A SUCCESSFUL EXEMPLARY TRAINING MODEL IN IC INDUSTRY

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Abstract**—***The rapid development of the IC industry in Hsinchu Science-Based Industrial Park, Taiwan has continuously created a serious shortage of manpower at the engineering level. The semiconductor technology training program, conducted by Tze-Chiang Foundation of Science and Technology, responds directly to this shortage by providing training for engineers who want to move into the IC (integrated circuit) field as well as by offering upgrading opportunities through continuing education for professionals who are currently working in the field. Since 1986, the program has trained more than fifty thousand engineers. The strong and tightly interconnected relationship between the IC industry and the program will be addressed in this paper. The program can be equivalently applied as a model for other high-tech industries. This unique program is one of the major driving forces sustaining Taiwan's success in the field of semiconductor technology.*

Index Terms: manpower, training program, semiconductor, technology.

INTRODUCTION

Tze-Chiang Foundation of Science and Technology (TCFST), a non-profit organization, was founded in 1973 by alumni of National Tsing Hua University (NTHU). The primary goal of TCFST is to build up connections among academic, research, industrial and governmental institutions in order to promote economic growth, upgrade the industry, popularize human and social science as well as speed up modernization of industrial and business management. TCFST is thus devoted to cooperative research and professional training programs by utilizing academic expertise and facilities as well as obtaining the support of the government.

In the area of professional training, TCFST has earned the reputation by providing high-quality training programs. In 1986, TCFST was appointed by the Administration of Hsinchu Science-Based Industrial Park, Taiwan to set up a training center of semiconductor technology. Since then more than fifty thousand engineers have been trained through the training programs. Customized training courses have been provided for many TCFST's cooperative partners, including Taiwan Semiconductor Manufacturing Company Ltd. (TSMC), United Microelectronics Corporation (UMC), and Winbond Electronics Corporation

TCFST's TRAINING PHILOSOPHY AND MISSIONS

The goal of TCFST is to become the best high-tech training center in the Asia Pacific area. To achieve this goal, the TCFST's training philosophy is that there are dignity in work and value in personal growth and learning. People should be given an opportunity to develop their talents, acquire skills needed to handle a job, become successful and contributing members of the country. Learning by doing is a primary focus of TCFST's instruction.

At the beginning, TCFST was set up as a semiconductor-based laboratory. With the success in semiconductor technology, TCFST has been expanded into a science- and technology-based research and training center. Missions of TCFST are as the following:

1. Upgrade employees already employed to meet the requirement of increasing job opportunities and demand.
2. Provide guidance and counseling service to the industry.
3. Emphasize on knowledge learning and skill development.
4. Establish the manpower of IC industry in Taiwan and to be competitive in the world.

SEMICONDUCTOR TECHNOLOGY TRAINING PROGRAMS

As depicted in Figure 1, procedures of program planning has been developed to guide the training program. The procedures are consisted of four phases: analysis, design, implementation and evaluation. If the program are effective measures of employability skills, more creative and innovative approaches should be encouraged. Based on the TCFST's missions mentioned earlier, the scheme of semiconductor technology training program has been used for the IC industry in Taiwan is shown in Figure 2.

Semiconductor technology training programs offered at Tze-Chiang Foundation of Science and Technology have three major elements that have been designed to train future

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employees and to provide to those who are currently working in the IC industry new skills or update existing skills.

The first of these program elements focuses on engineers whose majors are outside the field of electrical engineering. This three months program follows a lab project, training participants in specific skills essential for work in the semiconductor field. Courses in this program include subjects such as device physics and modeling, IC process technology and simulation, testing and reliability, equipment and facility maintenance and wafer fabrication.

The second of the three program elements involves a variety of short courses, which are offered to current employees. These courses upgrade employees' skill in technical areas that include circuit design and analysis, circuit layout, IC module process. Lab practice in these courses is delivered with the aid of CAD and computer simulation practice with PC's or work stations and process practice in class 100 and class 10 clean rooms.

