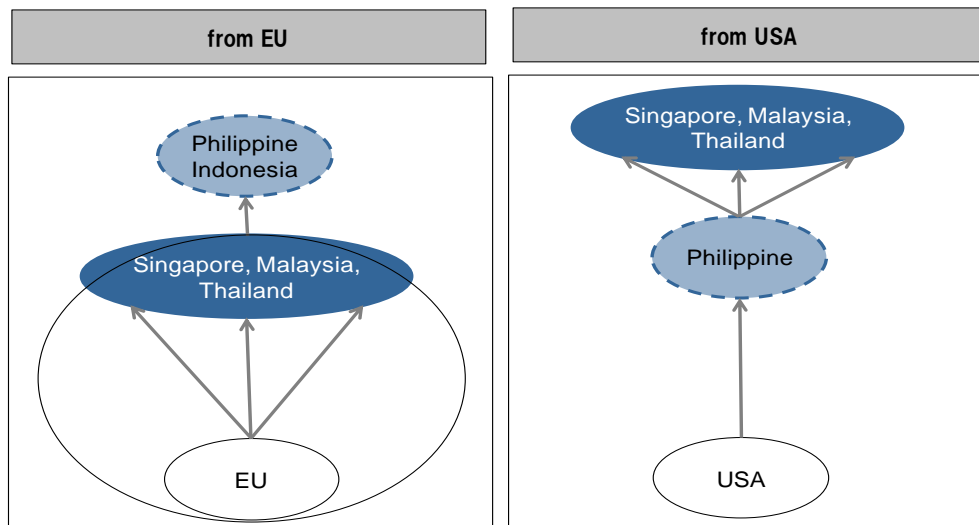
Manufacturers in Europe and the US see Southeast Asia as a growing market, following Japan and China, and are considering setting up not only sales bases but also production and maintenance bases in Southeast Asia. Some manufacturers have already started operating production bases there, due to not only cheap labor costs and convenient logistics, but also market potential, that is, the current market size and its growth potential over the next several years.

Many photovoltaic power generation companies are analyzing the possibility of moving into Malaysia, where the government has given the official green light and declared that it will introduce the FIT system in the autumn of 2010. When this was announced, major manufacturers of solar cells and modules such as First Solar and Q-Cells, which have already received various incentives from the Malaysian government, decided to make further large-scale investments.

Investments by these two firms will trigger expansion by related companies. First Solar and Q-Cells are two of the five biggest manufacturers in the industry and are large producers. Therefore, many of the material and system manufacturers who do business with these two companies are also considering setting up production bases nearby, which would create an industrial cluster. The same phenomenon has already been seen in industries such as semiconductors and FPDs.

Adopt a geographical perspective in attracting manufacturers

We interviewed several European and American photovoltaic power generation manufacturers at Intersolar Europe 2010 in Munich, Germany in mid June, and asked about their expansion plans for Southeast Asia and the possibility of investing in the Philippines. The survey revealed that European and American manufacturers have different opinions of the Philippines, which may be due to their geographical views of the Asian market.



Source: Japan International Cooperation Agency, Study Team

Figure 6-1 Asian market viewed by European and American manufacturers

The Philippines is not familiar to European manufacturers. Because of not only physical distance but also psychological distance (lack of direct flights), the Philippines is farther than any other Southeastern country from Europe. Many European companies seem to have little understanding of the Philippines. To solve this problem, we believe the government should send a mission for attracting investment from Europe.

In contrast, US manufacturers see the Philippines as geographically equivalent to Singapore or Malaysia. In addition, American firms consider the Philippines as a potential candidate for investment because English is used in business. The United States has many venture businesses with unique solar battery cell technologies; if the Philippines is serious about becoming an incubator, there is a possibility of attracting them.

6.2.1.2 LIB

Possibility of new investment

The output of LIB has steadily increased in recent years by about 40% per annum, which means that almost all LIB manufacturers are continuously investing. The demand for LIB for automobiles is expected to soar in 2010 and beyond, adding to the demand for LIB in portable equipment. Therefore, many manufacturers, including newcomers, will step up their

investments.

However, all Japanese, Korean, Chinese, and US manufacturers continue their policy of setting up plants only in their own country. LIB manufacturing requires highly sophisticated technology and completely automated processes. Like the front-end processes of semiconductors and HDD heads, the ratio of labor cost to production cost is extremely small, whereas the ratio of material costs and depreciation costs are high, so manufacturers have little incentive to establish plants in Southeast Asia. Even one American newcomer, which manufactures promising LIB for HEV/BEVs, plans to locate its plant in the United States because that is where its buyers (manufacturing plants of carmakers) are.

Under these circumstances, parts makers also prefer to remain in their respective regions, although Toda Kogyo is an exception. As previously mentioned, the company will establish a new factory in the United States to meet the expected increase in LIB demand for EVs. This investment was supported by the US government which strongly wants to expand the LIB industry domestically. Without \$35 million in subsidies, the company would not have invested there.

Major LIB components including cathode materials, anode materials, separators, and electrolytes are manufactured in large-scale plants. Like the LIB assembly process, the ratio of labor cost to production cost is extremely small, whereas the costs of materials and depreciation of facilities account for a high proportion. Therefore, parts makers also have little incentive to expand in Southeast Asia.

Strategies to promote new investments

Unlike other electric instrument companies, LIB manufacturers have no incentive to expand operations overseas to reduce labor costs, and will continue domestic production for a while. However, the shares of Japanese companies have been gradually decreasing; this is because their higher costs compared with Chinese and Korean competitors are slowly but steadily having an impact. Therefore, in the mid to long term, Japanese companies are expected to consider relocating production overseas. To become a candidate, the Philippines needs to have: (1) a large market at home or in neighboring countries, (2) the possibility of concentrating LIB companies in the Philippines, (3) more favorable conditions for investment than neighboring countries, etc.

