Hara, V. , Hyvönen, R. , Myers, D. & Kangasniemi, J. (Eds.)

Evaluation of Education for the Information Industry

PUBLICATIONS OF THE FINNISH HIGHER EDUCATION EVALUATION COUNCIL 8:2000

Helsinki 2000

Foreword

Today, the importance of the Information Industry cluster for the Finnish economy and society in general is very high. Over the past decade, the growth of the Finnish Information Industry has been remarkable rapid. Finland is already facing a severe skills and personnel shortage in this field. The rapid changes have also created a lot of new challenges for the higher education establishments. Thus, it is understandable that the Finnish Information Industry, in particular, expressed a strong wish to start this evaluation on 'Education for Information Industry'.

The higher education institutions in Finland have recently increased the intake of new students in the field. This has also been supported by the Ministry of Education in their policy. Additional resources have been allocated to this field. At this point, it was considered important to raise questions about the effect of the increased intake. Have the universities and polytechnics still managed to maintain the high quality of education? Can the traditional scope and depth of the engineering curriculum be sustained if education in the field continues to grow in terms of student numbers? What is the present quality of the students and the teachers in the field?

The Finnish Higher Education Evaluation Council approved the Steering Committee to start the evaluation project in Information Industry on Nov. 18, 1998. The number of different degree programmes for Information Industry needs is estimated to be close to one hundred. The Steering Committee selected, after the preliminary study of around 44 degree programmes, 15 of them for a more comprehensive evaluation. The programmes selected represent a good variety in the field. Business studies in information technology were excluded at this point to avoid too diverse a focus.

The Evaluation was done in close co-operation with the Universities and Polytechnics involved. In the beginning of this project, the Institutions were able to communicate their wishes concerning this evaluation. In the second phase, they prepared a self-evaluation report., which served the work of the Evaluation Team. The Evaluation Team visited the Programmes concerned and compiled the findings and recommendations in this report.

The Steering Committee hopes that the work done during and after the self-evaluation phase has been useful for the programmes concerned. We hope that the findings and recommendations of the Evaluation Team, and the report itself, will be equally valuable in helping to develop governance, teaching and learning opportunities and in evolving the contents of the programmes. We hope that the findings and recommendations of the Evaluation Team, and will be equally helpful to all educational institutions contemplating similar questions in this field. Many countries share the same problems and challenges in

the field of Information Industry. This is why we believe that this report will interest our international colleagues too.

The Steering Committee would like to express thanks to all, who have participated and been involved in the evaluation process at various stages. The Chairman and Members of the Evaluation Team deserve warm thanks for their interest in the evaluation work. Finally, we wish to thank the Project Managers for their valuable work. Outi Laitinen deserves warm thanks for her work during the preparation phase of this project and Jouni Kangasniemi for his work when the external evaluation took place and in the preparation of this report.

March 29, 2000

Professor Toivo Katila
Chairman of the Steering Committee

Contents

1 Introduction

Tens of thousands new jobs have been created in Finland in the field of Information industry since the beginning of the 1990. The demand for graduates from the higher education institutes and vocational secondary schools in the field has increased rapidly.

Several measures have been taken at local and national levels to improve the situation. The universities and polytechnics have themselves actively increased the intake of new students in their programmes. The Ministry of Education has steadily increased the provision of higher education in the 1990's. One aim is to provide higher level education for 70% of the relevant age group annually. The universities have themselves been able to identify the new areas of growth and allocated their resources to establishing new study places in the IT fields among others. In addition the Ministry of Education has earmarked extra funding to increase the study opportunities in the Information industry fields. This programme started in 1998 (see 1.3.).

The increase in student intake has created many challenges for the higher education institutions. Therefore, it was seen as important to start this programme evaluation and take a closer look at the programmes. We hope that this report will encourage the institutions to further develop their educational provisions.

The Electronics/Information Technology programmes were selected for closer programme evaluation for the following reasons:

- Rapid developments in the field; it was seen to be useful to see what is the current quality of the programmes.
- It is important to encourage and support the higher education institutions to maintain and improve the quality of education provided.
- A programme for increasing education in the fields of the Information industry was started by the Ministry of Education in 1998. It was important to see what kind of impact the rapid growth of intake of new students has had.
- There is a great shortage of skilled workforce for the IT industry.

1.1 Information Industry and Commerce

Finland's economy has gone through major changes in the 1990's. There has been a great shift from an industry-based economy (hierarchical, functional and investment based) to an economy often described as an information society (innovation, knowledge based, fast moving targets) or new economy. Today, the electronics and electrical products cluster accounts for about 27% of the

total value of Finnish exports. The largest export category being telecommunications equipment, with the share of 52% of all electronics and electrical products.

Table 1. Exports by industry in Finland in 1998.

Industry	*1998*
Electrical equipment	25,8%
Pulp, paper and paper products	23,6%
Machinery and equipment	11,3%
Basic metals and fabricated metal products	9,4%
Wood and wood products	6,2%
Transport equipment	6,2%
Other	17,5%

Source: Statistics Finland 1999, Finland in Figures

In the beginning of 1990, the Russian market, important for the Finnish paper and metal industry, collapsed. At the same time, a banking crisis swept the country. New areas of business were sought. In the beginning of the 1990's, the Information industry sector started to grow steadily. The Information technology sector and, especially, mobile communications were seen as promising fields by the industry.

In the early 1990's the unemployment rate soared, peaking in 1994 (16.5%). Since the mid 1990's, the electronics and telecommunications sector has created thousands of new jobs. In this period, the availability of skilled employees has dramatically changed to the current position, where there is a great shortage of people with appropriate skills. By 1998, the electrical equipment industry had become the biggest export industry in Finland. Finnish companies have become global leaders in mobile communications. (Statistics Finland 1998)

In the 1990's, the Information industry sector has had an important role for increasing number of employees and production in Finland. In 1997, the information sector enterprises accounted for 11% of the turnover of all enterprises and 10% of the personnel in Finland. (Jokinen, 1999.)

Table 2. Increase of new employees in selected industries in 1993, 1995 and 1997.

Industry	*1993*	*1995*	*1997*
Basic Metal Products	- 400	200	0
Fabricated Metal Products	- 1 600	1 700	1 700
Machinery and Equipment	- 2 700	3 600	2 400
Electrical Equipment	- 100	9 400	5 200
Transport Equipment	- 1 000	0	0

Source: Kansantalouden tilinpito (1998)

1.2 Lack of Skilled Personnel

The rapid growth of the Information industry sector in Finland as well as Europe has created a severe skills shortage. The same has occurred also in the Asia and the USA.

The large ICT companies are collaborating with the European Commission, European governments and the education sector in a project called Career-Space. The aim of the project is to attract more talented people to the field and explore new ways of addressing the skills shortage. It has been estimated that there were some 500,000 unfilled ICT job vacancies in Europe at the end of 1998. It is estimated that the figure may increase three-fold by the year 2002, if clear actions are not taken. The project has tried to capture generic skills profiles in the field to create a better understanding of the professions of today and tomorrow. (For additional information visit http://www.career-space.com).

The problem of lack of skilled personnel has been noticed in all recent surveys. Individual European governments have addressed the skills shortage in many ways. Industry representatives, especially, would like to see more rapid responses. Actions taken by the Finnish Ministry of Education are briefly described in the next paragraph.

1.3 Programme for Increasing Education in the Information Industry Fields between 1998–2002

In March 1998, the Government adopted a programme, which will increase the provision of education relating to the information industries between 1998 and 2002. The programme was started due to a shortage of skilled personnel in the Information industry. The programme includes both ad-hoc measures for promoting know-how and increasing the number of graduates in the near future and permanent increases in the provision of higher education and vocational education places. The total cost of the programme is 224 million euros. The institutions get an extra 143 million euros for ad-hoc measures in 1998–2004 and an additional 81 million euros for permanent measures in 2006. (Jokinen, 1999).

The programme consists of three elements:

- Increased Intake
- Professional Upgrading Programmes
- Specialisation Programmes

Increased Intake

In researcher (post-graduate) training at universities, the total number of graduate school posts in the engineering fields of the Information industry is currently 248. The number of posts was increased by 60 to the current level in 1999.

The permanent increase in the provision of university education in the field of the Information industry will be 1,000 larger than the permanent provision in 1998. In polytechnics, the increase will be 1,400 more by the year 2000. In adult education, 400 new study places will be established in secondary vocational institutions.

The numbers applying for admission to universities and polytechnics has increased slightly. At the same time the intake has grown rapidly. Entering a university or a polytechnic has become a little easier than before, although the number of applicants still exceeds the intake figures especially in the most popular fields of study in the institutions in larger cities. The scores for entrance tests have fallen slightly in most of the places. (See also Table 11 on page 29, and Appendix 4.)

Table 3. Number of new students applying to and those accepted for the university information industry training programmes in 1998 and 1999.

	Applied 1998	*Accepted 1998*	*Applied 1999*	*Accepted 1999*	*Increase (accepted)*
Technology	7,583	1,554	9,991	2,039	31.2%
Mathematics, Natural Sciences	3,797	1,260	4,929	1,802	43.0%
Other Fields	606	161	1,043	290	80.1%

Source: Ministry of Education 1999, HAREK

Professional Upgrading Programmes

The aim of this programme is to increase rapidly the number of graduates in the sector. The target group of the upgrading programme are those who want to upgrade their degree either from lower level (Bachelors degree) to higher education level (Master's or Doctor's degree) or from another subject specialisation to an information technology subject. Between 1998 and 2002, universities, polytechnics and vocational colleges will admit a total of 7,950 new students for upgrading their studies. In spring 2000 a campaign to promote this programme was launched by the Ministry of Education. The campaign includes advertising in newspapers and other media. (For more information see http://www.minedu.fi/ktpo/tietoteollisuus, in Finnish only).

Table 4. Increase in new students in different educational institutions by professional upgrading programmes 1998–2002

Institution	*Number of new students*
Universities	5 150
Polytechnics	2 400
Vocational Colleges	400

Source: Ministry of Education 1998

Specialisation Programmes

The aim of this programme is to provide education for those with a degree in the field to allow them to upgrade their skills and know-how in the field concerned.

Polytechnics will admit 2,400 new students into specialisation programmes between 1998 and 2002. They will also accept 1,000 new students from the related fields to take up subjects relating to the Information industry.

The programme was launched rapidly, and achieved its targets for increased intake much sooner than planned meeting them after the programme had been running for only one year.

1.4 Other Measures

In addition to the programme for increasing education in Information industry fields, several measures have been initiated by different organisations. The Ministry of Labour has financed labour market training for unemployed people. In 1998, about 1,500 new places were available for labour market training in polytechnics as ad hoc measures.

It is still too early to draw any definitive conclusions regarding the long-term impact of the different programmes for increasing the number of students in the information industry fields. Although the increasing number of students in the field is a clear trend, how many of them will complete their studies in reasonable time remains an open question.

2
Evaluation Procedures

This evaluation of education for the Information industry is organised by the Finnish Higher Education Evaluation Council (FINHEEC). The purpose of the this evaluation is to support the higher education institutions and the programmes in the Information industry field to maintain and improve the quality of education.

The aim of this evaluation is to help the institutions to develop their educational programmes by providing an "outside view" into their future views, programme contents and daily operations. The evaluation is done without seeking to rank the polytechnics and universities or the programmes according to their relative performance, or against any "gold standard".

The evaluation has been carried out as a close and collaborative process with the Polytechnics and Universities involved. As soon as the preliminary project plan was accepted by the Council and the institutions mapped for evaluation, the representatives of institutions were invited to attend to a seminar where the project plan was presented and discussed in an open dialogue. Taking into account the different views from the Polytechnics and the Universities, the project plan was re-structured and finalised.

The main tasks of the evaluation are to

- assess the present situation of the programmes for the Information industry
- outline the contextual similarities and differences of the programmes between the universities and polytechnics
- have an international view of the programmes
- evaluate the client satisfaction of the programmes (students and employers)

It is also hoped that the evaluation will provide important information for decision making in the institutions themselves and as well for the companies cooperating with them and at a national level.

2.1 The Project Plan

In spring 1998 the Council authorised the Steering Committee for the Programme Evaluation of Industrial Management and Engineering to recommend the next programme to be evaluated. The Steering Committee proposed unanimously that the next evaluation should focus on electronics/information technology programmes. The project was started in November 1998 and completed in March 2000. The project timetable is presented in the Table 5.

