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An Outstanding Example of University-Industry Partnership: the Latvian Case[1]

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Abstract. The Latvian ICT sector is unquestionably the leader in co-operation with educators. In the year 2000, leading Latvian professional ICT associations established the Council of Professional Education. The Council on behalf of employers and industry has coordinated the development of requirements for needed professionals, has established requirements for qualification exams, and approves membership of qualification commissions. Based on these requirements and on ACM/IEEE Computing Curricula, the University of Latvia performs an innovative computing study programme that organically comprises academic and professional education, and covers all the five ACM/IEEE Computing Curricula disciplines: computer science, software engineering, information systems, information technology, and computer engineering.

Keywords: computing, study programme, university-industry partnership.

1 Introduction

Relations between academy and industry are nearly always somewhat contradictory. The former relies on long-term research and education process, while the latter needs immediate solutions and narrowly, however, deeply educated employees. Overcoming the gap between the two parties is by no means easy.

The ICT sector is unquestionably the leader in co-operation with educators in Latvia. In the year 2000, leading Latvian professional ICT associations established the Council of Professional Education. The Council on behalf of employers and industry has coordinated the development of requirements for needed professionals, has established requirements for qualification exams, and approves membership of qualification commissions. Based on these requirements and on ACM/IEEE Computing Curricula [1], the University of Latvia performs an innovative computing study programme that organically comprises academic and professional education, and covers all the five ACM/IEEE Computing Curricula disciplines: computer science, software engineering, information systems, information technology, and computer engineering.

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Levels of ICT education are described in section 2. Current situation in ICT sector is covered in section 3. Latvian professional higher education system is explained in section 4. The unique employer' s ability to influence Latvian universities' study programmes and their presentation is given in section 5. The University of Latvia computing study programme as an innovative approach to education is presented in section 6. Bologna process movement in the right direction is questioned in section 7.

2 Levels of ICT Education

The Organisation for Economic Co-operation and Development (OECD) has recommended that skills related to information and communications technologies (ICT) be classified into three major categories:
Professional IT skills: The ability to use complex IT tools and/or to design, repair or create such tools;
Applied IT skills: The ability to use simple IT tools in general places of employment (not ones related to IT);
Basic IT skills: The ability to use IT tools for simple tasks and as an educational tool.

At this point it is worth explaining that the concept of ICT is interpreted in Europe as referring to information technologies, telecommunications or electronic communications, and electronics. In other words, it regards a sector of economy in which various kinds of electronic equipment are manufactured, including computers and electronic communications equipment, communications networks are established, software and information systems are designed, and relevant services are provided. Among these, of course, the most common ones are telephone and Internet services. The concept of "IT", however, has several meanings. In the narrowest sense, it refers to the design of computer software or information systems, while the concept of IT skills refers to the ability to use this software. However, in a broader sense, IT and ICT are synonyms.

ICT is a special sector because its products and services are used by almost everyone and everywhere. In this sense it reminds one of the infrastructure sectors-transportation. It is no accident that until 2003, the ICT sector in Latvia was governed by the Ministry of Transport. Not everyone has to know how to build motor vehicles and roads, but people do have to study before they can drive a motor vehicle. Not everyone must know how to design ICT tools, but there is usually a need to study them before use

There are 13 institutions of higher education in Latvia where one can pursue a degree in IT – in Rīga, Daugavpils, Liepāja, Jelgava, Rēzekne, Ventspils, Valmiera, Jūrmala and Jēkabpils. There are also some 10 professional IT high schools. 80% of those who receive a degree in ICT come from the Riga Technical University, the University of Latvia and the Transport and Communications Institute.

In Latvia applied IT skills can be learned through a programme known as the European Computer Driving Licence (ECDL). The programme was introduced in Latvia in 2001 by the Riga Information Technology Institute (RITI). The programme licence holder is the Latvian Association of Information and Communications Technologies (LIKTA). Currently the programme is being implemented by the University of Latvia, but certification exams can also be taken in Latvia's regional centres. It must be emphasised that a certificate issued in Latvia is valid in more than 40 countries, including all the European Union member states .

