PRELIMINARY DRAFT

INDUSTRIAL COMPETITIVENESS IN EAST ASIA:
A Case Study of the Electronic Components Industry in Japan[1]

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1. INTRODUCTION

The basic question driving this report is "Can Japan Compete?" (Kurihara and Tachiki 200?). In answering this question, we focus on one industrial sub-sector—electronic component makers—and trace in depth the strategies companies in this sub-sector use to compete in the global economy. Table 1 suggests our narrow focus yields broader lessons, however. In value-added terms for FY2000, the electronics components sub-sector contributed 11.4 per cent to the Japanese economy. Underscoring the role of this sub-sector in the domestic economy, we note that just the semiconductor segment contributed 5.4%, almost equal to that of the passenger cars industry (5.6%), another major driving force behind the Japanese economy (METI 2003). Beyond its sheer size, the electronics components sub-sector provides many of the key components required in other industries, magnifying its impact on the domestic economy.

Table 1: Snapshot of Japan's Electronic Component Industry

	1995	1998	2000	2001	2002
PRODUCTION (Mfg)[1]	306,029.6	305,840.0	300.477.6	286,667.4	n.a.
Electronic Component[2]	17,394.5	18,314.3	21,210.2	17,326.4	n.a.
Electronic Component[3]	9,564.8	9,459.8	11,714.9	8,846.4	8,749.7
Subsector %	5.7	6.0	7.1	6.4	n.a.
NUMBER OF ESTABLISHMENTS	171,201	159,346	154,723	155,182	n.a.
Electronic Component (%)	4.8	5.0	4.9	4.2	n.a.
EMPLOYMENT[4]	10,320.6	9,837.46	9,183.83	8,866.22	n.a.
Electronic Component (%)	5.9	6.2	6.4	6.0	n.a.
EXPORTS[1]	42,069	49,494	52,045	48,595	52,733
Electronic Component (%)	17.4	16.5	18.3	16.1	15.3
IMPORTS[1]	32,953	35,394	42,449	41,509	43,055
Electronic Components (%)	6.7	8.8	10.0	9.5	9.1

Notes: [1] units = millions of yen; [2] METI data; [3] JEITA data; [4] units = thousand persons
Sources: METI 1996 - 2003; JEITA 2003

In addition, Table 1 shows that the electronic components makers constitute around 4% of the establishments in the manufacturing sector, with one-third of them either large or medium-sized companies (more than 30 employees) and the rest small companies. The percentages across establishment size categories (data not shown) is higher than the manufacturing norm, suggesting many of them have been able to grow their businesses from humble beginnings over time (METI 2003). Altogether, these

establishments employee around 6% of the total labor force, a figure making it one of the top employers in the Japanese economy. These workers cut across the occupational categories from managers/administrators, technicians, clerical, to semi-skilled workers (citation). Electronic component exports clearly outweigh imports by a fact of 6:4. This export-import imbalance suggest Japanese electronic components makers is consist with the post-war corporate export-oriented strategies—that is, import raw materials and intermediary component, and then export value-added products. Consequently, the global market is also an important competitive arena for Japanese electronic component makers.

In the global economy, a Reed Electronics Research (2003) study estimates the value of the electronic components market at US$342 billion in 2002. Table 2 shows Japan has the largest market share at 25.3%, followed by the United States at 21.4%.

Table 2: Global Electronic Components Production

Rank	Country	Market Share (%)
1	Japan	25.3
2	United States	21.4
3	South Korea	10.4
4	China	6.4
5	Singapore	4.8
6	Taiwan	4.6
7	Malaysia	3.7
8	Germany	3.2
9	United Kingdom	2.6
10	France	2.0
11	Philippines	1.7

Source: Reed Electronic Research 2003

The globalization of the world economy has led to “mega-competition” in the electronics component industry. Just within East Asia, electronic component companies from South Korea and Greater China (China, Hong Kong, Taiwan) have increased their competitive strengths. Table 2 shows South Korea has risen to the third position over the past decade to account for 10.4% of the electronics components market and Greater China 11%. Singapore (4.8%), Malaysia (3.7%) and the Philippines (1.7%) round out the list of East Asian countries that play a significant role in this increasingly

competitive regional arena. Mega-competition in turn has led to price-cutting, squeezing the profitability of Japanese companies. For example, the commoditization of components such as the DRAM has forced some Japanese electronic component makers to relocate a larger portion of their low value-added production facilities overseas (METI citation). In some cases, they have actually conceded production to South Korean and Taiwanese electronic component makers.

The aggregate domestic and global data suggests Japanese electronic components sub-sector has established dominant market positions, however, it does not reveal how individual companies seemingly remain successful in the face of the growing mega-competition and price wars. To examine this company level side of the story we must look at the component product segments in this sub-sector. Electronic components cover a wide variety of products. In its narrowest sense, it consists of

1. Miscellaneous Products, including TV antennas, TV tuners, optical disks and so forth.
2. Passive Components, including condensers, coils and transformers, resistors, and crystal units,
3. Connecting Components, including connectors, switches, and relays
4. Transducers, including magnetic heads, audio-related components, and micro motors

And in its broadest sense, we would add:

5. Electronic Devices, such as electronic tubes, discrete semiconductors, integrated circuits (ICs), and liquid crystal devices and
6. Displays, such as liquid crystal displays (LCD), plasma display panels (PDP), light-emitting diode (LED) displays, electronic paper, and so forth.

Based on a narrow product definition of the sub-sector, 12 trillion yen is in electronic components. Across these four product segments, printed circuit board (4.1 trillion yen), connectors (3 trillion yen), condensers (1.7 trillion yen), micro-motors (1.3 trillion yen), resistors (600 billion yen), coils (580 billion yen), and transformers (510 billion yen) are the most common components (citation). The industrial dominance of Japanese electronic component companies is clearest when it comes to the narrow

definition of the sub-sector, where they accounts for two thirds of global production, half of which is located in Japan and the other half overseas[2].

Table 3: Major Products of Japan's Electronic Components

	Production	Exports	Imports
Electronic Components & Devices	8,749.74	8,089.10	3,898.56
(1) Passive Components	876.34	531.86	137.26
Resistors	133.33	56.68	23.30
Capacitors	491.75	383.82	47.09
Coils & Transformers	126.17	59.91	66.87
(2) Connecting Components	837.12	441.29	76.66
Connectors	465.63	153.86	16.45
Switches	222.04	124.82	43.74
Relays	149.46	63.63	16.45
(3) Transducers	155.63	63.20	116.41
(4) Other Components	398.95	331.30	87.02
(5) Electronic Devices	5,692.34	3,292.81	1,842.77
Electronic Tubes	310.35	127.95	18.97
Discrete Semiconductors	900.76	621.41	151.47
Integrated Semiconductors (ICs)	3,211.89	2,543.46	1,672.33
(6) Electronic Boards	788.86	253.75	81.89

Notes: units = billions of yen for the FY2002

Sources: JEITA (Website)

In contrast, the market for electronic devices and displays, included under the broader product definition, is 21 trillion yen, out of which the semiconductor markets is 16 trillion yen and the display market is five trillion yen (citation). When we consider that the rank order of product categories from miscellaneous components (1) to displays (6) approximates the technological ladder from low-medium sophisticated components to high sophisticated components (Lall citation), an empirical challenge in this paper is to account for the shifting strength of Japanese companies in each of the component segments over time and to what extent Japanese electronic components companies leverage these strategies and practices to establish competitive niches in the electronic devices and displays market segments.

In addressing this empirical challenge, we begin out discussion by presenting the major players in the electronics components sub-sector, and then examine where in the value chain do Japanese companies have a competitive advantage and where they are losing their competitive advantages. In order to understand how this shift occurs over time, we discuss which internal (strategy and practices) and external (business

[2] Interview survey results.

environment) factors explain the industrial competitiveness of Japanese electronic component makers in East Asia. Finally we broaden the analysis to discuss what lessons we can learn from how Japanese electronic components makers have responded to mega-competition in both a fast and slow growth economy, for large and small- and medium-sized enterprises (SME), with skilled and unskilled workers, to produce goods for export as well as to import goods. These aspects of the Japanese electronic component sub-sector experiences speak to the many of the issues confronting other East Asian countries as they attempt to upgrade their industries.

I. Japanese Electronic Component Makers

One of the key factors leading to the success of a Japanese company is whether it is a member of a *keiretsu* (corporate grouping).

A. *Keiretsu* Players

In Japan, whether a company is inside or outside a *keiretsu* largely determines access to factor inputs—labor, capital, and land (Gerlach 1992). A horizontal *keiretsu*, such as Mitsui, Sumitomo and Mitsubishi, is an *inter*-industry/inter-firm grouping that consists of a main bank and large, leading companies. In contrast, a vertical *keiretsu* is an *intra*-industry/inter-firm grouping organized around a major lead company, such as Toyota Motor, and three or more distinct layers of SME suppliers. Although *keiretsu* ties seem to be weakening in recent years, these major corporations and their subsidiaries and affiliates still dominate the industrial landscape of Japan.

The major electronic vertical *keiretsu* are well represented in Table 3. Particularly prominent are Matsushita Electronic Company and Kagoshima Matsushita Electronic for the Matsushita Electric Industrial *keiretsu*, Kansai NEC for the NEC *keiretsu* (Sumitomo Group), and Hitachi Hokkai Semiconductor for the Hitachi *keiretsu*. Toshiba (Mitsui Group) and Fujitsu *keiretsu* companies also appear in Table 3, rounding out the list of the major lead electric and electronics assemblers.

Table 4: Major *Keiretsu* Electronic Components Companies

	Major Business Segments	Sales	Profit
Matsushita Electronic Comp.	Fine Ceramics 24%; Electronic Devices 23%	368	77
Kansai NEC	Semiconductor 95%	99	-
Hitachi Hokkai Semiconductor	Semiconductor 100%	73	-4
Nippon Morex	Electronic Components 100%	70	5
Nippon Mectron	Electronic Components 100%	69	2
Toshiba Components	Electronic Components and Devices 100%	33	0
Kagoshima Matsushita Electronic	Diode 57%; IC 43%	29	-2
NTT Electronics	Electronic Dev. 47%; Photonic Devices 32%	29	-6
Yamagata Fujitsu	Magnetic Disc 65%	17	-6
Matsushita Applied Electronics	Semiconductor 65%	15	-4

Source: Individual companies' annual report, etc.

Table 4 shows the main business segments are concentrated in the more sophisticated components in the electronic devices and displays component segments, especially in the semiconductor. This suggests the major electronic assemblers, the lead company in the vertical keiretsu, tend to keep their core technology suppliers within their business orbit, but they are more catholic in procuring other electronic components. Although many of these companies consolidate their financial statements with their parent company, the relatively low sales (another proxy figure for production volume) and low profit margins in combination indicate these electronic component makers play an important in the early development of new products.

B. Independent Players

A second group consists of smaller and relatively independent companies. Many of the companies in the table supply components to the major electronic assembly companies, but they do not necessarily belong to any particular vertical *keiretsu*. In Table 5, Kyocera dominates this category followed by TDK and Alps. Indeed, unlike the keiretsu related electronic component makers, many of the independent makers are well known even to a causal business observer.

The independent companies have staked out niches in the traditional electronics component segments, but with innovative products. Kyocera, originally a ceramics maker in the Kyoto area of Japan, has applied its ceramic materials know-how to coat and insulate electronic components. Mabuchi Motor is particularly adept at developing

micro-motors. Each of these independent companies have managed to capture overwhelming market shares in their respective product niches (citation).

Table 5: Major Independent Electronic Components Companies

	Major Business Segments	Sales	Profit
Kyocera	Fine Ceramics 24%; Electronic Devices 23%	1060	77
TDK	Electronic Components 75%; Storage Devices 36%	608	18
Alps	Electronic Components 59%; Audio Equipment 36%	590	32
Murata Mfg. Co., Ltd.	Condenser 41%; Pizoelectronic Components 19%	393	57
Rohm	IC 45%; Semiconductor Device 38%	350	97
Nippon Densan	Micro Motor 55%; Semi-micro Motor 13%	315	18
Mitsumi	Communications Equip. 36%; Electronic Dev. 11%	244	4
Hoshiden	Electronic Components 67%; Audio Equipment 19%	227	8
Ibiden	Electronic Components 53%; Ceramic Parts 9%	203	8
Kyoden	Print Board 26%; EMS 16%	190	1
Taiyo Yuden, Co., Ltd.	Condenser 51%	154	7
Senken Electronic	Semiconductor 70%; Electronic Components 16%	146	7
Shiko Electronic	IC Lead Frame 32%; IC Package 57%	117	6
Mabuchi Motor	Micro Motor 100%	117	29
Nippon CMK	Print Board 62%	113	1
NEC Tokin	Electronic Comp. 44%; Electromagnetic Prod. 15%	110	-3
Nichikon	Condenser 100%	107	7
Nippon Aero Electronic	Connector 67%	105	5
Nippon Chemi-Con	Condenser 76%	97	2
FDK	Electronic Components 75%; Battery 25%	95	-3
Futaba Electronic	Electronic Components 69%	92	8
Shin Dengen	Electronic Devices 43%	89	-2
Tamura	Electronic Components 61%; Chem. Products 30%	72	1
Hamamatsu	Photonic Devices 80%	68	7
Hirose	Connector 96%	66	18
SMK	Video Equipment 26%; Communication Product 28%	61	2
KOA	Condenser 55; IC 12%	58	3
Forster	Electronic Equip. 52%; Electronic Components 45%	56	2
Shin Nihon Musen	Semiconductor 84%	55	3
Toko	Coils 62%; Semiconductor 24%	55	1

Sources: Individual companies' annual report, etc.

Table 5 shows that compared with the keiretsu affiliated companies in Table 4, the independent companies have much higher sales volumes and profit margins. Along with their larger business partner, the electronic assembly makers, the independent electronics component makers epitomize Japan's industrial might over the past two decades. Especially, globally competitive components makers, including Kyocera,

TDK, and Alps, have attracted the attention of market analysts as well as scholars of industrial economics and managerial sciences. TDK, for example, caught the attention of many people for its focus on new technologies based closely to its core competence. TDK's enviably high operating margin compared to Sony and Matsushita, for example, led an industry analyst at Morgan Stanley in Tokyo to say in 1996 that "the money in electronics is no longer in end products but in components."[3]

C. Variations in Competitive Advantages

II. Competitive Advantage

What accounts for the competitive strengths of Japanese electronic component makers? In this section, we examine the interplay between internal (competitive advantages) and external factors (business environments) in determining the competitive strengths of Japanese electronic component companies leading to the industrial competitiveness of this sub-sector.

A. CONFIGURING THE VALUE CHAIN

The starting point for understanding the competitive advantages of Japanese companies is the "customer" (Tachiki 1990). Kodama (19??) gives us the notion of "demand articulation," an awkward term that essentially argues that Japanese companies often take customer demand and articulate (translate) it into product specifications and design parameters. In this section, then, we trace how the "voice of the customer" reverberates back into the value chain, from the customer-supplier relationship to the sales and marketing, next manufacturing, then design and engineering, and finally research and development.

1. Customer-Supplier Relationship

Electronic components are basically intermediate goods for production of electronic products. Consequently, the industry dynamics is closely related to the customer-supplier relationship of end products. Therefore, the destiny of customers has a strong impact upon the fate of electronic components firms.

