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The Present and Future on Semiconductor Technology and Industry in Korea

Y.K. Sung

Department of Electrical Engineering, Korea University, 1, 5-ka, Anam-dong, Seoul Korea

This paper discribes the current semiconductor technology in Korea, focusing on recent IC process and industry structure.

1. THE TREND OF TECHNICAL DEVELOPMENT

1.1. The actual status of the Korean semiconductor technology

The manufacturing technology of DRAM in Korea has reached an international level, but the general basic technology, including design technology, is inferior to advanced countries. There is difficulty especially in the region of design automation and in the frailty of CAD technology as well as the poor software development such as programming inspection/test programs. Also, there is absolutely no super precision technology as well as ultra cleanliness technology.

The process technology of 0.6um 16M DRAMs nearly approaches the level of advanced countries and in the future will advance toward 0.3 μm in less then few years. But in the 16M DRAM area, CAD technology is insufficient and ensuring it is a important task. Advanced countries have the basic technology to produce 1G DRAMs, however, Korea has only a fraction of this basic technology, for the new generation. Due to the frailty of the semiconductor technology, the specific gravity of royalty is more than 20% of the sale price, and patent pressure is made gradually. Still more, under the condition that basic technology is not plentiful and the policy of technology protection of advanced countries made more secure each and every day, Korea can't continue to develop and grow without the knowledge of advanced countries.

In order to develop this knowledge, it is necessary to activate a co-research system, to introduce refined technology and coalition technology. Especially, daring R&D investment and the modification of the

Table 1

The comparison of semicondutor technology level

Region	Advanced Countries	Korea
1. Memory Device (Memory)	> Mass production of 1M, 4M DRAM > 16M DRAM development completion > 1G DRAM(posession of basic technology)	> Mass production of 1M, 4M DRAM > 16M DRAM development completion > imposession
2. ASIC	> 20,000 gate array > posession over 1,000 cells(standard cell) > 0.5um line width	> 7,000 gate array > posession of 400 cells > 1.0um line width (the early stage)
3. Logic Device	> Mass production of 32 bit microprocessor > the stage of development completion of 64 bit micro processor > under development of special logic device	> the introduction of 4/8 bit micro processor tech nology and under production > introduction of special logic device technology
4. Compound	> mass production of OEIC, MMIC etc	> the early stage of development of LED, low power LD etc

direction of investment is necessary.

1.2 The direction of development technology

In the case of production and design technology, although Korea developed an excellent design technology, it is of no use without the basis of production technology. Therefore, it is necessary to expand the settling of product technology. The expansion of production technology means that it must establish the organization of the required creation of design technology. However, design technology is not accomplished in a short time, so the government should induce individual companies to prepare the capability. This kind of the goverment support includes the support of basic technology, R&D funds, training of special human power and so on. These requirements are the most applicable to the existing resources(technology, human power,

facility), the daring introduction of the required technology, and domestic and overseas commission research.

In case of production research and basic technology, Korea has not yet been able to specialize in the area of production technology. Especially the expansion of ultra production technology due to the insufficiency of the required creation and expansion of basic technology. As a result, the research development of basic technology was insufficient. In the semiconductor production field, the production technology of semiconductors has been fixed to some degree, as its region has not been expanded yet. Its requirement is not enough to some level, however, it is urgent to research the much needed basic technology in the present or future, as well as the speciallization of a field.

In other words, it becomes necessary to research with consistency in the special research institute.

Although Korea has excellent technocomplex, its speciallization and the allotment of research fields should be certain. All the research enterprise should decide what the main body is, have continuance, and especially, have the R&D management capability.

In the case of R&D cost, it is being enlarged. It is next to impossible to be compared with other industries. 15-20% of the sale price of the research development price is on an upward trend. If we look at the direction of investment of R&D, the trend is production technology → plan technology → design technology, through the basis of DRAM production technology, the direction of development of manufactured goods is various (Memory → ASIC, Logic field). That is, changing from standard to customerzatioon and from large scale production to appropriate scale production. The R&D cost is invested from production automation to ultra clean equipment.