Customized training courses comprise the third element of the training program. These courses are designed to suit the highly individualized needs of specific company units and employees. These courses are developed in conjunction with the specific client/employee, and the duration of training is dependent on the training need.

SPECIALIZED RESOURCES

The above mentioned industry-oriented program offered by TCFST receives 50% of its financial support from the government. The major sources of financial support are provided from the Administration of Hsinchu Science-Based Industrial Park (since 1986), the Industrial Development Bureau of the Ministry of Economic Affairs (since 1990), and the Employment and Vocational Training Administration of the Council of Labor Affairs (Executive Yuan) (since 1992).

Most of the instructional staff and advisory board members of the training program are from the National Tsing Hua University. Additionally, based on recommendations from advisory board members, instructors from industry and academic institutions abroad are recruited into the program. Instructors are selected for their specific applied and research experts. Among them, 35 percent instructors are from the universities, 40 percent instructors from academic institutions, and 35 percent from the industry. All instructors are at the forefront of developmental research in the industry. By this way, the program is directly relevant and current with developments in the industry.

Specialized equipment used in the delivery of the IC design training includes networked SUN work stations, PCs, IC EAD tools, HDL and VHDL simulators and logical synthesizers, test compilers, FPGA design software and programmers from Cadence and Synopsys, color plotters and laser printers. The semiconductor process equipment includes mask Algiers, high-temperature furnace systems, CVD systems, sputter deposition systems, chemical stations, dry etching systems, ion implanters, and photo-resist coating systems and MEMS equipment. Analysis/testing equipment includes SEM, TEM, SRP, four-point probe, ellipsometer, I-V, and C-V measurements. Clean room specifications, critical to IC fabrication, are met with better than class 100 facilities. In keeping with its commitment to long-term cooperation, the TCFST utilizes the materials and electric characterization laboratories of the National Tsing Hua University on a time-sharing base.

CONCLUSION AND FUTURE STRATEGIES

The performance of the semiconductor technology training program has been very successful and famous in Taiwan so far. As shown in Figure 3, according to the statistic index, a total of 50,352 participants have been trained through the program during the period of 1986-2000. It represents around 4,500 trainees trained per year on average. The program has also benefited from significant contributions from industry, including both technical input and equipment donation. The technical inputs are technical expertise, technical documentation and knowledge transfer in support of this program from the local companies. In addition, various local semiconductor companies have supported job opportunities, join R&D projects, assessment panels and program evaluation in this training program.

The characteristics of participants are as the following:

- Most of the participants are young, in the range of twenty to thirty-five years of age.
- 80% of participants work for firms located in Hsinchu Science-Based Industrial Park.
- A large majority of participants are on-job training from the industry, so they receive financial aid from both the government and the company that they are working for.
- 30% of the participants have had some form of the training prior to entering the program.

Globalization and industrial growth have created competitive demands for new products. The challenge that one faces today is to provide a training program that will equip the workers with the necessary skills to meet future development. The futures strategies of training and development of the TCFST are as follows:

- Coordinate resources of industry and academic institutions to provide teaching and training services to meet the demand of IC industries.
- Provide industry with desired technologies to promote the technology transfer.
- Introduce new technologies through academic-industry

cooperation and exchange information with foreign organization to upgrade the technology.

- Promote IC industry through professional training in accordance with the technical development of related fields.
- Strengthen the cooperation between government and industry for training and development.