[3] *Forbes*, "TDK Inside," December 30, 1996, pp. 112-113.

Innovative End Product

Japanese assembly makers still enjoy their predominant market shares on the global marketplace and promote product sophistication and development of new products—Electronic components makers will keep their Japanese traditional customers inside Japan.

Currently, digital cameras and car navigation equipment are among the most competitive products Japanese assembly makers ever produced. In 2002, Japanese assembly makers keep 84.3 per cent of the global market share of digital camera, while 65.8 per cent for car navigation equipment. In addition, as ICT advances, the specification of these products is in the middle of endless sophistication. Digital cameras have experienced product specification toward lighter, thinner with higher-and-full-color resolution. And Japanese assembly makers have already abandoned lower value-added product segments to their foreign competitors after deciding not to go to profit-depleting price warfare.

Table 6: Innovative Products

	Digital Camera			Car Navigation Equip.		
	2001	2002	2003	2001	2002	2002
Japanese Electronic Assembly Makers						
Market shares (%)	86.3	84.3	83.7	67.6	65.8	62.8
Production: Regional Distribution (%)						
Japan	68.1	61.9	55.6	67.6	65.8	62.8
China	12.9	17.2	23.5	0.0	0.0	0.0
Other Asia	19.0	20.9	20.9	0.0	0.0	0.0
North America	0.0	0.0	0.0	5.8	6.0	6.1
Europe	0.0	0.0	0.0	26.6	28.2	31.1
South America	0.0	0.0	0.0	0.0	0.0	0.0
Japanese Electronic Assembly Makers: Regional Distribution (%)						
Japan	78.9	73.4	66.5	100.0	100.0	100.0
China	7.0	9.5	16.1	0.0	0.0	0.0
Other Asia	14.2	17.1	17.4	0.0	0.0	0.0
North America	-	-	-	0.0	0.0	0.0
Europe	-	-	-	0.0	0.0	0.0
Japanese Electronic Assembly Makers: Presence in Each Region (%)						
Japan	100.0	100.0	100.0	100.0	100.0	100.0
China	46.8	46.8	57.4	-	-	-
Other Asia	64.2	68.8	69.8	-	-	-
North America	-	-	-	-	-	-
Europe	-	-	-	-	-	-

Source: JEITA 2003

At the same time, as for the production of lower value-added but still profit-making products, Japanese assembly makers have already shifted their production onto the soil of China or other Asian countries. Accordingly, in 2002, Japanese assembly makers still keep 61.9 per cent of their total production of digital cameras within Japan. As for car navigation equipment, the figure for domestic production is 65.8 in 2002. In response to the efforts demonstrated by Japanese assembly makers, Japanese electronic components makers are solely concerned with the relationships with their traditional buyers in Japan.

Niche End Product

Japanese assembly makers focus their target on Japanese market in the middle of cut-throat competition with their foreign competitors on the global marketplace. They promote product sophistication and development of new products for Japanese customers—Electronic components makers will keep their Japanese traditional customers inside Japan while expanding ties with foreign assembly makers.

The niche type product requires a cosmopolitan approach for electronic components makers. In Japan, they enjoy their decades-long ties with Japanese assembly makes, however, irrespective of production sites, those Japanese assembly makers focus on Japanese marketplace. Outside Japan, Japanese assembly makers are not necessarily key players. For example, cell phone's dominant players are undeniably Nokia, Motorola, and Samsung, while laptop PC, Dell, HP. Accordingly, Japanese electronic components makers are developing their customer relationships with both Japanese and foreign makers. Thus, they would try to develop their indigenous capability to meet swiftly any need from customers—technological development.

Table 7: Niche Products

	Cell Phone			Laptop PC		
	2001	2002	2003	2001	2002	2002
Japanese Electronic Assembly Makers						
Market shares (%)	18.2	16.5	16.4	26.8	24.5	22.4
Production: Regional Distribution (%)						
Japan	12.7	11.5	10.9	18.9	16.6	13.6
China	21.9	26.9	30.1	5.2	20.1	35.2
Other Asia	23.5	26.1	26.7	65.8	57.4	46.7
North America	8.5	7.1	5.8	5.1	1.7	1.2
Europe	29.7	24.9	22.9	3.9	3.1	2.5
South America	3.6	3.5	3.6	1.0	1.0	0.8
Japanese Electronic Assembly Makers: Regional Distribution (%)						
Japan	69.5	69.6	66.3	70.7	67.8	60.5
China	6.7	9.6	12.5	0.7	1.5	10.6
Other Asia	4.2	6.5	8.4	15.0	24.3	25.1
North America	11.3	11.3	10.7	7.1	2.1	1.0
Europe	8.3	3.0	2.1	6.5	4.4	2.8
Japanese Electronic Assembly Makers: Presence in Each Region (%)						
Japan	100.0	100.0	100.0	100.0	100.0	100.0
China	5.6	5.9	6.8	3.5	1.8	6.7
Other Asia	3.3	4.1	5.1	6.1	10.3	12.1
North America	24.1	26.3	29.9	37.5	30.4	18.8
Europe	5.1	2.0	1.5	44.6	34.3	25.4

Source: JEITA 2003

Commodity Products

In commodity end products, Japanese assembly makers are faced with competitive challenges from foreign competitors while moving to overseas production—Electronic components makers will keep their Japanese traditional customers outside Japan while establishing new ties with foreign assembly makers.

First, Japanese assembly makers still produce end-products, but with the form of overseas production. In this category, the representative products are color television sets, VTRs, and DVDs. In each product market, emerging competitors for Japanese assembly makers are gaining their strengths and market shares. For example, the global market share of Japanese assembly makers in 2002 was 45.9 per cent. It was still high figure, but no one denies the rise of South Korean and Chinese assembly makers (citation). In contrast, the production of color television in Japan accounts only for 1.9 per cent in 2002. Japanese assembly makers have already shifted their production onto Chinese, South East Asian, and North America. When we look at the regional distribution of Japan's color TV sets makers, the Asia region (mainly in Malaysia,

Thailand and Indonesia) accounted for 48.2 per cent while China accounted for 7.9 per cent, and North America, 26.1 per cent. Their domestic production (Japan) was meager 4.1%. In China, Japanese companies' TV sets production accounted for only 14.8 per cent. The Chinese makers, including Changhong, TCL, Skyworth, Konka, HiSense, Xoceco, Panda, and Haier, constitute a huge share of TV sets production (citation). Accordingly, Japanese electronic components makers maintain their close relationships with Japanese assembly makers by supplying them in the Asia and North America regions, while supplying Chinese TV sets makers in mainland China. Similarly, in the fields of VTR and DVD, Japan's electronic makers keep their substantial market share, while their production facilities are located in either in China or in South East Asia (citation).

INSERT
Table 8: Commodity Product
ABOUT HERE

The second feature of electronic components is multiplicity of product specification, allowing electronic components maker with room for monopolistic rent-seeking. Accordingly, the electronic components industry exhibits a wide variety of monopolistically specializing companies. However, staggeringly rapid advancement of ICT and proliferation of new products and services do not necessarily provide electronic components makers with such rent-seeking luxury forever. In other words, a Neo-Schumpeterian competitive situation forces each maker to seek incremental sophistication of product specification. Monopolistic makers can keep their position only if they continue to enhance their product specification.

2. Marketing and Sales

Unlike American and European companies that keep the marketing and sales functions separate, Japanese companies often link the business activities of both functional areas. Once a market is identified, through sales and, more importantly, after sales service, Japanese companies try to deepen its relationship with "good" customers. Take the case of Toshiba. It has refocused its chip manufacturing on flash

ICs and cards and plans to use high-density NAND devices at Toshiba America Electronic Components Inc. (TAEC)[4].

As one of recognized worldwide leaders, Toshiba and its U.S. affiliate, Toshiba America Electronic Components, Inc. (TAEC), regard themselves as the leader in the fields of discrete semiconductor, opto-electronic, microwave and high-power solutions (See Table ??). Since 1986, Toshiba has ranked as the top discrete supplier on a worldwide basis. Accordingly, TEAC adopts its market-centric strategies based upon its long experience and rich technological resources in related areas. In this connection, Table 9 shows Toshiba's electronic components division is focusing its attention to the U.S. market being regarded as the largest "launch" market. In the "launch" market, attentive suppliers can detect any subtle change in market structure or see opportunities for new market. The strategic rationale here is that if the marketing of a product can be successful in this launch market, it can be adapted to the other major markets in Europe and East Asia.

TABLE 9: TOSHIBA'S DISCRETE MARKET SHARE RANKING (2001)

Products	Market Shares (%)	Ranking
Discrete Semiconductor (Total)	8	1
Power Transistors	9	1
LMOS Logic	80	1
CMOS Logic	15	1
Visible Laser Diodes	20	1
Photocouplers	24	1
Optoelectronic	7	3
IGBT	23	3
MOSFET	10	3

Source: Toshiba America Electronic Components, Inc. (TAEC), May 2002.

In order to enhance its presence in North America, TEAC links its marketing strategy with its (after) sales strategy. It has established a dedicated team named the "Discrete Business Unit." The Discrete Business Unit has four groups—(1) strategic management, (2) marketing technical support, (3) promotional product team, and (4) operations. This attention to good customers pays off in repeat orders and a steady after

[4] Interview survey results; See also *BEN*, "Toshiba Pegs 1Gbit NAND at Wireless Applications," September 9, 2002.

service revenue stream. In principle, most of the Japanese electronic components makers adopt the similar strategies—based upon its core technological competence in the past, they are adopting market-centric approaches.

Table 10 shows the market leaders of selected electronic components, with Japanese companies expressed in *italic*. Due to the statistical constraints, we are forced to abandon to carry the names of Japan's most competitive products. Table 10 shows, however, which products are highly regarded by Japanese electronic components makers. In some markets, only one Japanese maker is ranked among the top four companies. In this case, Japanese companies regard foreign makers as their competitors.

TABLE 10: INDUSTRIAL LEADERS IN SELECTED ELECTRONIC COMPONENTS

Products	Evalu-ation	Market Leader	Second	Third	Fourth
Standard Logic**	Val	TI	*Toshiba*	Fairchild	Philips
Flash Memory**	Val	Intel	AMD/*Fujitsu*	Samsung	*Sharp*
SRAM**	Val	Samsung	*Hitachi*	Cypress	IBM
Microcontroller**	Val	Motorola	Intel	*NEC*	*Hitachi*
LCD	Val	Sharp (14.0)	Samsung (13.0)	LG/Philips (10.0)	Seiko-Epson (9.0)
a-Si TFT-LCD	Val	Samsung (18.3)	LG/Philips (16.3)	*Sharp* (13.4)	Optronix (8.0)
CRT**	Vol	Philips/LG (25.0)	Samsung (15.0)	*Mat/Toshiba* (14.0)	Thomson (10.0)
Optical fiber**	Vol	Corning (28.3)	*Furukawa* (26.0)	Alcatel (15.8)	*Sumitomo* (7.3)
Cellular front end comp**	Vol	*Murata* (50.0)	-	-	-
VCO**	Vol	*Matsushita* (21.0)	*FDK* (15.0)	*Murata* (14.0)	*Alps* (13.0)
Mobile-use SAW filter**	Vol	EPCOS (38.0)	*Murata* (20.0)	*Fujitsu* (25.0)	-
TCXO*	Vol	*Kyocera* (40.0)	*NDK* (30.0)	*Toyocom* (20.0)	*TEW* (5.0)
DC power motor*	Vol	*Mabuchi* (58.0)			
AC servo motor**	Vol	*Yasukawa* (22.0)	*Fanuc* (20.0)	*Sanyo Denki* (9.0)	*Matsushita* (7.0)
Brushless DC motor**	Vol	*Nidec* (24.0)	*Sankyo* (13.0)	*Matsushita* (11.0)	*Minebea* (10.0)
Ironless rotor DC mot**	Vol	*Matsushita* (28.0)	*Namiki* (21.0)	*Shicoh* (10.0)	*CI Kasei* (9.0)
Cell phone vib. Motor**	Vol	*Matsushita* (26.0)	*Nidec Copal* (17.0)	*Namiki* (19.0)	*Sanyo* (12.0)
Digital tuner*	Vol	Microtune (40.0)	*Sharp* (20.0)	Samsung (20.0)	*Alps* (10.)
Ink jet head	Vol	HP (52.9)	Lexmark (24.3)	*Seiko-Epson* (8.8)	*Canon* (7.2)
LED print head	Vol	*Oki* (73.6)	Kycera (12.0)	Sanyo (9.6)	-
Magnetic head f. HDD**	Vol	Seagate (30.2)	*TDK* (29.5)	IBM (15.8)	*Alps* (12.5)
Nikkel hydride battery	Vol	*Sanyo* (55.0)	*Matsushita* (30.0)	-	-

Lithium ion battery	Vol	*Sanyo* (24.8)	*Sony* (16.7)	*Matsushita* (15.9)	GS-Melcotec (12.1)
Solar cell	MW	*Sharp* (19.0)	BP Solarex (14.7)	*Kyocera* (13.7)	Siemens* (9.9)

Notes: Val = value; Vol = volume; MW = mega watt; * Division was sold out; ** means 2002, otherwise figures based on 2001.

Source: Complied by authors from various sources.

In the opposite case where all of the top four companies are Japanese, competition is engaged globally but conducted as if domestically. For example, in the cases of TCXO (Temperature Compensated Crystal Oscillator, which is mainly used for cell phone) and Ironless rotor DC motor, competition was engaged mostly among Japanese makers. In the case of TCXO, the combined market share of the top four leaders accounts for 95 percent with leading Kyocera's share of 40 percent. And on the competitive battlefield of the remaining 5 percent, many firms—mostly Japanese—Daishiku (KDS), River Eletec, JVC[5], Seiko-Epson, Murata, Citizen, and British C-MAC—are competing.

In short, Japanese companies adjust their marketing and sales strategies, then, based on its market share and whether the market for a product is growing or declining. Among the possible strategies to increase sales figures—(1) develop new products, (2) expand current markets with existing products, (3) enter new markets with existing products, (4) enter new geographical markets (with existing products), and (5) better penetrate into existing customers, Japanese top executives regard the new product development strategy as the top priority.

3. Manufacturing (to be elaborated on latter)

The closeness of Japanese electronic component makers to their customers through their marketing and sales strategies feeds back into incremental changes in the manufacture of products and production locations. One trend is towards the modularization or packaging of various types of electronic components. A typical product is ceramic capacitors. Japanese makers have long enjoyed unrivaled dominance in the global market with a 90% market share worth US$6 billion (citation). Following the trend toward integration of electronic components, Murata is taking full advantage of its ability to procure almost all its component materials, including raw materials, in-

house. In addition, its proprietary expertise in processing is leading the industry in standardizing leadless ultra-compact chips and other surface-mounted devices (SMDs). Murata has also been an industry pioneer in developing chip ceramic filters and ceramic resonators, components that are traditionally difficult to integrate. It has commercialized a wide range of SMDs, and is recognized as an important innovator in surface mounting technology. The smaller an electronic equipment becomes, and the more complex its functions, the more extensive the integration of circuits. It is the ever evolving integration of capacitors and other components into chips, along with advances in mounting technology, and that stimulates and supports progress in the miniaturization of equipment.