As for the first point, the Philippines could become an LIB manufacturing base for automobile assembly plants in Thailand or Malaysia, etc. when the EV demand, which is now concentrated in Japan, the US, and Europe, starts to expand in Southeast Asia in the mid to long term.

To solve the second issue, the Philippines must attract investment in an integrated manner by not only LIB manufacturers but also parts makers. The supply chain must be concentrated as closely as possible, for example, by specifying an industrial park; Laguna Industrial Park for the HDD industry is a good example, where the main parts suppliers such as Nidec and TDK are adjacent to the HDD manufacturers including Toshiba and Hitachi.

For the third point, in addition to tax exemptions, measures must be taken to preferentially and quickly solve various problems in the Philippines, such as prioritizing the supply of electric power and improving the infrastructure. The government has already been offering incentives, trying more stable power supply by establishing power plants, and constructing highways and hence, some progress has been made. Nevertheless, compared to neighboring ASEAN countries, the Philippines does not have high competitiveness.

Moreover, encouraging packaging companies would help attract LIB manufacturers to the Philippines in the mid to long term. Cells manufactured by LIB makers are not used as single units, but multiple cells are packaged with a protection circuit and supplied to equipment manufacturers. Most of this packaging process is currently carried out by EMS companies in Taiwan or China. Because this process does not need high technology, ordinary electronics companies in the Philippines which excel in assembling parts could perform this task. If any company wishes to engage in this business, it should receive similar incentives as those for overseas enterprises.

6.2.1.3 LED

As described above, the Philippines has the potential to attract investment in the LED device (packaging) and module processes. The main players in these processes are manufacturers in Taiwan and South Korea. The government should encourage them to transfer or expand their production bases to the Philippines. Wage costs in southern China are rising sharply due to labor problems and many manufacturers are planning to close existing production bases and transfer them to other countries. The government should make these companies aware of the merits of the Philippines, with its large pool of skilled workers at lower cost.

Companies involved in the module process tend to choose places adjacent to the production facilities of their customers (application manufacturers). Sanken Electric, an LCD backlight bulb manufacturer, set up in the Philippines following Epson, one of its LCD module clients, just as automobile parts manufacturers came to the Philippines on the heels of auto manufacturers which set up assembly factories. Attracting application manufacturers to the Philippines would also lure supporting industry companies including module manufacturers. However, under the recent restructuring strategies of automobile manufacturers and LCD module manufacturers, new or additional investment in the Philippines appears to be unlikely. A more realistic approach is for the government to offer major incentives to the module manufacturers already in the Philippines, many of which produce older products and have not yet introduced LED technologies. It would be effective if the government offered incentives for additional investment for incorporating LEDs.

6.2.2 Embedded Software Business

6.2.2.1 Difficulties

Japanese companies are willing to place orders for embedded software to foreign countries, and US and European companies which are developing various products seem to have similar intentions. The Philippines, however, has not prepared itself to satisfy such needs. In contrast, both the public and private sectors in China, India, and Vietnam are actively marketing and striving to attract outsourcing by Japanese electric appliance manufacturers and others. As a result, outsourcing to these countries is increasing, and some companies have established bases, although there are still few such cases.

The reasons why the Philippines cannot satisfy the demand for embedded software are as follows:

- There are few companies which can handle embedded software development.
- There are few human resources who can develop embedded software.
- The industry (PSIA, etc.) makes little effort toward embedded software.
- There is a language barrier (most Japanese and Koreans employees of electric or electronic manufacturing companies are not good at English).

In neighboring countries like Vietnam, initially there were no companies that could deal with embedded software. However, as application software developers started to focus on embedded software development as a new business, the number of capable companies increased, thereby forming an industry. In addition, sales staff at many embedded software companies in China and Vietnam can speak Japanese. In the software industry in the Philippines, application software firms as major players are expanding their outsourcing business chiefly with US and European countries. Philippine people can use English with such businesses, and seem reluctant to engage in the embedded software business with Japanese companies that struggle to communicate in English. This may be one of the reasons why the Philippines has not prepared itself to meet the demand for embedded software.

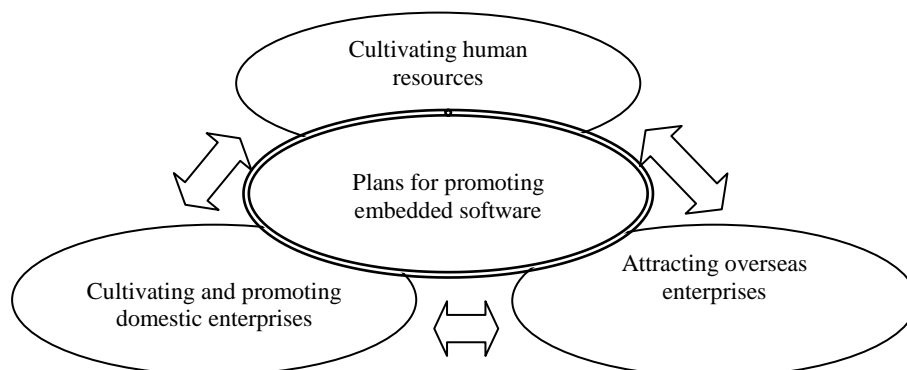
6.2.2.2 Measures

At present, embedded software is not being industrialized in the Philippines; the government needs to actively work to develop this industry. The infrastructure is fragile because both human resources and companies who can handle embedded software are scarce. The embedded software development would expand the activities of electronics industry. In fact, it is reported that ASTEC, an affiliated company of Emerson is already operating designing, procurement and customer support in the Philippines.