Table 5. The project plan

Time	*Action*
09.06.1998	Council decides to start the project and appoints the Steering Committee.
18.11.1998	First meeting of the Steering Committee
12.01.1999	Project plan prepared by the Steering Committee
18.01.1999	Project plan approved by the Council
22.02.1999	Universities and Polytechnics mapped for the evaluation
26.03.1999	Self-evaluation guidelines sent to the selected Institutions
16.04.1999	Seminar arranged for Institutions participating in the evaluation
25.08.1999	FINHEEC appoints the Evaluation Team
30.09.1999	Self-evaluation reports prepared and returned to FINHEEC
18.10.1999	The Evaluation Team convened for the first time to agreeing on the evaluation procedures
19.–29.10 and	Site visits, external evaluation (8 sites)
09.–17.11.1999	Site visits continue (7 sites)
15.–31.12.1999	Evaluators turned in their personal evaluation reports
31.01.2000	First draft version prepared
08.03.2000	Draft presented to the Programmes concerned for comment
13.04.2000	Report published

2.2 Selecting the Programmes for the External Evaluation

At the moment, the number of higher education institutions in Finland is 51. There are 20 universities and 31 polytechnics. About a half of them offer Information industry related programmes. The programmes include technical sciences – and natural sciences as well as business studies.

According to the Steering Committee's preliminary survey, it was estimated that the number of different programmes for the Information industry in the higher education institutions in Finland is almost one hundred. In the final phase, 15 programmes were selected for this evaluation.

The Steering Committee used the following criteria for selecting the programmes:

- *Discipline.* Technical and natural sciences were included. IT in business studies was excluded, because of the number and great variety of programmes.
- *Degree programmes* mentioned in the Programme for Increasing Education for the Information Industry Fields 1998–2002, were included (electrical engineering, information technology, electronics, telecommunications, computer science).
- *The size of the programme.* Both large and small programmes were included.

- *The increase in intake* of new students. (A Programme for Increasing Education for the Information Industry, Ministry of Education). Those programmes, where the total number of students is rapidly increasing were emphasised.
- *The number of years* the programme has run. Both new programmes and those with a longer history were included.
- *Regional factors.* Programmes were selected from different areas of Finland.
- *Linguistic factors.* The programme using Swedish was also included in this evaluation.

The Information industry related programmes in the business studies area were excluded from the evaluation project in order to avoid too wide a focus in the evaluation. During the evaluation process, this decision was questioned by some members of the Evaluation Team, especially those representing the IT service sector.

Table 6. Programmes selected for evaluation

Institute	***Programme***
1. Espoo-Vantaa Institute of Technology	Information Technology (160 cu.)
2. Helsinki Polytechnic	Electrical Engineering and Telecommunications (160 cu.)
3. University of Helsinki	Computer Science (160 cu.)
4. Helsinki University of Technology	Computer Science and Engineering (180 cu.) and
5. Helsinki University of Technology	Electrical and Communications Engineering (180 cu.)
6. Kajaani Polytechnic	Information Technology (160 cu.)
7. Lappeenranta University of Technology	Information Technology (180 cu.)
8. Oulu Polytechnic	Information Technology (160 cu.)
9. University of Oulu	Information Engineering (180 cu.)
10. Pohjois-Savo Polytechnic	Electronics and Information Technology (160 cu.)
11. Satakunta Polytechnic	Information Technology (160 cu.)
12. Tampere Polytechnic	Electrical and Computer Systems Engineering (160 cu.)
13. Tampere University of Technology	Information Technology (180 cu.)
14. Vaasa Polytechnic	Electronics and Information Technology (160 cu.)
15. Åbo Akademi	Computer Science (160 cu.)

2.3 Project Organisation

The Finnish Higher Education Evaluation Council appointed the Steering Committee for the project in June 1998 and approved the project plan in January 1999. The Steering Committee was responsible for gathering background information from different sources and mapping the target groups in order to focus the evaluation.

Furthermore, the Steering Committee represented the Council and was responsible for:

- determining and approving the objectives for the project.
- proposing the budget and preparing the project plan
- implementing and monitoring the project

The Steering Committee for the project consisted of the following members:

Chairman of the Steering Committee
Toivo Katila, Professor of Engineering Physics
Helsinki University of Technology

Members of the Steering Committee
Ari Kekarainen, Student
SAMOK, Vaasa Polytechnic
Eero Leminen, General Secretary
ARENE – The Rectors' Conference of Finnish Polytechnics
Tytti Varmavuo, Director
Nokia Corporation
Antti Virtanen, Senior Adviser
Finnish Higher Education Evaluation Council

Secretary of the Steering Committee
Outi Laitinen, Project Manager (until 10.10.1999)
Jouni Kangasniemi, Project Manager (from 13.10.1999–)
Finnish Higher Education Evaluation Council

The External Evaluation Team for the evaluation project was appointed in August 1999. The members were invited by the Finnish Higher Education Evaluation Council to evaluate the programmes concerned. The Team was responsible for producing an independent, critical and development-oriented evaluation based on the self-evaluation reports, site visits and members own experience from other corresponding organisations.

The recruitment of the Evaluation Team was carried out through professional contacts. The final evaluation report has been compiled and co-ordinated by the Secretary of the Evaluation Team. The issues and recommendations represented in the report are the sole responsibility of the whole Evaluation Team.

The External Evaluation Team for the project was as follows:

Chairman of the Evaluation Team
Veikko Hara, Senior Vice President (15 site visits)
Head of Research
Sonera Mobile and Media

Members of the Evaluation Team
Raimo Hyvönen, Director & Vice Chairman of the Evaluation Team (15 site visits)
Department of Technology
Turku Polytechnic
Flemming K. Fink, Associate Professor (8 site visits)
Aalborg University
Ulf Henriksson, Professor (8 site visits)
Department of Electrical Engineering
Linköping University
Ari Hirvonen, Director of Technology (3 site visits)
TietoEnator Oyj
Jouko Häyrynen, Vice President (1 site visit)
Research and Development
Nokia Mobile Phones
Aimo Maanavilja, Vice President (3 site visits)
Research Centre
Elisa Communications
David Myers, Engineering Manager (4 site visits)
BT Advanced Communications Technology Centre
Jaakko Pääkkönen, Student (7 site visits)
University of Oulu
Birger Rapp, Professor (7 site visits)
Department of Computer and Information Science
Linköping University
Pasi Sahlberg, Counsellor of Education (2 site visits)
National Board of Education
Jaakko Talvitie, Director of Research (4 site visits)
Elektrobit Ltd.
Antti Yrjölä, Student (8 site visits)
Helsinki Institute of Technology

Secretary for the Evaluation Team
Outi Laitinen, Project Manager (–10.10.1999)
Jouni Kangasniemi, Project Manager (13.10.1999–) (15 site visits)
The Finnish Higher Education Evaluation Council

2.4 Collecting the Information

This programme evaluation report is based on:

- Self-evaluation reports provided by the Universities and Polytechnics involved
- Meeting with the representatives of faculty/department and those involved in writing the self-evaluation report
- Meeting with the programme students
- Meeting with the representatives of industry and commerce, who co-operate with the programme
- Other additional materials provided by the institutions (study guides, brochures, lecture materials, course books, project reports etc.)
- Additional information collected from different sources (statistics etc.)

The process of gathering the information for this evaluation is two-fold; Firstly, the institutions themselves prepared a self-evaluation report, and sent them to the external evaluators in advance. The Guidelines for the self-assessment are presented in **Appendix 2**. Secondly, the Evaluation Team visited the institutions and interviewed in a panel, different groups of people selected for this purpose. This evaluation is based to a large extent on the two above mentioned processes. The plan concerning the site visits and personal participation of the Evaluation Team members are listed in **Appendix 3**.

The composition of the Evaluation Team varied a little on different site visits. The Chairman, Vice Chairman and the Secretary of the Evaluation Team visited all 15 places. The rest of the members visited 1–8 places each.

Each member took part into a half-day evaluator training session prior to the visits. The training was arranged by the FINHEEC. The focus of this training was to identify some of the critical issues to be looked for during the visits. (See. Dill 1999) The topics covered during the site visits were as follows:

- Programme aims and strategies
- Management issues
- Programme contents and development
- Co-operation with industry
- Internationalisation
- Facilities and equipment

The Evaluation Team attempted to check whether plans, strategies and management policies designed and implemented at the department and programme level were understood and supported by the students, teaching staff, management and representatives of industry and commerce. Students and the staff were interviewed about their views on the role of teaching, learning, student support and process development. Representatives of industry were consulted over their satisfaction concerning the quality of graduates and teachers, co-operation with the institute and processes by which their needs were identified in the programme.

Table 7. The programme of the day during the site visits

Time	*Programme*	*Persons involved*
09:00–09:30	Arrival to the Institution Preparatory meeting of the Evaluation Team	Evaluation Team members (6–8 people)
09:30–10.00	Initial welcome & Introduction to the Institute	Dept. Representatives (4–8 people)
10:00–11.00	Meeting with the programme students	Students (4–6 people, 1st–5th year students)
11:00–12:30	Meeting of the programme staff	Staff members (4–8 people, professors, teachers, lecturers, assistants)
12:30–13.30	Lunch with students and staff	
13:30–14:45	Meeting with the representatives of commerce and industry	Representatives of industry (2–6 people)
14:45–15:15	Time for studying student exercises and theses work	Display of materials, thesis work, project papers and course books
15:15–17:00	Visit to lecture halls (lectures), laboratories, library and introduction of equipment etc.	Persons in charge of facilities and individual teachers
17:00–17:30	Discussion on the findings of the day	Evaluation Team members

2.5 Structure of the Report

This report aims at evaluating the education in the 15 programmes. The evaluation is based on the self-evaluation reports produced by the Universities and Polytechnics as well as on the discussions with the staff, students and industry representatives during the Evaluation Team's site visits.

The report consists of three parts. In the first part, we describe the practical arrangements concerning the evaluation and provide some background information for the work done. In the second part, we have tried to analyse the situation common to all of the programmes and conclusions relating to all programmes. In the end of the second part, we have provided a short list of recommendations.

It is strongly recommended, at this point, that the reader not only looks through the recommendation points, but also reads the descriptive part of the report in order to relate the recommendations fully. In the third part, each of the institutions is discussed in more detail. In the end of the section for each institute we have provided a short list of recommendations and good practice. The outside reader is advised not to draw too clear-cut conclusions based on them. Each recommendation should be seen in the wider context providing additional information to the self-evaluation reports and discussions during the site visits. The geographical location of the institutions should also be taken into account.

3
Common Findings

3.1 Aims and Strategies

One important aim of Finnish higher education in information technology fields is to produce sufficient graduates to meet the needs of Finnish society and industry. There is an increasing demand from industry and the public sector (including the education sector itself) for information technology graduates at Bachelor's, Master's, Licentiate and Doctoral levels.

To help achieve this aim, the universities and polytechnics have increased the intake of new students in the programmes in the Information industry field during the past few years. The Government has also allocated extra funding to finance an additional increase of students for the Information industry fields as described in 1.3.

It is obvious that if the number of students admitted increases and the rates of student progression remain constant or even lengthen, then staff student ratios will rise. This has the effect of putting a heavy teaching burden on the departments concerned and increasing pressure on learning resources such as lecture rooms, laboratories, computing facilities and libraries. This, in turn will have an adverse affect on the student learning experience.

The challenge for the institutions is to find ways of dealing with this which do not involve simply increasing the amount of money 'thrown at the problem'.

- The first and most important recommendation is that institutions develop and implement clear strategies and long-term plans to produce more graduates with up-to-date skills matched to the requirements of Finnish society. This strategy should address the problem of rising student numbers now, by finding ways of reducing the average time students spend in the system and speed up the average time taken to graduate.

This is particularly important for the universities. It will free up time and resources to allow the development of innovative teaching methods to enhance the student learning experience and curriculum to be evolved to match changing needs. According to the interviews with the programme staff, there were great variations between the understanding of institute and department level visions and strategies. Often, the current strategies dealt only with development of physical environment (recruitment of staff and building bigger facilities). Subsequent recommendations reinforce this recommendation and contribute to achieving it.

3.2 Management Issues

In order to be able to change processes, the programme management needs to understand the processes and establish better control and more quicker responsiveness.

