Higher Education Quality Assessment Centre of Estonia

Joint Final Report

University of Tartu

Programs Assessed

6464120 Computer Science (Bachelor)
7464110 Computer Science (Master)
8464110 Computer Science (Doctorate)
7141041 Teacher of Informatics (Master's Diploma)

Visit Dates

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Part I

General Overview

The Higher Education Quality Assessment Centre of Estonia has invited three university experts from Denmark, Germany, and the United States to review and make accreditation recommendations for four computer-related programs at the University of Tartu (hereinafter called "University"). The programs include Computer Science at the bachelor, master, and doctoral level and a post-bachelor diploma program in the Teaching of Informatics. The Institute of Computer Science (hereinafter called "Institute") directs these four programs.

The expert team visited the University Monday and Tuesday, 15-16 February 1999. The expert team met with and personally interviewed each full-time member of the faculty. It also conducted interviews with groups of graduate and undergraduate students. It visited all computer laboratories at local and remote sites where the students of the Institute could work with computers. It visited the library of the University and the local collection of volumes and periodicals within the Institute. The expert team also met with the Vice-Rector and the Dean of Academic Affairs during its introductory meeting.

At the conclusion of the visit, the expert team conducted an informal exit interview with the members of the faculty and highlighted some of the strengths and weaknesses of the programs under review. The expert team was well received by the members of the Institute and in its opinion, the outcome was a positive and constructive experience for the University and the Institute.

What follows are the findings of the expert team (Part II), general recommendations (Part III), and accreditation conclusions (Part IV). In Part II, the findings are relative to the program standards as established by the Ministry of Education, which are found in Appendix 4 from the *Manual on Quality Assurance in Higher Education in Estonia* dated 1995 (hereinafter called "Standards"). It is the hope of the expert team that the Institute, the University, and the Accreditation Council view its findings, recommendations, and conclusions as a constructive mechanism to improve the quality of the programs.

Part II

Findings

The following are the findings of the expert team. The self-study report submitted by the Institute, the observations made at the time of the visit, and the supplementary material received by the expert team during the visit form the basis of these findings. The observations are in two subdivisions: A and B. Subdivision A concerns the programs in computer science for the bachelor, master, and doctoral levels. The expert team has integrated its observations for the three programs in these findings. The bracketed indicators refer to the relevant sections of the Standards. Subdivision B concerns the Teaching of Informatics master's diploma program.

Division A – Programs in Computer Science

1: Structure and Management of Educational Policy

The Institute has developed well its courses and the faculty performs their execution carefully. Distance learning has advanced the evolution of the curriculum and the faculty has made efforts into the preparation of a strong distance learning program. Such classes have begun this semester and there are high hopes for the future of this initiative. The expert team appreciates the initiative as a competent and far-sighted project.

The Institute must cope with several difficult problems. The most pressing problem is to recruit a new generation of academic teachers for the Institute. The graduating students are attracted to positions in industry, which is good for the country. However, without excellence in research and teaching, the quality of the graduating student will diminish and will produce long-term harmful effects. While these considerations are not deficient with respect to the Standards [201.1], they do raise a concern relative to the future growth of the program.

The units collaborating in teaching computer science are the institutes of computer science, applied mathematics, pure mathematics, and mathematical statistics. The collaboration appears to be functioning relatively well and satisfy the Standards [201.2]. However, there is no systematic procedure to analyze the academic quality of the teaching program, which is a deficiency regarding the Standards [201.3]. However, the faculty members do carry out some quality control on a ad hoc basis, and as a consequence, some program modifications transpire when needed.

There does not seem to be an explicit supervisory system to monitor performance of staff except for the responsibility of the professors in the department. This introduces a deficiency concerning the Standards [201.4]. The faculty does monitor student performance and their progress by weekly exercises in their subjects and by examinations at the end of the terms. Furthermore, the department of computer science teaches the introductory computer classes for students from the entire faculty. There is a clear definition of this responsibility satisfying the Standards [201.5].

2: Students

The worldwide labor market indicates a high demand for computer professionals that is not met by the small number of computer science and informatics students in Estonia. In particular at Tartu, only a small number of students are admitted to the bachelor, diploma, master, and doctoral programs in computer science and informatics. Students start their bachelor-degree study at the Faculty of Mathematics without a clear understanding of their admission prospects in computer science after their second year. Some proceed with pure mathematics just because they were not admitted to the computer science program because of the quota set by the Faculty of Mathematics.