The government should publicly announce its commitment both inside and outside the country; it should inform foreign companies that the Philippines is industrially promoting embedded software and attracting companies, and encourage them to consider the Philippines when expanding overseas.

As for human resources, it is indispensable to cultivate staff with the necessary skills. With embedded software, it is difficult to follow the conventional style of simply inviting overseas companies and offering simple labor power; the embedded software industry needs more than just a workforce in assembly plants, but people with strong technical skills. Among these skills, programming based on detailed specifications is simple, and yet even this needs a basic knowledge of software such as programming languages and algorithms. Workers in the embedded software industry must gain expertise and experience to be able to handle the industry-unique program structure, etc.

Currently, neither embedded software companies nor organizations in the Philippines are considering how to respond to this technology. Therefore, there is no interest in exploring the possibility of the embedded software industry. Unlike manufacturing, logistic costs in the embedded software industry are negligible and it is not difficult to receive orders for outsourcing directly from overseas companies. Thus, the Philippines could win orders if it has the right industrial and language (Japanese) skills. Increase of outsourcing from overseas will help domestic human resources upgrade their skills.



Source: Japan International Cooperation Agency, Study Team

Figure 6-2 Strategy for Promoting Embedded Software

6.2.3 R&D&D

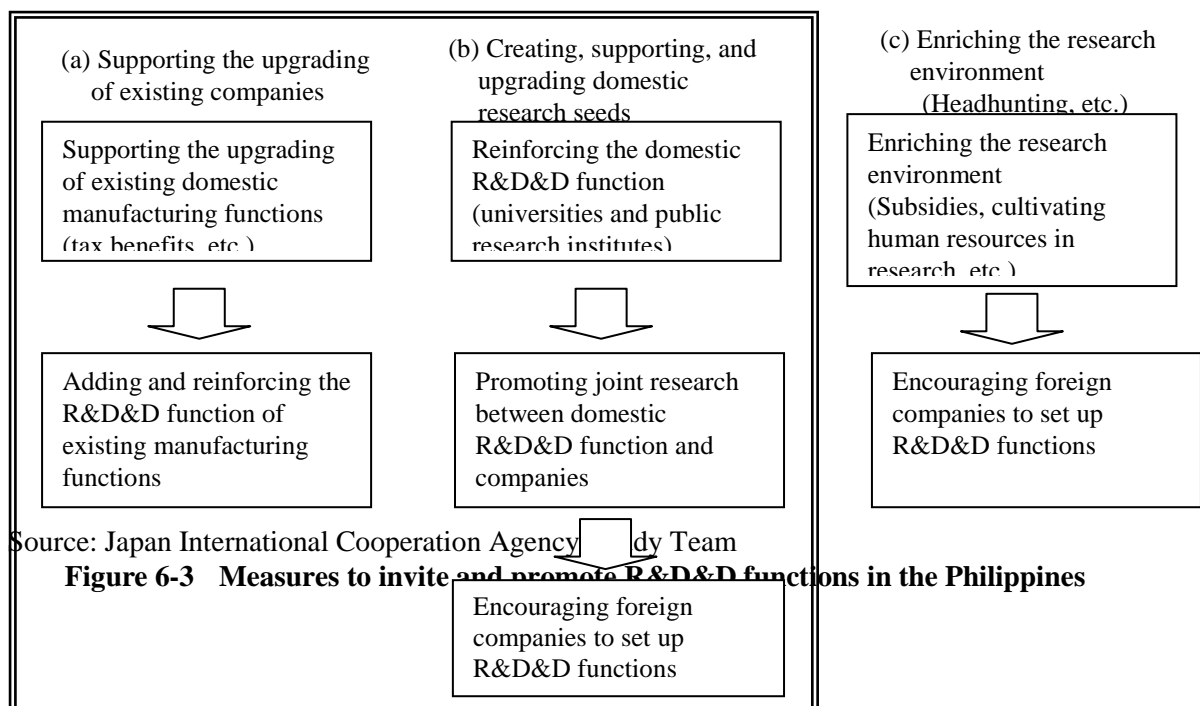
The key factor in attracting an R&D&D function of companies is whether or not there are local research seeds such as human resources or research institutions. We suggest three ways of creating research seeds and attracting R&D&D functions.

The first measure is to reinforce the R&D&D activities of existing companies. Companies are always aiming to upgrade their existing bases and improve competitiveness. One approach is to improve productivity and quality by such basic activities as Kaizen (“betterment”). Improving the R&D&D function and reviewing product designs or development processes will greatly boost the productivity and quality of production bases, and the government should support this.

The second measure is to enrich domestic research seeds and activate the domestic R&D&D activities, in order to attract companies. Many companies are conducting joint researches with universities or public research institutes, and some foreign firms are also working on joint research projects with the University of the Philippines or University of Ateneo, etc. Stepping up and strengthening such joint research efforts will make it possible to attract the research arms of companies.

The third measure is to strongly support the R&D&D activities of companies, including headhunting, to encourage investment. Singapore is a typical example of this approach. The Agency for Science, Technology and Research (ASTAR) takes the initiative to attract not only companies but also researchers, by offering excellent research and development support systems. However, this approach is expensive and would require complete commitment to outperform other countries such as Singapore.

Among these measures, we believe that the Philippines should actively take the first and second ones.