- It is recommended that formal management processes need to be strengthened where they exist, and established where they do not exist, at the department level and above, to provide a clear management framework. There should be formal, clearly understood and effective processes covering the essential teaching activities of the department. These should include:
  - Curriculum planning and review, and new course approval. This should take into account resources, financial and budgetary implications.
  - Assessment procedures, including guidelines on providing marks and feedback to students on their work. Consideration should be given to implementing a system of peer review in this area.
  - Student support guidelines, including the approach to providing student tutoring and advice, and training for members of staff in this area.
  - Processes for monitoring student progression through the programme, to provide information on how students are completing their studies and allow potential problems with progression to be identified.
  - Staff development plans, to provide training and development in pedagogical skills as well as up-dating current knowledge and skills.
  - Student feedback mechanisms, with clear processes for gathering appropriate information efficiently, reviewing it and using it to improve the delivery of the programme.

All of the above processes make up a management "Quality Plan", which should itself be regularly reviewed for effectiveness. The institutions should also consider how they can share ideas and establish a good practice in all the above areas. It is recommended that the universities and polytechnics establish ways of co-operating more on the local, national and even international level.

The management at the universities is rather professor-centred. Each professor is in charge of his/her laboratory rather independently. The main focus in universities is on research. Much organisational development is done in informal discussions with the staff. The current structure makes managing the department as a whole, rather stable and is suitable for working with a small number of staff and students. Efficiency in learning and management could be increased if common rules and more control and co-operation could be introduced between the different (often separate) laboratories.

3.3 Programmes

Degree programmes in the universities and the polytechnics form a solid general basis for the student's skills and knowledge. The programme contents varied a lot between the different institutions. In general, the Evaluation Team felt that the polytechnics concentrate mostly on delivering solid general engineering knowledge to the students. The universities pay more attention to delivering specialised knowledge with better links to research.

The Bachelor's degree programme in universities is not equal to the one offered by polytechnics. The credit units are more application-oriented in polytechnics than in the universities. Universities of Technology do not offer B.Sc. - level degrees at all.

Programme Focus

The Evaluation Team wishes to highlight the importance of continuous development of programme focus.

The industry environment is very dynamic and new areas are emerging continually. Teachers are mainly responsible for creating and planning the bases for student learning.

- The Evaluation Team recommends that the universities continue to determine their areas of expertise and make their focus areas clear to the students and their future employers. It would be worthwhile, if the polytechnics in general could consider the possibility of creating clearer focus areas.

The Evaluation Team accepts the view that in the Information industry, there are a number of opportunities both for people with good general knowledge and also those with more specialised knowledge. The universities have clear programme focuses. The Evaluation Team recognised the following areas of expertise in the universities:

- University of Helsinki has a clear focus on Software Engineering and Distributed Systems and Data Communication. The areas are to a high degree software oriented. The specialisation areas in the Information Science programme are: algorithms, intelligent systems, software engineering, information systems, distributed systems and data communication.
- Helsinki University of Technology being the biggest technical university in Finland has several focus areas. The two programmes evaluated; Computer Science and Engineering, and Electrical and Communications Engineering, have focus especially on communication technologies, especially in Transmission and Network Technologies in OSI layers 1–3 as well as in ITC application services and processes in OSI layers 4–7.
- Lappeenranta University of Technology has had a history of focusing on Telecommunication Protocols and Neural Networks. However, recent changes in the staff have made it more difficult to keep the focus.

- Tampere University of Technology has a clear focus on Software Systems, Digital Signal Processing and Telecommunications. It also places much emphasis on industry co-operation.
- University of Oulu has a well-articulated focus on Embedded Computer Systems.
- Åbo Akademi focuses on Programming and Formal Methods in Computer science Programme. In the Computer Engineering the focus is on Software Engineering and Embedded Systems.

In the polytechnics the Engineering Education focuses more on providing general basic engineering skills for the students. There are some examples of polytechnics focusing on more specialised subject areas.

Development of Programmes

Two different approaches for curriculum development were found. First, professors and teachers had rather 'free hands' to develop and suggest the course contents. After that the courses were compiled and accepted to form the programme. Secondly, in some places more co-ordinated approach was adapted. Either the Head of Department or an active staff member co-ordinated the curriculum development activities. It was noticed by the Evaluation Team that a more co-ordinated approach ensured cohesive programmes.

The Evaluation Team found only a little or no co-operation between the different universities or polytechnics in sharing the curriculum planning activities. Some exchange of course materials had been initiated, but other than that, was on a small scale. It is recommended that the institutions initiate more collaboration in this respect.

The Employers Views of the Programmes

There was a clear signal from the representatives of industry to the institutions concerning the industry's wishes that the graduates be able to work in teams and have better communication skills. As the Information Technology industry itself is very internationally oriented they also wished the graduates to be able to work abroad if needed. In particular the English language has become dominant in the field. Some Polytechnics required the students to learn the basic vocabulary from as early as the 1st year.

In the interviews with the representatives of industry and commerce, it was revealed that the employers look for more than technical skills. The graduates are expected to have some or all of the following elements:

- acquire general competencies
- be able to work in teams
- have acquired some social sensitivity and communicative skills (including understanding of different cultures and at least one or ideally two foreign languages)

- be versatile in basic skills which cut across different natural sciences disciplines such as mathematics and physics
- have acquired some job specific skills still lacking (documentation skills, general regulations, testing etc.)
- be able to manage projects and lead development teams and projects
- be able to contribute to innovation (creativity and vision)

Contrary to studies conducted on higher education graduates in other countries, there were only a few people who wished the graduates to have some entrepreneurial skills or to be willing to learn them. It was noticed during the interviews that most students prefer working for large companies in the beginning of their careers. Some students were interested in starting their own company after graduation. They preferred to do so only if they had 'enough' work experience during or after the studies.

As regards the "generalist versus specialist" dimension, both dimensions had their supporters. The interviewed person's position in the management hierarchy seemed to correlate with the demand for more generalist skills and knowledge. Those who stressed the importance of developing specialist skills noticed that many newly emerging and fast growing sectors in the information industry are calling for relevant in-depth expertise. There seems to be a wide market for research specialists in the field especially in the research laboratories. As described by one representative, his laboratory is only willing to recruit from the universities.

The universities and polytechnics in reflecting the future challenges, need to constantly provide themselves with information on employment and the work of their students while still studying. Efficient links between university and industry and commerce should include obtaining indicators of long-term changes in the employment situation. It is especially important to have a clear picture of the future demands. One has to be aware that signals from the industry may be incomplete and short-term oriented. Long-term partnership between the education providers and companies is needed.

Programme Co-operation with Industry and Commerce

The universities were often more reluctant to allow direct industry involvement in studies than the polytechnics. Modes of successful communication vary substantially – some advocate a more informal involvement of representatives of industry and the educational staff, others favour more structured consultations. All seem to share the idea that regular communication is vital in avoiding the problems of inward-looking teaching and learning.

University links with industry are often maintained through research projects and they rely on personal contacts. Most polytechnics have Programme Advisory Boards with industry members. Their task is to review the contents of current courses and to support more structured co-operation. Most of the industrialists in these boards represented large manufacturing companies. In few

cases small and medium sized companies were represented on the advisory board.

- In some universities and polytechnics, the consultation with industry was rather occasional and based on the personal activity of students or staff members. In such cases it is recommended that these relationships need to be put on to a more structured and regular basis.
- It is also recommended that the education institutions also communicate their work also to small and medium-sized companies in a more customised way.

It was noticed that industry representatives were often not familiar with the current programme contents. They knew only a little about them. Programmes often failed to provide up-to-date information for the outside world. More systematic feedback systems for industry demands were also not in use.

3.4 Teaching and Learning Issues

Based on the Evaluation Teams observations, the teaching- and teacher-centred practices are still dominant throughout the field. The traditional orientation in education emphasises teaching and professor/teacher centred working methods rather than learning and performance of students. Within the conventional learning, paradigm well-designed educational objectives have been implicitly recognised as the achieved outcomes of teaching. Contemporary conceptions of learning, however, shift the focus from the teacher's behaviour to students' learning processes.

- Therefore, we recommend that in all institutions the focus on teaching should move more towards learning issues, i.e. the criteria of success should shift from 'inputs' of education towards 'outputs' of education both in educational practices and curriculum planning.

During the first two years of studies, students often felt that the context in which they apply theory is missing. Therefore they said that it is very important to work while studying. "It is necessary to have some working experience in the field before you graduate. It helps you to understand many things more easily" (Student opinion). Some students felt that the employers also valued their work experience more than their studies.

- The institutions should review the way that the curriculum is delivered, with the aim of reducing the amount of material that is covered in traditional classroom situations via lectures. More student-centred learning opportunities should be introduced, where the students are encouraged to learn for and between themselves.

Development of team working and other non-technical skills should be integrated into the curriculum at all levels via group projects, with presentations

and opportunities for students to provide feedback to each other. Small scale study projects in co-operation with companies could be made more use of in teaching from the beginning of studies. Later on, larger projects could be organised.

Lecture materials were available to the students on the Internet in most of the institutions visited. However, it was not systematically used by staff. Some cases where teachers were reluctant to share their teaching materials on the Net were found. Their fear was based on the fact that students would not show up to classes.

- The Evaluation Team strongly encourages the use of the Internet in sharing the lecture materials and exercises. Virtual learning experiments should also be encouraged more.

Feedback Issues

In almost all places visited, the course feedback system was not functioning well. In many cases, the system did not provide summaries for the teachers. In some cases, it was delivered months after the course had ended.

- Clear statements and procedures need to be established for when and how students should submit feedback or appeal against grades or results and how these should be dealt with.

Discussions with students indicated that feedback to students on their work was generally weak. Tests were used mostly as a means for measuring learning. Often it was limited to grades, with no in-depth feedback on why students got a particular grade or what they would need to do in the future to obtain better grades.

- The institutions should consider introducing systems of peer review of examination or project papers. This could involve members of staff within the same department but could also be widened to include external review by staff in other or similar departments.

Teaching Staff

The teaching staff/student ratios vary considerably between the institutions. In six programmes the teaching staff/student ratio is bigger than 1:30. The teaching staff-student ratios in the different programmes are described in table 8. The ratio may correlate closely with the teachers' work load, which was said to be high in most programmes. At the universities, teachers accounted for less than 30% of the total staff while at polytechnics the situation was better.

Table 8. Teaching staff/student ratios in programmes

Universities						
HU	***HUT C.S.***	***HUT E.C.***	***LUT***	***OU***	***TUT***	***ÅA***
1:43	1:37	1:37	1:17	1:25	1:13	1:16

Polytechnics							
EVT	***HIT***	***KP***	***OP***	***PSP***	***SP***	***TP***	***VP***
1:30	1:48	1:17	1:23	1:32	1:37	1:18	1:18

Co-operation between the staff on teaching matters was often limited. In most places professors/lecturers and teachers had many informal discussions on the programme. However, there is a greater need for formal approaches to planning and agreeing on the development of the curriculum, within the constraints of limited available budgets.

In the course of the evaluation visits, it appeared that there was little staff movement between institutions. Movement of staff between institutions could be one way of disseminating good practices.

Workload

In almost all places, the teaching staff complained about the workload. A couple of clear burn-out cases were reported in two places visited.

Professors and teachers workload should be reduced considerably by recruiting additional staff with more long-term contracts. Additional salary incentives should be allowed to attract high quality staff to stay in teaching positions or attract new staff from the industry.

Current short-term contracts together with the low salary level (if compared to industry) does not attract enough qualified staff. The workload could also be reduced by other strategies including 1. Streamlining courses available within the curriculum, 2. Addressing the question of pass rates in exams; is it a reasonable expectation that 50% of students should routinely fail, and 3. (which follows on from 2) improving student progression rates to reduce the overall student population, which should be achievable even in the context of increasing student admissions.

Links with Research

In universities the programmes had close links with research. It was noticed that often graduate school students were used to deliver the latest knowledge to the students. Some polytechnics also used graduate school students as teachers. New knowledge was also sought from the visiting lecturers from the indus-

try. The polytechnic reform has created pressure on teachers to upgrade their basic education level to at least licentiate level. Many teachers were involved in research work through his/her own studies at university.

