THE DEVELOPMENT OF THE ELECTRONICS INDUSTRY IN INDONESIA AND THE ROLE OF THE PHYSICS DEPARTMENT

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I. INTRODUCTION

Electronics technology and industry has been contributing considerably to the development of Indonesia and this contribution is expected to increase in the years ahead. This contribution is mainly in the form of providing goods and services for the industrial, telecommunication and entertainment sector and creating direct and indirect employment in the process of providing those goods and services.

To make the electronics sector even more prominent in its contribution to the development, the following steps have to be taken:

a. To increase its contribution as a foreign exchange earner.
b. To bring down the price of its goods and services.
c. To increase the domestic content of the electronic products.
   To be able to achieve this, considerable amounts of effort have to be exerted, first, to identify the parameters most effective in determining the goals and secondly to stimulate those important parameters in the desired direction.

Logically those parameters can be categorized into regulations pertaining to trade and those which will maximize the comparative advantages of a certain country. For developing countries this is mostly in the form of a vast supply of less expensive labour, a potentially large domestic market and relatively uncommitted industry. Education and training will improve the quality of the labour force while research and development will produce domestic technology and hence bring down the price of imported technology.

II. Present status and future development of the electronics industry in Indonesia.

The present status of the electronics industry in Indonesia is elaborated in a recent World Bank report as follows: 1)

"The central problem in Indonesian electronics seems to be the low production levels of finished products. The two primary causes of this low output are the lack a significant export program and the absence of consumer affordability at present levels of retail prices and consumer purchasing power. Low production levels, in turn, cause other problems:

- insufficient private sector revenues to fund technology and product improvements;
- manufacturing inefficiencies;
- weak infrastructure of supporting industries, especially component manufacturing;
- minimal opportunity for personal training.
   These problems tend to feed on themselves and appear to be stagnating the industry.

It should be noted that, to date, successful electronics programs in developing countries, such as Korea, HongKong and Taiwan, have all been based on exports. It should also be noted that these successful count ries have been forced into an export strategy because their own small populations are unable to provide the needed levels of consumption for economies of scale.

Indonesia is in a unique position of having a rather large population, mostly unserved by electronics. Export opportunities continue to exist even though Indonesia is somewhat late in promoting electronic exports. This suggests that the country could adopt a dual strategy, both parts based on the dramatic lowering of costs and selling prices, which would emphasize both domestic consumption and exports.

With regard to exports, there is now a ripple-down effect taking place worldwide in which the rising labor rates in some countries are forcing them out of some types of electronics activities

1) "Present Status of Indonesian Electronics Industry" World Bank Report (English).
with the lost activities being relocated in countries with lower labor rates. There is no reason why Indonesia cannot be the beneficiary of activities which will be leaving Japan, Korea, Taiwan, Hong Kong and Singapore.

It has been noted that domestic selling prices are preventing the development of a local market because of the lack of consumer purchasing power. A large portion of this affordability gap appears to be the result of import duties on components and other fees and charges associated with importing. These costs appear in some cases to be ‘doubling the selling price of the product in question. Industry sources have suggested that removal of these government costs and the resulting lower selling prices would probably double the size of many consumer product markets.\(^a\)

Within the condition as pictured by the report, 1983-84 output of the electronics industry in Indonesia is valued at about 450 Million US$, covering professional electronics, consumer electronics and components. \(^2\)

To produce a firm foundation for the development of the electronics industry in Indonesia, the following technologies have to be mastered:

a. Analog technology
b. Digital technology
c. High frequency technology
d. Fast response circuit technology
e. High power technology
f. Low noise technology
g. Data processing technology
h. Control technology
i. Electromagnetic wave propagation through various media
j. Microelectronics technology
k. Components technology
l. Printed circuit board technology
m. Packaging technology
n. Raw material technology for the electronics industry. \(^3\)

It is suggested that in the years ahead various electronic industries based on an assessment of the Indonesian and export market and providing an application media of above mentioned technologies be established:

1. Industries producing telecommunications, navigation and radar equipments
2. Industries producing electronic instrumentation
3. Industries producing control and automatic equipments
4. Software industry
5. Industries producing custom and semi-custom integrated circuits
6. Industries producing printed circuit boards
7. Industries producing electronic components
8. Industries producing raw materials for the electronics industry
9. Service industries

III. The role of the Physics Department in supporting the development of the Electronics Industry in Indonesia

Considering the development program in the electronics industry and the trend toward more use of solid state electronic devices, support from the Physics Departments is needed in the field

\(^{a}\) “Pola pengembangan industri Elektronika”, Direktorat Industri Mesin Listrik dan Elektronika, Direktorat Jenderal Logam Dasar dan Mesin, Departemen Perindustrian (Indonesia).

\(^{b}\) “Kebijakan Pokok Pengembangan Teknologi dan Industri Elektronika”, BPPT (Indonesia)
An even more important activity would be joint research and development programs between physicists and chemical, mechanical and electrical engineers with the objective of developing equipments for making semiconductor devices and integrated circuits. These equipments are for instance: Vacuum evaporation systems, sputtering systems, plasma dry etching equipments, diffusion furnaces, chemical vapour deposition systems, ion implanters, photolithography equipments, molecular beam epitaxy equipments. Considerable amounts of foreign exchange can be saved by composing the equipments ourselves and only buying the essential components from abroad. Prototypes can be developed in universities and manufactured by local industries. This will create a solid base activity for the semiconductor industry in the future.

Another area where the Physics Department could be of prominence is in the field of microwave power devices, which is presently still dominated by vacuum tubes using time of flight techniques. The telecommunication and navigation equipment industries will be dependent on these devices and having an active group in this field will considerably support the operation and maintenance of these equipments and eventually smoothing the way for a microwave power device industry.

The inevitable transition from silicon to gallium arsenide or possibly other compound semiconductors as a material for semiconductor devices and integrated circuits is another area where the Physics community could play an important role.

Industry participation in this field of material science would be minimal at the moment, but with the planned integrated semiconductor industry operation in Indonesia, this activity will definitely be in their interest.

For developing countries with scarce financial resources and desiring an integrated semiconductor fabrication facility, the only way to justify such an investment is to find niche markets domestically and internationally for their products. Special semiconductor devices and sensors are areas where the possibility of finding such products are great. And here again, the role of the physicist will be significant.

Photolithography is an important area of joint research by physicist and chemical, mechanical and electrical engineers, where the fruits of this effort can be of significant value to shorten the road to semicustom integrated circuits, also called gate arrays. Having the capability to produce the final interconnection masks of the gate arrays and doing the final processing locally, will give the local professional electronic industry a competitive edge against foreign competition.

IV. Conclusion

Physics has always been the prime mover in the development of electronics technology, so that the importance of a well designed curriculum with concrete objectives in the Physics Department cannot be over emphasized.

For developing countries with scarce expertise, also important are the links with the other applied disciplines in the form of joint research and development programs.

With most of the industries still in infancy, consolidating research and development efforts within the university is probably more effective than everybody trying to reach directly to industry.