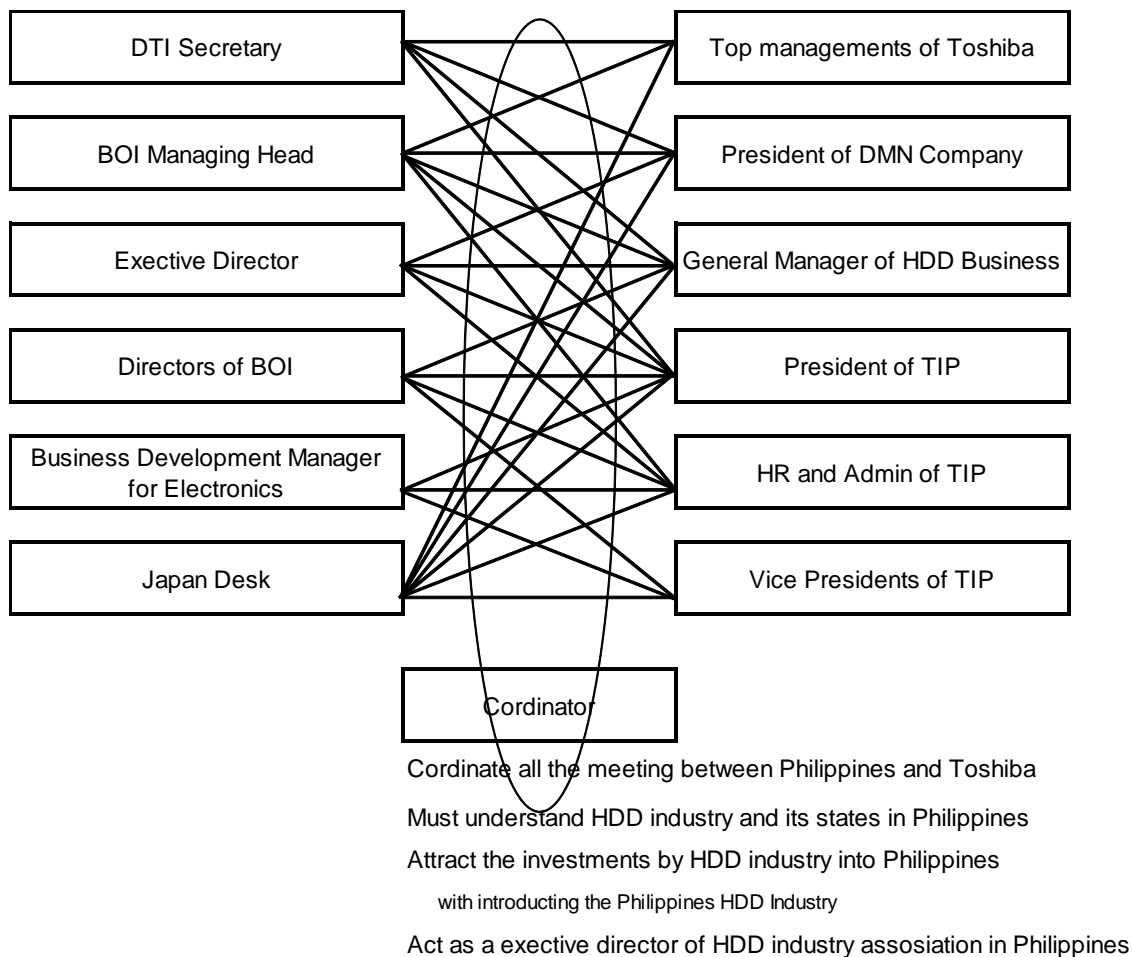


6.3 Specific Action Plans

6.3.1 Action Plan in HDD Industry—Approach to Toshiba

As mentioned before, the first step to attracting the investment of the HDD industry is to increase HDD production. The sole HDD manufacturer operating in the Philippines at present is Toshiba. It is necessary to actively attract investments toward Toshiba.

The first step for doing so is to build close human relationships between the Philippine Board of Investments (BOI) and Toshiba. Presumably the key persons of Toshiba are the president, the head of administration, other Japanese staff members (11 persons), and several local executives, and the key persons of BOI are the President, Vice-President, Directors, several managers, and the Japan Desk officer. The BOI should appoint a person in charge (coordinator) who centrally manages the information collected at meetings, including the dates and times, places, and participants of the meetings.



Source: Japan International Cooperation Agency, Study Team

Figure 6-4 Building Relationships with Toshiba and Position of HDD Industry Coordinator

It is desirable to contact Toshiba in some form at least once a month; if possible, once a week. The reasons to give for contacting Toshiba are, for example, explaining the policies and systems of the Philippine government, or changes to the systems, which have relevance to Toshiba. You can also ask Toshiba about their requests to the government. Anyway, it is necessary to continue contacting Toshiba to get an understanding of the current situation of the business of Toshiba and gain as much information as possible about the needs of Toshiba with regards to the Philippine government. The government is required to make its best efforts to meet these needs. It is also necessary to report the progress and results of the efforts of the government to Toshiba. It is advisable to invite officers from other agencies, as necessary, to the meetings in order to build good relationships.

The current President of Toshiba Philippines, is a sympathizer of the Philippines. He started his career at Toshiba in manufacturing and is recommending other manufacturing departments of Toshiba to transfer production to the Philippines. In fact, the heads of other departments have visited the factories in the Philippines many times. The BOI should use these kinds of opportunities and ask Mr. Yano to arrange a meeting with the BOI. It will be extremely advantageous to advertise the Philippines and explain the backup system of the government to the department heads.

At present, Toshiba has two HDD factories in the Philippines. One is an original Toshiba factory (located in the Laguna Techno Park) and the other is a former Fujitsu HDD factory (located in the Carmelray Industrial Park). The two factories will be integrated into a single uniform operation in the future. However, at present, the two factories maintain the different operational styles of Fujitsu and Toshiba, respectively. The original Toshiba factory produces 2.5" HDD and the former Fujitsu factory produces HDD for enterprises, and the products are developed by different developers, respectively. For the time being, the same attention should be paid to the head of the former Fujitsu factory.