In some universities it is hoped that the graduate schools will provide staff needed in the future. In the long run, these institutions will benefit from these schools and are able to attract the qualified staff needed.

Students as Teaching Assistants

Most of the teaching is carried out by the full and part-time teaching staff both in universities and polytechnics. Students are responsible for carrying out some special courses if they have the special knowledge needed, for example, skills learned at work. In some of the places visited, students were not involved in teaching. However, in the universities especially a number of advanced students are engaged in the exercise sessions of the basic and intermediate courses. The use of students as exercise or laboratory assistants in different programmes is described below in Table 9.

Table 9. Proportion of exercises and laboratory courses undertaken by advanced students (%).

Universities						
HU	***HUT C.S.***	***HUT E.C.***	***LUT***	***OU***	***TUT***	***ÅA***
50%	55%	10%	10–30%	15%	50–60%	10–15%

Polytechnics							
EVT	***HIT***	***KP***	***OP***	***PSP***	***SP***	***TP***	***VP***
5–7%	0%	0%	0%	0%	0%	1%	5%

Visiting Lecturers from Industry

In the best cases, visiting lecturers from industry and commerce add value to the programmes. In some places, the amount of courses undertaken by visiting lecturers was close to one-fifth. The progress requires “effective management”, which was lacking in some institutions visited. Some of the representatives of industry and commerce claimed that when they give lectures in the institute, the department head usually gives only a very general topic and little instruction. It was seen as a good practice that some large companies collected feedback from the students about the use of their employees as lecturers, especially if the institute failed to do so.

In some cases students complained that some of the industry representatives were too busy. They only gave the lectures and if one had to ask for some advice, he/she was too busy to guide them. The courses often touched on special issues so there was no danger of overlapping with other courses.

In general, visiting lecturers often bring fresh ideas and up-to-date information and project knowledge directly from the industry. On the other hand, they might lack some pedagogical skills or their view might be based only on their own or their company's work. There might also be some difficulties with timetabling.

- It is recommended that the universities and polytechnics closely monitor the quality of courses run by visiting lecturers from the industry. A process for ensuring the coherence of those courses in relation to the programme in general is needed.

Mass Lectures

In several places, the Evaluation Team found attempts to mass produce the basic courses. This has led to the situation where everybody involved is unsatisfied. Students have no opportunity (or are afraid to do so) to ask for additional help and teachers feel they have a heavy work load running the course.

If mass lectures are undertaken, it is recommended that the most experienced professors/teachers take care of the lecturing. Proper guidance, assistance structures and feedback systems need to be put in place.

3.5 Studying and Guidance

It has been a common cause for concern that the quality of students may decrease because of the vast increase in intake of new students from a fairly static pool of applicants. According to the representatives of industry, there was no clear evidence that the graduates were less qualified than before. In this respect, the Evaluation Team trust that this reflects the good work done in the institutes. Some university representatives had noticed some changes in the skills of basic knowledge of mathematics. However, these students had often better knowledge in other areas.

Table 10. Applicants and accepted (%) in the Universities, between 1995 and 1998

Universities	*HU*	*HUT C.S.*	*HUT E.C.*	*LUT*	*OU*	*TUT*	*ÅA*
1998	706–39%	487–45%	493–84%	198–52%	239–77%	396–78%	55–73%
1997	725–37%	514–34%	524–63%	164–64%	221–42%	423–57%	67–43%
1996	821–35%	424–39%	488–70%	180–52%	144–53%	303–88%	52–67%
1995	876–34%	412–37%	550–66%	137–56%	173–28%	292–73%	27–100%

The challenge for the Institutions is to increase their "value-added" so that learning outcomes are not compromised. It should be noted that in most of the above mentioned programmes already three out of four applicants were accepted to study. It may be a bit alarming that the number of applicants in the programmes increased only by 4.3% since 1995.

Table 11. Applicants and accepted (%) in the Polytechnics in 1998

Polytechnics							
EVT	***HIT***	***KP***	***OP***	***PSP***	***SP***	***TP***	***VP***
777–27.3%	1,096–67.4%	92–57.0%	693–42.9%	232–44.8%	86–80.0%	552–21.7%	241–44.5%

Attracting Female Students to Study in the IT Fields

Women have shown a notable lack of interest in taking courses in technology in recent years. Several projects, local and national, have been launched in Finland to promote the technical fields to women. Only a little progress has been made. Unfortunately, the situation appears likely to remain the same in the next few years. In all of the institutions visited, the number of women studying in IT related programmes was less than 10%. No single project has been successful enough to attract considerable numbers of women to study technology. Perhaps the concept of engineering studies needs to be re-examined to be better fitted for women, too.

Introduction of First-year Students, Tutoring and Guidance

In all of the universities and in most of the polytechnics the Evaluation Team was impressed by the initiative shown by the students' guilds in supporting the tutoring system for the new students. Students had in most cases an important stake in introducing the freshmen to educational arrangements, providing advice on choosing course options and socialising them. However, the teachers' active role in tutoring was often missing and needs to be addressed more carefully in the future.

The role of the class lecturers in the polytechnics was different from the role of professors in the universities. Often the class lecturers were responsible for formal institutional management issues. The teachers' and students' collaboration in tutoring the new students appears to be more or less incidental in all institutions visited.

Discussions with the students suggested that the students often found it difficult to approach professors in matters of student guidance with studies or tutoring, especially in the large universities. The professors were seen by the students as people who were too busy to be approached.

- Tutoring systems should be strengthened so that members of staff provide greater support and guidance to students.

This will enable the staff to identify problems that individual students may be experiencing and allow advice to be given and remedial action to be taken where necessary. It should also provide guidance on choosing courses that are well matched to the abilities of the individual student.

Student Progression

In the large units, especially in the universities, it was often observed that the teaching staff had only a little knowledge of student progression in their studies. It is advised that the universities plan for more structured approaches to monitoring student progression and using this information in their planning.

> *"They just come in and after a number of years we see some of them graduating"*

Monitoring student progression is problematic in most places. Polytechnics are better off than the universities in this matter. Collecting information on students progression in the studies was often taken care of by the centralised service units. The data collected and processed was not properly used at the department level. The statistics better served the needs of the governance of the university or polytechnic as a whole. There is a clear need for more customised information for the department management.

A key tool available to the institutions in monitoring their success is the student records system. This is their Management Information System that enables them to monitor student progress, and also to monitor their own progress in reducing student drop-out rates and improving the average time students take to graduate.

- The institutions should strengthen their student records systems to ensure that they provide up-to-date information on each individual student, and a clear summary of information on overall student progress by course and by year.

The courses that each student has enrolled on must always be clear. At the beginning of each semester, the student must express a clear choice which must be recorded by the student records system. If there is an opportunity for students to sample a number of courses for a week or two at the start of a semester, then the student choice must be made at the end of this period.

Students Working Whilst Studying

There is tough competition between the 'joy of learning' and 'joy of working' (and money). The transition from school to work is gradual. Young people usually start working while they are still studying. Most students work part-time at

some stage during the year, either during the holidays or while studying. Nowadays, study programmes and curricula include more and more practical training in close co-operation with industry.

The practice of students in Information Technology starting work early in their academic studies has come about in part due to the acute shortage of graduates to meet the demands of industry. This has led to a "Catch 22" situation arising. Students take work and this delays their graduation, reducing the flow of graduates and forcing industry to recruit from the population of students who have not yet completed their studies.

- The fact that most students are working whilst studying from the 3rd year on creates big challenges for the traditional programmes. The need for flexibility increases and new means of delivering the education are needed. One solution would be the establishment of a full-time and a part-time programmes to better serve the different needs of the students. More emphasis could also be put to develop distance learning methods and competence based exams to name a few.

Often the companies offer professional personnel and on-the-job training. The big challenge for the educational institutions is to adjust themselves to support this kind of activity and find their role as counselling organisations to help students and companies to learn.

It will be necessary for some of the institutions to consider how part-time studying fits into the programme structure or rather how the two systems education and work fit together. Some personnel training or work assignments provided by the companies could well be fitted into the programme studies. Most universities and polytechnics already have some experience in providing distance and online education. The use of information and communication technologies (ICT) may contribute to more flexible teaching and learning arrangements.

Graduation Times

The polytechnics are 'faster' to produce graduate students than the universities. The mean duration of studies in polytechnics is 4.3 years, whilst in universities it is 6 years. The number of students dropping-out is also smaller in polytechnics than in universities. The average age of students graduating from the polytechnics in the information industry fields is 25.7, in universities it is 28.5.

Full time studies for a M.Sc. degree in a university requires a minimum of five years study. A Bachelor's degree in a polytechnic requires a minimum of four years. However, Finnish students often take much longer to complete their degrees.

After the graduation almost all students find work. In 1998 only 0.7% of the recently graduated engineers in the field of information technology were unemployed. 5.4% of the graduates serve in the armed forces right after the

graduation. Most students (male) serve before the studies or after the 1st year of studies. (IL ry, Valmistuneiden insinöörien sijoittuminen työelämään, 1999)

Average Age of Graduates

The average age of graduates in the evaluated programmes is listed in Table 12. The average age of graduates in the Finnish universities is older than in the rest of Europe. The independent nature of university studies allows for a considerable freedom of choice. Often students use this freedom to its full extent. Studies in the polytechnic are more structured and freedom of choice is more limited.

Table 12. Average age of graduates in the programmes involved in the evaluation

Universities						
HU	***HUT C.S.***	***HUT E.C.***	***LUT***	***OU***	***TUT***	***ÅA***
28.9	28.5	27	27.5	31	27	28

Polytechnics							
EVT	***HIT***	***KP***	***OP***	***PSP***	***SP***	***TP***	***VP***
26	26	24.4	26	28	25.5	26	26

Most young men serve six to twelve months in the armed forces at some point during their studies, usually after the first year.

The polytechnics also offer programmes for adults in evening classes. The above-mentioned average ages consist mostly of students in the day-time youth programmes.

Full-time studies for a Doctor's degree take approximately four additional years. The average ages of students completing their Doctor's theses in the universities are:

Universities						
HU	***HUT C.S.***	***HUT E.C.***	***LUT***	***OU***	***TUT***	***ÅA***
37	30.5	34	30	34.3	34	34

3.6 Transition from Education to Work

The transition from school to work in the Information industry is very short. In fact almost all students start working whilst studying. Most students find jobs in the big companies after they graduate. Only a few students were thinking of working in small companies. A very small number of students indicated a willingness to start their own companies. In these cases, they often thought, it would be beneficial to work for a large company for a while before establishing their own.

In some institutions visited, especially in the big cities, most students were working part-time while studying. It appears that after the 2nd year, employers wish to "earmark" prospective employees and offer them a part-time job. In general, the large companies encourage the students to graduate. There is often a salary increase at stake and availability to larger projects.

Graduation is not seen as important in the small companies. Some companies tend to place more value on the knowledge required to meet their immediate needs and do not pay much attention to graduation. Small companies are often more dependent on the work of the students. The small and large scale projects they are involved in at work allow less opportunities to students to complete studies.

It was recorded with satisfaction that almost all students find employment right after graduation. According to the Finnish Association of Graduate Engineers, only about 2% of engineers in the Information industry are unemployed.

Table 13. Engineers (incl. Architects) in the working life in 1999

	Engineers in the IT industry fields	*Engineers in general (excluding IT fields)*
Sample	N = 983	N = 7070
Regular job	93.2%	83.9%
Temporary, full time job	1.7%	5.8%
Part-time work	0.4%	0.5%
Part-time retired	0.3%	0.8%
Self employed/entrepreneur	0.8%	2.3%
Continuing studies	0.3%	0.7%
Unemployed	2.0%	4.7%
In the military service	0.3%	0.3%
Other (maternity leave etc.)	0.9%	0.9%

Source: Työmarkkinatutkimus, Insinööriliitto IL ry (1999)

3.7 Co-operation Between the Universities and Polytechnics

Co-operation between the universities and polytechnics should be encouraged rather than calling for more competition. So far co-operation is mostly based on informal contacts between individuals. The field was often described as "everyone knows everybody and his/her work anyway". Increased mobility of staff, with greater movement between institutions, for example to obtain promotion, would be a means of encouraging the establishment of common practices and disseminating good ones. Another approach that could be considered is the exchange of visiting peer examiners.