Latvia is the first country in the world to introduce the ECDL programme in the general national education programme. Since the autumn of 2003, basic IT skills have been taught at the elementary school level, while applied skills to satisfy all ECDL requirements are taught at high schools. There are several companies that offer training in this area on a commercial basis. Still, we are at the beginning of the road, because only about 2,000 certificates have been issued so far. In nearby Sweden, by comparison, nearly one million certificates have been issued.

3 What Is Happening in the ICT Sector?

The days when anyone who knew how to switch on a computer could hope for a salary of USD 100,000 per year in America are long gone, and they are irretrievable. Neither is it true any longer that naïve investors are in a hurry to invest all their money in any company that has anything to do with information technologies. Economic stagnation in America, Germany and many other "engines of the global economy" in the early part of the 21st century made people think about every dollar and euro before it was spent. Research and development budgets were the first to be cut, and there was also less spending on the development of information systems and on outsourcing. These, however, are the three major pillars of the entire ICT sector. The economies have recovered, and the pillars are back in place, but there are far fewer pointless investments and thoughtless spending projects in the area of information systems. National economies require experts with in-depth knowledge, skills and experience in the area of ICT and and in its relevant areas. "Soft" skills will also be of key importance – the ability to read, speak and write in several languages, dedication, responsibility, the ability to manage others, etc. It will be very hard to find job without the aforementioned "soft" skills and professional experience. University students need to think about professional and "soft" skills while they are still at school, and they should accumulate as much professional experience as possible.

We understand increasingly that there are two possible routes in the ICT profession – the "deep" and the "broad" route. In the first case, the professional has very detailed technical skills and knowledge in a fairly narrow sector in which he or she will always be able to find job – although not always in Latvia. In the second case, the knowledge and skills will be broader, but the professional will not always have sufficiently detailed or precise skills for a specific job. Compensation for this will be provided by a wealth of "soft" skills. As one person humorously put it, those who

know how will always have work, and those who know why will always be their bosses.

There are several places on the Internet [2, 3] where one can learn about the specific knowledge, skills and properties that are needed in the ICT sector. The first of these was established by a consortium of prominent European ICT companies so as to encourage universities to adapt their ICT study programmes to the demands of the labour market to a greater extent. The second site was established by the Professional Education Administration of the Latvian Ministry for Education and Science. The PEA is the institution which maintains professional standards. These standards are defined by the state so that employers can inform educators about the kinds of workers and qualifications that are required No professional education programme may be launched in Latvia before the relevant professional standard has been implemented. ICT is the only sector in the economy which, thanks to the sector's Professional Education Council, has drafted all the necessary standards (Table 1).

Table 1. The standards of the ICT profession

	IT	**Telecommunications**	**Electronics**
5th-level qualification	IT project manager; Systems analyst; Software engineer	Telecommunications engineer	Electronics engineer
4th-level qualification	Software developer; Tester; Computer network administrator	Telecommunications specialist	Electronics specialist
3rd-level qualification	Software technician; Computer systems technician	Telecommunications technician	Electronics technician

It is worth looking at the level of education among European ICT specialists. Research shows that the proportions vary from one EU member state to another, but on average 50 to 70% of ICT specialists hold at least a bachelor's degree, while 30 to 50% have the so-called sub-degree education. In Latvia, this applies to people who have pursued their education at a college or a professional secondary education institution. There is a view that in quantitative terms, demand for ICT specialists is currently satisfied in Europe, but there is a need for a greater proportion of specialists with a college diploma or bachelor's degree. The education structure in Latvia's ICT world is dominated by bachelor's degree programmes, and there are more master's degree students than there are college students. This structure would be considered mistaken in Europe, but in Latvia it may be quite commendable. The labour market for our ICT specialists cannot be limited to Latvia alone. Specialists will be able to compete abroad only if they have higher education – a master's or doctoral degree.