1.3 The development direction of a cooperative system to research technology

The solidification as well as activation of a technocomplex system

A. The specialization of a research institution of technology field.
   * Industry field : design and production technology - the education of technical man power
   * Academic field : the induction of specialization of basic technology and application technology
   * Research institution : application technology and design technology, the solidification of R&D management

※ Application to other technology through the activation of cooperative reserch of DRAM

B. The solidification of a research system for the special technology region
   * Electronics and Telecommunications Research institute (ETRI)
     - semiconductor, communication system, circuit application technology.
   * Electronic parts research institute
     - compound semiconductor.

* Contribution research institute
  - the application technology of the equipment as well as FA research.
* Seoul Univ. semiconductor cooperation research institution - device, material etc.

※ The necessity of speciallized research by demand of development technology of the research institute of company.

C. The improvement of a supply system as well as technical man power in the industry
* The enlargeness of industrial university of company
* The expansion of education center of technical man power of special laboratory
* The encouragement of the education center of the company

※The education of technical man power

In conclusion, it is necessary to form a consortium of technocomplex for the preparation of a development plan for the industry technology of semiconductor.

2. THE DEVELOPMENT DIRECTION OF INDUSTRY STRUCTURE

2.1 Problems

In 1990, the scale of international semiconductor market was about $56 billion and the memory field occupied about $14.2 billion, roughly 25% of the market. This occupation ratio is gradually on a downward trend.

In conclusion, Korea's semiconductor industry is competing with advanced countries only in the memory field which occupies 25% of the total market. This is the production technology field excluding design technology.

Korea can't compete with advanced countries in the rest of the semiconductor market(ASIC, microprocessor, etc.) that occupies 75% of the total semiconductor market. Especially, the development of the ASIC field is necessary, which has become a rapidly growing area in the semiconductor industry.

2.2 The development direction of the semiconductor industry

The domestic semiconductor industry has structural drawbacks. The organization of manufactured articles places too much importance to DRAM, in the supply and demand structure, both 87% of the semiconductors domestic demand is imported and 80% of memory goods is exported. In this way, the domestic semiconductor industry show the contradictional form.

Due to the insuffiency of standardization of production technology and inadequecy of specialization in manufactured goods between large enterprises and small/medium enterprises, the domestic industry is not capable of using resources in the most practical manner.

Table 2
The characteristic analysis of semiconductor goods

	Technical industry			The property of the business	Bringing up as well as the development	The relative gravivity of market
	Design	Manufacture	Marketing			
Memory/ individual device		○		industry dependent on equipment	financial support as well as the bringing up of the front industry	30
Micro goods	○		○	industry dependent on technology	the development of system technology	20
ASIC			○	customer business	the cooperative development of design technology, the development of goods technique of each of the companies	20
exclusive goods of SET	○		○	the increase of customer	the development of each company for circuit technique as well as the bringing up of the rear industry	30

2.3. The introduction tariff on production equipment

With regards to the introduction of production equipment, the basic tariff is 11% in 1992, the provisional tariff is 5.52%. However, it is high compared with the abroad non-tariff, and the tariff of parts is 11%, since it is the opposite tariff of equipment parts. As a result, it becomes a great barrier for the domestic equipment as well as the relatively high cost of maintenance.

Table 3
The introduction tariff

Division	Japan	America	Korea
Equipment	0%	0%	11%(5.52%)
Materials	3-4%	4%	11%

Table 4

The equipment of domestic industries as well as the R&D investment resuts

(Unit : Billion $)

Company Name	Equipment Investment		R&D Investment		Total	
	'91	'92	'91	'92	'91	'92
SAM SUNG	4.375	6.5	2.5	3.3	6.875	9.8
HYUNDAI	0.8	0.9	0.225	0.388	1.06	1.29
GOLD STAR	2.325	2.975	0.425	0.713	2.75	3.688
Total	7.504	10.38	3.18	4.4	10.68	14.78

(DATA ; KSIA '92. 11)