The institutions are also invited to consider a more structured approach to institutional co-operation. The co-operation could be in the form of sharing educational materials or individual expertise. There seems to be some co-operation already with the universities of technology in Finland in the production of educational materials, equipment and sharing individual expertise.

The Evaluation Team shares the idea that there could be a more synergy if the educational providers jointly develop programmes in the field. The big challenge is to find a suitable way of collaboration in specific activities and in combining the knowledge from the different universities and polytechnics. For example, the Internet could technically link the institutions together. Especially in the basic studies, a more comprehensive approach should be encouraged. The younger staff also often need to have access to broader contacts other than in their own field.

- It is strongly recommended that the universities and polytechnics develop a common forum for co-operation and sharing of good practice on programme development, new and flexible teaching methods, educational materials and exchange of individual expertise in the field.

3.8 International Co-operation

The internationalisation of education took a quick upward turn in Finland in the 1990's, mainly due to the progressively enlarged EU education programmes over the past few years. Internationalisation is manifest in many ways: students and teachers participate in exchange programmes, education in a foreign language is becoming more common, the curricula are being developed in international projects, students are actively informed of opportunities for studying abroad or completing their work practice period, etc. Internationalisation of education, especially through student and staff mobility, has been an education policy priority in Finland in the 1990's.

Table 14. Participation in international student exchange programmes

Universities							
	HU	*HUT C.S.*	*HUT E.C.*	*LUT*	*OU*	*TUT*	*ÅA*
Short-term	4	n.a.	n.a.	0	21	4	2
Long-term	4	11	21	0	0	9	0

(Short-term: one week to less than one semester. Long-term: over one semester)

Polytechnics								
	EVT	*HIT*	*KP*	*OP*	*PSP*	*SP*	*TP*	*VP*
Short-term	0	4	0	12	5	0	10	0
Long-term	18	11	3	10	7	5	10	4

(Short-term: less than 3 months. Long-term: more than 3 months).

The low internationalisation of students in the programmes evaluated raises issues such as attracting different types of links and more active exchange programmes with foreign universities. The figures in the Table 15 show the fact that the teaching staff should also be more active in the international activities.

Table 15. Number of teaching staff participating in international staff exchange programmes in 1998

Universities							
	HU	*HUT C.S.*	*HUT E.C.*	*LUT*	*OU*	*TUT*	*ÅA*
Short-term	0	0	1	3	1	5	0
Long-term	1	4	10	0	0	0	3

Polytechnics								
	EVT	*HIT*	*KP*	*OP*	*PSP*	*SP*	*TP*	*VP*
Short-term	4	0	2	9	2	0	1	2
Long-term	3	0	1	0	2	0	0	0

(Short-term: one week to one month. Long-term: over one month).

Only a few universities are active in international research and development projects. The Polytechnics are beginning to take the first small steps. The Evaluation Team recommends that the Polytechnics and the Universities initiate more co-operation in international projects.

Table 16. Participation in international research and development projects in 1998.

Universities							
	HU	***HUT C.S.***	***HUT E.C.***	***LUT***	***OU***	***TUT***	***ÅA***
Mp yrs	4,6	n.a.	50	2	20	24,4	0

Polytechnics								
	EVT	***HIT***	***KP***	***OP***	***PSP***	***SP***	***TP***	***VP***
Mp yrs	1	0	1	1,5	1	0	0	0,5

(Estimated time (in years) personnel is working for the project (Manpower years = Mp))

3.9 Financial Aspects to be Considered

The additional funding provided for increasing education in the fields of Information industry should be "earmarked" by programmes for meeting course development and delivery costs of the specific courses and not used to contribute to general department funds. The financial control of most of the educational institutions visited should be developed in this respect. The current mechanisms for university funding mean that increased budget allocation for information technology does not necessarily feed through to funding at the department level basic studies.

The scope of governmental concern may widen if it is interested in further expanding the intake of new students in the field. It may wish to offer its education to foreign students and promote opportunities for launching European programmes in the field.

Today, the universities are more dependent on external funding from industry than the polytechnics. Some universities attracted more than 50% of their funding from the external sources. The pressure on polytechnics to obtain external funding is also increasing. So far the funding from the companies to polytechnics has been relatively small and limited to grants or wages during the students' final work project. A couple of university representatives were concerned that too much industry involvement will come with too tight "strings attached", and the university may compromise its academic freedom. Sincere concerns about the cuts to university basic funding by the Government were also expressed.

3.10 Facilities and Equipment

All institutions had good facilities containing networked PCs with full high-speed Internet access. Only in a couple of places did students wish for more computers. The computer premises were often open from morning (8.00 a.m.) until late evening (8.00 p.m.–10.00 p.m.). In Åbo Akademi, the students had open access, 24 hours a day, to the computers rooms. In almost all universities, student dormitories were connected to the Institute's Net with open access.

Several institutions are planning to expand their library facilities. In the rest, libraries are large enough and rather well-equipped. Students have access to international on-line databases on the Internet from the libraries. In almost all places visited, the students complained about the availability of course books in the library. The libraries also complained that the prices of the new books in the field are rather high compared to the funding received to purchase the books.

Most institutions visited had construction projects under way. New facilities had been built or would be built in the near future in Lappeenranta (LUT), Espoo (HUT), Tampere (TP) and Turku (ÅA). Recently renovated facilities were found in Espoo (Evitech), Helsinki (HU and HIT), Kuopio (KP), Pori (SP) and Vaasa (VP).

4
General Recommendations

Aims and strategies

- Due to the great demand of graduates in the information technology area, the first and most important recommendation is that institutions develop and implement clear strategies and long-term plans to produce more graduates with up-to-date skills matched to the requirements of Finnish society.

It is obvious that if the number of students admitted increases and the rates of student progression remain constant or even lengthen, then staff student ratios will rise. This has the effect of putting a heavy teaching burden on the departments concerned and increases pressure on learning resources such as lecture rooms, laboratories, computing facilities and libraries. This in turn will have an adverse affect on the student learning experience and may lengthen studies

In addition, the Evaluation Team recommends that polytechnics and universities continue to determine their areas of expertise and make their focus areas clear to the students and their future employers.

Management issues

- Formal management processes need to be strengthened where they exist and established where they do not exist at the department level and above to provide a clear management framework.

In some cases, the programme staff were not fully aware of the specific institute or department level plans and strategies for the coming years. To improve the information flows within the departments, there should be a formal way to collect and distribute information for everyone concerned. Elements to be emphasised include: developing better visibility of department visions and strategies, providing real-time information about the programmes, enhancing long term staff recruitment plans and staff development, improving visibility of financial management and its relationship with the aspect of the provision (e.g. encouraging staff to actively consider the cost vs. benefit of running some poorly attended specialist modules).

- It is recommended that the polytechnics and the universities co-operate more on local, national and even international level.

In order to establish better conditions for work in the sector, institutions should develop a common forum for co-operation and sharing of good practice on programme development, new and flexible teaching methods, educational ma-

terials and exchange of individual expertise in the field. The education institutions and research institutes provide also 'neutral' forums for local industry and commerce co-operation and for development of new innovations.

Teaching, learning and development of programmes

Based on the Evaluation Teams observations the teaching and teacher-centred practises are still dominant throughout the field. The teaching typically consists of lectures, group exercises and laboratory work. Each course and work is assessed or tested separately. Most emphasis is placed on developing the physical environments for teaching, less emphasis is put on developing student's own learning activities. Luckily, some individual teachers are active also in this field. They are often working as 'lone riders' in their organisations. Collaboration in teaching matters with colleagues is often limited to informal discussions.

- A critical factor for the institutions is to review the way that the curriculum is delivered, with the aim of reducing the amount of material that is covered in traditional class room situations via lectures.
- There is a need to introduce more student centred and collaborative learning opportunities. Development of team-working and other non-technical skills should be integrated into the curriculum in all levels.

The fact that most students are working whilst studying from the 3rd year on creates big challenges for the traditional programmes. The need for flexibility increases and new means of delivering the education are needed. One solution would be the establishment of a full-time and a part-time programmes to better serve the different needs of the students. It is recommended that clearer codes of practice be established for combining work and studies.

It is recommended that more emphasis be put to developing distance learning methods, competence based exams and project based learning methods to name a few. Co-operation between the polytechnics and universities in this respect should be strengthened.

Some institutions have split up their study modules into shorter courses (e.g. from 5–8 credit unit to 2–3 credit units) to reflect the wishes of the students. Where this is done care should be taken to ensure the coherence of the programme as a whole.

- Institutions should put in place formal targets for providing written feedback to students on their work and progress, which goes beyond simply providing them with a set of raw marks.
- Tutoring and guidance systems should be strengthened so that members of staff provide greater support and guidance to students. Improved performance could lead to lower drop-out rates.

Co-operation with industry and commerce

- Long term partnership between the education providers and companies is needed. Continuous improvement of curriculum should be encouraged to reflect the current and future needs of industry and commerce.
- It is also recommended that the higher education Institutions communicate their work also to small and medium sized companies.

It was recognised that in some universities and polytechnics the consultation with industry was rather occasional and based on teaching staff's personal activity and interests. In such cases it is recommended that these industry and commerce links need to be put on to a more structured and regular basis. This includes, for example, development of clear aims and policies, staff development, evaluation of the progression, outputs and benefits of the activities.

The Evaluation Team wishes to recommend also that the polytechnics and universities monitor closely the quality of courses undertaken by visiting lecturers from industry. A systematic processes for ensuring the coherence of those courses in relation to the programme aims is needed.

- It is recommended that all student work related to studies be kept as public as possible. If the final works or theses deal with confidential development work then the time for keeping them confidential should be kept as short as possible.

Recruitment of students and staff

- Steps should be taken to widen the recruitment base of new students. Many programmes offer training also in English. It would be worth thinking of establishing an international programme in co-operation with different polytechnics and universities in the field.
- Attracting female students to continue their studies in the technical fields seems problematic. Universities and polytechnics should take steps to understand why female students are not taking their programmes and where possible put in place changes necessary to make their courses more attractive to women. Perhaps the concept of engineering studies needs to be re-examined to be better fitted for women too.

Both Helsinki and Tampere University of Technology have been successful in attracting female students to new programmes, where physics and chemistry were replaced by psychology. One-third of students in both of the programmes are female.

- There is concern that staff numbers are not rising to match the increasing number of students. Assistantships and other posts, which would help alleviate the pressure, are not being filled due to the relatively low pay compared to industry. It is recommended that more flexibility and innovative approaches are developed when filling the teaching positions in the institutions.

- Current staff/student ratios are rather high in some places. If the ratio is more than 1:30, it might lead heavy workload. In some places visited, there is a serious concern to reduce the workload. Additional salary incentives should be allowed to put in place in order to attract high quality staff to stay in teaching positions or to attract persons working in the industry.

International co-operation

- The evaluation team recommends that the polytechnics and the universities initiate more activity in international projects.

The low internationalisation of students raises issues such as attracting different types of links and more active exchange programmes with foreign universities. The figures show the fact that the teaching staff could also be more active in the international exchange programmes and projects.

4.1 Additional Recommendations for Universities

- A clear strategy focusing to support the development of teaching and learning and managing the increasing number of students in the programmes is needed. Emphasis should be placed also on attracting more staff for teaching positions and other support services.
- The average time to graduate should be reduced especially in the universities. Universities need closer monitoring of student progression. There is also a need to develop some common performance indicators for better monitoring purposes. (e.g. drop-out -rates, staff on leave numbers, industry involvement, secrecy of the student's final work etc.). Formal student support systems should be put in place where they do not exist. Where they do, institutions should ensure that they are put properly into practice.
- Greater emphasis should be placed on internationalisation and attracting student participation to exchange programmes.
- Institutions should give a thought to founding an intermediate level degree programme in the field of Information Technology. It could be awarded after 100–120 credit units taken and studying would be made available especially for part-time students offering a grounding in broad basic and practical skills and offer a chance to continue studies at a later time to complete a master's degree.

4.2 Additional Recommendations for Polytechnics

- It is recommended that the polytechnics "earmark" some part of the additional funding not only for programme studies, but to run additional basic courses in mathematics and other important studies. According to the interviews, it was clear that those students continuing their studies from the vocational secondary level had greater problems with basic mathematics

courses. The Tampere Polytechnic had achieved good results and limited dropping-out from the programme by offering extra courses for those needing them.