Latvia is a very small country, and its ICT market will not be worth more than EUR 60 million per year in the foreseeable future. This means that no more than 2,000 specialists will find work in the near future. Others will have to find jobs in state, local government and other organizations, taking care of their information systems. Perhaps several thousand specialists can find work in these areas. This is not good news, given that each year more than 1,000 specialists graduate from higher education institutions. The good news, however, is that since May 2004, the ICT market has become 200 times larger, because Latvia is now a member state of the European Union. Of course, without preparedness and only with Latvian and Russian language skills no one is going to find a job outside Latvia, but another bit of good news is that the proportion of small companies in Latvia will triple and draw closer to the European level. This will mean a major increase in the use of information technologies at such companies. If one ICT specialist can provide services to 10 small companies, that will mean a need for approximately 8,000 specialists .

4 Professional Higher Education

Over the last 15 years, massive changes have taken place in the Latvian economic system, and one of the negative side effects to this was the breakdown of connection between the economy and the education system. New study programmes were often based on the capacities of education institutions, not on the requirements of the labour market. There was no one to formulate that demand in any event. During the previous era, internship in industrial setting was an integral part of study programmes, but that was no longer true. Employers regularly complained about the fact that the knowledge and skills of graduates were not in line with modern requirements, particularly in the field of information technologies and other areas of engineering. There was concern about the fact that Latvia, in comparison to the "old" countries of Europe, had proportionally low numbers of students at the so-called post-secondary non-tertiary level of education (the phase between secondary and higher education, as defined in UNESCO ISCED-97 [4], the 4th level, and in Latvia's case, approximately at the level of former "tehnikums"). This suggests that there were some areas in which graduates suitable for the market could be trained in a shorter period of time – just a few years after graduation from high school.

Here it should be explained that the issue back then was not the present-day trend of insisting that everyone pursue a three-year bachelor's degree. Instead, the aim was to ensure that high school graduates pursued areas of specialisation that were in demand in the labour market. Later this process unofficially became known as college education – the first level of a professional higher education. Officials at various universities were afraid of the competition and the possibility that their students might be tempted to attend colleges instead. Making use of competition among the various departments of the Ministry of Education and Science, they achieved the inclusion of colleges in the system of higher education. This was completely in opposition to the initial goals of the reforms, as well as to the intentions of the minister of that time, Jānis Gaigals. The numerical disproportion between students pursuing higher

education, professional secondary education and post-secondary non-tertiary education has expanded, not shrunk. Latvia has become a country in which there is basically no opportunity to pursue education that corresponds to the aforementioned 4th level of the UNESCO ISCED-97.

We know this now, but we could not know it in 1999, when the author of this article invited several leading specialists from IT companies to visit the Riga Information Technology Institute (RITI, a research institute belonging to the stock company Exigen Services DATI) so as to draft requirements related to the professional qualifications of specialists in the area of software development and design of information systems.[2] First to respond were Valdis Lauks from Fortech, Ivo Odītis from the Bank of Latvia, Jānis Plūme from IT Alise, and Uldis Sukovskis from RITI. Employers wanted to dissociate from fruitless criticisms of the education system and its universities and to become involved instead in the restructuring of study programmes in a practical way. There was a certain degree of serendipity. Shortly after the working group was assembled, I was sought out by Aleksandra Joma, a project director for the Professional Education Development Programme. She was looking for people who could handle a PHARE-financed programme, "Professional Education 2000". The working group immediately became involved in what proved to be an enormously successful and sustainable project, "Establishing a Structure of Professional Qualifications". Our aim was to study the condition of the information technology sector (the construction industry was also studied), to consider the professions that are needed therein, to select one or two most highly demanded areas (we sensed that this could be in line with the so-called fourth professional qualifications level in the understanding of the law on professional education, with employees of this kind trained by the intended colleges), to draft descriptions or standards for the professions and to prepare sample study programmes. We hoped that the methodology that we were designing and testing would serve as an example for similar standards in other professions and sectors.