The head of Toshiba's HDD department (director of the HDD division), the head of Digital Media Network Company (President of DMN) to whom the HDD division director reports, and executives of Toshiba headquarters, including the presidents and vice-presidents, visit the Philippines frequently. The BOI should use these kinds of opportunities and arrange meetings to explain the backup system of the government to make sure they understand it well. These executives should be treated as VIPs by the government, if possible. For example, they should be transported to and from the airport and hotel by limousine, a smooth path through immigration and customs should be ensured, and security guards should be provided when travelling from one place to another. It is also advisable to arrange a meeting with the government officials (President and ministers). These executives are final decision-makers for the transfer of production overseas and expansion of the existing factories overseas. The impression they have about the Philippines has a great impact on the decision-making.

In the meanwhile, the above coordinator is also expected to carry out the role of understanding the outline of the HDD industry and the whole picture of the HDD industry in the Philippines, and, if necessary, introducing the actual situation of the HDD industry in the Philippines and promoting the attraction of investments when carrying out public relations activities for investment attraction. It has been confirmed that more than 20 Japanese companies are involved in the HDD-related business in the Philippines, and the number will be found to be many times that when a close look is taken at the Philippine companies and companies of other nationalities. It is necessary to maintain close relationships with these companies and develop mutual relationships, and meet their needs and requirements.

In the HDD industry, there is a trade association called IDEMA (The International Disk Drive

Equipment and Materials Association). At present, IDEMA has offices in the United States, Japan, and Singapore, and carries out activities with the aim of achieving sound development of the industry. At present, the Philippines has no such organization (does SEIPI play the role?) so we think it will also be effective for the BOI to take the initiative and set up an organization specialized in HDD and the above coordinator to get involved in the practices. If necessary, it is also possible to make a proposal at the IDEMA Global Board Meeting (the supreme decision-making body of IDEMA) which is held once in three months.

6.3.2 Action Plan in Semiconductor Industry

The proposal made in this section is not limited to the components and devices in the semiconductor industry but applies to the semiconductor industry in the broad sense of the term that covers the intermediate parts and assembly of parts to final products. The reason is that the semiconductor industry in the narrow sense of the term is dominated by a few semiconductor companies and there is almost no chance for emerging semiconductor manufacturers in emerging countries including China to grow into leading players. The semiconductor industry in the narrow sense of the term consists of two processes called front-end and back-end processes. The front-end process consists of the fabrication of integrated circuits on silicon wafers, and the back-end process consists of the cutting, wiring, and sealing of fabricated silicon wafers to make chips. There are some back-end process operations but no front-end process operations in the semiconductor industry in the Philippines. Many EMS enterprises are investing into China. However, they are feeling China Risk because of labor cost and labor difficulties. They are planning to invest into any other country than China.

- Positioning of Semiconductor Industry

The electronics industry (particularly the semiconductor industry) is one of the important industries for the Philippines, which accounts for a large part of the GDP and exports. The Philippines should strengthen the existing semiconductor back-end process and some assembly operations in the Philippines and try to expand the upstream and downstream value chain.

- a) Strengthening Semiconductor Back-End Process and Expanding Upstream Value Chain

The semiconductor industry in the Philippines imports silicon wafers with fabricated integrated circuits, and performs wiring, sealing, cutting, inspection, and shipment in the domestic factories. Major companies such as Intel, Texas Instruments, STMicroelectronics and medium-sized semiconductor manufacturers such as Fuji Electric and Sanken Electric previously had operations in the Philippines. However, Intel and STMicroelectronics withdrew from the Philippines as a result of the global reorganization of the production bases of the semiconductor companies. Instead Samsung Electronics is considering setting up operations in the Philippines. The Philippines maintains its cost competitiveness and high quality workforce. To strengthen these advantages, it is necessary to make steady efforts to attract internationally competitive semiconductor companies to the Philippines and strengthen the downstream industry, namely component and module assembly. Expansion of the upstream value chain is also considered to include the final inspection of the semiconductor front-end process. We NRI recommend approaching to following EMS enterprises.

Table 6-1 Target enterprises

Enterprise		Main Product
Foxconn	Taiwan	IT Products
Wistron	Taiwan	LCD TV, Cellular Phone
Quanta	Taiwan	Notebook PC, LCD Monitor
Compal	Taiwan	Notebook PC, LCD Monitor
BenQ	Taiwan	Notebook PC, LCD Monitor, Smart Phone
TPV	Taiwan	LCD TV
Flextronics	Singapore	IT Products
Celestica	Canada	IT Products
Siix	Japan	Printer, Car Navigation
Sumitronics	Japan	Printer, Air Conditioner
Kaga Electronics	Japan	Car Navigation, Pachinko

Source: Japan International Cooperation Agency, Study Team

b) Strengthening Component and Module Assembly Industry and Promoting Final Assembly Industry

The most important activity when strengthening the electronics industry in an emerging country is strengthening the component and module assembly industry and the final assembly industry. Once you have assembly of final products, it is easy to attract the adjacent component and module industry and then the upstream semiconductor back-end process. Although the Philippines already has a high reputation for its low cost and high quality workforce, its relative position is declining as the neighboring ASEAN countries are catching up. At the very least, the Philippines should carry out investment attraction activities equivalent to those of the neighboring countries.

- **Implementing Body**

It is necessary to accelerate the effort to attract companies to the Philippines, not only companies in the semiconductor industry in the narrow sense of the term but also those in the entire electronics industry. Some neighboring ASEAN countries are keen to conclude a free trade agreement (FTA) with EU countries, China, Korea or other countries in order to attract and develop the assembly industry. The Philippines is not following this move and its position is relatively declining. It seems to be essential for both the BOI and PEZA to work together and carry out investment attraction activities that are more competitive than those of the neighboring ASEAN countries.