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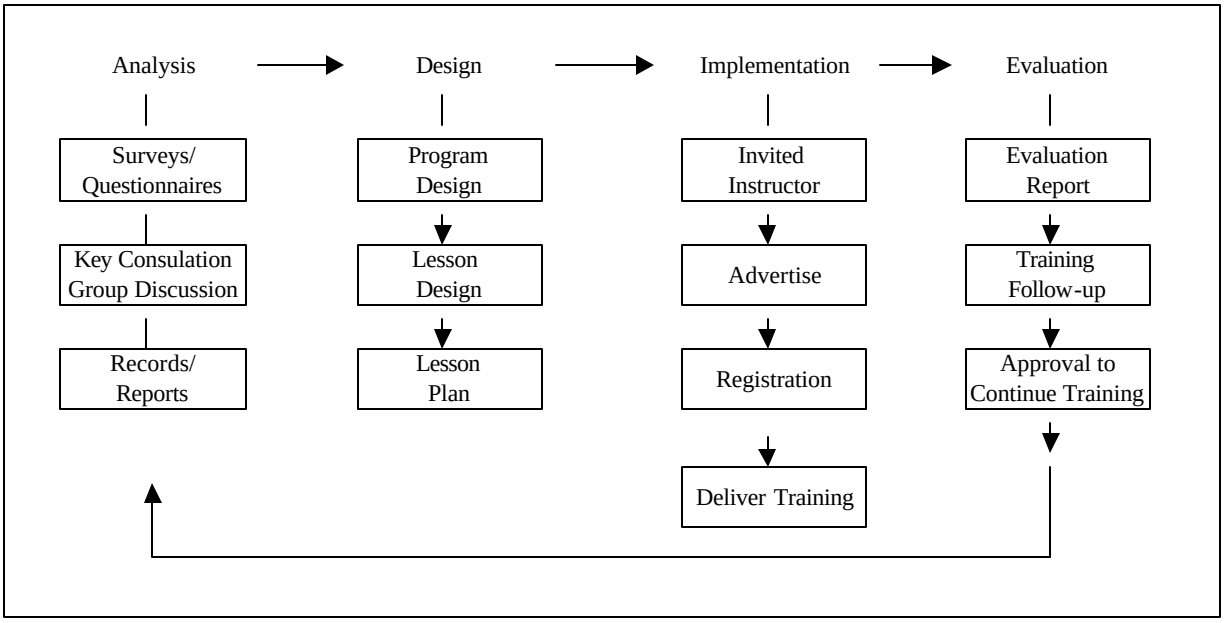