2 This was not the only Exigen Services DATI and RITI initiative in the area of education and research. One can cite, for instance, the co-operation between RITI and DATI with the University of Latvia Institute of Mathematics and Computer Science on the design of the well-known GRADE system. The RITI introduced the European Computer Driving License programme in Latvia in 2001. It served as a cornerstone for research and development in the IT industry, including the writing of doctoral dissertations. DATI guaranteed Hansabanka loans for students before the national government began to do so. We have worked with the Latvian Education Fund and its "For Education, Science and Culture" programme to award scholarships to doctoral students and prizes to the authors of the best master's degree, bachelor's degree and engineering papers. DATI holds conferences for computer science students each year. The Latvian Academy of Sciences works with DATI and the Latvian Education Fund to award the Eižens Āriņš prize. There is ongoing support for informatics olympiads for schoolchildren at the Latvian, Baltic, and global level. RITI is also the "seat" for the Sub-Commission on Information Technologies and Telecommunications of the Terminology Commission of the Latvian Academy of Sciences, and of the Council on Professional Education in the Fields of Information Technologies, Telecommunications and Electronics.

By September 2000, we had prepared the description for the information technology, telecommunications and electronics (now known as the ICT) sector [5], as well as a professional standard for the category "Software Developer" [6]. We had also prepared a sample programme of study. The work was done by a group of educators under the leadership of Professor Jānis Grundspeņķis of the Riga Technical University. All that remained was a seemingly petty issue – ensuring that project director Aleksandra Joma would not be concerned about whether the ICT sector would declare the results to be good and about who would be able to do so in the name of the entire sector. At that time the author was the president of the Latvian Information Technology and Telecommunications Association (then the LITTA, now the LIKTA), and he had involved people from three other professional organisations in the sector in the work that was done. These were the Latvian Association of the Electronics and Electronic Technologies Industry (LETERA), the Latvian Telecommunications Association (LTA), and the Latvian Computer Technology Association (LDTA). It was not therefore difficult to reach agreement with the fellow presidents (the well known Inārs Kļaviņš, Pēteris Šmidre, and Dzintars Zariņš) on how to evaluate and approve the project results. This gave the green light for the Sub-Council on Tripartite Professional Education and Employment Co-operation (PINTSA) to give its approval as well. In January 2001, as a result of this, the Minister for Education and Science officially confirmed Latvia's first professional standard on behalf of the government. The four association presidents also reached agreement on the establishment of a Professional Education Council for the sector. It was entrusted with representing the sector in the area of education – coordinating and confirming professional standards, coordinating and confirming requirements for examination of qualifications, and confirming experts who would represent employers when those examinations occurred. It is easier to walk down a beaten path, and so it was far easier to draft the following standards after the first one was in place. Today there are 14 standards which have been implemented with the direct or coordinating participation of the Professional Education Council. The ICT sector is unquestionably the leader in co-operation with educators. Since 2006, the Professional Education Council has been chaired by the vice president of Exigen Services DATI, Uldis Smilts.

5 The Employer's Ability to Influence Study Programmes and Their Presentation

As was mentioned in the previous section, employers, via the offices of the Professional Education Council established by professional associations, participate in the preparation of standards in the profession, but that is not the only way how they participate. According to government rules, at least a half of members of examination commissions must represent employers, and that includes the chairperson of the commission. Membership of commissions is approved by the Professional Education Council.

The same commissions also award professional qualifications. To make sure that the work of the commissions is not arbitrary, the Professional Education Council approves qualification requirements that are afterwards examined by members of the commission. Educators will prepare students to satisfy the qualification requirements.