There have always been more applicants for compute science specialization than allowed by the quota, which the Dean of the Faculty of Mathematics establishes. This is counterproductive to the needs of the Estonian society that is in a higher demand of computer professionals than mathematicians. Hence, this is a deficiency with respect to the Standards [202.1]. The expert team strongly suggests the establishment of separate bachelor admission quotas for computer science and

for mathematics. In particular, this should occur at the beginning of their studies. Transfer between study programs (computer science and mathematics) should be allowed within the first two years of study. Additionally, the University should set a quota of entry-level students that is commensurate with the resources of the Institute of Computer Science. Moreover, the University should gradually increase the number of computer science students in harmony with the resources of the Institute.

There were approximately 50 students in computer science at the bachelor-degree level within the first three years of the Institute. At the end of 1998, there were 62 students in this bachelor program in computer science out of 385 at the Faculty of Mathematics. The number of students admitted to the bachelor courses in computer science was 24 in 1998, 20 in 1997, and 20 in 1996. The number of students in Master courses was 16 in 1998, 15 in 1997, 15 in 1996, 17 in 1995, 16 in 1994. The number of doctoral students was 13 in 1998, 10 in 1997, 8 in 1996, 4 in 1995, and 4 in 1994. The admission standards appear complete and satisfy the Standards [202.3]. However, the expert team recommends strongly an increase in the number of admitted students provided the University adequately increases the badly needed faculty resources.

The education entry level is adequate (gymnasium/secondary school). There are systematic approaches to help students with deficiencies such as an introductory computer course before the regular first programming course. In this regard, the Standards [201.2] are satisfied. Additionally, the Vice-Dean provides advice to students if the number of credits is not met.

A system exists to monitor student achievement and the Institute uses these results to improve program, which satisfies the Standards [202.4]. Although the expert team did not see evidence of program improvement, it was implicit in the manner in which the Institute monitored student performance by their method of examination.

The computer science programs are comparable to other universities and provide student mobility, which satisfies the Standards [202.5]. (See recommendation in Part III.)

Student Interviews

The expert team did meet with undergraduate and graduate students. The team interviewed six bachelor students (2^{nd} to 4^{th} year) for one hour. The students requested more flexibility between diploma and bachelor programs. Because the diploma program does not yet exist, third- and fourth-year students did not had the choice at time of starting their studies. Two would have preferred the diploma instead of bachelor program because they argue that it gives them stronger chances for industry employment. Two suggest they would prefer to do a diploma program and afterwards a bachelor or master program if that would have been possible.

Students expressed concern about the quality of teaching when master-level students sometimes teach low-level courses rather than the regular academic staff. They think that use of structured Pascal in the first two courses is not adequate for the current computing environment. There should be a greater selection of modern courses scheduled at non-conflicting timetables.

Computer access for free (open laboratory) exercises is limited due to the lack of equipment. Sometimes students must make reservations one week in advance. The situation has improved considerably during the last years, but there is a severe need for many more modern computers. Students would like better software to meet the quality standards of industry. They used the Internet regularly and all have access to email and use it extensively. The students recommend a stronger cooperation between the university with industry and would like to do practical industrial work.

The student organization selectively performs program assessment, but they do not do it on a regular basis. The students are not sure if the faculty considers their assessments seriously and believe that their assessment would probably have little impact on the faculty.

The students are aware of exchange possibilities with other countries. They know of scholarships through an Internet mailing list. There is even a special mailing list for scholarships and the person in charge of the mailing list seems to be knowledgeable about scholarships. However, there is no student exchange advisor.

At the graduate level, approximately ten (5 master, 5 doctoral) students met with the expert team. The students work on very differing research subjects and many of these subjects have a theoretical bases. Most doctoral students have studied outside of Estonia and most plan to pursue a university career. The expert team hopes that their academic enthusiasm is not lost when they compare university salaries to those of industry. There is a lack of doctoral courses, so students learn mainly by guided reading.

Some students have raised the issue that they cannot work on problems that are more practical. In addition, they voiced concern that the University lacks the monetary resources to purchase specialized software they would need for their thesis. Specialized hardware is practically non-existent. They

suggest a closer bridge to industry hoping to get access to modern equipment used in the commercial world. The cryptography project is a major positive step in bridging the industry gap.