TABLE 11: MARKET SHARE OF JAPANESE PRODUCERS OF CERAMIC CAPACITOR

Makers	Market Share (%)
Murata Manufacturing Co., Ltd.	47
TDK	21
Kyocera	14
Taiyo Yuden Co., Ltd.	11
Matsushita Electronic Components Co. Ltd.	6
Other Japanese makers	1

Source: Sangyo-Joho Ltd. 2003

Despite its lead in niche electronic components, companies such as Murata Manufacturing, TDK, Kyocera, and Taiyo Yuden Co. Ltd., are also segmenting their production processes and locating them in the most efficient domestic and overseas production bases. The top producer, Murata, for example, opened a new facility in Okayama Prefecture in July 2000, and the following year saw expansion of its domestic production capacities in Fukui Prefecture (a 25% increase in production capability in March) and in Shimane Prefecture (a 40% increase in March) as well as a new facility in Singapore. Taiyo Yuden Co., Ltd. also expanded its domestic production for sophisticated components in Iwate Prefecture and in 2000 established new factories in China, Korea, and Malaysia to address price pressures from emerging competitors. Kyocera also established a new facility in Shanghai in 2000 while expanding its domestic production facility in Oita Prefecture.

[5] The factory located in Koriyama, Japan was closed at the end of 2002.

As long as technological dominance of Japanese makers can last, this market segment will continue to be one of the most competitive products for Japanese makers. There are two things to note. First, in 2002, Taiwanese companies reached the technological level to produce these types of ceramic capacitor. Although Japanese companies do not feel competitive pressures from their Taiwanese counterparts, the leading companies including, Murata, Taiyo Yuden, and Kyocera, are now increasing their efforts to develop related miniaturization technologies.

4. Design and Engineering

As we have stated, every maker understand that market competition is cruel and their strategy for survival is technological advantage over its competitors. Most Japanese electronic components makers have their confidence in technology-dominated competition in the market. Accordingly, they are obsessed with cutting-edge technologies in their manufacturing businesses. Given the notion that innovation is the basic source of competitive advantage, many Japanese firms adopt (a) strategies for higher value-added products, (b) strategies for miniaturization technology, (c) strategies for modularization/packaging, and finally (d) strategies for new high-tech products.

Strategies for Higher Value-added Products

The first strategy adopted by Japanese electronic components makers is focusing on higher value-added products. We can easily imagine this strategy. In the electronic components field, flash memory and LED are of most importance. This strategy, however, is not necessarily viable one fending off unflinching challenges from their competitors. Quickly learning South Korean and Taiwanese competitors will soon acquire a high command of manufacture the competitive products or sometimes surpass their Japanese counterparts without difficulty in a short period.

We examine the cases of flash memory and LED.

Flash Memory
Higher Value-added, but Competition and Precipitously Declining Price Have Started

Japanese companies invented the flash card memory technology as a sort of EEPRM. Flash memory is further subdivided into several segments— (1) the largest NOR, (2) newer NAND, and so forth. Despite the pioneering role of Japanese electronic component makers, the industry's leader is America's Intel Corp. with the 2002 sales figure of US$2.01 billion, followed by Korea's Samsung Electronics Co., Ltd. (US$1.0 billion), AMD (US$0.71 billion), Sharp (US$0.67 billion), Toshiba (US$0.67), STMicroelectronics (US$0.58), Fujitsu (US$0.52), Mitsubishi (US$0.35), SanDisk (US$0.32), and Hitachi (US$0.26). The reason we pick this flash memory in our study is that among the semiconductor segments, the flash memory market has the largest number of surviving Japanese makers—five. The second largest is SRAM (four companies—Hitachi, Mitsubishi, NEC, and Toshiba) and microcontrollers (four companies—NEC, Hitachi, Toshiba, and Mitsubishi).

In this market, competition is merciless. In 2002, Intel took significant market share away from the AMD-Fujitsu alliance and held 35 percent of the total market. It, however, gave some back in the first half of 2003 when customers rejected its attempt to raise flash prices. Of note is the second market leader, South Korea's Samsung's aggressive move. Samsung and smaller Hynix Semiconductor Inc. of Korea are expecting an explosive growth in NAND flash memory demand. Hynix tries to enter this market aggressively by forging an alliance with 6th-ranked STMicroelectronics[6]. According to our interview survey, in the flash market there might be a danger of the case of DRAM market, where excessively intensified competition led to price falls and profit-erosion with Japanese chip-makers forced to retreat from the market. Such price competition has already started. Prices for NAND (Not And) electronic logic gate components--a newer type of flash memory that differs from the NOR (Not Or) electronic logic gate flash that previously dominated the market--declined in 2002 and in the first half of 2003, according to the report. The fall in price has helped push flash cards into the consumer products, with which increasing number of consumers find the benefits of the storage worth its cost.

So far, price fall and an expansion in the area of use have generated a virtuous cycle. Technological advancement in flash card performance, in conjunction with decreasing prices at the component level, has driven new flash card usage in applications including mobile phones and digital video cameras, leading to greater demand for flash cards. This virtuous cycle has stimulated growth opportunities for the flash memory industry; however, now a growing number of analysts think this trend will not last after 2005 due to profit-depleting price erosion. Accordingly, many companies including Intel and Motorola are therefore looking into new technologies to drive the industry forward.

Light-Emitting Diode (LED)
Technologically Brighter, Economically Better

[6] Interview survey results; See also *EBN*, "For Korea, Flash Is the New DRAM—Samsung, Hynix detail NAND, NOR Investment Plan," August, 18, 2003.

Light-Emitting Diode (LED) is one of the most promising segments in the semiconductor industry. Demand for LEDs has rapidly grown as they have been used widely in cell phones, automobiles, traffic signals and outdoor signs. According to an industry estimate, the high brightness LED market grew about 50 percent in 2002 to $1.8 billion. In 2003, strong demand will push the LED market to $2.5 billion and by 2007 the market will reach $4.7 billion. A growing number of cell phones equipped with color liquid crystal displays (LCD) has led to the use of LEDs to display backlighting and keypads. Now, mobile phones account for about 40 percent of the total high brightness LED market. At the same time, the use of LED has been increased since a safety improvement measure by Advanced High-mount Stop Lamp (AHSL), or emergency braking advisory system to the following vehicle's driver, has become mandatory or needed among national regulators. Consequently, LEDs have experienced impressive growth since the early 1990s with the advent of brighter LEDs and full-color LEDs. Japanese electronics component makers have initiated the development of these LEDs. Toshibas developed the high-bright LEDs and the full-color LEDs became available when Nichia Corporation commercialized super high brightness Blue LED in 1993.

Despite growing demand, like the case of flash memory, prices for LEDs are expected to decline. Although many people still think LED-related products are costly, according to industry sources, buyers can expect a 10-15 percent drop in LEDs made with aluminum indium gallium phosphide (AlInGaP) and a 15-20 percent drop in tags for LEDs that use indium gallium nitride (InGan). InGaN produces blue and green LEDs while AlInGap produces red, orange and yellow LEDs.

At the same time, fierce competition is about to begin. About ten years ago, LEDs were monopolistically produced by Japanese makers. Taiwanese companies—Liteon, UEC (Universal Electron Co.), and PoToTech, Tyntec—produce LED by importing wafer from Japan. These Taiwanese firms ship 60 per cent of its LED production to their affiliated factories located in mainland China, while distributing its 20 percent within Taiwan, and export the remaining 20 percent[7]. Although Japanese firms have technologically superior capabilities in manufacturing blue and high brightness LEDs over their Taiwanese and Korean competitors, some analysts judge that it is just a matter of time their competitors from abroad catch up with them. For example, the Korean phone makers—Samsung and LG—and Kyocera in Japan started putting blue LEDs into keypad backlights. In addition, America's Agilent Technologies and Dutch Siemens and some Chinese companies as well as Japanese firms, including Sharp, Matsushita, Stanley, and Toyoda Gosei, are expected to enter the market.

Strategies for Miniaturization Technology—Smallest, Thinnest and Lightest Products

Expanding demand for mobile phones, PDAs, laptop or handheld computers has led to miniaturization in every components and modularization of components. In other words, IT ubiquity has required the importance of miniaturization. Miniaturization has been the focal point for packaging technologies with growing demand for pagers, cell phones, PDAs, video digital cameras, and portable DVD or MP3 players for over decades. Accordingly, a wide variety of electric components have shown dramatic

[7] Chunichi-sha (2003), p. 193.

miniaturization—smaller, thinner, and lighter. For example, RF Surface Acoustic Wave (SAW) filters for cell phones have been reduced in size from 0.026cc in 1997 to 0.018cc in 2001[8]. Another type of electronic component for cell phones, temperature compensated crystal oscillator (TCXO) has shown a similarly dramatic reduction in size from 0.300cc in 1997 to 0.02cc in 2001[9]. Toshiba has also long enjoyed and maintained its leadership in circuit miniaturization and advanced packaging technology since it initially developed single gate CMOS logic in 1987. Toshiba America Electronic Components, Inc. (TAEC), Irvine, Calif., and its parent Toshiba Corporation have introduced a wide variety of LMOS (Logic-MOS) logic, including its VHS series that are the smallest and thinnest packages for single-gate CMOS logic in the world[10]. The new logic devices are designed for use in cellular phones and other miniature portable electronics including PDAs. On December 10, 2001, as a forerunner in the field of Bluetooth module development and manufacturing, Taiyo Yuden Co. Ltd announced the world's smallest RF module for the next generation of Bluetooth-based wireless communications devices, including cell phones and PDAs. The ultra-compact RF module employs a unique LTCC (Low Temperature Co-fired Ceramics) substrate that is achieved by embedding the filter, inductors and capacitor into the substrate and using flip-chip assembly techniques to mount the semiconductor[11].

American companies as well as other Asian makers also seek miniaturization strategies. In other words, miniaturization is a globally accepted strategy, which again forces Japanese electronic components makers to further their efforts to miniaturize their products. In the United States, a seasoned researcher with a decade-long experience at the Sandia National Laboratories set up a start-up company in 1990 and is now thriving with product offerings ranging from monolithic ceramic capacitors to nano-sized ceramic powders.[12] These powders, which are used in the manufacture of multilayer ceramic capacitors, represent a tremendous growth opportunity for the company.

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[8] Chunichi-sha (2001), p. 227.

[9] Chunichi-sha (2001), p. 263.

[10] Interview survey results; See also *Electro Manufacturing*, October 1, 2003.

[11] Interview survey results; See also the website of Taiyo Yuden (http://www.taiyo-yuden.com/)

[12] See *Ceramic Industry* (Susan Sutton), "The Smaller The Better," June 2003.

Result: Smallest, Thinnest, and Lightest Products Expel Larger, Thicker, and Heavier Ones. Small-sized capacitors have long been the realm of aluminum and tantalum capacitors mainly produced by U.S. and European components makers. Recently, with technological advancement in ceramic capacitors, U.S. and European sellers of tantalum capacitors face increasing competition from Asian companies making miniaturized multilayer ceramic capacitors (MLCCs) as alternatives to tantalum. Asian challengers are spearheaded by Japan's Murata Manufacturing, Taiwan's Yageo, and Korea's Samsung Electro-Mechanics. Kemet, a South Carolina's Greenville-based tantalum capacitor producing specialty producer was forced to cut its workforce more than 50 percent and is moving manufacturing offshore[13]. The company will begin production in China later in 2003[14]. European firms are now sharing their fate with their American counterparts. Germany's Epcos A.G. is also forced to cut its expenses while shifting its production to Eastern Europe and China.

Strategies for Modularization/Packaging Technologies

An attempt to make things smaller is made to implement modular electrical design of electronic products at the system design level. This approach is proposed to identify modules by analyzing the design matrix, which represents the mapping relationships between design objectives (Functional Requirements) and physical solutions (Design Parameters). In other words, Japanese electronic components makers are concerned not only with making things smaller, but also with making a group of things smaller. Accordingly, algorithms derived from similar problems in group technology and cellular manufacturing are applied to the cluster analysis of the design matrix. A real case study in power supply design is conducted to illustrate the proposed approach.

Accordingly, Japanese electronic components makers are focusing their technological efforts on complex technology to make a group of electronic components smaller and packaged into "one-chip" or a "black box." Japanese electronic components makers pursue this technological strategy has two reasons. First, they can take full advantage of miniaturization technology accumulated through the development of consumer electronics in cooperation with Japanese assembly makers. As we have

[13] See *EBN*, "Kemet Lands First Acquisition, Shifts Production Focus To China," July 7, 2003.

[14] Interview survey results; See also *EBN*, "Rising Competition, Price Erosion Continue To Roil Passives Makers," April 14, 2003.

seen before, Japanese assembly makers have been challenged by their South Korean, Taiwanese, and more recently, Chinese home appliances makers in each home electronic segment. However, Japanese makers, in every segment, monopolized the highest value-added products. Second, by making a group of electronic components modularized or put all of them into a "black box," Japanese electronic components makers can enjoy a longer period for monopolistic rent while their technologies are concealed or masked from the eyes of their foreign competitors.

Second, intermediate goods are designed to add function to any products across industries. For example, thinks to IT ubiquity, semiconductors are widely used in the manufacturing industry, raging from the automobile and airspace industries to the toy/game and communications industries. Accordingly, a product of the same category might be used by totally different industries with totally different product specification. Such multiplicity of product specification provided each electronic components maker with room for monopolistic rent-seeking. Consequently, the electronic components industry exhibits a wide variety of monopolistically specializing companies.

Through these three design and engineering strategies—higher value-added, miniaturization, and modularization—Japanese companies have been able to meet the needs of its customers and keep one step ahead of its competitors.

5. Research and Development

Strategies for new high-tech products predominate in Japanese top-executives' psyche in the electronic components industry. Generally speaking, Japanese companies are the most technology-obsessed among their counterparts in advanced countries. According to a Deloitte survey unveiled in October 2003, Japanese executives regard developing new products as the most effective strategies for revenue growth[15]. Although Deloitte's survey includes whole range of industries, including the electronic components sub-sector, the results indicate interesting national characteristic traits of Japanese industry. International comparison suggests the Japanese place this strategy most importantly compared with their counterparts in advanced countries. On the other hand, they show least interest in the strategies of entering new markets with existing

[15] See Deloitte, 2003, "Deloitte Global COO Survey and COO Confidence Index," p. 14. Press release in New York, October 20, 2003.

products. The above information serves a quick and fast understanding of strategies adopted by Japan's electronic components industry.