Another way to influence the study process is to establish study programme councils at universities on the principle of parity between educators, students, and employers. Each major change to the curriculum must be first discussed and confirmed by this council. That does not mean that university Senates will automatically approve changes, but there have to be very fundamental arguments to get the Senate to disagree with the solution of such councils.

Employers make an enormous investment by offering internships to many students. These internships last for four to six months. Industry experts with higher education are often asked to serve as academic advisors to final theses, particularly at colleges and at the bachelor's degree level.

At the national level, an important annual event is the meeting between members of the Professional Education Council and directors of ICT study programmes at universities and colleges. Education issues are also usually on the agenda of the annual LIKTA conference, as well as of the international "Baltic IT&T" conference. The most important requirements of the ICT sector are included in LIKTA declarations which are then submitted to the government.

Universities and colleges are willing to include elective courses in their curricula which are provided by ICT companies. Companies are expected to provide the necessary equipment, software, textbooks and lector. Alternatively, they can provide financing for the course. This approach has led to the fact that many Latvian universities and colleges have the Microsoft IT Academy, CISCO Academy, and study courses provided by the Exigen Services DATI, the Baltic Technology Group, Tilde, IBM Latvia, etc.

A particularly high level of academic co-operation involves doctoral dissertations written on subjects that are of interest to companies in the ICT sector. Authors can use the infrastructure and information base of these companies as they write their dissertations.

6 The University of Latvia Computing Study Programme as an Innovative Approach to Education

The ICT sector in Latvia and the world has experienced a very rapid growth over the last 10 years. According to the Ministry of Economics of Latvia, the sector produces 5 to 6% of Latvian GDP, and exports are worth nearly EUR 150 million. The sector has been declared a national priority by several governments, but in the Latvian language, sadly, it does not have a single name. The terms that are used, as translated

into English, include "computer studies", "informatics", "information technologies" and "information and communications technologies." On April 4, 2006, the Cabinet of Ministers approved the order No. 267 [7] to announce that the word "datorika" is to be used as a translation for the word "computing". The term "computing", as we know [1] refers to a thematic part of education – the one which covers computer sciences, information technologies, information systems, software engineering, and computer engineering. The objectives of higher education in terms of supporting the further development of the computing sector are the following:

1. Prepare highly qualified and export-capable specialists for practical work at companies and government institutions – specialists who not only can design and produce complex information systems, but also manage projects and independently learn about new technologies in the rapidly changing environment of computing;
2. Prepare academically educated specialists who are prepared to do scientific work in the computing sector – research projects in the computer sciences in Latvia, as well as expert participation in the evaluation of new technologies and systems.

These are contradictory requirements because an academic higher education is based on science, while the knowledge that is needed in practice is based on engineering and the study of production processes.

The proposal is to train computing specialists on the basis of a four-level pyramid:
1) The college level, which trains software designers and computer network administrators with a level of knowledge and skills equal to the first-level higher professional education standard;
2) The bachelor's level, where students learn not only about software design, but also about the design and development of complex software systems;
3) The master's level, where students learn to analyse and design large systems, and to run projects;
4) The doctoral level, where highly qualified specialists are trained to work with major and complex projects and to work at universities.

This proposal regarding the training of computing specialists has been approved at several meetings of company representatives and university representatives (the first in 2000, with the participation of Ministers of Economics and Education, another during the November 2004 LIKTA conference, the third organised by Exigen in March 2005, etc). The focus on the demands of the Latvian economy for highly qualified computing specialists is very different from other exact science study programmes at the University of Latvia, because these programmes are focused, at least formally, on the training of scientists and teachers.

The objective of the proposed programmes [8] is not only to ensure that specialists are trained at all four higher education levels, but also to ascertain that there are opportunities to pursue all five areas of specialization (disciplines):
1) Computer science (CS), where the programme covers the mathematic processes of computer science, system modelling and issues related to artificial intellect;

2) Information technologies (IT), covering the design and use of computer networks and clusters, as well as sound and image processing;
3) Information systems (IS), focusing primarily on database management systems, as well as the design, implementation and maintenance of information systems;
4) Software engineering (SE), focusing primarily on software design and production of software, including embedded systems;
5) Computer engineering (CE), which covers the design and manufacturing of electronic equipment.