3: Educational Study Program (Curriculum)

The Institute offers a quality program that reflects the tenets of programs within a classical university. The faculty members demonstrate a high quality of professionalism and the programs they teach in are fundamentally comparable to other classical universities within Europe. There appears to be a proper proportion of lecture and individual learning within the bachelor's program. For the graduate programs, many courses are taught as independent study, seminars, and guided reading due to the lack of students (minimum 5) to conduct a formal class. At the doctoral level, the courses assume the guided reading scenario rather than lectures. The Standards [203.2, 203.5] are satisfied in this regard.

It appears that the institute has properly formulated the academic goals of the three programs and these goals reflect the requirements for graduation. However, it does appear that the goals are immediate and they do not seem to reflect the long-term interests of the programs. The expert team recommends strongly that the faculty develops the future (long-term) goals of the program and that it modifies the graduation requirements of its programs to reflect these future goals. In this respect, the Standards [203.1] are satisfied, but a concern remains that if these goals are not addressed expeditiously, it may have a negative impact on the future stability of the program. Additionally, it is questionable whether the bachelor program is currently flexible enough to withstand the changing circumstances and requirements in Estonia. In this regard, the program is deficient with respect to the Standards [203.3].

The basis of the program is on an entirety of education and does enable students to obtain a level of general, specialized and professional education. There is a lack of applied courses with high-tech topics. It is therefore questionable if the studies students receive have sufficient competitiveness in the labor market. This is a concern relative to the Standards [203.4]. However, the expert team is very hopeful that a modified exit structure in the bachelor degree program will diminish that concern.

The educational program very much involves problem-solving tasks and creativity at all levels. The graduating procedures are clear, they guarantee objective evaluation, and they correspond to program goals. The Standards [203.6, 203.7] are satisfied. While the content of study corresponds to academic goals of the program, it is questionable whether it offers the newest knowledge and skills. The programs are deficient regarding the Standards [203.8] because of insufficient resources (such as funding for modern classrooms, offices, facilities, equipment and modern hardware and software), that does not enable the faculty to deliver modern-level courses. Additionally, the Institute does not properly introduce or realize quality assurance systems in any program; this is a deficiency regarding the Standards [203.9].

Notwithstanding the deficiencies and concerns cited above, it is highly likely that the faculty, together with the administration, can correct these problems in a short time period so that the Institute can improve the curriculum of the three programs. Affirmative and deliberate action in all curriculum areas will enable the programs to achieve a status of excellence that will be competitive in modern environment.

4: The Educational (Teaching) Process

Teaching is of high quality and the methods used are standard. There are efforts to establish strong telelearning methods in "distant teaching". The students use computer extensively at all levels. The faculty teaches in computer-related classes. Congruous programs exist at different academic levels to allow transfer students to join program easily. An academic calendar forms the basis of the educational experience as the Institute offers its courses during the academic semesters. Student assessment is fair and a flexible examination procedure exists. The program satisfies the Standards [204.1,2,3,4,5] in these areas. However, it is not clear how the Institute uses the results of student assessment to analyze and monitor their programs and therefore, there exists a concern regarding the Standards [204.5].

5: Organization of Studies and Resources

The studies appear well organized to rational use of the students' time. Student counseling is efficient and information about courses is available without difficulty. The Standards are satisfied in areas [205.1,2].

The Institute monitors and improves the organization of study when necessary. However, the expert team is not aware of any systematic use of student loads, student grades, and of failures to improve the organization of courses; this is a deficiency regarding the Standards [205.3].

Professors make the distribution of study loads. However, the renewal of staff remains a serious problem for the department and is a serious concern relative to the Standards [205.4]. There does not exist an explicit plan (other than the hope that some graduates will remain) to recruit staff. The number of staff is lacking. The expert team observed that some graduate students sometimes carry excessive teaching loads that are disproportionate and excessive for such students. One must be careful to allow young and talented researchers to develop themselves. They should be encouraged to develop international personal contacts. The expert team has observed that several doctoral students have left the country and will not return. It is the expert team's impression that currently there do exist better conditions for young researchers in Estonia. It is definitely the way to encourage people to mature. They must have optimal conditions for the development of their talents when they are young; they should not be diminished by excessive workloads. This aspect is a concern as related to the Standards [205.5].