TABLE 12: KEY STRATEGIES FOR ENHANCING REVENUE

	Japan	US	Ger.	UK	Can.	Aus.
Develop New Products	85	63	80	74	69	62
Expand Current Markets with Existing Products	76	72	70	68	69	73
Enter New Markets with Existing Products	51	57	56	60	61	67
Enter New Geographical Markets	51	46	60	60	47	55
Better Penetrate into Existing Customers	84	77	78	82	75	80

Notes: figures are for % of respondents; US = United States; Ger. = Germany; UK = United Kingdom; Can. = Canada; Aus. = Australia

Source: Deloitte 2003:14

In the area of research and development, Japanese companies do not focus on "blue sky" projects. Instead, the fundamental approach is to stick to one's intrinsic technology. An intrinsic technology is the basic science underlying a company's product. For example, Toyobo, a textile company, does not view itself as a manufacturer of fabrics, but a manipulator or "long molecules." By understanding the material science of long molecules it has developed a wide range of products from automobile parts, intelligent materials, and so forth. In our interviews, we learned that smaller components companies also stress the importance of the introduction of new products based upon their technological competence. Murata Manufacturing Co., Ltd. has succeeded in developing a ceramic PTC thermistor ("POSISTOR") with the world's first multilayered structure. Using this technology, Murata started mass production of the small PTC thermistor with circuit protection in September 2003. Conventional ceramic PTC thermistors are designed using a monoplate structure, and have almost reached the limit in compatibility between low resistance in normal conditions and miniaturization of the components. To circumvent such a limit, Murata has struggled for technical development by adopting a monolithic structure, aiming to achieve further miniaturization and low resistance.[16]

We learned that during the R&D phase, Japanese companies are also concerned about the marketability of a product. For example, Bluetooth technology, a new technology, has been developed by a lot of Japanese firms. The burgeoning market for Bluetooth-wireless technology-enabled devices has brought with it a growing need for a

Japan-based Bluetooth wireless technology qualification organization. The new company is expected to make it much quicker and more convenient for Japan-based manufacturers to obtain qualification of Bluetooth wireless technology enabled products, and is also expected to contribute to shorter development time and lower associated costs. A locally based qualifying organization is also expected to speed the diffusion of Bluetooth wireless technology products in the domestic market.

Taiyo Yuden, Co, Ltd. is also among Japan's most innovative companies producing phalanx of new products. According to press releases of its website, it has introduced its new products for the past—It introduced in November 2001 new multilayer chip thermistors, ultra miniature multilayer chip capacitors and Bluetooth wireless technology RF modules. Two months later, in January 2002, it introduced cold-cathode fluorescent tubes (CCFT) inverters. The company does not put merely emphasis on the introduction of new products. It looks to the first market entrance for any new product markets. In June 2001, the company announced it would present a full-scale demonstration utilizing its Bluetooth wireless technology modules, the first in the industry to receive qualification as compliant with the Bluetooth wireless technology specification version 1.1. In August 2001, Taiyo Yuden U.S.A. Inc. introduced the world's first surface-mountable micro DC/DC converter, the latest addition to its popular line of ultra-compact, high-reliability power electronics modules.

The company, at the same time, looks to the quality. The above-mentioned product—micro DC/DC converter—achieves an astonishing increase in efficiency for energy conservation efficiency (up to 85%). Accordingly the product would be suitable for use in the cell phone, PDA, DSC or other portable/handheld devices. According to Taiyo Yuden, Inc., the product will make a cellular telephone—a typical application—conserve energy much enough to talk 39 percent longer. Furthermore, the company introduced in September 2001 an ultra-compact, high-reliability ferrite chip bead inductors. The product achieves the highest performance in reducing high-frequency noise in power supply circuits of laptop computers, cell phones, PDAs and computer peripherals (including USB devices).

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[16] Interview survey results; See also the website of Murata Manufacturing Co., Ltd. (http://www.murata.com/ninfo/nr02e1e.html)

Rohm Co., Ltd. echoes other Japanese electronic components firms. In September, 2003, it unveiled its product which possesses industry's top level super-low ON resistance power MOS FET (an optical memory device)[17]. The power MOS FET is playing major roles in the power supply blocks of all types of applications. Due to the reduction of the operating voltage of electronic devices, in particular, there has been an increasing demand for low-voltage, high-current power supplies. Among them, the CPU of the notebook-type PC has the severest demand for a special power supply. There is a rapid tendency of the power supply block of the CPU to drop its output to a level as low as 1.3 V, while it demands a current as high as 60A or over. With the adoption of multi-phase design, the power supply block uses a number of DC-DC converters of synchronous rectification type. As a matter of course, super-low ON resistance with a low Qgd is strongly demanded from the MOS FET units used for the synchronous rectification block. There was no single MOS FET model that achieved the required ON resistance in the past. Therefore, the conventional power supply needs to two MOS FET units connected in parallel to satisfy the requirement. In order to meet to the severe market demand and respond to expectations of an increase in the efficiency of the power supply with a space-saving feature, ROHM has developed the RQW250N03 as a new package device.

B. INTERNAL and EXTERNAL FACTORS

The QCD Function—high quality, low cost, short delivery times—has always concerned Japanese companies. This was echoed in out company interviews where they expressed concern about the speed and costs of innovation. In this regard, they adopt internal efforts such as (1) strategies for strengthening domestic R&D headquarters, and external efforts and external efforts such as (2) strategies for developing strategic technology alliances (STAs) both at home and abroad and (3) strategies for purchasing technologically advanced companies.

1. Internal Efforts—Strengthening Domestic R&D Headquarters

We learned that Murata Manufacturing Co., Ltd. cherishes its sophisticated technological base in Japan where production and R&D staff workers communicate smoothly to work out highly competitive products. Many companies share the basic

[17] Interview survey results; See also the website of Rohm (http://www.rohm.com/index.html).

principle adopted by Murata. Omron completed in March 2003 its Keihanna Technology Innovation Center and it would think that the Center will become the center for Omron's global R&D innovation strategy. The Center, Omron's largest R&D facility, is expected to play a significant role in creating technology that supports the Omron group's core competence--sensing & control technological base. In pursuing the consolidation of geographically dispersed research laboratories, Omron has combined research functions from each of four central labs (currently located in Nagaoka, Tsukuba, Kyoto, and Kusatsu cities) into the Technology Innovation Center. Along with building the latest research facility, Omron aims to increase the fruits of research and development by strengthening the synergy effect of in-company R&D. Moreover, Omron will take advantage of conditions intrinsic to Kansai Science City, striving for the "generation of value that astonishes" through collaborative innovation with advanced research organizations and corporate research labs in the surrounding area. Omron positions the Keihanna Technology Innovation Center as a research base for supporting the expansion of Omron in the 21st Century while aiming for harmony with local communities and contributing to the development of society.

2. External Efforts—Building Alliances

Without doubt, internal efforts within individual component makers are limited in their effectiveness. Accordingly, collective or external efforts should be sought by a group of companies.

Strategic Technological Alliances (STAs) for Economizing R&D Efforts

Many Japanese companies have forged their strategic technological alliances with their partners that had sometimes been former competitors, if partially or in other business fields. Take the case of the Fujitsu and Hitachi plasma display panel (PDP) alliance. In April 1999, Fujitsu and Hitachi announced to from Fujitsu Hitachi Plasma Display Limited (FHP) that would co-develop high-definition plasma display panels with a 42inch size. Now, FHP will produce PDP with the size of 55inch, 42inch, 37inch, and 32inch. Especially, 55inch-WXGA PDP is world’s first size that utilizes its newly developed ‘e-ALIS’ technology, which features a progressive displaying and the highest brightness. This STA has been evaluated as lessen the R&D costs and shorten the development periods by which both Fujitsu and Hitachi can compete in a highly

competitive PDP-product market where strong competitors including NEC, Pioneer, Matsushita and Korea's Samsung and LG Electronics are vying for leadership.

Table 13: Plasma Display Panel—STAs and OEM Relationships

Makers/STAs	Production Facilities	OEM Customers
Fujitsu-Hitachi	Miyazaki, Japan	Fujitsu General, Hitachi, Sony, Philips, Sanyo
Pioneer	Shizuoka, Japan	Pioneer, Sharp
Matsushita	Ibaragi, Japan; China	Matsushita
NEC	Kagoshima, Japan; Kawasaki, Japan	NEC, Sony, Victor JVC, Thomson Multimedia,
Samsung	Korea	Samsung
LG Electronics	Korea	LG Electronics

Source: Chunichi-sha 2003: 147.

In January 2003, Matsushita Electronic Components Co., Ltd and Fujitsu Interconnect Technology Limited (FICT) reached an agreement on the joint-development of the printed wiring board (PWB) with a new structure that would meet the next-generation mounting needs. The products of PWB have been widely used in the mobile phone market. Matsushita Electronic Components wanted to develop a new PWB, but its related technology named "ALIVH (Any Layer Interstitial Hole)" had been known as a matured technology. Matsushita looked to Fujitsu's FICT which is an expert in the field of industrial equipment including exchanges and office computers[18].

Strategic Technological Alliances (STAs) for Establishing International Technological Standards

STAs are not necessarily established only for economizing R&D efforts but also for aggressively establishing new technological standards. In February 2001, Toshiba Corporation, Taiyo Yuden Co., Ltd. and IBM Japan, Ltd. established a joint venture company to provide official qualification of use of the Bluetooth Wireless Technology logo[19]. The logo is mandatory for all products that claim to meet the Bluetoothb Wireless Technology standard and will assure consumers that products they purchase are fully Bluetooth Wireless Technology compliant. Bluetooth wireless technology enables users to connect mobile computers, digital cellular phones, handheld devices,

[18] Interview survey results; See also the website of Matsushita Electronic Components Co., Ltd. (http://industrial.panasonic.com/ww/news_e/nr200301MC002_e/nr200301MC002_e.html)

[19] See, for example, the website of Taiyo Yuden (http://www.taiyo-yuden.com/)

network access points and other mobile devices via wireless links, unimpeded by line-of-sight restrictions. It eliminates the need for proprietary cables to connect devices, greatly increases the ease and breadth of wireless connectivity, and is expected to become a core feature of a wide range of mobile equipment. Market research firm Brain-Child recently estimated that there will be approximately 700 million consumer-use Bluetooth-wireless technology-enabled devices worldwide by 2005.

Global R&D Institutional Framework—Global Networking Strategy

Basically, smaller specializing electronic components makers concentrate their R&D facilities on one or few places mainly in Japan. Larger companies, however, try to leap the benefit of global networks of R&D. Matsushita Industrial Co., Ltd has expanded its production and R&D facilities in Asia. Matsushita set up two new operations in Malaysia to strengthen the competitiveness of its products with a view to enhance its timely delivery to its customers including its affiliated companies producing home appliances including Matsushita Television & Network Systems Co. in Malaysia[20]. It invested RM230 million in a new cathode ray tube (CRT) line at Matsushita Electronics Corporation Malaysia (MMEC), and started its operation in July 2000, and established a new R&D center named the Matsushita Home Appliance R&D Centre Sdn Bhd, in Shah Alam, Selangor in October 2000. Matsushita's expansion of overseas production is not necessarily confined to the Asia region. In April 2003, Matsushita Electronic Components Co., Ltd. established a new affiliate company of Panasonic Components Electronics de Brazil Ltda (PCOB) that had been established in 1974 in Manaus, Brazil. The new establishment named PCOB-AM will serve local customers by providing their products including audio-visual products, coils, and trances[21].

3. Purchases of Companies To Strengthen Technological Competitiveness

Acquiring technologically competitive but economical faltering companies has been a usual business for U.S. and European companies while both Japanese and foreign analysts and economists regard Japan as an exceptional case. In the United

[20] Interview survey results; See also Eirmalasare Bani, "Two More Matsushita Operations Coming Up," *Business Times*, April 8, 2000.

[21] Interview survey results; See also the website of Matsushita Electronic Components Co., Ltd (only in Japanese, http://industrial.panasonic.com/jp/news/nr200302MC003/nr200302MC003.htm)

States, every one remembers that Indiana's Elkhart-based CTS Corporation acquired Motorola's Component Product Division (CPD) to transform it to CTS Wireless Components in 1999. This acquisition made CTS Corporation the largest manufacturer of electronic components for wireless applications in North America and a global leader in the fast growing industry.

Recently, some Japanese companies have started assimilating the strategy adopted by CTS Corporation. They have bought foreign companies to strengthen the competitiveness of their electronic components. Hitachi had though of expanding its automotive product businesses. In April 2002, along its vein, Hitachi acquired an automobile-related electronic components maker, Unisia Jecs (established in 1956) to strengthen its automotive product businesses and renamed it Hitachi-Unisia, Ltd. The Unisia Jacs' whose shares were also held by Nissan Motor Co. with 25.3 percent and by German Robert Bosch with 10.1 percent. Unisia Jacs is the second largest supplier of automobile parts to Nissan. And for Unisia Jacs, Nissan is the largest customer with 64.7 percent of its sales as of 2001. By absorbing Unisia Jecs, Hitachi aims to develop new types of automobile parts combining conventional engineering with electronics and information technology[22].

III. PROBLEMS ON THE HORIZON

In concluding this section, we would look to problems on the horizon regarding industry dynamics. We examine the obstacles prohibiting Japanese electronic components makers from growing faster than the extent to which their technological resources deserve.

A. Lack of Socio-economic Support, Institutional Harmonization, and New Business Services

Any industry in the world has its own Achilles' heels. Based upon our interview survey results, we examine the less competitive products in the industry despite its enormous competitive potentials. We learned that Japan's current electronic components industry market and technological dominance has been achieved by its forward linkage—demanding customers both in consumer and in corporate sectors.

Accordingly, in markets where demanding customers do not exist, there naturally appears no strong forward linkage for Japanese electronic components industry. Given the fact that Japan's network society is still left behind compared with the case of the United States or that of South Korea. We learn that Japanese web-service related customers do not possess demanding request to enhance responsive and technological capability of Japanese electronic components industry. In other words, Japanese components manufacturers have weaknesses in the markets where their American and European counterparts have a close forward linkage to the market.

B. Optical Transceiver Modules—Behind a Less Developed Internet Society

First, take the case of optical transceiver modules. With rapid expansion of the Internet in North America, America's JDS Uniphase and Lucent Technology, and Canada's Nortel Networks have grown rapidly with a market size estimate of about $8 billion. In sharp contrast, a miniscule $7 million market in Japan is crowded with a numerous companies including NEC, Fujitsu Quantam Devices Ltd. and Hitachi with their 90 percent market share combined[23].

C. IC cards—Institutional Harmonization Struggles

Despite ample technological resources, Japan's IC card market has not seen a commensurate growth. The reason behind the lackluster performance lies with associated industrial and institutional problems. Clearly, Europe is still the market leader[24]. The decade-long adoption of smart cards has evolved into a customer base of the 3 billion IC cards with a 50 percent market share. Other industrial estimate says that Europe accounts for 70 percent of current smart card uses, followed by South American and Asian regions with about 10 percent each. North America, however, languishes at less than 5 percent[25].

With the recent use of non-telecom smart cards in bank, identity cards, and traffic, there is great potential for further development of the IC card market. Such successful

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[22] Interview survey results; See also *Daily Deal* (Charles Smith), "Hitachi To Acquire Unisa Jacs Corp.," April 19, 2002; Hitachi-Unisia's website (http://www.hitachi-unisia.co.jp/index.html).

[23] Chunichi-sha (2001), p. 123.

[24] See, for example, *EE Times*, "It's Showtime," September 16, 2002.

[25] See Business Communications Company, "Use of Smart Cards to Continue to Grow through 2007," April 23, 2003.

achievements in Europe materialized though the close cooperation among government, business, and society through the experimental use in the field of banking, medical services, or the intelligent transport system (ITS).

An industry survey suggest that out of (1) contact cards, (2) contactless cards, and (3) dual cards, contact cards account for 92 percent of the total shipments in 2002[26]. Why cannot Japanese electronics components makers establish more competitive position on the world marketplace? They have a splendid technological base both in the fields of contact cards and contactless cards. In the contact cards, Dai Nippon Printing, Co., Ltd. (DNP), Toppan Printing have their cutting-edge technologies strong enough to export their products to Singapore and other countries. In the contactless card, Sony, NEC Tokin, and Toppan Printing enjoy their technological superiority. Or in the RFID market, NEC Tokin , Omron, Hitachi Maxell possess their own technological resources.