In what sense are these study programmes original?
1) *All areas of computing are covered in one programme at each level of higher education*. During the first two study years, students can choose to pursue SE to receive the qualification of "Software designer", or they can study IT and receive the qualification of "Computer network administrator". This is a choice that has to be made at the beginning of the second study year. During the first two years, the two areas of specialisation differ only in terms of internships that are worth 24 ECTS credits (16 weeks). The internships are organised in the fourth semester. There are also 12 ECTS credits for writing the thesis, and work on that begins in the third semester. Those specialising in SE need software design practice and a qualification thesis in software design. Those pursuing IT must engage in an internship focused on computer network administration and also write a paper of the same kind. Internships can begin before the fourth semester. In the third study year (the fifth semester), students can choose any of the five areas of specialisation, irrespective of the diplomas or qualifications that they already have: CS (more theoretical), SE (more focused on software design), IS (more focused on the design and maintenance of information systems), IT (more focused on computer networks), or CE (more focused on the construction of electronic equipment). This study programme organically merges the study of fundamental aspects of the profession with vast opportunities for specialisation and theoretical study. It is the only programme of this kind in Latvia.

2) To a certain extent, this programme represents a return to the Soviet system, which provided for a *mandatory semester-long internship outside of the educational institution at the conclusion of the 2nd year of studies*. This internship allows young people to decide whether they have made the right choice in terms of their study programme and their selection of a profession. They also begin to accumulate professional experience, and that is often the first criterion for hiring a new employee.

3) There are *very close links to the industry* – representatives of employers are on the councils of study programmes and on the commissions which test people's qualifications. There are more than 50 contracts on internships and specialised courses of study provided by leading IT companies such as Microsoft, CISCO, the Exigen Services DATI, the Baltic Technology Group, etc.

4) *There are still powerfully academic and research-based studies* in the upper years of bachelor's degree studies and, of course, at the master's and doctoral level. Instructors at the University of Latvia are equally strong in theory and practice. The science citation index of peer reviewed scholarly publications produced by instructors

at the University exceeds the total number of science citation index of such publications produced by all other instructors and scientific researchers in Latvia, Lithuania and Estonia taken together.

5) The study plan is structured so that *when a student receives a diploma, he or she can pursue further studies in any other area of specialisation without having to take a catch-up course*. The specialization does not have to be selected before the young people start their studies – often they have a fairly unclear understanding of the programme of study and of their future profession. The first choice – software designer or computer network administrator – must be made at the beginning of the second year, while the second – CS, SE, IT, IS or CE – must be made at the start of the third year. The first university diploma (college level) is received at least one year sooner than elsewhere in Latvia.

7 Is the Bologna Process Moving in the Right Direction?

Once we come to the firm understanding that there are very different areas of knowledge and that those which are of use in theology are not of use in physics and vice versa, it will be easier for us to understand that a unified process is not possible without specific exceptions. Europeans tend to move toward three-year bachelor's degree programmes, which may be all right for humanities, but is certainly unacceptable for those areas of study which cannot be imagined without serious internships (medicine and engineering, including computing). One cannot understand at what expense Europeans are trying to achieve the main goal of the so-called Bologna process – to compete with the United States and to surpass the USA in terms of the level of higher education. Do we have far better instructors and far more talented students so that we can achieve in three years what the Americans achieve in four?

This means that in the higher education system related to ICT, there should be no study programmes which allow students to receive a diploma without a serious internship. Three-year programmes with no internship opportunities are at all absurd. The so-called academic study programmes in engineering produce hundreds of young people each year – young people without the slightest industrial experience.

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