- **Proposed Schedule**

Q4 2010	Organize a Working Group Make a list of prospective electronics companies
Q1 2011	Detailed study on the investment attraction activities and results of the neighboring ASEAN countries
Q2 2011 and after	Approach prospective companies to attract investment and hold investment presentation meetings Consider the use of FTA/EPA (Economic Partnership Agreement)

And then, hold a world-wide electronics exhibition to invite global electronics firms

- **Items to be Implemented**

It is necessary to make a list of prospective companies not only in the semiconductor but also in the final product and intermediate part assembly industry, study and understand the actual conditions of the investment attraction activities of the neighboring ASEAN countries, and

prepare to make the Philippines attractive as an investment destination. The Philippines should not only provide generous preferential treatment to prospective companies, but also consider tariff reductions and requests for cooperation and support, with focus on the semiconductor industry within the framework of FTA and EPA, with EU countries, United States, Japan, and other countries. This year, labor costs in China increased due to labor disputes, so prospective companies that have concentrated production operations in China are considering global reorganization of production bases. Therefore, it is effective to strengthen investment attraction activities in response to this move.

6.3.3 Action Plan for LED Industry

To develop the LED industry in the Philippines, it is necessary to stimulate the application industries that use LED modules; namely, industries such as printers, copiers, LCD modules, and general lighting, which are the main applications of LED modules. There are two activities to develop the LED industry; one is supporting the production bases of printers and LCD modules located in the Philippines or that used to be manufactured in the Philippines, and the other is developing the general lighting market that uses LEDs, which are expected to grow in popularity in the future. In particular, the production bases of laser beam printers and LCD TVs and monitors that use many LED modules are expected to serve as driving forces to form the LED industry around them.

6.3.3.1 Attracting and Supporting Printer and LCD Module Factories

- Positioning Printers and LCD Modules

The printer and LCD module project is positioned as one of the important projects to revitalize the electronics industry (in particular the assembly industry) in the Philippines.

- Implementation Body

Led by the BOI, efforts are made to attract manufacturers of printer and LCD application products that have the potential of being a core industry to attract the LED industry. It is recommended that PEZA takes the leadership and considers expanding the benefits of various kinds of preferential treatment for companies that have operations in the Philippines and that will help create a new market.

- Proposed Schedule

Q4 2010	Make a list of prospective companies and consider the strategies for when contacting them
Q1 2011 and after	Hold investment presentation meetings and seminars, and visit prospective companies one by one

- Items to be Implemented

The first step is to visit related companies that have operations in the Philippines, hear about their activities regarding the LED-related business and their requests to the government, and understand the current market trends and problems. The second step is to use these results to make preparations for attracting prospective companies, and carry out activities to attract prospective Taiwanese and Japanese electronic manufacturing service (EMS) companies to the Philippines. Specifically it seems to be necessary not only to hold an investment presentation meeting and seminar once a year, but also to be active and organize a mission delegate to attract investments and visit prospective companies one by one.

6.3.3.2 Developing General Lighting Market Using LED

- Positioning LED Lighting Industry

The purpose is to develop the general LED lighting market led by the government so that the Philippines becomes a country that attracts the interest of global LED-related manufacturers.

- Implementing Body

The Department of Energy considers the incentive policy in order to increase the use of the LED lighting at home and in offices, and the Department of Public Works and Highways considers the project to change the street light bulbs of highways and public roads to LEDs.

- Proposed Schedule

Q4 2010	Understand the situation in the Philippines and calculate the energy saving and cost reduction effects of changing bulbs to LEDs.
Q1 2011	Consider the incentive policy
Q2 2011 and after	Prepare a budget for the actual project

- Items to be Implemented

The departments promote the use of LED lighting in order to ease the tight power supply and stabilize it. The departments simulate the amount of the decrease in the demand for electric power when bulbs and fluorescent lights are changed to LED lighting at home and in offices, and consider the amount of subsidies while comparing them with the cost for constructing new power plants. It is necessary to negotiate and cooperate with the relevant government agencies before carrying out this project.

6.3.4 New Industries

6.3.4.1 Electrical Energy Industry (LIB and Sunlight)

Despite a growing interest in renewable energy worldwide, there are only a few countries that are successful in attracting this industry. Developed countries such as Japan, Germany, and Korea are trying to develop the industry through the companies in their own countries that have a high capability for technological development. To develop a new energy industry, it is most effective to create a market of a certain size in the country. There are various means such as the introduction of electric energy purchase programs such as a feed-in-tariff (FIT) program, or subsidies for purchasers. Among the neighboring ASEAN countries, Malaysia has been the first to announce the introduction of an FTI program and is considering details on the purchase price. The Philippines has also implemented systems to use the energy generated by solar panels for electric jeepneys, as a self-generating power source on remote islands, or as an emergency power source. However, the market size is still too small to attract foreign companies to the country.

Besides photovoltaic energy generation, there are various methods to generate renewable energy; for example, biomass or micro-hydraulic energy generation. A wide range of technology applications to use the generated energy, such as a smart grid system, are required. One such application is lithium-ion batteries, which are used in a system to store the energy generated by solar panels or low-priced energy at night so that it can be used or sold during periods of high energy demand. There is no global standard for the smart grid system yet and each country continues to search for the best system. The Philippines has 7,700 islands, so there is a large potential market of LIBs for storing energy generated by solar panels and using it as an emergency power source. Therefore, it is necessary to take advantage of this potential to attract prospective companies and develop the new energy industry.

- Positioning of New Energy Industry

The new energy industry has the potential to become the second largest pillar industry after the electronics industry. It will not only become a cash cow to earn foreign currencies, but will also help improve the environments of big cities such as Manila that suffer from significant air pollution due to chronic traffic jams. The new energy industry should be positioned as one of the next-generation industries that the Philippines must develop.