- Increased emphasis should be placed on developing partnerships with industry and commerce during the first two years of studies. This practice could lead to more interest in basic studies as well.
- Institutions are recommended to be more active in attracting external projects and funding. Polytechnics are still mainly dependent on government and local municipality funding. Only relatively little external funding is attracted except the scholarships for students final project works. Almost all of this work was done for the local companies or other organisations.
- Students should be encouraged to choose optional studies also from the other educational fields of the polytechnic. It was found that often in practice the students did not use this opportunity much. In some institutions visited the students claimed it to be difficult due to the mismatch of the timetables.

5
Programme Specific Findings

5.1 Espoo–Vantaa Institute of Technology (www.evitech.fi)

Information Technology (160 cu.)

Programme established: 1985. Number of students: 330 (and 270 in adult education). Number of teaching staff: 11. Teaching staff/Student ratio: 1:30. Visiting lecturers: 20%. Acceptance rate: 27.3%. Drop-out rate: 7%. Median time for graduation: 4.2 yrs. Average age of graduates: 26 yrs, in adult education 41 yrs. Percentage of female students: 14%. Industry advisory body: Industry Relationship Board. Number of industry partners 30. Funding from corporate services 3%.

Espoo–Vantaa Institute of Technology (Evitech) was established in 1985 by the cities of Espoo, Vantaa, Kauniainen and Kirkkonummi. The polytechnic reform was launched in 1992 and in 1995 Evitech was granted a permanent operating licence as a polytechnic.

The Polytechnic consists of three institutes: Business and Administration, Design, and Technology. The institutes operate fairly independently, although there is some co-operation between the units. Students can select optional courses from other institutes and include them in their degree programme.

The Information Technology degree programme is rather new. It focuses on Applications of Software Engineering and Embedded Systems, especially in the areas of Telecommunications and Measurement Systems.

The programme staff consists of 11 teachers, a laboratory manager and a programme assistant. Teachers shared with other departments and programmes and part-time lecturers are also used especially during the basic studies. The number of students is 330 in the youth programme and 270 in adult education.

Close to the needs of industry

The aims of the Polytechnic are closely linked to the needs of working life. Each department has quite a free hand in formulating aims of its own. This is supported by the management structure, which was considered to be solid, with firm guidance and direction setting by senior management. The Rector is closely involved in the strategic decision making process in dialogue with departmental management. Day to day decisions are devolved to the department level. However there did not appear to be any strong links between departments.

Guidance to the administration comes from two sources. Firstly, because the Polytechnic serves the regional needs of the local municipalities (owners), members of the municipalities sit on the Board of Representatives. Secondly, each department has its own advisory board where members of industry and commerce are represented. The students also have a representative in the board meetings.

It is recommended that the Polytechnic maintains and improves its open and proactive approach towards industry in the future.

The management stated that they believed that the vision they outlined in their self-evaluation report has already been more or less achieved. Still "more applicants for the 100 places available would be nice. 1000 instead of the current 600...". The number of applicants is showing good growth and the minimum score for entrance has been increasing steadily in the past few years. The evaluation team found that the members of staff are well aware of the Polytechnic's aims. They understand well the different roles of the universities and the polytechnics and have learned to benefit from it. The Polytechnic attempts to concentrate more on the immediate needs of industry. Its success in this is demonstrated by its ability to attract students despite potential competition from other universities and polytechnics in the region.

To sum up, the Department appears to be a cohesive unit with shared goals and values. It focuses on the core aspects of the Polytechnic's mission. However, it is recommended that the Department should co-operate more with the other institutes in the Polytechnic.

Keeping in contact

Both teachers and students considered that students find it easy to ask for advice or help if needed. The interaction between the staff and students was friendly. Students complete their basic studies in the same group (class size about 30) and there is one teacher responsible for each group.

The industry representatives were satisfied with the level of collaboration with teachers. Two teachers had taken sabbatical leave and spent one year in the industry. Unfortunately, after that year they both continued to work in industry and did not return to teaching. The Department should discuss with its industrial collaborators ways of continuing to provide industrial experience for members of staff, whilst avoiding staff loss.

Alumni activities have been initiated despite the programme being rather young. The anniversary of Evitech takes place in January. Students, who have graduated from the institute are invited to attend a seminar. Enterprises and well-known keynote speakers are invited, as well as potential students.

Limited co-operation between courses

Members of staff appear to be motivated to develop teaching and new learning projects. Both on-the-job and theoretical skills are valued. A significant amount of material in English is used in the programme. This was seen as good. However, it is recommended that the teachers ensure that every student learns the basic vocabulary in English.

During the first two years, all students complete basic courses in mathematics, physics, languages and in the basics of IT. During that time teaching mostly takes the form of traditional lecturing and exercises. During the 3rd and 4th years students are more involved with a variety of projects. The programme should consider introducing more real-work-related studies earlier in the course, perhaps even from the beginning.

Although project work was favoured by many teachers, it was sometimes less well co-ordinated. Students pointed out that sometimes several deadlines fall on the same dates. Although teachers show flexibility when this happens, it would be preferable if there was more co-ordination on projects between the teachers, so that the deadlines were respected and students would learn the importance of project schedules.

There seem to be quite a large number of optional courses for students. Visiting lecturers from industry are widely used. Students appreciated their practical knowledge, however, the Department should be careful that the use of a large number of outside lecturers does not adversely affect the development of the student's in-depth theoretical skills. Some of the industry representatives expressed a wish to see the students develop non-technical skills such as presentation skills and team-work.

In the Department, there was activity in the area of creating more project-based learning opportunities for the students. Where stress is placed on the learning experience as well as the learning outcome, the Polytechnic has the potential to shift its focus to introducing larger projects for the students. For their final projects, a number of students could work as a team on same problem, with individual students taking on different aspects.

The teaching load is rather heavy for some of the teachers. It is recommended that the Polytechnic pays close attention to this group of teachers and creates flexible opportunities for updating their competencies.

Need for more systematic feedback system

In general, the amount of study that equates to a credit unit was not consistent across the programme. It was rather difficult to find correlation between the average time spent and credit units obtained, especially in the programming courses.

The course assessment by students could be more systematic and focus on the most important and critical courses, particularly at the beginning. The feedback system is still under construction and it does not seem to be a top priority

at the moment. The team recommends that the management pay more attention to utilising feedback. It should also think carefully about the role of the feedback system, as it did not seem to be clear to the staff. The feedback system could also be expanded to include the views of industry.

Students are well taken care of in the Polytechnic. There is a one-month tutoring period at the beginning of the studies. After that period guidance personnel and teachers are available for the students. Guidance books and other additional materials for the students also seem to be up-to-date.

Internationally active

International activity is lively and students take part in exchange programmes. The Polytechnic has an international liaison officer, whose task is to maintain international links and guide students. The evaluation team got the impression that the active international profile was well grounded.

Resources

The student numbers have grown during the past few years. Based on the current intake of students, the polytechnic is planning to build new facilities in the next few years. The increase in new students creates pressure for more long-term planning for facilities.

Recommendations

- The Polytechnic could initiate more national co-operation with the other polytechnics and programmes in the field.
- A processes for reviewing the quality of courses undertaken by the visiting lecturers (20%) is needed.
- The Polytechnic should develop additional measures to attract more female students to the programme.
- Small and medium sized companies could have a representative on the Industry Relationship Board.

Good practice

- Active involvement of local municipalities in polytechnic governance
- Professional management and clear decision-making channels
- Good and open communication between staff and students
- Experiments on project-based learning, process orientation of studies

5.2 Helsinki Polytechnic (www.hkiamk.fi and www.hit.fi)

Electrical Engineering and Telecommunications (160 cu.)

Programme established: 1972. Number of students: 1 539 (+ 245). Number of teaching staff: 32. Teaching staff/Student ratio: 1:48. Proportion of visiting lecturers: 20%. Acceptance rate: 67.4%. Drop-out rate: 11%. Median time for graduation: 4.3 yrs. Average age of graduates: 26. Percentage of female students: 8%. Industry advisory body: Advisory Board of the EE Department. Number of Industry partners 35. Funding from corporate services 1%.

The Institute was established in 1881 first as a private training centre and in 1886, the State took over and re-named it the Helsinki School of Industry. Education in electrical engineering began in 1889. The Department of Electrical Engineering was founded in 1912. In 1972, study field classifications were standardised in accordance with State education planning standards in such a way that the institutes electrical engineering study fields were defined as electrical power engineering, telecommunications and control engineering. The Institute will be granted a permanent polytechnic licence in August 2000. The Helsinki Polytechnic has about 6 000 students in the study fields of Technology, Health Care and Social Sciences as well as Culture and Services.

Today, with 1 300 students, the Department of Electrical Engineering is the largest department in the Helsinki Institute of Technology. The number of permanent teaching staff is 32. The programme also shares 23 part-time lecturers in general basic studies.

General engineering skills

The aim of the Polytechnic is to promote general engineering skills in education. Students are taught the basics of mathematics, physics, chemistry and technology. The evaluation team defines the Polytechnic aim as “flat education”, which provides good basic practical knowledge for the students. The aim of the new curriculum is to “meet the training targets of the companies in the region.”

The Department has five options for major studies. They are Telecommunications, which specialises in work in the area of electronics and radio engineering, data transmission and switching systems, and computer and software engineering. Software Engineering is focuses on software engineering and digital signal processing. Electronics focuses on electronics design and EMC and control engineering. Students can also complete majors in Electrical Power Engineering and Health Care Engineering.

Transforming the old institute into a polytechnic has created a relatively positive spin in the institute. The curriculum has been completely revised recently. Staff has participated actively in in-service training and different projects have been initiated. Other development work is just beginning to show at the department level.

Lot of expectations created

There seems to be a lot of expectations when the Polytechnic will receive a permanent status in August 2000. It was not quite clear to the evaluation team, if the staff fully understood why and how they were developing the new curriculum. It is important that those planned changes take place. Action has been limited to bringing the necessary changes gradually into the programme.

It was noted that one individual person was responsible for developing each issue. Other teachers around these individuals seemed to be working more like as work groups rather than teams.

Competent teachers

The co-operation between the staff and students seems to be open. There may be some gaps among the staff. However, the spirit among the staff was optimistic. The teachers were competent in their fields. Everyone had a degree in a special field and pedagogic training.

Virtual learning and visiting lecturers

The Polytechnic has been developing a new virtual learning environment. However, there seems to be some lack of interest among the staff to find both a time and place to learn the new technologies needed for open and distance learning. As the project has been running for almost a year, there is a great need to get all staff involved in using it. It is, therefore, recommended that the Department of Electrical Engineering and Telecommunications should ensure coherence between the aims and intended use of open learning environments. The use of the new learning environment should be developed in ways which involve all members of the staff and meet the stated aims of the programme.

Visiting lecturers were used frequently. It is recommended that the Polytechnic carefully reviews the quality of the courses provided by the visiting lecturers. There might be a danger of creating too fragmented a programme. Often the visitors lack the overall information about the programme. According to the students, some visiting lecturers provided up-to-date knowledge. However, they were often too busy to provide additional support.

All in all there was a positive attitude among the staff to develop teaching. It was noted however, that most of the basic studies, at least were taught in rather a traditional way.

Sufficient student guidance

The student guidance was considered sufficient. Some measures were started rather recently, such as student tutoring. Guidance in general can be obtained from the head of the department, managers of the study specialisation options, tutors, the work practice instructor, the international co-ordinator and individu-

al teachers. Adequate materials are also available both in texts and on the Intranet. The following documents are available both in texts and on the net:

- Introduction to studies
- Study guide
- Study regulations
- Curriculum descriptions
- Guide for studying abroad
- Guide for work practice
- Guide for writing the thesis
- Guide for writing an English abstract

There seems to be an open dialogue between the staff and students. As a "rule of thumb", students' complaints are handled 'on the spot' if possible. The first person in charge of handling the complaints is the class supervisor. Other counselling personnel are available if needed.

Students also get assistance in creating their personal study plans (HOPS). An area that might need some improvement in the future is that of combining work and studies.

Increasing international activity

The Polytechnic has many international activities and many students have participated in student and trainee exchange programmes. Students who had been abroad had an active role in encouraging other students to participate as well. Student guidance concerning the international activities seems to be adequate.