FIGURE. 1
Procedures of Program Planning

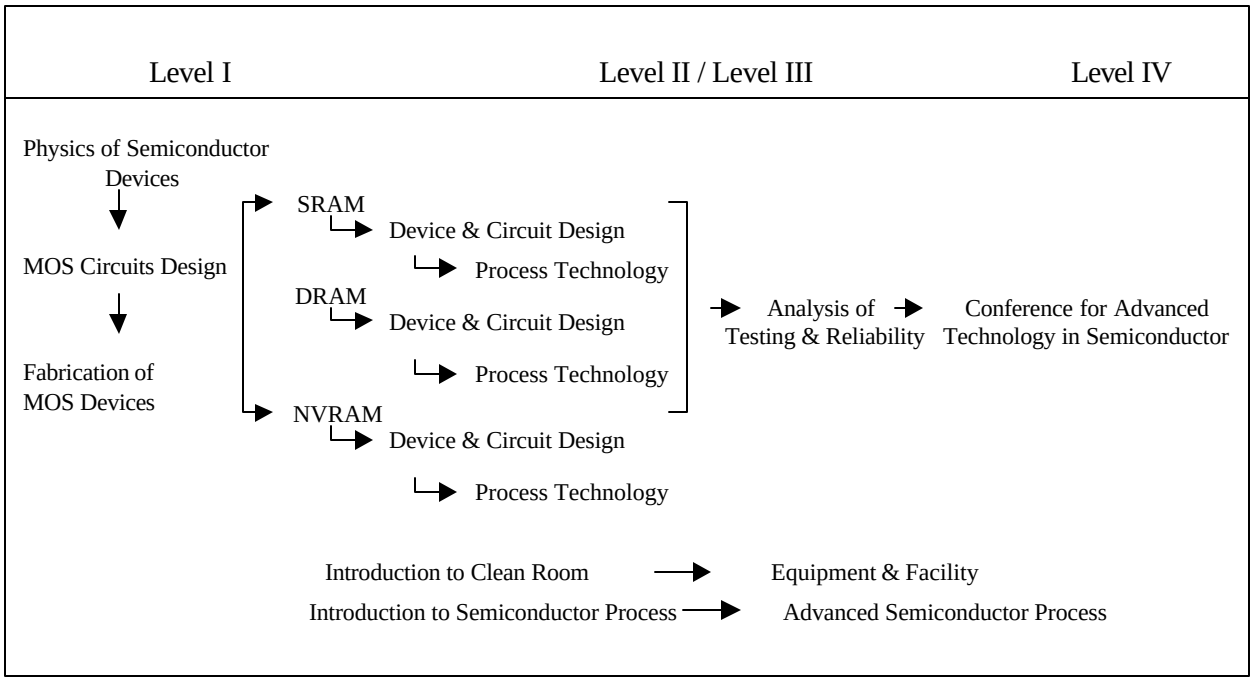

FIGURE. 2
Scheme of Semiconductor Technology Training Program

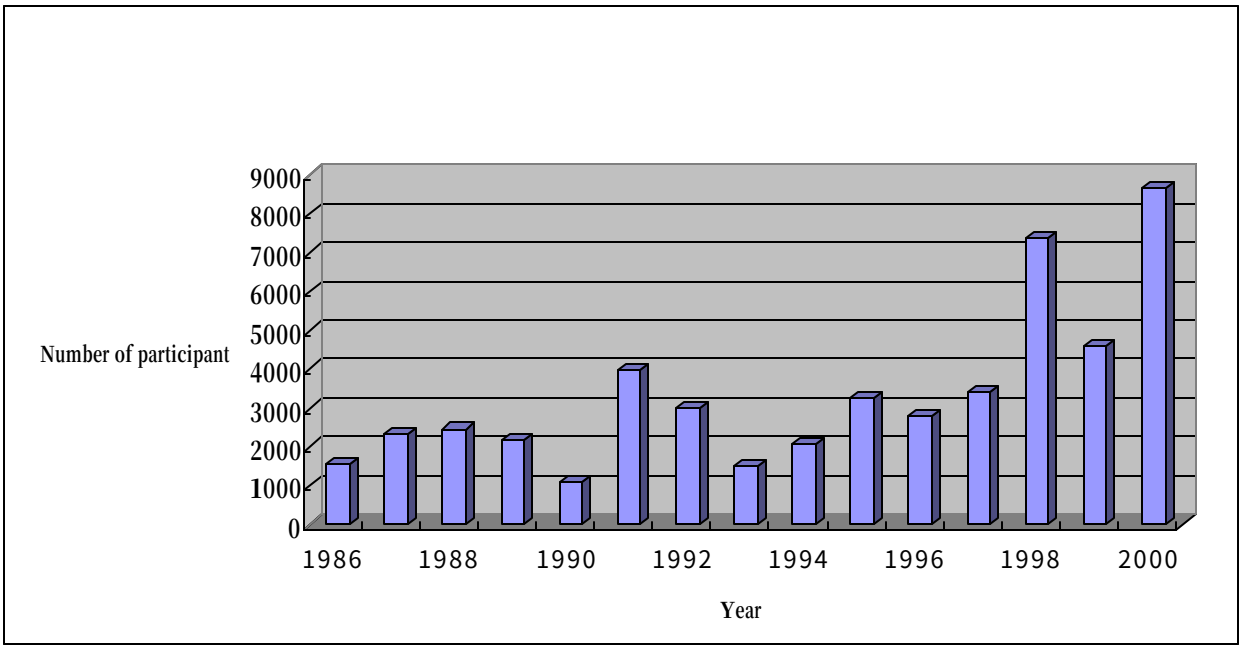

FIGURE. 3

NUMBER OF PARTICIPANTS IN SEMICONDUCTOR TECHNOLOGY TRAINING PROGRAM