The Institute lacks sufficient financial and material resources to fulfill the goals of the program. A major concern is the students' use of computers in their work. The PCs at the computer laboratories are available for the students from 08:00 in the morning to 21:30 in the evening. The students use these computers for classes and there is free time for the students to work individually. The available time, however, is *not at all* sufficient. Currently, some students have to sign up for individual time up to a week in advance. Free laboratory time must be available at any time a student of computer science may want. The Institute very much needs more space for computers and there must be a substantial increase in the number of PCs. This is a deficiency with respect to the Standards [205.6]. The department must develop a long-term plan for the future. The plan should include one or several strategies to recruit academic research and teaching staff. Two possibilities may meet the departments needs. One is the recruitment of young post-doctoral students from abroad. The Institute should not expect them to stay in the country for more than a few years, but this will introduce innovation in the curriculum and in doctoral education. If necessary, the University should engage individual salary or contractual arrangements with them. Another possibility is to let an Estonian doctoral graduate have the opportunity to work at post-doctoral position abroad—a plan by which the department desires to import knowledge. After some time, such individuals can bring back important expertise to Estonia. The long-term plan must include a build-up to the optimal number of students. If this number is too small, few graduates will result, which will deprive the Institute of a critical mass of students to deliver bona-fide programs of study. This again is detrimental to Estonian industry and for recruiting new academic staff. This is, of course, a difficult issue since a heavy teaching load may encourage people to leave the department.

There is no fundamental obstacle to impede cooperation between the Institute and the dean's office. It seems as if the dean's office wants to support the Institute. However, one cannot expect this office to produce a vision for the future of the Institute. The Institute must produce its own vision to expedite administrative action for it. The situation is a serious concern relative to the Standards [205.7]. The expert team recommends that the members of the Institute immediately consider engaging in an off-campus retreat to discuss alternatives.

6: Feedback and Quality Assurance

The Institute deals with a subject area that is evolving and it is important that it monitor its activities so it can respond to a changing intellectual, commercial, and cultural environment. One way to monitor this performance, is to monitor regularly the outcome and performance activities of its graduates from the bachelor and master degree programs. Unfortunately, the Institute has not gathered such information on a regular basis; consequently, it could not use such information to improve the quality of the program. This is a deficiency with respect to the Standards [206.2].

The Institute has neither developed nor used a systematic means to gather information about the working career of its graduates. Likewise, the Institute does not gather information regarding employers' satisfaction with the level, knowledge, and skills taught within the Institute regarding the students' programs of study. This is unfortunate because of the changing circumstances and technology of the computing field and because the market-driven nature of the subject. This is a deficiency with respect to the Standards [206.1].

The students of the programs sponsored by the Institute do not have an ongoing process whereby they participate in the system of quality assurance of the three programs. Student discussion groups exist on an ad hoc basis. However, no system exists whereby some groups can participate formally in

the educational process. Consequently, they cannot influence the quality assurance of the programs. While not considered a deficiency by the expert team with respect to the Standards [206.3], it remains a concern. The Institute should attend to this concern immediately.

Division B – Program in Teaching of Informatics

The Institute provides a one-year master/diploma program in Teaching of Informatics for those individuals possessing a bachelor degree in the subject area. An accreditation review of the program had taken place in 1996. For reasons unknown, the University received no official action at that time. The expert team has reviewed the summary of previous findings and it is submitting them and the report (written in Estonian) as an appendix to this report.

Part III

General Recommendations

The expert team offers the following recommendations to the Institute and the University. The parties should view these recommendations as suggestions from colleagues as and adjunct to but not part of its official findings mentioned in Part II. The expert team has not given these recommendations in any order of priority and the Institute and the University may consider them for the general improvement of its programs.

?? The Estonian credit point system (40 credits per full study year) differs from other credit point systems. For example, universities in USA use 30 semester-credits per year; European Union countries use the European Credit Transfer System (ECTS), which is 60 credits per year. Nevertheless, students can transfer credits by using the formula ECTS credits equal 1.5 times Estonian credits. However, it may be difficult to convince foreign universities on the transfer equivalence using the current system, especially since there are strong prospects for the incorporation of Estonia in the European Union.