Modern facilities

The Polytechnic has recently renovated its facilities. The laboratories are well equipped. The language centre offers students an open learning environment for studying at their own pace. The self-study facilities include computers, video and audio equipment and satellite services for 18 places. The library has co-operation contracts with some polytechnic, university and other libraries.

Helpful self-evaluation report

The self-evaluation report was found to be comprehensive and honest. It will serve the Polytechnic with its future development work. The evaluation team recognises that the majority of its own concerns and suggestions have already been identified in the self-evaluation report and are being addressed in various ways within the Polytechnic.

Recommendations

- The number of higher education institutes in the Helsinki area calls for a clearer focus in education.
- The teacher tutoring system should be improved and all teachers activated.
- The polytechnic uses a lot of visiting lecturers (20%). It is worth paying closer attention to monitoring the quality of those courses and ensuring coherence in the programme. A processes for reviewing the quality of courses undertaken by the visiting lecturers is needed.
- The retirement of qualified staff will create challenges in the near future. A comprehensive plan is needed to avoid possible problems in the future.

Good practice

- Guidance materials available for the students.
- Staff assisting students to create Personal Study Plans.
- Activity in international exchange programmes.
- Process of preparing the self-evaluation report and the report itself

5.3 University of Helsinki (www.helsinki.fi)

Computer Science (160 cu.)

Programme established: 1967. Number of students: 1 793. Number of teaching staff: 42. Teaching staff/Student ratio: 1:43. Proportion of visiting lecturers: 5%. Acceptance rate: 70%. Drop-out rate: 30%. Median time for graduation: 6.8 yrs. Average age of graduates: 28.9 yrs. Percentage of female students: 20%. Industry advisory body: through personal contacts. Number of industry partners 47. Funding from corporate services 10%. Funding for R&D services 24%.

The University of Helsinki is the oldest and most multi-disciplinary university in Finland. It was founded in Turku in 1640 and then transferred to Helsinki in 1828. A separate faculty for sciences was established in 1852. The Department of Computer Science was founded in 1967, when the first full professorship in computer science was established.

Today, the Department has 47 teaching positions consisting of 12 professors, 13 lecturers, 15 assistants and 7 teachers. The number of students is 1 793. The intake of new students was 270 in 1998 and 310 in 1999. The Department is also responsible for providing Computer Science courses for all students at the University.

The degree programme in Computer Science is divided in three sub-programmes: Computer Science, Applied Computer Science and Teacher in Computer Science. The sub-programme Computer Science is made of five areas of specialisation: Algorithms, Intelligent Systems, Software Engineering, Information Systems, and Distributed Systems and Data Communication. The last two areas of specialisation have been introduced since 1998.

Focus on research and education

The aim of the programme is twofold. Firstly, the programme strives to provide a modern and all-round advanced level education for computer experts to suit the needs of the industry sector. Secondly, the Department seeks to be among the top research institutes of computer science within its own selected research areas.

Old and new systems

There have been some recent changes in the Department management. The Head of the Department changed in 1998 and again in 1999. This has initiated changes in the Department. Old systems and traditions still continue although new units and roles have been established. The roles of the different specialisation area heads seem to be a little unclear at present. This creates some areas of activity where nobody seems to be taking responsibility, e.g. student counselling or additional administrative work. In theory, executive powers rests with the Head of the Department. However, during the interviews it was noted, that in practice, many decisions were still made informally, according to the old management structure, within each of the laboratories. A term used often was "but in practice..." The faculty staff seemed to be happy with this situation, but some students felt it was difficult to cope with.

The Department seems to be made up of individual, independent units (of expertise) rather than being a single coherent system. New courses are designed by the different laboratories, and then pooled together. The evaluation team learned that the new management had not yet formed a clear and communicable vision for more than one or two years ahead. It is recommended that the Department Head takes more responsibility for the overall co-ordination of the Department's work.

Information flows also need to be examined more closely. Some students described the information flows in the Department as "hunting information through rumours". This issue needs to be addressed more clearly in the Department. It was learned that the Internet was actively used. However, it should be noted that it is not a suitable channel to be used as the only means of communication especially if information is not updated regularly.

Recent changes in the programme

The degree programme has undergone major changes since 1998. Two new areas of specialisation have been added to the programme. Furthermore, many courses have been split into smaller components. Our discussions with the students suggested that the split courses were liked by the students, especially those working whilst studying. It should be noted that by splitting the courses, it may become more difficult to monitor the programme as a whole.

Academic students

The evaluation team recommends that the Department pays attention to the fact that in the five year period 1994–1999 only 11 Ph.D. degrees were completed. This could easily lead to a lack of a post-doctoral young faculty and, in the long run, could lead to the Department having difficulty finding qualified staff.

The intake of new students has grown rapidly during the last few years. The basic admission limit has been 180 new students per year. In 1998, the programme accepted 270, and in 1999, 310 new students. The rapid increase in student intake in the past three years has created several challenges for the Department. A significant fraction of the students drop out of the programme each year. The management does not seem to be too concerned about this, but explain that the reason is that the industry demand for computer science students is very high. Another reason might be the fact that many students decide to change their majors later on and no longer continue Computer Science as a major. These students, too, are reported as drop-outs.

The students interviewed took their studies seriously; they also seemed to value their so-called 'academic freedom' highly. Students were not very goal-oriented as far as completing their studies was concerned and seemed to treat the studies as one of many part-time occupations. Some of the students really enjoyed the academic freedom, which enables them to study different subjects freely within the University of Helsinki framework. This, combined with the lack of staff measures to encourage and support student progression, may be one reason for prolonged studies.

The University of Helsinki has been successful in attracting female students. The average proportion of female students in other institutions in the field has remained close to 10% whilst at HU the figure is 20%. However the department is not as successful when measured in terms of female students who go on to complete their studies and graduate.

Specialised knowledge

The University has been very successful in identifying and developing specialisation (niche) areas to satisfy the needs of selected computing industries. The industry representatives considered the programme to be highly theoretical. They felt that less emphasis was paid to promoting practical knowledge.

In general the quality of teaching is viewed as good and is based mostly on the professors' core competence. Both professors and students seemed to be satisfied with the contents of the programme. However, some courses were based on rather traditional lecturing with little interaction. In particular, some basic courses were arranged for huge groups with 300–600 students.

The professors' knowledge was recognised and valued by the industry representatives in general. There is a plan to develop teaching methods in a direction that involves more student activity. So far, the development of teaching has

been left to individual teachers. The staff is well aware of the increasing number of new students and the pressure it will cause teaching in the near future.

It was noticed that the professors had only limited co-operation with each other regarding teaching issues. According to the students, this can cause some overlapping of course content. There is a need for more co-ordination.

Lack of feedback

Students were asked to evaluate their course twice a semester. The professors did not seem to be too concerned about the lack of student interest in giving feedback. The lack of criticism or even interest among students should be cause for alarm. The feedback system is not fully serving the needs.

Some of the lecturers attempted to collect feedback on the curriculum development by facilitating discussions in news groups. The discussions were described to be lame.

Limited industry links

The Department has only limited co-operation with industry. Almost all thesis work subject areas are selected by students based on their own interests. The Department has some grants available for those students wishing to focus on basic research, instead of focusing on applied research, which is more readily funded by industry. The evaluation team felt that the research and teaching at the Helsinki University is more "academic" in the sense that it is not strongly influenced by industry and commerce. The most visible example of industry co-operation is a dual professorship, one person working half the time at the Department and the other half in the industry.

The industry representatives valued the academic skills of the students. After all, as the Department slogan says, "Linux was invented here".

A lot of expectations are also being placed on the establishment of a new research institute, Helsinki Institute of Information Technology (HIIT). This is a joint venture between the University of Helsinki and Helsinki University of Technology. Its main goal is to provide facilities as well as funding for top researchers in computer science and engineering. It is hoped that the Institute will not draw the most talented professors away from teaching.

Students like it at home

International activities are limited to a couple of research projects. Greater emphasis should be placed on students' internationalisation. Only 2–3 students take part in exchange programmes annually. This is due, in part, to the fact that so many students also have part-time employment. It is recommended that the programme staff give additional recognition to student participation in international activities.

Under the same roof

The Department of Computer Science is also responsible for teaching some of the basic courses on computer science at the University of Helsinki. As the way the University funds the Department is mostly based on graduation numbers the money available for running the basic courses is said to be limited when compared to the size of the groups in the studies. Some of the largest lectures hosted about 600 students. The Department approach to accepting students on the courses is very "academic": a broad range of subjects, available to all students who can benefit from them.

The Department maintains the largest library in the field of computer science in Finland. There are about 52 000 volumes available for the staff and students. The collections are freely available to all visitors. Home loans, however, are normally granted only to University personnel and students of the Department from the second year on.

The University of Helsinki has facilities scattered around the Helsinki area. The Department staff felt that the current location is isolated from the rest of the university. There are plans to build new facilities in Kumpula. New and bigger facilities could link together more science departments.

Recommendations

- There seem to be two management systems in use, formal and informal. It is recommended that management priorities are clarified. This would also enable more focused long-term planning.
- The group size in some of the basic courses is alarmingly high. Addressing this should be one of the top priorities in the Department.
- Collecting feedback from the students should be improved.
- The University should consider initiating more activity related to industry and internationalisation.

Good practice

- Identification and development of specialisation areas for the computing industry.
- A co-operative research venture (HIIT) between the two universities (HU and HUT).
- Programme designed to attract female students above the average in the field.
- History of allowing some students to work freely on personal development projects.

5.4 Helsinki University of Technology (www.hut.fi)

Computer Science and Engineering (180 cu.)

Programme established: 1984. Number of students: 1 433. Number of teaching staff: 39. Teaching staff/Student ratio: 1:37. Proportion of visiting lecturers: 16%. Acceptance rate: 45%. Drop-out rate: 14.1%. Median time for graduation: 7.2 yrs. Average age of graduates: 28.5 yrs. Percentage of female students: 8.3%. Industry advisory body: no, one industry representative in the Board of the Department, indirectly through research institutes. Number of Industry partners 60. Funding from corporate services 32.4%. Funding for R&D services 13.2%.

HUT was founded in 1849 as the Helsinki Technical School. It acquired university status in 1908. Today, it is the oldest and largest university of technology in Finland. The study programme started in 1984 with 7 professors and 85 students. The number of new students admitted annually stayed below 100 until the mid-1990s. There was a re-organisation within HUT at this time, at which point the current department was formed. Since that time, growth in the area of Computer Science and Engineering has been rapid.

Currently the Department has 24 Professorship positions and an intake of 220 students. With additional students via the national Programme for Increasing Education in the Information Industry Fields in 1998–2002, the number of students accepted will rise to 350. The Department is also responsible for providing Computer Science courses for all students at the University.

The Department is made up of four laboratories. These are the Laboratory of Computer Science, which specialises in work in the area of Signal Processing, Neural Networks and Computational Efficiency; the Laboratory of Information Processing Science, the Laboratory for Theoretical Computer Science, concentrating on theoretical aspects of Computer Science, and the Telecommunications Software and Multimedia Laboratory concentrating on Telecommunications and Multimedia.

The programme emphasises on software development, networking, formal methods, adaptive and intelligent systems and human-computer interaction.

Educating e-Engineers

According to the self-evaluation report, the main objective of the programme is to provide education for engineers at Master's level. The current situation at the Department is in many respect good. The programme provides good research, teachers are qualified and the industry is also happy about the quality of the students they recruit from the programme.

In discussions with the evaluation team, the Department did not seem to be happy about the increase in the number of students and would rather see the intake reduced from the present numbers. They are afraid that the quality of new students will be more mixed/heterogeneous. It is also a fact that it is

difficult to find new staff in the region. In the longer run there are not large enough facilities for all the new students and lectures.

The organisation of the Department seems to be built around the specific expertise of the professors. The details of the departmental organisation and its central functions remained unclear to the evaluation team.

The programme consists of about 70 credits of core mandatory courses such as mathematics, physics and the basics of various engineering subjects. Minor subjects can be selected from another laboratory, but otherwise there is little inter-laboratory co-operation within the Department. There are a many optional courses available for the students. Some of the courses are not offered annually and in some courses the content changes every year according to what is thought to be needed. This process of curriculum change was described as informal, rather than planned and co-ordinated at the Department management level. Professors are responsible for course planning and development. The system of "everyone collecting new topics for the courses next year" is likely to lead to gaps in the curriculum and a lack of information about the course contents. There seems to be little emphasis on co-ordinating the programme focus. The Department should put in place more formal approaches to curriculum review.

