Educational Model the Case of Master Training in the Sphere of Multimedia Multiprocessor Systems-on-chip

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The article describes the educational program «Multimedia multiprocessor systems-on-chip» that is established on TSUCSR basis and implemented in «Elecard Devices» LLC. It is financed by the «Rosnano» PLC Fund of infrastructural and educational programs. The aim of the program is personnel training for developing and production implementation of new generation chips for digital television receivers, technologies 95-65 Nm [1].

Key words: *TUSUR, Elecard, Rusnano, Magistracy, Multimedia multiprocessor systems-on-chip.*

Educational model description

The main idea of master training is maximum immersion in working environment, corporate culture. It also implies competence approach to the training process, which means having training modules to form particular competences [2]. For example, one of the declared competences is the skill to develop digital devices on the basis of programmable logic integration circuit (PLIC). To form this competence the subject «Design basis of systems-on-chip» is included in the program. 21 competences are formulated in the same way and are implemented through 13 training modules (Table 1). Every competence corresponds to a number of requirements.

Our model provides the rotation principle inside the enterprise during the first term. It means that every student should pass three departments: customer support, marketing and sales department, and production testing department. Such rotation inside the company allows a master to choose the direction of his/her future activity.

After the first term the group is divided into three sub-groups according to the following directions:

- Systems-on-chip development
- Audio and video codec development
- Sales and marketing.

Every direction has its own set of disciplines, which are determined

Table 1.

Name of the module	Short description
Design basis of systems-on-chip	Processor modules with ARM architecture. SoC expansion module development. Prototyping for FPGA. Organization principles and basic elements of FPGA-macrocircuit. Languages for description of digital equipment. Introduction into VHDL, Verilog. Functional, structural description and development stages of a digital device. Design of system for digital signal processing. CAD modeling of digital devices.
Design of radio electronic means	The module contains three directions: microelectronics, pc card and mechanics of the body. These directions study the following issues: materials, technologic process, productivity, electromagnetic compatibility etc.
Systems-on chip architecture	Digital signal processors classification. Digital signal processors architecture and their peculiarities. Development and implementation of algorithm of digital signal processor considering its architecture. Architecture of general-purpose processors ARM, MIPS. Cross-platform compiling, remote debugging. Digital signal processor emulation and simulation.
Basis of audio- and video data compression	Basic concepts, color spaces, reception psycho models, quality notion. Digital processing of images. Theory of multimedia file and stream compression: compression with loss, compression without loss. Discrete cosine transform, fractal image compression, discrete wavelet transform, quantization scalar and vector. Video/audio compression standards. MPEG standards. Data multiplexing and synchronizing.
DVB digital video broadcast standards	Use and peculiarities of DVB-systems. Transport streams for reporting digital multimedia data. Coding and organization of digital data. Preprocessing. Error correcting codes.
Operating systems	Functions and architecture requirements to OS. Processes and streams. Time distributing of the processor. Memory architecture. Virtual memory. External device operation. Principles of computer system benchmark evaluation. Multiprocessing OS structure. Communication means of multicomputer system. Virtualization technologies. Protection of OS objects. Peculiarities of embedded OS and real-time Oss.
IP nets	Basis of computer nets. Physical level technologies. Information channel operation. Local nets. Level of network protocol. Level of transport protocol. Structure of an application layer and joint functioning of ULP.
IPTV technology	IPTV complex architecture: middleware, reception sub-systems, subsystems of processing, retranslation and protection of content, subsystems of quality monitoring of streams and customers' equipment. Services: VoD, TVoIP, Time Shifted TV, NPVR, EPG, NVoD. Interactive and Integrated services. Extra services: Video Telephony, Voting, Information Portals, Web, Games. Advantages of IPTV if compared with cabled and satellite TV. Web-TV. Broadcasting on HTTP protocol. RTMP protocol, its implementation and use prospects.
Programming languages and technologies	C/C++ and other contemporary programming languages. COM, SOM, COBRA. Structural, declarative and functional programming. Design patterns, abstraction layers, interfaces and contracts, error processing. Refactoring, specification of action sequences. Stages and types of software testing. Programming culture. Support systems and development of software projects. Effective use of C++ mechanisms.
Object-focused methods of analysis, programming and design	Basic elements of object-focused approach to the software development. Development of methods of object-focused analysis and design. Unified Modeling Language (UML). Direct and reverse engineering. Code re-use engineering. Typical structural, generating and management design techniques. Standard techniques of organization of software architecture. The Concept of independent architecture layers. Peculiarities of Web-applications architecture structure.
Translation techniques	Translation aim. Types of translation (compiling, interpretive translation, emulation, cross-compiling). Formal languages theory, generating grammars. Finite-state grammars, finite automation, lexical analysis. Context-free grammar, derivation trees, push-down automaton. LL(1) – parser. Postfix line and its generation by LL(1) – parser. Generated code optimization.

