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Knowledge and know-how in microelectronics; strategy of innovative practice to counterbalance the new theoretical on-line courses approach

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The huge evolution of microelectronics has led to a strong increase of the complexity of the circuits and systems. This evolution concerns all the aspects of the field from computer-aided-design and testing to the fabrication processes and characterization. In the same time, the spectrum of applications is increasingly wider and covers many domains from communications, energy and security to transport, environment and health. The knowledge and the know-how of the technicians, engineers, and doctors of the core of the discipline are more and more specialized but they must be also growingly wider for their applications.

The development of internet and internet of things associated to a huge improvement of the communications, of the computing power of the tools, and of software, encourage the development of pedagogical tools on-line that are supposed to make easier the theoretical learning of the students. Indeed, new on-line courses connected to big-data centers, allow the development of pedagogical tools that contain classical text, demonstrations, theoretical calculation, but also animations, videos, and simulations. If they supply some good bases to the students, this is definitely insufficient to prepare these students to apply their knowledge on real and physical objects, to solve new problems, and to have an innovative approach suitable to the societal needs. The mandatory complement can be given by practice under the form of lab-works, training on design tools, training on testing equipment, and on fabrication processes in dedicated cleanrooms.

This strategy was adopted by the French national network for the formation in microelectronics and nanotechnologies. This network is composed of 12 interuniversity centers that offer the possibility of training to 90 academic institutions but also to companies on more than eighty innovative platforms that include seven cleanrooms. The presence of these common centers is justified by sharing the expenses associated to the functioning and to the expensive equipment that cannot be assumed by only one institution as prestigious as it may be. These centers are first of all dedicated to education but are also opened to research laboratories and to the companies for specific experiments. In order to insure a high quality of the practice and an up-to-date content, each year, project calls for innovative practice on new platforms are made in the frame of the network. The topics are adapted to these new trends, i.e. for introducing topics included in the development of connected objects and their applications. Each year, these centers receive about 14,000 users corresponding to more than 800,000 hours of training. The training activities are composed for two thirds of initial education, and for one-third of innovative approach, a way to specialize the graduate students and the engineers, mainly. Several examples will be given showing the strong links between, higher education, knowledge, know-how and innovative behavior in a technological context with a fast and permanent evolution.

Experience:

Olivier Bonnaud was born in Marseilles (France) in 1950. Student at Ecole Normale Supérieure de Cachan from 1971 to 1975, he obtained the Master degree in 1973 at University of Paris-XI (France), his

PhD in Microelectronics in 1978 at Ecole Centrale de Lyon and Docteur d'Etat es-science degree in 1984 at University of Lyon 1.

Assistant-professor from 1975 to 1984 at Ecole Central de Lyon, he reached the full professor position at University of Rennes 1 (France) and Supelec (Engineers school or "Grandes Ecoles") in 1984 where he created the Microelectronics research lab which is today a department of IETR. He managed this laboratory during more than twenty two years. His research activities concerned mainly the polysilicon-based thin film technologies involved in integrated circuits and large area electronics, in sensors and actuators, and in multi-physics approaches in the last years. He published and presented more than 300 papers in these topics.

In parallel he co-created the Common Center of Microelectronics (CCMO), a multi-institution center mainly devoted for higher education in microelectronics for the West part of France. He managed this center till 2010 when he was nominated by the French Ministry of Higher Education as Executive Director of Public Interest Group (GIP) of the National Coordination for Education in Microelectronics and Nanotechnologies (CNFM), a National Structure that coordinates all the activities of higher education in microelectronics and nanotechnologies. He manages this GIP, since. Strongly involved in Higher education since more than 40 years, he has published or presented more than 200 papers on pedagogical purpose.

He was member and President of the University National Council in electrical engineering, President of the French Association of Electrical Engineering, President of the European Association for Education in Electrical and Information Engineering, Scientific Delegate for the National Research evaluation Agency (AERES), and President of the French Association of Microelectronics. He is since 2011 a Guest Professor at South-East University in Nanjing (China). Prof. O. Bonnaud was awarded with the title of "1000 Talents" by the Chinese government in 2013.