?? The Institute should develop an external professional advisory board comprised of industry, business, and other computing professionals. This board can help ensure a system of analysis of the academic quality of its student programs (see Standard 201.1). The Institute can also use this as a vehicle to conduct an outcome assessment of its programs.

?? The Institute should consider joining digital libraries, particularly those of the ACM and the IEEE Computer Society. Digital libraries have the power of desktop access to tens of thousands of professional articles at a fraction of the cost of paper copy publications.

?? The Institute should exploit its potential of mathematical excellence and use it to establish innovative and creative avenues of specialization and centers of excellence. Some areas to consider include mathematically based fields such as encryption for electronic commerce, computer graphics, virtual reality, theoretical computer science, and computational linguistics.

?? The Institute should exploit its early steps made in distance learning and teacher training. It should explore to its fullest the potential to develop new methods of learning and to attract students who cannot easily conform to the traditional methods of learning.

?? The expert team recommends that the members of the Institute immediately consider engaging in an off-campus retreat to discuss the goals and alternatives of their programs and to develop a long-range development plan for the future.

Part IV

Accreditation Conclusions

Division A

The Institute has a dedicated and distinguished faculty with a strong foundation of basic principles of computer science. The students of the Institute have deep interest in the study of computing and possess an honest respect for their teachers. The members of the Institute reflect the tenets that form the basis of a classical European university. The dedication shown by the faculty and the students, even when they have to work under difficult conditions, impressed the expert team.

Notwithstanding the high principles of faculty and students, there do exist deficiencies and concerns relative to the Standards established by the Estonian Ministry of Education. The expert team chose the term "deficiency" for a criterion of the Standards that is "not met" and *must be* removed within the time period (of two years) until the renewal of the accreditation. It chose the term "concern" for a criterion of the Standards that was a concern and that *should be* removed before the accreditation renewal. In the sequel we provide a listing of deficiencies and concerns that refers to the findings of Part II.

The deficiencies are abbreviated as follows.

1. There is no systematic procedure to analyze the academic quality of the teaching program [201.3].
2. There is no explicit supervisory system to monitor performance of staff [201.4].
3. The limit on the computer science quota is counterproductive to the needs of the Estonian society that is in need of more computer professionals than mathematicians [202.1].
4. The bachelor program is not flexible enough to withstand the changing circumstances and requirements in Estonia [203.3].
5. It is questionable whether the program offers the newest knowledge and skills [203.8] because of insufficient resources [203.8].
6. The Institute does not properly introduce or realize quality assurance systems in any program [203.9].
7. There is no systematic use of student loads, student grades, and of failures to improve the organization of courses [205.3].
8. The Institute lacks sufficient financial and material resources to fulfill of the goals of the program [205.6].
9. The Institute has not gathered outcome assessment information on a regular basis and does not use such information to improve the quality of the program [206.2].
10. The Institute does not gather information regarding employers' satisfaction with the level, knowledge, and skills taught within the Institute regarding the students' programs of study [206.1].

While not considered deficiencies regarding the program, the expert team has found areas of concern that the Institute should address to improve the future development of the programs and to assist the next evaluation team. These areas include the following.

1. The Institute must recruit a new generation of academic teachers for the Institute [201.1].
2. Students should work on problems that are more practical.
3. The faculty must develop the future (long-term) goals of the program [203.1].
4. The Institute should use the results of student assessment to analyze and to monitor its programs [204.5].
5. It is questionable if the studies students receive have sufficient competitiveness in the labor market [203.4].
6. Staff renewal remains a serious problem and there does not exist an explicit plan to recruit effectively new staff members [205.4].

7. Graduate students should have optimal conditions for the development of their talents that should not be diminished by excessive workloads [205.5].
8. The Institute must produce its own vision and to expedite that vision through effective administrative actions [205.7].
9. No system exists whereby some student groups can participate formally in the educational process and consequently, they cannot influence the quality assurance of the programs [206.3].

Accreditation Recommendation for the Bachelor, Master, and Doctoral Degree Programs

Provisional Accreditation

The expert team has based its decision on the information received, the outcome of the accreditation visit, and the finding of deficiencies and concerns cited herein.

Division B

Accreditation Recommendation for the Diploma/Master Program in the Teaching of Informatics

Provisional Accreditation

The expert team has based its decision on the outcome and findings of the official visit conducted in 1996.