THE FRENCH MICROELECTRONICS TRAINING NETWORK SUPPORTED BY INDUSTRY AND EDUCATION MINISTRIES

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Abstract

The Microelectronics Education in France is organised through a National Committee (CNFM) which makes links between Ministries (Education, Industry, Research), education institutions, and the trade Associations of this field. Eleven interuniversity centers providing education in process technology and Computer-Aided-Design in several fields of application were created during the 80's taking into account the geographic distribution of the research laboratories and training institutions. The aim of this paper is to show how CNFM constitutes a strength in the french education system and allows the development of the microelectronics education, as well as research beginner or continuing education.

1 Reason to create a National Commission

The pressing necessity for the french economy for a significant increase of the training capabilities in microelectronics appears clearly in the early 80's.

In order to answer to the industry's requirement, a first 4-year plan set up in 1982 by the Ministry of Education, allowed a multiplication by a factor 10 of the number of students trained at the "bac+5" level (engineers, Diplôme d'Études Supérieures Spécialisées, Diplôme d'Études Approfondies). The second plan, set up in 1986, aimed to double the number of graduates further, with a special emphasis on those trained in the design and testing of integrated circuits, an harmonization of software and workstation being achieved. The following plans aimed to consolidate the centers and particularly in order to insure their functioning and renewal equipments.

Such educational programs required that teachers had to be strongly involved not only in research but also in the practical use of the facilities that are compatible with those used by industry. To provide such practical knowledge, 11 inter-university centers have been established, representing both the large number of students being served (more than 5,000 students trained per year in the 90's), and the geographic distribution of industries, research laboratories and training institutions. The centers provide the means to supply the institutions within geographic area with significant resources for initial and continuing education as well as for the training of teachers or graduate students for research activities.

The coordination of these centers, with the dual objectives of covering the full needs of the industry and avoiding duplication of expensive and "heavy" equipments is carried out by the "Comité National de Formation en Microélectronique" (CNFM). The CNFM joins representatives of Ministries of Education and Industry, representatives of the trade associations, namely SITELESC and FIEE, and directors of the inter-university centers.

Continuous dialogue within the CNFM along with the movement of students and teachers among the centers are the main features of this resource center network. Each year, several meetings of the CNFM committee are held to review the results of the activities, in order to develop future objectives and to determine the facilities needed for continuously up-dating the practical projects carried out by the students. Every two years, a national meeting of teachers is organized by CNFM in order to update and exchange ideas regarding the microelectronic education programs.

2 CNFM / industry connection

All CNFM centers have close relationships with their regional area. They take advantage of the support of Universities, CNRS (Centre National de la Recherche Scientifique) and research laboratories of private organizations. CNFM centers are assisted by local industries which provide technical support and donate equipments. Dialogue between CNFM and the industries allows to adapt the education programs to the industry needs and to trade evolution. In return of the industry support, the centers provide industries with post-graduate students and engineers who have been trained in practical skills required for the careers in microelectronics. The centers also assist the industries by providing continuing education, especially SMI's.

3 The interuniversity Centers

The various centers are divided into three major centers along with eight specialized centers. In the technology area, the major centers provide complete facilities for the design and fabrication of silicon integrated circuits.

The specialized centers were created according to the same criteria as the major centers but they have not some of the required equipment for the silicon technology and they have to play a complementary role in the national training network in specific technologies. All the centers offer, mainly to local users, facilities for design and testing...
VLSI circuits (workstations, industrial CAD software and digital and analog test facilities).

The three major centers in France are:

- Atelier Interuniversitaire de MicroÉlectronique (AIME) located in Toulouse,
- CEntre de MIcroélectronique de Paris Ile de France (CEMIP) in Paris,
- Centre Interuniversitaire de MicroÉlectronique (CIME) in Grenoble.

They include a clean room of about 250 m² with all the equipments needed for the fabrication of silicon chips: diffusion, oxidation, ion implantation processes, etc...

