An Experience of Industry/University Collaboration in Microelectronics Education

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ABSTRACT

Producing well-trained engineers for the semiconductor industry poses unique challenges to existing educational systems worldwide. Creation of a new educational model, based on substantial cooperation between leading industry companies and universities, is required to overcome these impediments. This paper describes an experience of applying such a model which was developed and deployed by Synopsys Armenia Educational Department (SAED) with major universities in Armenia and the region.

1. INTRODUCTION

Training of highly-qualified specialists in the field of microelectronics has several unique aspects which pose special challenges to the existing higher education system worldwide. The rate of change [1] is incongruent between industry and university. It is necessary for students to combine theoretical knowledge with practical skills. Computer hardware and software for university engineering programs are expensive and often unattainable because of limited budgets. The latest technologies are usually not available to universities. These and other obstacles to effective, efficient engineering education are prevalent in most regions of the world - ultimately affecting the competitiveness of countries that want to develop technical industries.

2. THE ESSENCE OF SAED EDUCATIONAL MODEL

The SAED educational model augments students' basic training and promotes their specialization in the field of microelectronics. In the first years of the Bachelor program, students obtain a fundamental education in mathematics, physics, or other technical field at their selected university. Then, top-performing students are selected to participate in the SAED program. Further education in Bachelor and Master Programs and PhD studies is conducted using customized SAED curricula which address contemporary requirements of the semiconductor industry.

Studies are carried out in specially-equipped classrooms donated by Synopsys, located both in Synopsys Armenia offices and at the university. Classrooms are newly renovated and equipped with computer hardware, networks, software, and the latest EDA software tools from Synopsys. Teaching, course projects, diploma works, Master theses and PhD dissertations are targeted toward real industry projects at Synopsys Armenia.

3. AN EXPERIENCE OF MODEL IMPLEMENTATION

Taking into consideration the distinct characteristics of each University, different modifications of the presented educational model have been applied in the framework of cooperation with Synopsys and the following universities of Armenia and the region: State Engineering University of Armenia (SEUA), Yerevan State University (YSU), American University of Armenia (AUA), Russian-Armenian (Slavonic) State University (RAU) and Moscow Institute of Electronic Technology (MIET).

Cooperation with SEUA

On December 1, 2004, a cooperation agreement was signed between SEUA and Synopsys Armenia CJSC, according to which the SEUA Interdepartmental Chair of Microelectronic Circuits and Systems became a member of Synopsys' Worldwide University Program. According to the modifications of the new Industry/University educational model, Synopsys Armenia CJSC provided the SEUA Interdepartmental Chair of Microelectronic Circuits and Systems with: classrooms, laboratories, Synopsys EDA tools, computer hardware and software, professors' salaries, students' scholarships, professors' training, university degrees (Bachelor, Master, PhD), development of the University's technical infrastructure, and employment offers to students upon successful graduation.

Synopsys provided SEUA with 70 complete packages of the company's commercial EDA tools, and the total value of the tool contribution was 350 million dollars. The tools are used in practical, laboratory, diploma works, Master theses, and PhD dissertations. Each student has a PC in the classroom which is connected to the educational network where Synopsys tools are installed. The professors are trained by Synopsys' leading specialists. The University provides the curricula and the best professors. Selection of students is carried out upon their completing the 2nd year in the Bachelor program from the following departments: Computer Science and Informatics, Cybernetics and Radioelectronics.

The distinctive aspect of this modification of the Industry/University educational model is that classrooms and laboratories are located on the premises of the Company. Students study their 3rd and 4th years of the Bachelor program as well as the Master and PhD programs on the premises of the Company. This modification can be viewed as "University goes to Industry". The 7-year experience of applying this modification has demonstrated that it is the most effective. The cooperation between Synopsys and SEUA has already provided 180 graduates from the Bachelor program and 75 graduates from the Master program. Six graduates have already been conferred PhD degrees. Currently 201 students study in this program (123 in Bachelor, 69 in Master and 11 in PhD).

Cooperation with YSU

Following the successful experience of cooperation with SEUA, Synopsys decided to expand its cooperation with other leading Armenian universities. On December 7, 2005, an agreement of cooperation was signed between Synopsys Armenia CJSC and YSU. Simultaneously, Synopsys provided YSU with 30 complete packages of the Company's

commercial EDA tools. The total value of this contribution was 150 million dollars. Synopsys also provided computer hardware and software, professors' salaries, students' scholarships, professors' training, and employment offers to students upon successful graduation.