- Implementing Body

First, it is necessary for the Department of Energy and the Department of Budget Management (DBM) to work together to stimulate the renewable energy market in the Philippines. The BOI and the Philippine Economic Zone Authority (PEZA) should work together and attract companies by creating a domestic market with large potential and drawing the interest of prospective foreign companies to the Philippines.

- Proposed Schedule

Q4 2010	Form a cross-functional strategic organization and task-based working group, with BOI, DOE, DOST, SEIPI, PEZA, Partners (Foreign company) Make a list of prospective companies related to secondary batteries (including LIB) and photovoltaic power generation
Q1 2011	Study the investment attraction activities and results of the neighboring ASEAN countries
Q2 2011 and after	Carry out the investment attraction activities targeting prospective companies and hold an investment presentation meeting in major countries Consider the use of FTA, EPA, or the like, and develop a plan for FIT and demonstration testing programs and promote them.

- Items to be Implemented

A list of prospective companies related to secondary batteries and photovoltaic power generation should be made and the investment attraction activities should be carried out as soon as possible.

There is a manual coil winding process for the secondary batteries and it is difficult to reduce the cost for this process in developed countries. Therefore, there is a move to establish a production base in emerging countries. It may be difficult to attract the most advanced LIB operations. However, it is highly likely that companies are planning the transfer of production of secondary batteries such as Pb, NiCd, and NiMH batteries to emerging countries including the Philippines.

The activity to attract companies related to photovoltaic power generation should effectively use SunPower, which already operates in the Philippines. It seems to be possible to attract the parts and materials suppliers of SunPower to its adjacent areas, as well as to attract American companies with which SunPower cooperates in technology development. In general, companies in the United States have more affinity with the Philippines than the European companies do, so it seems to be more effective to target startup companies in the United States when attracting photovoltaic generation companies.

To develop the next-generation electrical energy industry, it is necessary to stimulate the domestic market and create a size that exceeds a certain level. To achieve these two goals, for example, an FIT program could be introduced and a demonstration testing project could be carried out.

It requires a large amount of money to introduce an FIT program. Therefore, it is necessary first to talk with the DBM about the amount of budget that can be obtained. Malaysia plans to finance the FIT program using a private equity (PE) fund. One of the solutions for the Philippines may be to use the plan of Malaysia as the benchmark and talk with the PE funds in the United States and

Europe.

With respect to demonstration testing, it is recommended to promote the ongoing program of the electric jeepneys. At present, this program is led by a non-profit organization (NPO). It should be elevated to a national program to improve the environments of cities such as Manila. The Philippines has 7,700 islands and is one of the nations that are well known in the world for having many islands. Therefore, it is necessary to develop independent electric and water infrastructure for each island. This is a big challenge for the Philippines. However, if the Philippines is able to establish a stable infrastructure system, there will be a big opportunity for the Philippines to create a new infrastructure service that can be offered to the world market. If it is difficult for the Philippines to do this alone, it will be necessary for the Philippines to offer this kind of opportunity to a global company and work together with the company to create such a service.

With respect to the LIB industry, the long-term goal is to attract LIB manufacturers to the Philippines. However, as mentioned before, unlike the electronics industry, the LIB manufacturers have no motive to transfer production overseas in order to reduce labor costs. To attract the LIB manufacturers to the Philippines, the following conditions must be met: (1) potential strong demand in the Philippines and/or the neighboring countries, (2) prospect of the LIB industry being concentrated in the Philippines, and (3) investment climate that is more favorable than that in the neighboring countries. Accordingly, in the short term, it is necessary to create demand for LIBs in the Philippines.

Table 6-2 Development Strategy for LIB Industry Accumulation in Philippines

	Material & Parts	LIB Assembler	Pack Assembler	Electronics Products & Car
Now	Japan Korea	Japan Korea China	Taiwan China	Asian Countries
Short Term	Japan Korea	Japan Korea China	Taiwanese Investment Local Companies	Asian Countries
Long Term	Japanese and Korean Companies' Investment to the Philippines	Japanese and Korean Companies' Investment to Philippines	Taiwanese Investment Local Companies	Asian Countries

LIB Industry Accumulation

Source: Japan International Cooperation Agency, Study Team

As part of the medium-and long-term actions to attract the LIB industry to the Philippines, developing pack assemblers is an effective short-term action. Cells manufactured by the LIB manufacturers are not used discretely, but multiple cells and a protection circuit are usually packed into a single package to form a pack and supplied to the equipment manufacturers. At present, most of this manufacturing is performed by the EMS manufacturers headquartered in either Taiwan or China. This manufacturing does not require high technical ability. It is a field at which the conventional electronics industry in the Philippines that receives and assembles parts is good.

Most of these pack assemblers are based in Taiwan and have a strong tendency to operate in China. One of the approaches that will be effective to some extent is to attract these companies to the Philippines. A more effective approach is to develop pack assemblers in the Philippines. In the Philippines, there are already EMS companies that manufacture HDD, FDD, CD-ROM, and DVD-ROM on an OEM basis. Integrated Micro-Electronics (IMI) is a good example of such companies. These companies have enough technical ability to enter the pack assembly business. They will play a key role in leading the electronics industry in the Philippines in the future.

Some incentives are needed to encourage these companies to enter the pack assembly business. The pack assembly business has to rely on the import of the majority of parts such as LIB cells and protection circuit ICs and will export almost all of the completed battery packs. It is recommended to consider providing the same incentives as those for companies certified by the BOI or PEZA for this kind of business even though it is not direct investment from overseas. If enough incentives, such as corporate tax reduction or credit, exemption from customs, and simplified customs clearance, are provided, they could be sufficiently competitive against the Taiwanese and Chinese pack assemblers. (The latter are domestic companies and do not receive any support from governments). This kind of preparation (= domestic demand) will encourage the LIB manufacturers to set up operations in the Philippines.