Despite high level of technological achievements, they are now behind France's gigantic Gemplus whose market share is estimated to be a predominantly 30 percent. Now, Gemplus being unleashed from the French market, tries to penetrate into the global market. Now the French company has an extensive network of IC card services. The reason why Gemplus prosper and Japanese do not lies is due to differences in the socio-economic environment.

In Europe, government backing throughout the relevant fields aims at building political and social institutional networks in which economic efficiency of networking though IC cards can be exploited. In Japan, on the other hand, economically and technologically superior IC cards cannot be utilized under political and social institution in which economies of networks cannot be incorporated. In Tokyo, passengers in Tokyo area commuters feel embarrassed when they try to change trains from one in which they can use the cards to another in which they cannot use the contact cards but only magnetic cards. In a compartmentalized condition, IC cards cannot enhance the economy's efficiency. Accordingly, despite technological competence of Japanese electronic components industry does not reflect its reputation in the fields where a strong forward linkage does not exist. Their technology is only evaluated in outside Japan. One year ago, Japan and South Korea conducted an experiment for similar IC

[26] Business Communications Company, "Use of Smart Cards to Continue to Grow through 2007," April 23, 2003.

cards when they cohosted the World Cup soccer finals last year. NTT Data Communications Establishes IC Card JV in China a while ago. Thus, Japanese technological competence in this field can be seen on an ad-hoc basis or outside Japan.

In the meantime, China is emerging as the most promising region for IC cards. In China, a huge industrial link of IC card application has been formed, though still at its nascent stage. The Chinese government, telecom companies, financial institutions are now aggressively exploring the possible use of IC cards[27]. With a strongly government-backed forward linkage, China's IC card industry will transform itself in a short time. Even the Japanese government tries to impress Japan's technological superiority of IC cards on the Chinese[28]. In August 2003 when Japan's minister for land, infrastructure, and transport, Ms. Chikage Ogi, visited China to promote the Shinkansen bullet train technology for China's planned high- speed link between Shanghai and Beijing, she met He Guangwei, director of the China National Tourism Administration and told him that Japan would propose a project to develop integrated circuit cards that allow tourists to pay for goods and services in the Japanese yen, South Korean won and Chinese yuan in the lead-up to the 2008 Beijing Olympic Games.

As China's emerging smart-card industry begins to attract major overseas manufacturers, Chinese government agencies are now concerned about security issues and have began increasingly seeking locally designed and produced IC cards. The government requires foreign producers selling smart cards in China to obtain a certificate from the State IC Card Registration Center. Despite the government restrictions, foreign chip and module suppliers are expected to flourish here since card makers expect about 200 million devices will be placed an order from China Telecom and other customers. The 14 smart-card vendors are expected to be primary users of ICs and modules produced by the semiconductor industry. Meanwhile, credit-card firms such as Visa and Mastercard subsidiary Mondex Asia are stepping up activities here. Visa and smart-card makers helped China People's Bank establish the IC-card specification for the local banking industry. They also helped introduce an open

[27] See, for example, Electronic Engineering Times, "With Eye on Security, China Nurtures Domestic IC Cards," August 9, 1999.

[28] Interview survey results; See also Jiji Press English News Service, "Japan Proposes Tourist IC Card Project to China," August 4, 2003.

smartcard platform for the Chinese market. The platform has enabled faster development of an interoperable smart-card network with greater security.

The resulting response from the authorities has been a boost in domestic development and production. No less than ten Chinese design houses and chipmakers have announced that they will enter the market. Three design houses and one chipmaker have already announced commercial products and have received government registration to produce smart cards. The local producers must compete with entrenched multinationals including Sun Microsystems Inc. and Microsoft Corp. Both are becoming big players here as Sun's Java card battles Microsoft's Smart Card for Windows in the Chinese market.

D. EMS—New Type of Business Services

There has risen drastic change in *modus operandi* among the world business community with the advent of the Internet. The Internet has brought about a drastic change in notion of time, geography, and economic transaction. If one is armed with globally communications capabilities, he or she can forge mutually beneficial scheme around the globe in a flashing moment of time. Accordingly, the Internet (and foreign language) manipulation capabilities are now changing a grand picture of global mega-competition—leading to a new type of rule of economic game. Despite the bursting of the U.S. IT bubble, the "New Economy" still survives and e-Economy is now expanding along with e-Learning and e-Government. Japanese firms feel that their American and European counterparts are superior in building the Internet-related business schemes. In this connection, emerging business models including EMS and SCM might act as a double-edge role in global competition facing the Japanese electronic components industry. Here, we will examine the case of EMS (Electronic Manufacturing Services)

EMS has long been regarded as a sort of activity in which "manufacturing" and associated R&D are to be abandoned and separated by many Japanese electronic companies. For those who put emphasis on "manufacturing" and "process technology," transferring the whole process of manufacturing would mean abandoning any possibility to earn profits. For example, recent moves adopted by EMS companies including Selectron to strengthen their design capabilities have posed a threat to many of Japanese electronic components makers in the sense that EMS "can" generate "new

technologies." Early in 2001, Selectron decided to purchase Centennial Technologies Inc. in order to start its design and manufacturing services line memory modules[29]. Market analysts think Centennial has gone through challenging times, furthermore, it has strong technical capabilities. Since its stock price has fallen down by more than 95% from its peak in late 1996. Accordingly, Solectron has increased its competitive edge swiftly against their Japanese companies with relatively smaller financial resources. This acquisition is expected to enhance Solectron's business with datacom, medical, mobile computing, and telecom OEMs by extending its customer base. The firm will seize the opportunity to strengthen our flash memory- module and PC-card business, which might pose dangers for Japanese, Korean, Taiwan and European companies. We will explore how Japanese firms respond to the issue of the rise of EMS in detail in the following chapter.

Currently, one of the front burner issues is the rise of EMS. Japan's ailing electronic giants have long struggled to prune their ill-managed or loss-making businesses. EMS looks attractive for large electronic companies seeking every cost-cutting effort. In an illustrative way, NEC's latest reorganization was designed to reduce substantially its procurement costs for fiscal year 2003[30]. In this connection, NEC tries to narrow the focus of its backward linkage with its suppliers. NEC tries to follow in the footsteps of Lucent Technologies Inc. and Nortel Networks Corp. The two firms slashed the number of electronic component suppliers from several thousand to about 100 each. NEC intends to place larger orders with the fewer but remaining suppliers with lower prices in exchange. Closer ties with fewer suppliers are expected to bring about greater procurement efficiencies and speedier deliveries. Although NEC officially declined to reveal the number of suppliers, it will decisively implement a series of its supplier reduction program. According to the media sources, NEC's executives told the new plan was part of the company's efforts to reduce its operating expenses after posting a quarterly loss of almost US$1 billion in its December 2001, compared with net income of US$359 million in 2000.

Under these circumstances, NEC intensified its use of contract manufacturers as part of its cost-cutting efforts. In January 2002, NEC signed a US$2.5 billion contract

[29] Interview survey results; See also *EBN*, February 5, 2001.

[30] Interview survey results; See also, *EBN*, "NEC Speeds Up Plan To Pare Supplier Roster –Move May Force Other Japanese Equipment Makers to Follow Suit," February 25, 2002.

with Tronto-based EMS provider Celestica Inc. Celestia was expected to manage the supply chain activities, final assembly, integration, and testing for NEC's optical backbone and broadband access equipment. Through the adoption of EMS, NEC tried to speed up the completion of its online parts ordering system, code-named Pegasus, and establishing greater ties with vendor supply chain management systems.

When everybody admits NEC's latest action results in more forceful cost reduction activities, many of Japanese giant equipment manufacturers could assimilate NEC's strategies. At the same time, NEC expresses its intention to expand acquisitions of parts and materials outside Japan, especially from China with a view to cost-cutting measures. However, so far, few people acknowledge NEC's latest decisive action as a productive strategy. Rather, other people still think it best to wait and see. In the meantime, NEC wants to cut parts costs by having design engineers work more closely with its supply chain staff in the early design phases of products to use the most cost-effective components. Here, it remains to be seen that NEC can successfully achieve this goal of closer and more flexible relationships with components makers while it seek to streamline its relationships with components makers through the introduction of EMS.

IV. CONCLUSION

As the Japanese assembly makers move domestic production facilities overseas, they try to respond swiftly and technologically to their customer needs but keep their main operations—production and R&D—within Japan. Today's market dominance has been achieved by technological supremacy according to their judgment. Such technological supremacy cannot be achieved without close relationship and indefatigable efforts of technical and production staff. Accordingly, moving and relocating such technical and production staff workers from Japan does not seem a wise policy. In order to respond swiftly and efficiently to the demands of foreign customers and Japanese customers stationed abroad, they have their own strategies. First, they adopt a technological approach to avoid profit-depleting price warfare. But quickly learning South Korean, Taiwanese, and nascent Chinese firms are following the steps of Japanese electronic components makers. Accordingly, they adopt strategies for (1) higher value-added products, (2) miniaturization of products, (3) modularization/packaging of a group of products, and (4) new products. Since

miniaturization is of urgent need in this field, by developing smaller products within Japan, they can serve the emerging needs of their customers.

At the same time, we learned that lack of matured network society and economy in Japan underutilizes the potential productive power of the Japanese electronic components industry. In the past, Japanese electronic components industry has developed new materials and new types of components in cooperation with their customers—Japanese electronic assembly makers. Now, in the advent of the Internet, technological complexity has been accentuated. In addition to technological complexity in hardware, complexity in software, networking solution technology, and socio-economic reengineering have raised a wide variety of technological challenges. Such business climate change has increased pressure toward Japan's electronic components industry.

A. National Policy Agendas

1. World Trading System

In addition to the above intrinsic industrial challenges, a general environment for world free trade should be firmly secured to activate the world economy. Accordingly, recent developments concerning the 5th WTO Ministerial Conference at Cancun and Japan-Mexico Free Trade Agreement are rather disappointing for the Japanese business community at large. The Japanese government is expected to exert its influence along with its American and European counterparts over successful negotiations in the future. Japan's electronic and electronic components industry organization, JEITA, issued a statement calling for an open, equitable and non-discriminatory multilateral trading system on May 13, 2003[31].

A Japan-Mexico Free Trade Agreement is of very importance for two reasons. First, a second free trade agreement for Japan after the Japan-Singapore Free Trade Agreement is expected to accelerate the pace of negotiations with other trading partners including South Korea, Thailand, Canada and Indonesia. Second, Mexico is a significantly strategic country for Japan's electronic and automobile industries with which Japan's electronic components industry provides their products. Accordingly,

[31] Japan Electronics and Information Technology Industries Association (JEITA), 2003, "Initiative for Elimination of Tariffs on Digital Consumer Electronics Products in WTO New Round Negotiations." (May 15).

the Japanese government is expected to proceed with both of the multilateral and bilateral approaches in trade negotiations for engendering a generally favorable trade environment for Japan's electronic components industry.

2. Intellectual Property Rights

In addition to policy measure regarding the world trading system, an effective enforcement of legal procedures regarding Intellectual Property Rights is of vital concern for Japan's electronic components industry. Fear of illegal use of information-related products including both hardware and software will pose a threat to stable growth of electronic and electronic components products around the globe. In this connection, JEITA has a favorable view toward recent responses adopted by the Chinese government. At the same time, JEITA submitted a report to Japan's jurisdiction authorities calling for swifter responses in court on November 2002[32].

3. Environmental Regulation Policy Measures

Our interview survey suggests a worldwide growing concern about the environment has a significant impact on business planning for Japan's electronic components firms. Some times adept response to environmental regulations plays an important role for dividing the winners and the losers. For example, Tyco Electronics Power Systems, an affiliate company of the Tyco group whose Tyco Electronics is the world's largest supplier of passive electronic components and a major producer of active components, have successfully penetrated into European and Japanese markets by complying with both regions' environmental regulations[33]. Some environment-related regulations including the RoHS Directive banning the six types of products in the EU member countries will surely have undeniable impact on the practices of Japanese firms and some times place economic burdens for related investigations[34]. Accordingly, environment-conscious recycling regulations should be established and coordinated among industries and among nations. In recent years, several electronic

[32] JEITA, 2003, "Chiteki Zaisan-ken Sosho ni kansuru Teigen (Recommendation Regarding Legal Procedures for the Violation of Intellectual Property Rights)," (Nov. 7)

[33] Interview survey results; See also *EBN*, "Tyco Electronics Climbs on Board Lead-free Train—Offers DC/DCs for European, Japanese Markets," November 25, 2002.

[34] As for the RoHS Directive, see, for example, the website of the European Union (http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_037/l_03720030213en00190023.pdf)

and electronic components firms play a key role to harmonize and workout exemplified environment-friendly practices in related fields.

Among such activities, Japan Green Procurement Survey Standardization Initiative (JGPSSI) is notably well known[35]. Such environment-friendly practices are now diffused among voluntarily participant companies. Policy measures to lead not-yet participants in the related industries should be adopted as part of public policy. In other words, the Japanese government is asked to proceed with international harmonization and international exchange of information regarding environment protection policy and with familiarization and promotion policy for these policy measures.

4. Vision for IT Society

The Japanese government has put an emphasis on IT-related measures by formulating e-Japan Strategy. Despite stringent efforts, there remain ample room to be desired to accomplish a safer, more efficient IT society with wide use of e-commerce and e-government. On August 8, 2003, the government's IT Strategic Headquarters unveiled "e-Japan Priority Policy Program," in order to strengthen its effort for the coming years[36]. The Program focuses seven areas that would take full utilization of IT infrastructure—medical services, food, lifestyle, SME financing, knowledge industry, employment and labor markets, and public services. In these areas, the concrete measures of deregulation should be swiftly devised and implemented. At the same time, future IT society has a risk of widened digital divide. The Japanese government is asked to devise a framework to provide future use of digital consumer products with a view to the elimination of the digital divide[37]. In addition, some tax credit measures are welcome among Japan's electronic components industry in the sense that Japan's industry will increase the purchase of IT-related products. Although a temporary measure, IT-related tax credit for SMEs for fiscal years 2003-2005 is well accepted among vendors and purchasers of IT related products[38].

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[35] As for JGPSSI, see the website of JEITA (http://home.jeita.or.jp/eps/greendata/Foreword/Foreword-Jp-20030722.pdf)

[36]IT Strategic Headquarters, 2003, "e-Japan Priority Policy Program (Summary)," (http://www.kantei.go.jp/foreign/policy/it/0808summary/030808gaiyo_e.pdf)

[37] In this connection, see JEITA, 2003, "Initiative for Elimination of Tariffs on Digital Consumer Electronics Products in WTO New Round Negotiations," (May 15), p. 2.

[38] See, for example, JEITA's website (http://home.jeita.or.jp/ps/sokushin.pdf).

B. Industry-wide Recommendations

Along with general policy measures adopted by governments, industry-wide efforts are needed. Led by industry organizations including JEITA, some industry-wide policy measures are considered.

1. Standardization of e-Commerce

JEITA, the nation's industry association, started in 2000 the practical use of the computer-readable standard dictionary for semiconductor devices and electronic components (ECALS), which had been launched its compilation in 1996. In March 2002, around 260,000 Japanese in the ECALS dictionary entries were made available to the public. On April 4, 2002, with the completion of the ECALS dictionary, a new service company named PartsWay Corporation was established by Japanese electronic components and JEITA. They would make PartsWay Corporation as the "world center" for the distribution of electronic components information in the 21st century[39]. Remaining tasks related to this standardization effort will be how to expand the use of the ECALS dictionary. In this connection, JEITA and its member companies are required to work collaboratively.