Synopsys EDA tools are used in practical, laboratory, and diploma works at YSU. The University provides the curricula, professors, students, and university degrees (Bachelor, Master, and PhD). The best students from two of the technical departments of YSU – Radio Physics and Applied Mathematics – continue their further education in the program after completing the 5th semester of their studies in the Bachelor program.

The characteristic of this modification of the Industry/University educational model is that classrooms and laboratories are located on the premises of the University. Students study their 6th, 7th, 8th years of the Bachelor program as well as Master and PhD programs on the premises of the University in the classrooms and laboratories donated and equipped by Synopsys. This modification can be viewed as "Industry goes to University". More than two years of experience in applying this modification demonstrated that this variant is also viable. Currently 42 students study in this program (21 in Bachelor, 21 in Master Programs). PhD education is anticipated in 2009.

Cooperation with AUA

In the framework of the Industry/University cooperation, Synopsys provides AUA with industry-leading electronic design tools, training, support, curriculum assistance, industrial input, consultations, and employment opportunities. AUA provides Synopsys with customized managerial courses for Synopsys managers, academic input, consultations, and qualified candidates.

So far, 48 employees of Synopsys Armenia CJSC have completed training in managerial courses.

The described Industry/University model has enabled high achievements from the viewpoint of improving Armenia's technology competitiveness. As a consequence, it attracted the attention of other universities in the region, and they have expressed their wish to apply a similar educational model in their universities.

Cooperation with MIET

On October 6, 2006, Moscow Institute of Electronic Technology (MIET), a former USSR leading university in microelectronics, became a member of Synopsys' Worldwide University Program. Given MIET's geographical distance from Armenia and other considerations, this Industry/University model is different form the previous ones.

First of all, only the Master program is jointly realized. Additionally, distance learning is carried out. Prior to educating students, MIET professors receive training in SAED. SAED provides MIET with all the necessary teaching materials – texts of lectures, presentation slides, descriptions of laboratory works, course projects, homework, etc.

In the beginning of each semester, distance learning is provided by SAED professors with participation of MIET professors who have been trained in SAED. In the last two weeks of each semester, SAED professors deliver the teaching and conduct exams in MIET. Supervision of Master theses is also performed by SAED professors.

Thus, Synopsys supports MIET by enhancing and modernizing the Synopsys-MIET Educational Center while providing coursework, professors' training, teaching, hardware, and administrative support. Synopsys' EDA tools are used in practical works, laboratory works, and Master theses at MIET.

Currently 40 students study in this program (20 1st year Masters, 20 2nd year Masters).

Cooperation with RAU

On September 25, 2007, Russian-Armenian (Slavonic) State University (RAU) became a member of Synopsys' Worldwide University Program. Synopsys Armenia has established "Microelectronic Circuits and Systems" Common University Chair in RAU, providing 50 complete packages of the company's commercial EDA tools, and the total value of the tool contribution was 260 million dollars. Synopsys tools are used in practical, laboratory, and diploma works. RAU provided equipped classroom. The selection of students is carried out from the following faculties: Physics-technical, Bioengineering, and Applied Mathematics. Studies are implemented in 1 specialization – VLSI Design.

At present, 22 students study in Bachelor program. 11 of them study in the 4th year and 11 are 3rd year students.

4. RESULTS AND FUTURE DEVELOPMENTS

The new Industry/University cooperation model, during the several years of its existence, has demonstrated obvious advantages. It is worth mentioning that as a result of the Synopsys and SEUA cooperation which began more than 7 years ago, more than 60% (about 200) of graduates have become employees of Synopsys by meeting the necessary requirements put forth during implementation of the model. They are filling the positions of leading specialists of the Company and even Technical Managers. The rest of the students continue their education in other programs – Master and PhD. Simultaneously, about 65% of employees of one of the largest business units within Synopsys are SAED graduates.

Considering the achievements of a new model for Industry/University cooperation, different foreign universities, particularly the Chinese Academy of Sciences, have expressed desire and started to apply the developed curricula.

As the new educational model realized by Synopsys in Armenia has brought enormous success, it has been highly appreciated by the Armenian community as well as by the involved Universities. Considering the achievements, Synopsys has been recognized as the 2006 Best Partner by SEUA. In addition, Synopsys management received Higher Awards from SEUA and YSU managements.

Going forward, the presented Industry/University educational model will be further developed. Constant modernization of the curricula, its standardization, and involvement of the needs of other Companies in the microelectronics industry located in Armenia are among the opportunities for enhancing this valuable and effective model.

REFERENCES

[1] G.E. Moore, "Cramming More Components Onto Integrated Circuits," Electronics, volume 38, number 8, 1965.