In addition, consideration should also be given to attracting the assembly industry of secondary batteries that are one generation or more older, such as NiCd and NiMH batteries, or Pb batteries, instead of the most advanced LIB batteries. These previous generation secondary batteries may not have great potential like the LIB batteries. However, they have already captured a certain market size. If these can be attracted to the Philippines, they will have a considerable impact on the Philippines. Even though NiCd, NiMH, and Pb are previous generation secondary batteries in terms of technology, they still offer cost competitiveness against the LIB battery in some application areas. In particular, Pb secondary batteries have higher cost competitiveness than LIB batteries in some cases for the purpose of storing energy generated by solar panels, if space and weight do not matter. Sometimes it is more effective to attract and develop previous generation technologies and industries that are still highly effective than to attract the most advanced technologies and industries. The previous generation secondary batteries are already at the final stage of the technology development race and at the life cycle stage at which cost competitiveness matters. It seems that there is considerable possibility of attracting costly processes such as one hundred percent inspection by workers and the manual coil winding process of negative electrode material to the Philippines.

6.3.4.2 Embedded Software

In modern society, various products are computerized, and electronics has become indispensable to our daily lives. Furthermore, embedded software is essential for using such electronics products. With an increase in the use of electronics, the number of man-hours to develop embedded software increases. Some simple software can be developed without sophisticated technology because special development tools are available. However, demand for the development of complex software is growing.

Promotion of the skills to develop such embedded software and, in particular, promotion of the development of human resources increases the interest in the Philippines and the chance of attracting investment from overseas.

- Positioning of Embedded Software

The software industry is a field in which excellent Filipino engineers are employed. However, the mainstream of software development in the Philippines has been business software, and the development of software embedded in machinery and equipment has not been the mainstream.

With respect to embedded software, the skills required from the industry are constantly changing. Therefore, it is necessary to incorporate the requirements from the industry and develop human resources that have the skills most required from the industry. The development of human resources with skills in the right fields increases the chance of attracting investment from countries such as Japan and Korea that are good at manufacturing.

- Implementing Body

To attract companies to the Philippines, it is necessary to further promote the development of human resources in the Philippines and create a high-quality workforce. A system engineering development course at the University of the Philippines, which is sponsored by the Japan International Cooperation Agency (JICA), is highly regarded by the industry. Therefore, it is desirable for human resource development institutions at college level get involved in the project.

- Proposed Schedule

Q4 2010	The BOI and the Department of Trade and Industry (DTI) take the initiative and study the needs of the industry in cooperation with the Philippine Software Industry Association (PSIA), etc., and develop an embedded software promotion policy.
Q1 2011	Work together with the Commission on Higher Education (CHED) and consider setting up an embedded software engineer development course.
Q2 2011 and after	Take advantage of the overseas missions of the government and PSIA to present the situation of human resource development, in particular, in countries such as Japan and Korea in which demand for embedded software is strong.

- Items to be Implemented

Embedded software is a field in which it is possible to utilize the advantages of the Philippines, which has excellent engineers who speak English fluently, and feasibility is high because a huge amount of investment is not required. However, it takes time to develop human resources, so it is important to work together with education institutions such as universities. Therefore, it is necessary to develop a program as soon as possible and make sure it is implemented.

First, a detailed study should be carried out in cooperation with the industry to find out what skills are required of human resources. Based on the results, human resource development courses should be designed in cooperation with the CHED and university institutions.

When human resource development courses are set up and the implementing bodies are determined, presentations on the activities for embedded software human resource development should be made on the occasion of the missions to Japan and Korea.

6.3.4.3 R&D&D

To strengthen the competitiveness of the electronics industry in the Philippines, it is desirable not only to attract simple assembly work but also to accumulate more sophisticated technologies and use them to develop the next-generation industries. This has also been pointed out by the business community such as the Semiconductor and Electronics Industries in the Philippines (SEIPI).

However, it is not necessarily effective to pour a lot of money into basic research and development. The manufacturing industry consists mainly of the assemblies at the moment, so we think that there are not a lot of chances to use the developed technology in the Philippines.

It is more realistic to first strengthen the areas close to the current industrial activities, such as design and testing/inspection, and then strengthen the upstream of the research and development in the long run. The steering committee of this project has the same opinion.

- Positioning of R&D&D

Research and development and design (R&D&D) are strengthened gradually in order to advance the electronics industry in the Philippines. The first step is to strengthen functions such as testing/inspection that are close to the current industrial activities.

- Implementing Body

With respect to research and development, the Department of Science and Technology (DOST) is involved in various activities, so it is desirable to work together with the DOST and its affiliated institutions to conduct the activities.

- Proposed Schedule

Q4 2010	Determine the focus areas of testing/inspection required by the business community, and consider the specific facilities, equipment, and machinery to be introduced and the effects of the introduction.
Q1 2011 and after	Set up a research center that leads the testing/inspection activities in the Philippines, and conduct public relations activities in order to attract companies in the long run.

- Items to be Implemented

The steering committee of this project has the opinion that the facilities and equipment required should be capable of conducting testing/inspection and certification in order to make sure the standards in major markets, such as Europe, the United States, and Japan, are met.

First of all, adequate consideration should be given to the feasibility and effects of such a research center. Based on the results, necessary facilities and equipment are to be installed and the activities to be strengthened in order to stimulate the research and development activities of companies that already have operations in the Philippines, and promote the attraction of new companies to the Philippines.