2. Information Sharing and Education Activity among the Industry

We touch upon the mounting pressure from an environmental concern and the related regulatory change including the RoHS/WEEE legislation. Rising social responsibility of manufacturers in any country will force them to know if there are additional requirements for electronic component as a result of it being lead-free, and whether electronic components' physical parameters have changed. Accordingly, further technological and procedural complexity will require both the procurement and commodity management teams of customers and Japan's electronic components makers to acquire the knowledge of legislation related to automotive, medical and military/aerospace, and telecommunications infrastructure applications.

Accordingly, an educational system concerning lead-free products and related legislation will play a key role in international competition and compliance. In this connection, information-sharing among industrial partners and competitors will be of

[39] Interview survey results; See also the website of PartsWay Corporation (http://www.partsway.org/English/index.html)

vital importance. Especially, detailed information including legal requirements, market trends, customer expectations, and our own technical requirements is hard to learn for each individual companies. Japan's smaller electronic components makers have no luxury to keep educational and information-providing personnel in their own corporate structure. Therefore, industry association including JEITA will have to take the initiative to assume an educational and information-sharing task in these field.

REFERENCES

Branstetter, Lee and Yoshiaki Nakamura, 2003, "Is Japan's Innovative Capacity In Decline?" NBER Working Paper No. 9438.

Chunichi-sha, ed., 2001, *Denshi-Buhin Nenkan* (*Annual of Electric Devices Components*), Tokyo: Chunichi-sha.

Chunichi-sha, ed., 2003, *Denshi-Buhin Nenkan* (*Annual of Electric Devices Components*), Tokyo: Chunichi-sha.

Deloitte, 2003, "Deloitte Global COO Survey and COO Confidence Index," (Oct.).

Development Bank of Japan (DBJ) (Research Institute of Capital Formation), 2003, "Waga-kuni no Inobeshon wo Tenbo-suru: Inobeshon Keiei Kenkyu-kai Hokoku-sho, (Report on Japan's Innovation System)," *Keizai Keiei Kenkyu* (*Review of Economics and Management*), vol. 23-7 (March)

Financial Times, 1999, "Changes in the Competitive Battlefield," October 4, Surveys edition.

Harada, Nobuyuki and Yuji Honjo, 2003, "Does the Creative Business Promotion Law Enhance SME's Capital Investment? Evidence from a Panel Dataset of Unlisted SMEs in Japan," Japan Center for Economic Research Discussion Paper No. 88, (Oct.).

Hirakubo, Natato and Michael Kublin, 1998, "The Relative Importance of Supplier Selection Criteria: The Case of Electronic Components Procurement in Japan," *International Journal of Purchasing and Materials Management*, Vol. 34 No. 2 (Spring), pp. 19-25.

Iwasaki, Nakato and Hidetaka Kaiho, 1996, "How Japanese Electronic Component Firms Evolved Turnaround Strategy," *Competitive Intelligence Review*, Vol. 7 No. 2, pp. 20-35.

JEITA (Japan Electronics and Information Technology Association). 2003, "Outlook for Major Electronic Products," (Mar.).

Japan Finance Corporation for Small Business, 2004, "Degital Kaden no Fukyu to Chusho Denshi Kairo Meka e no Eikyo, (Spread of Digital Home Appliances and Its Impact on Small and Medium-sized Makers of Electric Circuits)," Chosa Repoto (Research Paper) No. 15-5. (Jan.).

Japan Finance Corporation for Small Business. 2003 "Denki Denshi-kiki Sangyo ni okeru Ajia-kakkoku-kan no Bungyo-kozo no Henka to Nikkei Chusho-kigyo no Taio, (Structural Change in International Division of Labor within Asia and the Responses of Japanese Small and Medium-sized Firms)," Report No. 2002-7 (Mar.)

_____. 2002 "Chugoku no Sangyo Kodoka to Nikkei Chusho Kigyo no Keiei Senryaku, (China's Industrial Sophistication and Its Impact on Strategies of Japan's Small and Medium-sized Firms)," Report No. 2002-1 (Apr.).

_____. 2001 "Hando-tai, Ekisho Sangyo no Gyokai Doko to Chusho-kigyo no Bizinesu Chansu, (Business Opportunities for Small and Medium-sized Firms in the Semiconductor and Liquid Display Industries)," Report No. 2000-2 (Jan.).

Lara, Arturo A. and Jorge Carrillo, 2003, "Technological Globalization and Intra-Company Coordination in the Automotive Sector: The Case of Delphi-Mexico,"

International Journal of Automotive Technology and Management, Vol. 3 Nos. 1-2, p. 101.

Michaels, Ronald M., Alan J. Dubinsky, Masaaki Kotabe and Chae Un Lim, 1996, "The Effects of Organizational Formation on Organizational Commitment and Work Alienation in U.S., Japanese and Korean Industrial Sales Forces," *European Journal of Marketing*, Vol. 30 No. 7, pp. 8-25.

METI (Ministry of Economy, Trade and Industry). annual. Census of Manufacturers, Report by Industry. Tokyo: METI

Reed Electronics Research. 2003 *Yearbook of World Electronics Data 2002/2003*. City?: Publisher?

Sugawara, Tsutomu, 1998, "Capturing the Market with Strategic Information Tools: How Japanese Companies Are Winning Market Share," *Competitive Intelligence Review*, Vol. 9 No. 2, pp. 40-45.

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IT in ASIA:
The Case of Japanese Electronic Component Makers

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PRESENTATION OUTLINE

- Japan's Electronic Components Sector
- Industrial Competitiveness
- Policy Implications

JAPAN'S ELECTRONIC COMPONENTS SECTOR

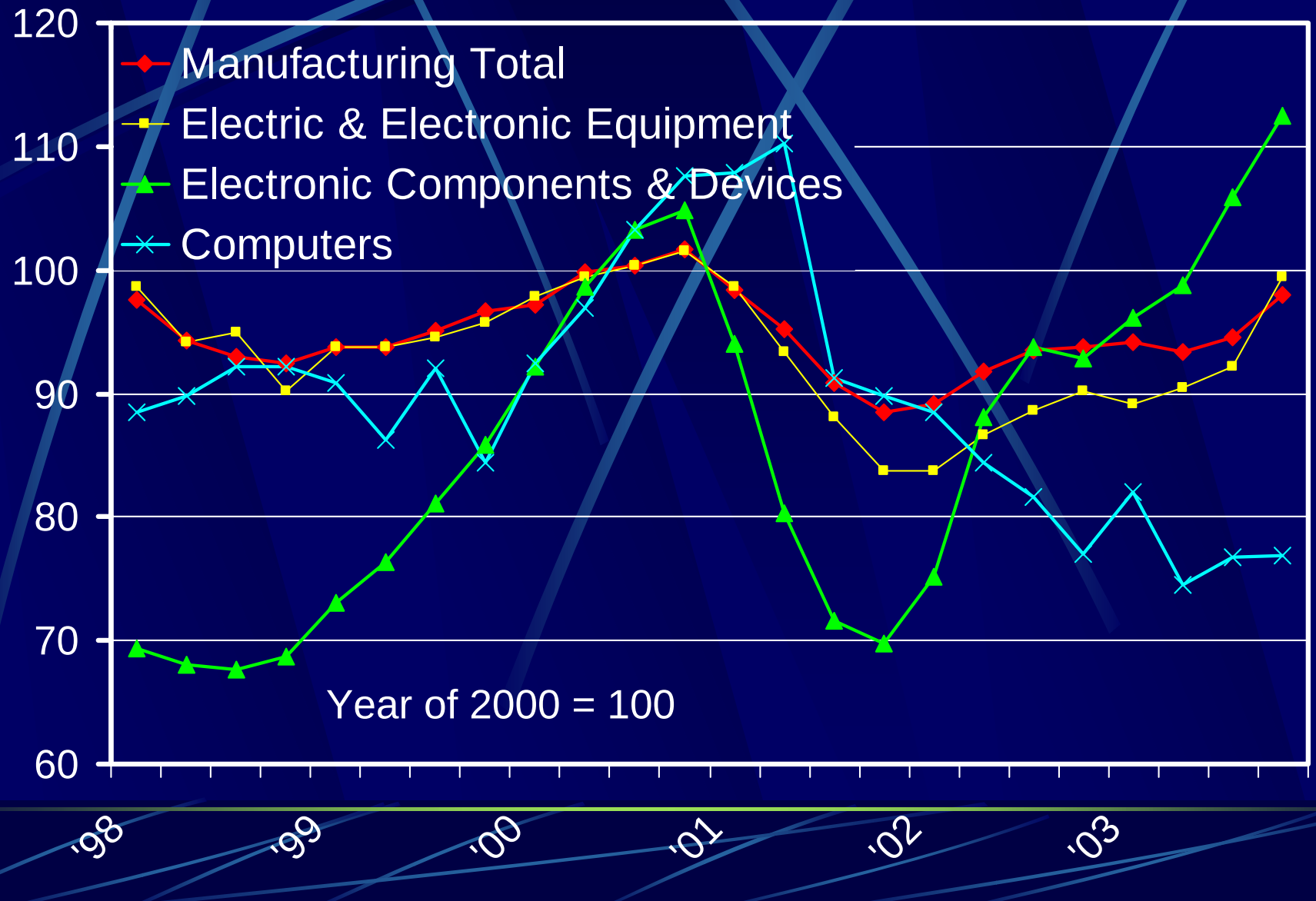
Sub-sectors

- **Misc.**
  TV Antennas, Turners, etc.
- **Passive**
  Connectors, Switches, Relays
- **Transducers**
  Magnetic Heads, Audio, and Micro Motors
- **Devices**
  Electronic Tubes, Discrete Semiconductors, IC, LCD
- **Displays**
  LCD, Plasma Display, Light-emitting Diode

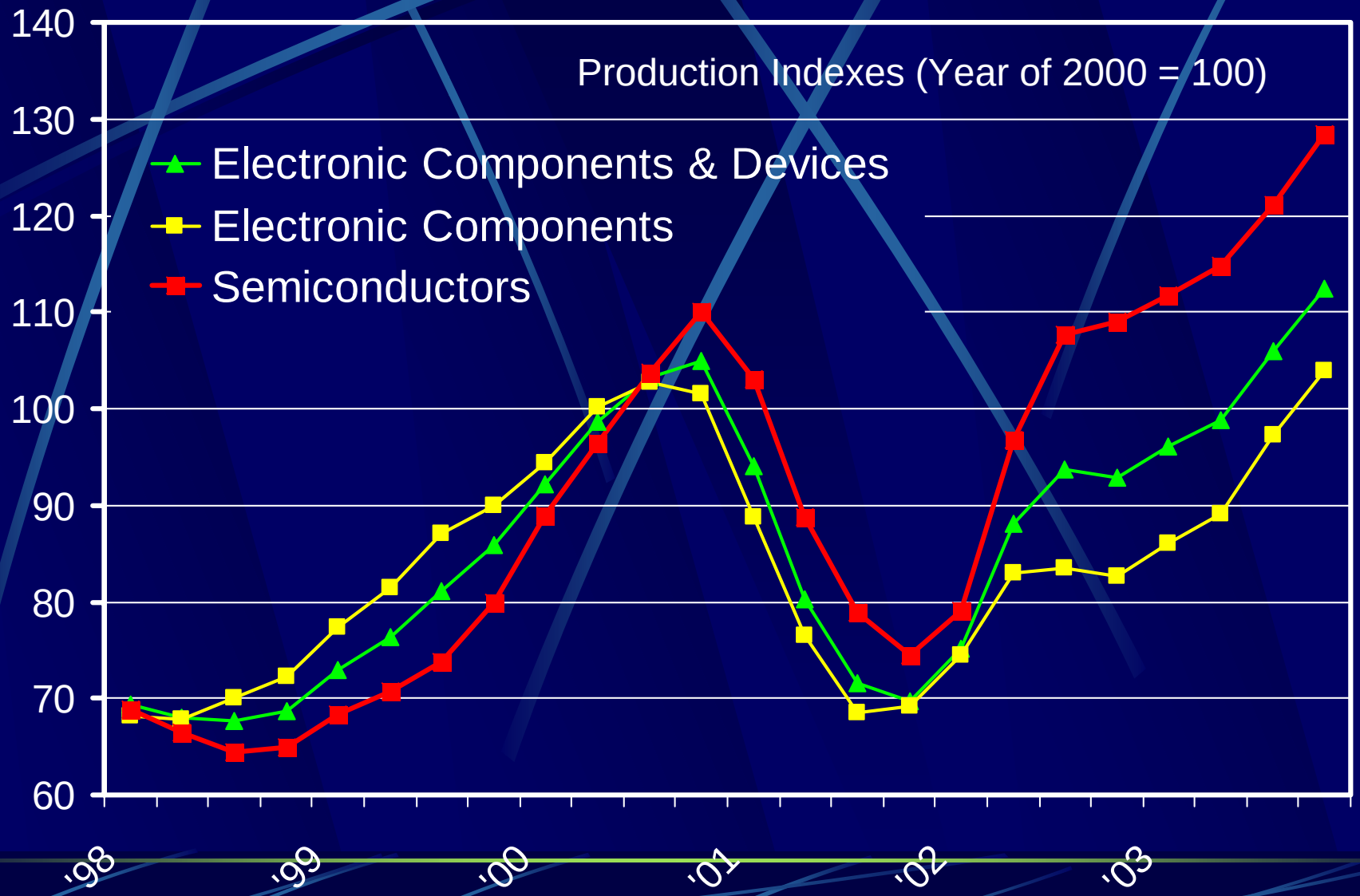
Major Players

- **Keiretsu-Affiliated**
  Matsushita Electronic Components, Kansai NEC, Hitachi Hokkai Semiconductor, Nippon Morex, Nippon Mectron, Toshiba Components, Kagoshima Matsushita Electronics, NTT electronics, Yamagata Fujitsu, Matsushita Applied Electronics
- **Independent**
  Kyocera, TDK, Alps, Murata Mfg., Rohm, Nippon Densan, Mitsumi, Hoshiden, Ibiden, Kyoden, Taiyo Yuden, Senken Electronic, Shiko Electronics, Mabuchi Motor, Nippon CMK

Production Index



Sub-sectors


Production Indexes (Year of 2000 = 100)
Electronic Components & Devices
Electronic Components
Semiconductors
140
130
120
110
100
90
80
70
60
'98
'99
'00
'01
'02
'03