The major centers also offer both technological simulation tools as well as instrumentation for physical and electrical characterization and measurements, packaging and testing facilities. The major centers make their operating facilities available to the different university institutions. In the area of technology, every student carries out a complete fabrication run of an integrated test circuit, including several hundred components or basic circuits.

The specialized centers are coordinated with the major centers. They are:

CCMO: Centre Commun de Microélectronique de l'Ouest in Rennes is equipped with simplified silicon technology (clean room of 90 m²) and CAD facilities. CCMO is the support for Western France institutions. It is, in fact, a "small" major center that develops also hybrid technologies for radiofrequencies and microwaves.

CCESMMA : Centre Commun d'Enseignement Supérieur de Microélectronique Avancée d'Aquitaine in Bordeaux, within the framework of IXL Laboratory. It has hybrid facilities technology and surface mount component technology as well as equipment for reverse engineering and failure analysis.

PLFM: Pôle Lillois de Formation en Microélectronique in Lille; it has facilities for III-V technology components and facilities for design and characterization of microwaves components and circuits.

PLM: Pôle Limousin de Microélectronique, in Limoges; it offers CAD resources and characterization of microwaves and optronic circuits.

C21MIRLY: Centre Interuniversitaire de Microélectronique de la Région LYonnaise in Lyon; it has facilities for characterization of materials and components and resources for signal processing.

LIRMM: Laboratoire d'Informatique, de Robotique et de Microélectronique de Montpellier, in Montpellier; it brings together all software and hardware CAD tools, and various test equipments.

MIGREST: Microélectronique du Grand EST in Strasbourg; it is the support for Eastern France institutions in design projects involving analog and digital circuits for instrumentation systems.

PMIPS: Pôle de Microélectronique de Paris Sud in Orsay; it has a clean room for implementing silicon process IC’s. Its projects have a MMIC orientation.

4 The role of CNFM

The major centers are organized to receive students of many regional institutions. The involved formations have to support part of the charges, the complement is provided directly by the CNFM. As a consequence, the CNFM has to negotiate each year with several Ministries to obtain both the usual working expenses and the equipment support. The annual direct financial support from Ministries to CNFM is more or less, without salaries, 4 million US$; this amount is significantly increased by support from territorial organisms, continuing education and industrial or research contracts. In addition, about 60 people are directly involved as manager or technical staff in the centers. As an example, CIME has an annual budget of 1.5 million US$ per year including the salaries of the technicians.

The CNFM centers use the same package of integrated circuit design tools, commercial CAD software available worldwide. LIRMM is in charge of the distribution and update these CAD software tools such as CADENCE HILO, XILINX & ALTERA, COMPASS, SUPREM III, SUPREM IV, ATLAS. These software tools run on SUN, HP, DIGITAL or PC-type workstation purchased in the framework of the CNFM equipment program.

CNFM is in connection with the Multi Project Chip service located in Grenoble; this organization allows the educational institutions and the University research laboratories to have their circuits fabricated in an accessible cost. Since 1981, more than 1300 circuits in NMOS, CMOS, bipolar, GaAs and BICMOS technologies have been manufactured.

5 CNFM in European actions

The CNFM has been involved since its creation in many european actions such as COMETT JITT (JESSI Transnational Technology Training), EUROPIC, EUROFORM UETP (University Enterprise Training Partnership) specialized in microelectronics, JESSICA (JESSI Conception d’ASICS), EURO-PRACTICE and FUSE (first user).

6 Conclusion

Since 1982, more than 20,000 students at last year engineer level (high engineer schools, DEA and DESS) had been sensibilized to the microelectronics technology and design. About 10,000 of them were specialized in these fields; in addition, more than 10,000 students at a lower level or in continuing education had benefited from these formations.

Today, the objective of CNFM is to sustain the number of students fully trained in microelectronics, to improve training quality, and to extend the microelectronics concept to more and more students, mainly by providing them with experience in practical IC's design.