Name of the module	Short description
Technology of creating commercial software	Software product market research. Software production process stages. Cost estimation of commercial software product. Advertisement and software promotion on the market. Sales techniques.
Parallel programming	Basic notions, terms and basic laws of parallel processing of information. Review of formal models of parallel systems and processes. Connection between elements of parallel systems. Net link metrics. Functions of data routing. Static and dynamic layout of communication nets. Conveyer computers. Superscalar processors: their architecture. CISC and RISC architectures. Program optimization. Hardware optimization. SIMD computing systems. Vector processor. Computing acceleration in vector processors. The structure of matrix computing system. Stream and reduction computing systems. Adaptation of sequential programs to parallel architectures. Languages and libraries of parallel programming.

by individual curriculum. One and the same subject can be often met in the syllabus of both technical directions.

A typical thing for the education process is weekly-held seminars where the masters report on the process and results of their researches. Current educational issues and problems are also discussed on the seminars. Such seminars and masters' reports are beneficial not only for current control but also for good feedback that provides content correction of the program.

Apart from the special modules, the program includes the English language. The practical training is carried out by a teacher who has good language experience. The practical training is mostly focused on listening and understanding authentic dialogues, news, TV programs connected with the sphere of the enterprise activity: digital TV, multimedia data compression etc. Such attention to the foreign language is conditioned first of all by the requirement to modern professional environment: any successful IT-specialist should know English well. The students of the program have the possibility to take part in annual international exhibitions where they can communicate with foreign customers of the enterprise. During such communication it is important not only to understand the questions asked, but also to be able to describe the advantages and peculiarities of the software and hardware solutions made by our company.

Like any social environment, the model under consideration has its system of incentives and penalties. One of the encouragements is the exhibition activity mentioned above. Financial stimulus for the best students is more significant: they have increased university scholarship and salary of the enterprise.

Problems of the model implementation

Most part of the model described above has being implemented since the 1st of September 2010. However, like any real system, it has some problems.

Firstly, it is student quality. In spite of high requirements of the program to the applicants not everybody meets them. The reason is more likely the lack of time for admission rather than defects of admission testing.

Secondly, the degree of student immersion in this or that subject is still unclear. For example, what level of communicative skills should a developer of devices based on programmable logic circuits have? There is an opinion that it is useful for students to know all the subjects they are taught. In this case a student spends a lot of time on subjects he/she doesn't like. This time could be spent on more profession-focused (oriented) courses. This problem refers directly to the education model and should be solved while the discussion between the university and company representatives. One of the solutions might be the possibility for

the student to attend non-core subjects in reduced volume.

Thirdly, heads of the departments don't pay enough attention to the rotated students. Not all the heads would agree spending a lot of working time with students. Even less would give them serious tasks (problem) risking to fail it because of students' lack of experience. Such problem can be solved at the enterprise level.

Naturally, the whole set of problems includes more than these three points. There are minor problems that are solved in the course of the program. Time will certainly show even more obstacles but they all can be solved if the university and business find common ground.

REFERENCES:

1. «Elecard» company and ROSNANO create a base for digital TV using Russian developments [electronic resources]//ROSNANO: site «ROSNANO» OJSC. – Moscow, 2007-2011. – URL: http://www.rusnano.com/Post.aspx/Show/24933, free. –Headline from the screen (reference date 01/02/2012).
2. Medvedev D.S. Master program in Innovation Institute for «Elecard» company: ..... In-tainnovation. On the result of 2010. / D.S. Medvedev, A.A. Pozdnyakov. – Tomsk, 2011. – pp. 18-22.