Share of Japanese Electronic Components in Global Market

INDUSTRIAL COMPETITIVENESS

INTERNAL

Business Plan

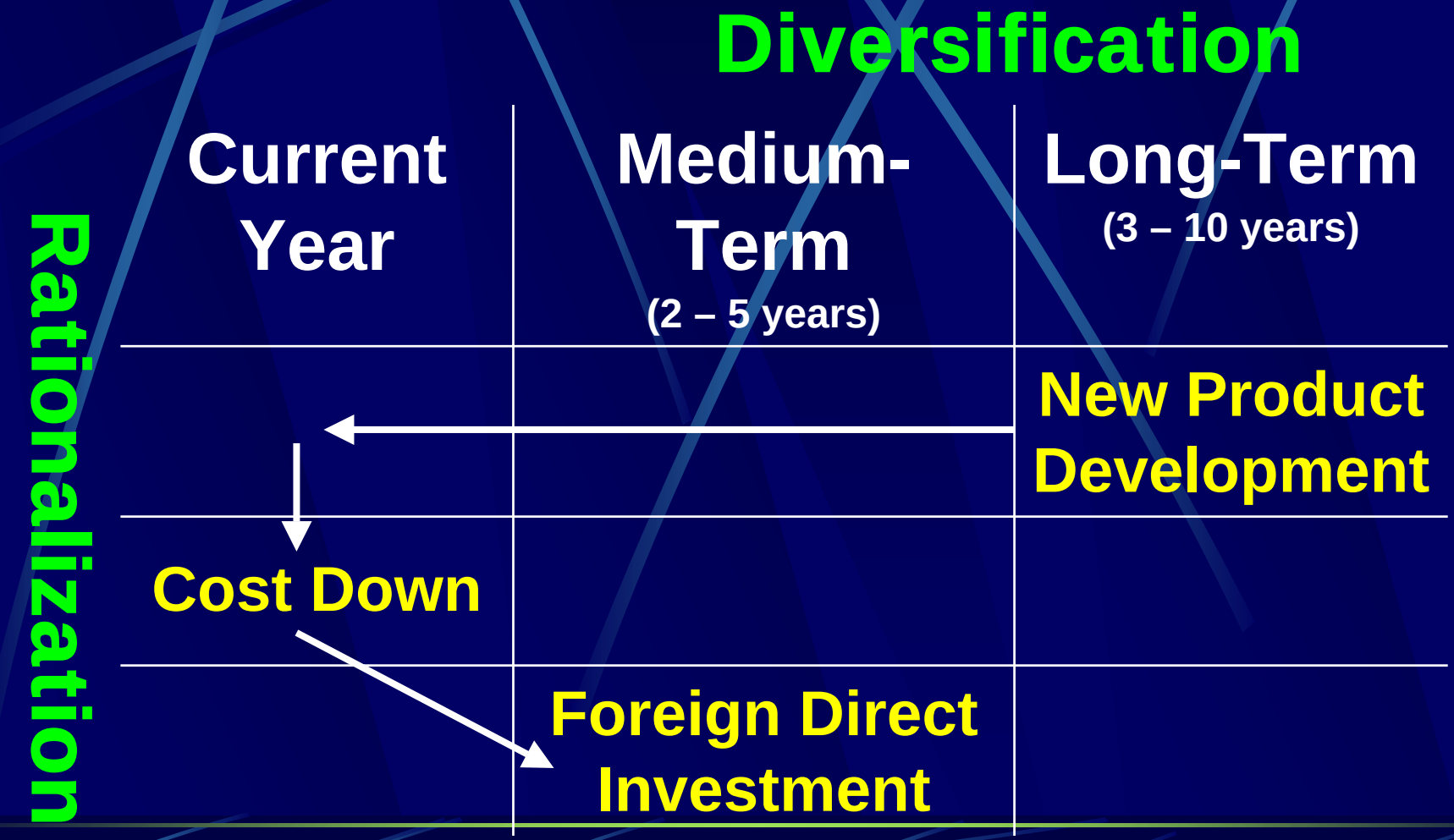
- Rationalization
- Diversification

EXTERNAL

Political Economy

- Business
- Bureaucrats
- Politicians

Business Plan



Rationalization

QCD Function

$$P = \frac{V - E}{L}$$

TQM Story

P = productivity; V = volume; E = error; L = labor

6Ms

Manpower

Money

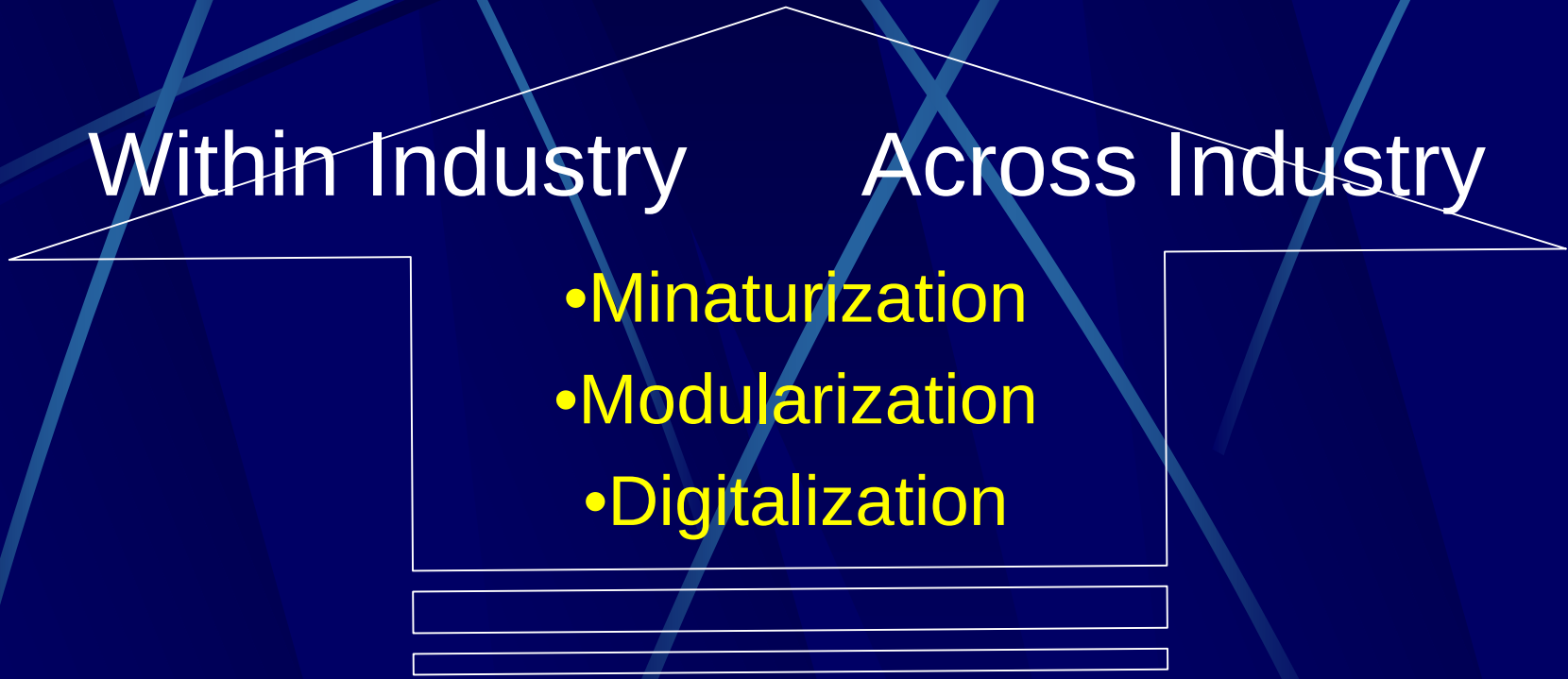
Materials

Machine

Market

Methods

Diversification

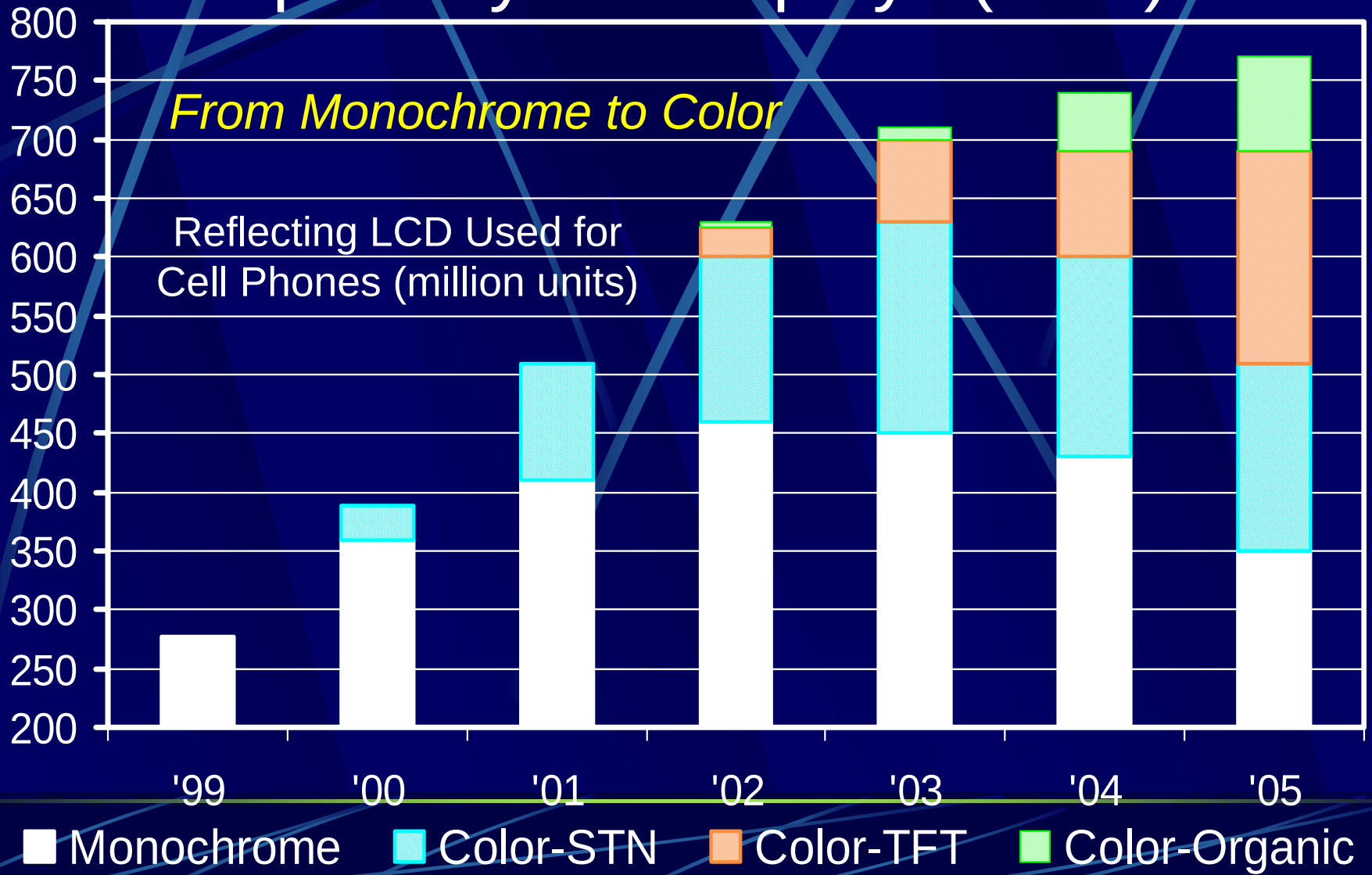


Intrinsic Technology

The basic science underlying a company's products

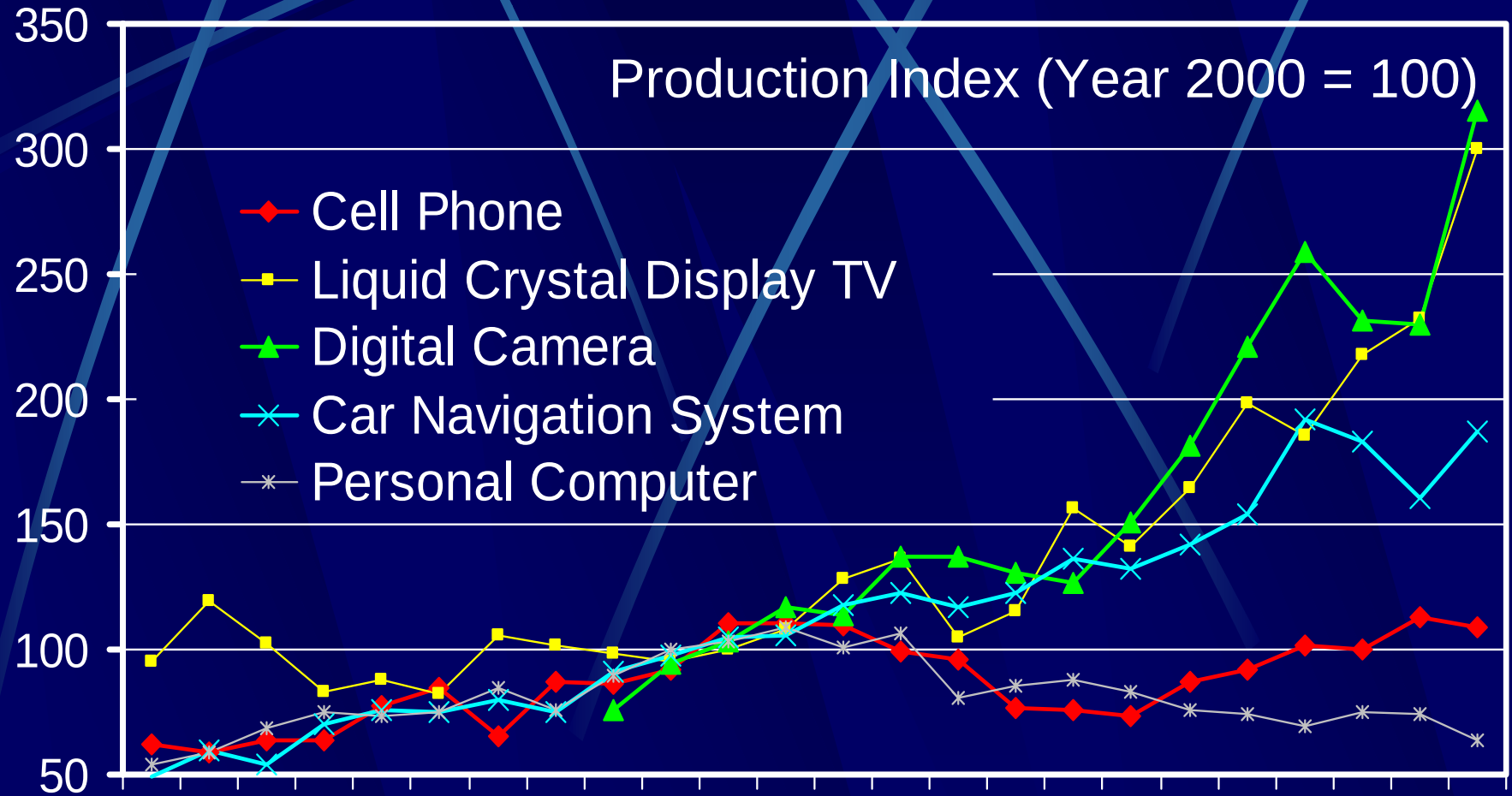
Diversification Within Industry

Liquid Crystal Displays (LCD)



Diversification Across Industry

High-end Digital Products



Political Economy

"From Iron Triangle to Economic Cooperation"

Domestic Options

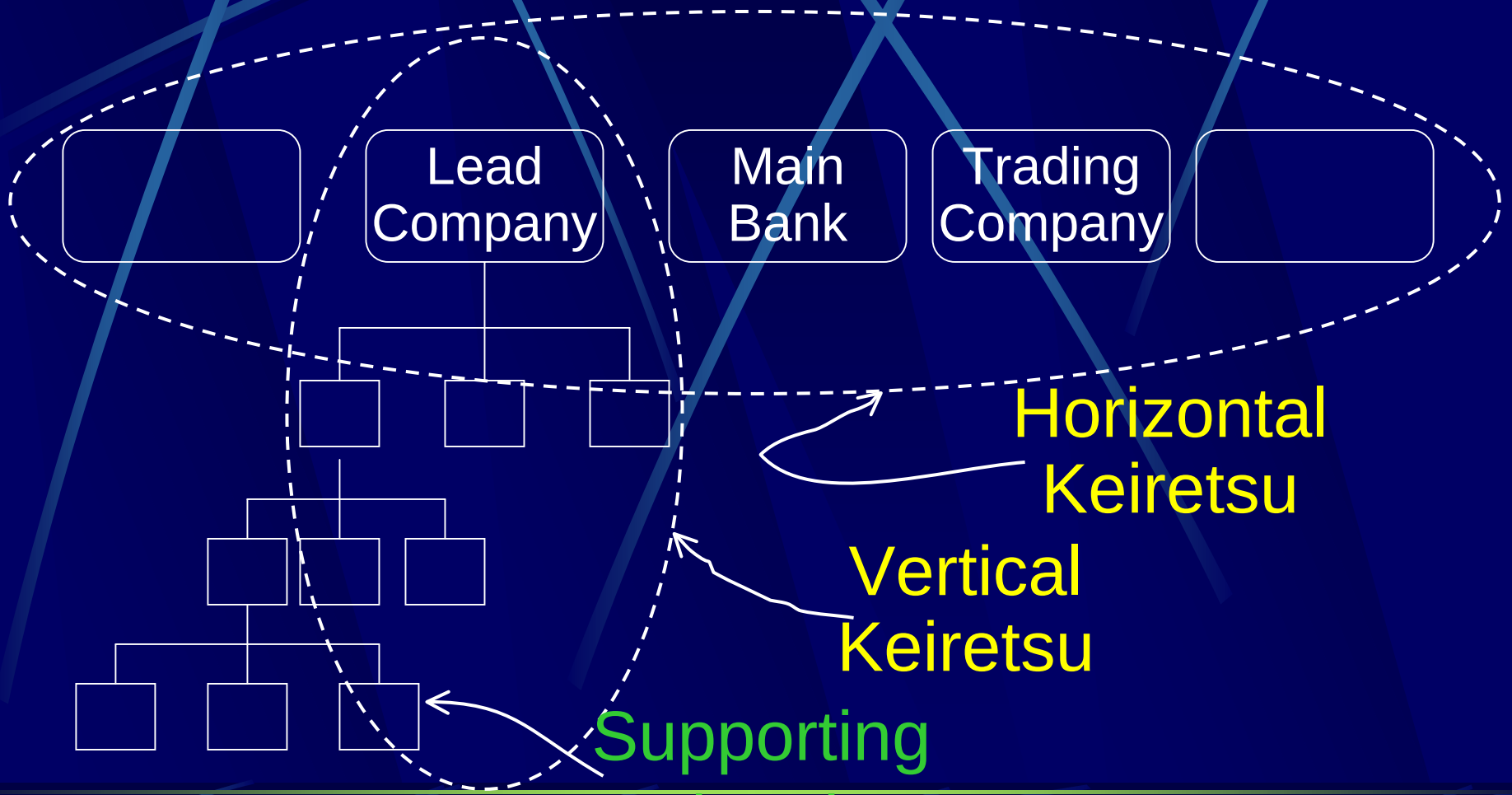
- Iron Triangle
- Keiretsu

Regional Options

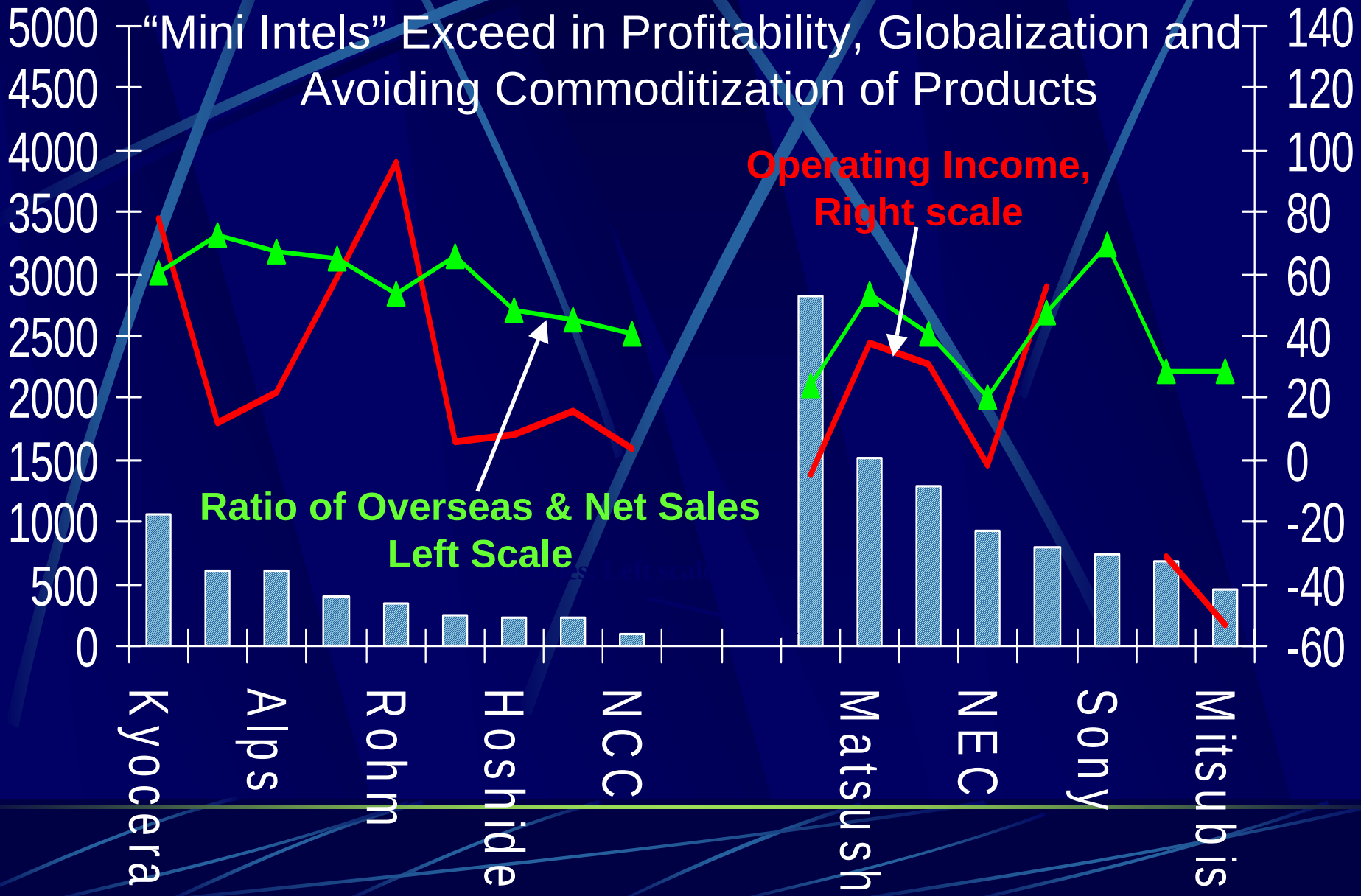
- Regionalism
- Regionalization

Keiretsu

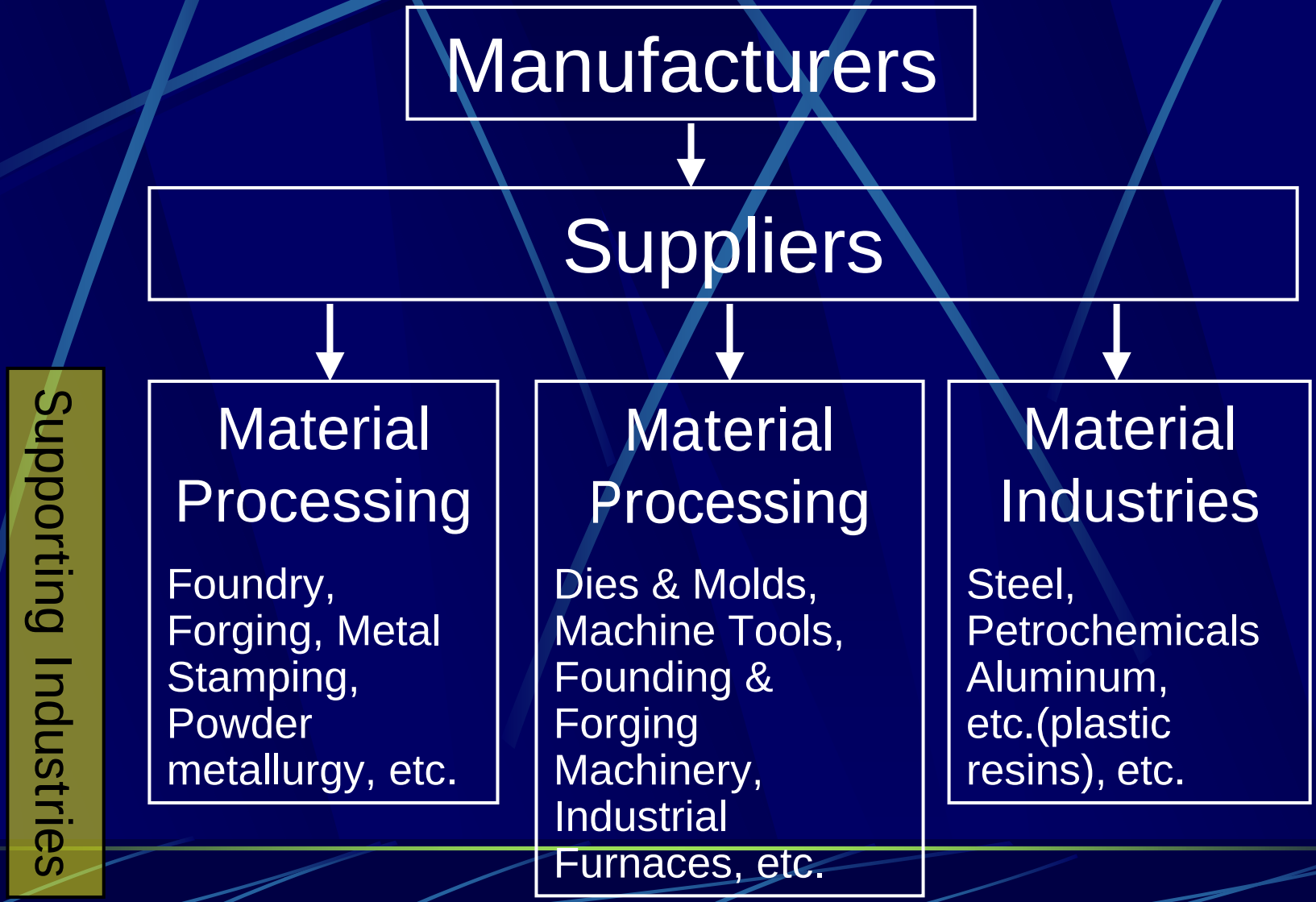
"Corporate Groupings"



“Mini Intels” vs. Large Affiliates

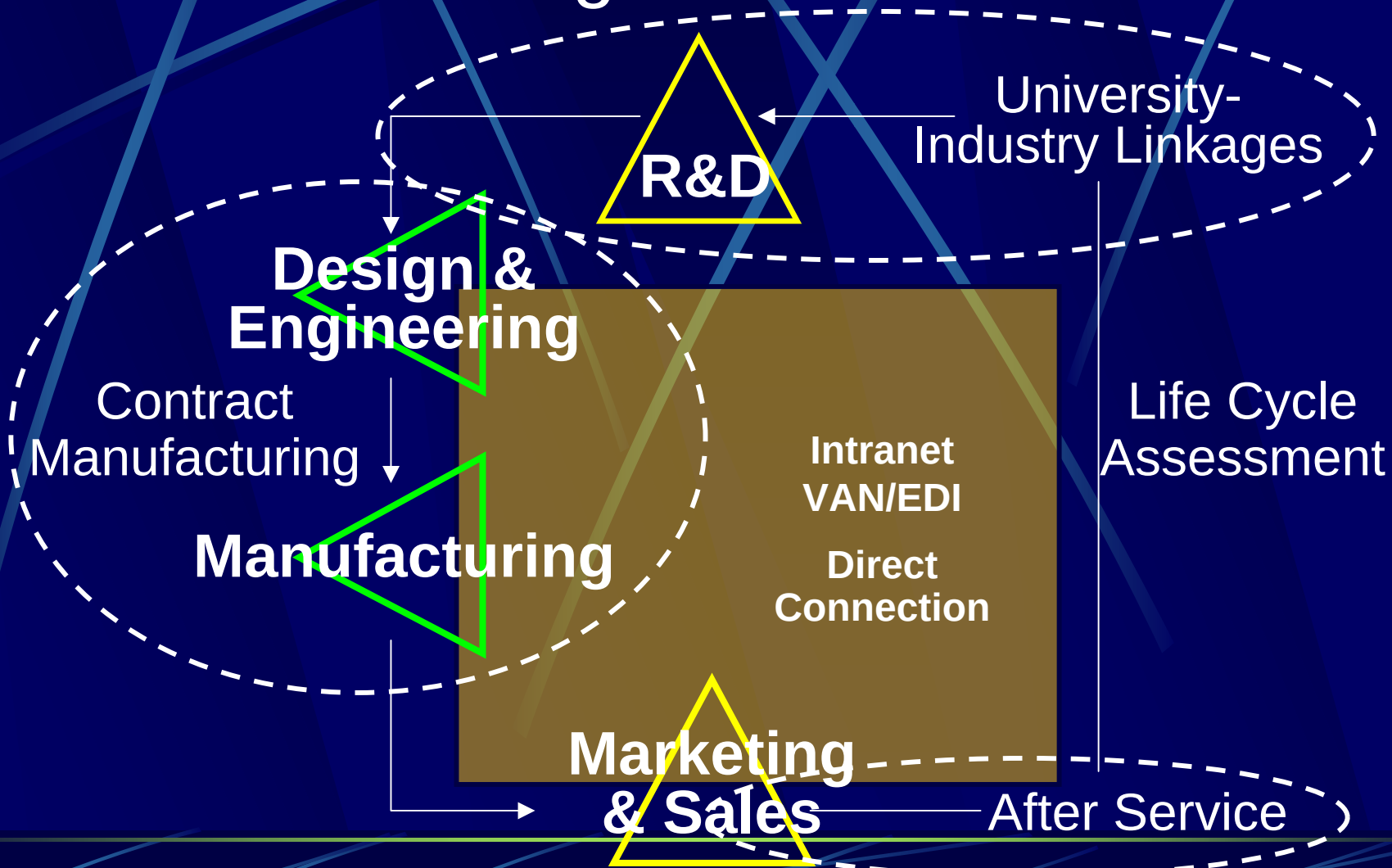


Supporting Industry



Regionalization

"Evolving Value Chain"



POLICY IMPLICATIONS

- Technical Efficiency
  Movement towards the production frontier
- Technical Progress
  Shift of production frontier
- Input Growth
  Movement along the frontier