It is also strongly recommended that the University encourage more collaboration in course development and delivery functions across Departments, especially in the area of telecommunications. The topic is taught in both Departments participating in this evaluation. The university should also establish a mechanism for more co-ordination on demands set for the individual departments by the different internal service providers within the University.

Critical next steps

The number of students is growing rapidly. This is likely to cause some problems in organising the teaching in the future. The development of strategies for managing the student flows seems to be lagging behind. The evaluation team strongly recommends, that the Department monitors and reviews student progression more closely and takes appropriate actions to establish more systematic procedures for following student progress. The increase is not yet fully visible because the majority of students are still attending general courses and have not yet started their major subjects.

Competent staff and diligent students

The teachers are qualified in their fields. There is a big shortage of staff and the workload is high. There is a big gap between the number of teaching positions (64) and the number of staff in post (39). To attract qualified staff for the teaching positions seems to be one major problem. The current teacher–student ratio is alarming.

According to students, teachers are easy to approach even outside the official meeting hours, if they can be found. The availability of professors is very problematic during the busiest times.

The reasons provided for not attracting enough staff were: there is a high demand in the industry and salaries in the teaching profession are considered too low. There also seem to be some internal planning and financial aspects to be considered. For example, the most recently founded Telecommunications Software and Multimedia Laboratory is growing rapidly and has only recently started producing graduate students (M.Sc.). However, the number of graduates is the basis for the financing. Many students also select Computer Science and Engineering as a minor, but the internal policy for allocating funding does not take this into account.

The good reputation of the Helsinki University of Technology attracts good quality students. Students are not strongly motivated to graduate in a short period of time. The average time to complete the studies in the programme is 7.2 years. The students were not willing to set a limit on the maximum number of years within which they have to complete their studies.

The drop-out rate is 14.2%. No one seemed sure of this figure, nor knew, how or if the students are really progressing with their studies. It is evident that the use of centrally collected data is not serving the Department processes effectively.

Most lectures are during normal office hours. Students who work sometimes find it difficult to combine work and studies. Working while studying seems to be a necessity in the Capital region as the financial support for study is considered to be rather poor compared to the cost of living in the area. Most students stated that they are forced to work for this reason.

Teacher tutoring problematic

There is a strong tradition of students providing support for each other. Student guilds have an active role in running the initiation programmes for the first-year students. Tutoring by the staff has been recently introduced in the programme and, from discussions with the students, does not yet seem to be fully operational. Some students said that that they have not seen their tutor at all during the first year.

Dropping out of the courses

The evaluation team found that it seems to be common practice for the students to begin more courses than they plan to continue with. This causes some uncertainty at the beginning of most popular courses. The situation indicates that there is a lack of proper information available about the courses. The students show up at the lectures and evaluate the quality and usefulness of the course based on the first couple of lectures. Better guidance and better tutoring may help in this situation. In general, the programme offers great flexibility for the students.

Teaching methods were described by the students as mostly traditional, including a lot of lecturing. The teaching staff estimated that 10 – 20% of exercises are done in groups of 2–6 students.

The University of Technology has big lecture halls and large groups of students attending basic courses. Delivering courses in large groups is efficient in some senses, but not from the point of view of learning taking place. The evaluation team noted that the University had recognised the dangers of big groups in lectures and the Department had made a special effort into ensuring that these basic courses are given by senior staff members and other lecturers with good teaching skills. It is recommended that new and innovative teaching methods should be experimented with.

High priority to research

In general, research appears to have higher priority than teaching. Obtaining research contracts from industry seems to be more highly regarded than a willingness to teach. The improvement of teaching has been left to individual staff members. There is little collaboration among the staff to create common courses. The University of Technology has some centralised services available for those members of staff who wish to improve their pedagogical skills.

Students described some compulsory courses as too basic for those studying computer science as a major. They suggested that some courses could be offered just for students from other departments as introductory courses. It was viewed as good practice that the most experienced teachers ran the most critical basic courses to guarantee a solid basis for further learning.

Feedback system not in effective use

It is the opinion of the evaluation team that the course evaluation system is not effectively benefiting the lecturers. The information provided for the them often comes too late and has only a limited impact on courses. Students are not accustomed or willing to provide oral feedback during large lectures with hundreds of students.

Grading problems

According to the students in some cases it has taken several months to receive the grades for the courses. It is recommended that tests are returned to the students in no more than a few weeks. More feedback could also be provided for the students than just grades.

Visiting lecturers from industry regularly give lectures. There is a much research co-operation with the industry in the region. In particular, the usability testing laboratory was serving the needs of programme and industry well.

Lack of space

The Department facilities are new, but are already getting too small because of the vast increase in student intake. There is a need for more long-term planning in the University.

The Net provides a good platform for delivering assignments and lecture notes for the students. Those living in the Otaniemi campus have full access to the HUT intranet from their dormitories.

Recommendations

- It is recommended that the Department pays close attention to the growing number of new students. A strategy is needed to deal with the expected growth, if future problems are to be avoided.
- The relation between the Department's strategy and the financial incentives given by the university's internal system should be improved. The current budget allocation system in use does not encourage efficient use of funds at the Department.
- Action should be taken to ensure that individual student progression is monitored and greater guidance is provided.
- The heavy teaching load should be addressed.

Good practice

- Investment in student learning and motivation via basic courses taught by senior staff members with good teaching skills.
- Active use of the Internet to deliver study materials and exercises to students.
- Usability testing laboratory and its relation to studies.

5.5 Helsinki University of Technology (www.hut.fi)

Electrical and Communications Engineering (180 cu.)

Programme established: 1942. Number of students: 2 564. Number of teaching staff: 69. Teaching staff/Student ratio: 1:37. Proportion of visiting lecturers: 10%. Acceptance rate: 85%. Drop-out rate: 20%. Median time for graduation: 7.0. Average age for graduates: 27 yrs. Percentage of female students: 8.7%. Industry advisory body: no, one industry representative in the Department Council. Number of Industry partners 60. Funding from corporate services 25.3%. Funding for R&D services 39%.

The Department of ECE was originally part of Mechanical Engineering, but became an independent department in 1941. It is now the largest department, making up one quarter of the University of Technology. In 1996, the name of

the Electrical Engineering department was changed to its current title of Department of Electrical and Communications Engineering.

Today, there are 20 laboratories, 48 professorships, 2 564 undergraduate students and 516 post-graduate students. In the year 2000 the programme will be divided in two: Communications Engineering, and Electronics and Electrical Engineering. The aim is to enhance the visibility of the variety of topics and make the programmes more attractive to potential university students.

Rapid growth

The intake of students is growing rapidly. The increase in student intake is really not fully apparent yet because the majority of students are only on their common general subject state and have not started their major subjects in full. There does not seem to be a clear plan on how to deal with the increasing number of students (facilities, equipment and staff). The student to teacher ratio is now 1:37. The management is organised according to the optimal number of staff. Given the fact that not all positions are filled, it is recommended that a more realistic growth strategy be made for the Department.

Students were feeling the pressure of the large numbers of fellow students. They did not like the large class sizes and felt that the system and resources are being pushed to the limit. Their opportunities to for choosing freely between different courses have been limited. Due to the large groups, some courses were restricted in numbers, with priority given to those students who are about to fulfil the requirements for graduation.

The Department has been working within its current framework and processes to solve the problem of the increasing numbers of new students. Lectures have been moved to larger halls. However, it is recognised that more innovative changes in the administration and organisation of the University are needed. Splitting the programme in two is the first of these changes.

Several professors at the Department would like to introduce a B.Sc.-degree as one solution for shortening the long average time required for graduation.

Flexible programme

The programme consists of about 70 credits of common mandatory courses such as mathematics, physics and the basics of various engineering subjects. The selection of possible major subjects is very wide, the largest in Finland in this field. As a consequence, some of the majors have very few students which makes the teaching expensive. The Department believes that it has a duty to offer study programmes that are needed and not offered by any other department in Finland.

Minor subjects can be chosen from other laboratories, departments or even from other universities. Some majors are also offered by other departments (e.g. Industrial Management). Choosing courses from other departments and from different levels causes co-ordination problems for students. The vast in-

take to the Computer Science department causes "bottle-necks" for students selecting minors in that field. The student view of the curriculum is that it is up-to-date. They also indicated that combining theory and practice could be improved.

The strategy for evolving the curriculum is adversely affected by the level of freedom available to individual professors. The evaluation team found out that the Department Curriculum Committee has tried and failed to limit the courses offered by individual professors. It is acknowledged that the content of individual courses changes without reference to the curriculum committee. The different options within the programme were described as "sub-cultures" which operate quasi-autonomously. This may cause some unnecessary overlapping in courses.

Shortage of staff

The Department considers there to be a shortage of staff and the workload is said to be high. The rapid growth in student numbers may increase teaching loads in the near future.

The students and the study guilds themselves have been responsible for several tasks traditionally the responsibility of the Department such as study guidance and introduction of new students. Availability of staff outside the time-tabled hours was seen as problematic by the students.

Students

The industry representatives valued students from the programme. They were happy with the technical knowledge that the students possess when they graduate. In most cases, the graduates are equipped with knowledge that enables them to start making a contribution immediately.

The students were proud of being students of HUT. They would make the same choice again were they in that situation.

Teaching and learning

Student perception of the teaching varied. In the best cases teachers, were enthusiastic and inspiring, in other cases teachers seemed less enthusiastic and regarded teaching as a necessary chore. Students felt that the level of informal feedback during the lectures was low for cultural reasons. The University has offered an opportunity for pedagogical training for all lecturing staff. However, it was not been taken up by many staff members.

Students felt that teaching methods tended to be traditional, with little group or "student-centred" learning exercises. Students would like to get more assistance in laboratory courses. According to the students, getting assistance from the professors and other teaching staff is encouraged, but sometimes difficult. The threshold for the student to approach the professors is, for some reason, high.

Students liked the flexibility of the programme. However, they acknowledged that it, also, frequently leads to timetable clashes. Starting courses and then dropping them seems to be common practice in the University. The students are not too keen to graduate in a short time, but give high value to the social life and academic freedom in the sense that they understand it.

Students felt that the exams tended to test their ability to remember facts rather than their ability to apply knowledge.

The industrialist mentioned that software skills for telecom is an area that would need some further strengthening.

Teacher tutoring and feedback systems

The choice of study options was based on students particular interests. Guidance and advice can be best obtained from other students and in tutorials organised by the student guilds. Every freshman joins a tutoring group, which is mainly taken care of by older students. The culture of teacher tutoring is young and is not working properly yet. The students at the meeting could not recall ever having consulted staff on the choice of courses. They wished for more co-operation with the teachers in this matter. Students are supposed to meet their teacher tutor once or twice during the first year of studies.

Feedback to students on their work is often restricted to a grade mark. It is not customary to get more detailed feedback from the professors during or after the course.

The passing rate in the exams varies from 10% to 90% with an average of 50% passing. According to the university regulations, every course can only be repeated twice, but very few professors are strict on this rule and allow students to repeat courses as needed.

The evaluation team shares the view, that improving student support and guidance, and monitoring student progression, is likely to lead to improved student completion rates. This will reduce the time to complete studies as well as the large number of students in the system.

Working whilst studying

Over half the students are working in industry during their studies and this number is increasing. Programme students are often offered a permanent job during the 4th year of studies. This creates challenges for the Department in running the 4th and 5th year courses and getting students graduated on time.

Resources and facilities

The increasing number of students in the field appears to be leading to a potential crisis in terms of teaching loads and physical resources (accommodation and equipment). There are plans to renew the student cafeteria and build a

larger library. However, not so precise plans were available for expanding the teaching facilities. The classrooms are extended by the use of the Internet to deliver mainly lecture materials for those deciding to study on their own.

The evaluation team also visited a very crowded and busy Basic Electronics Laboratory. The laboratory operated on a rota-basis almost continually, in order to allow all the students enrolled on the course to undertake the necessary practical work. The approach seemed to have reached full capacity. If student numbers grow, a radical re-thinking of this approach may be necessary.

Recommendations

- The Department should establish strategic priorities and plans to deal with the growing number of students.
- The teaching load is rather heavy and should be reduced. New and innovative solutions in delivering education should be encouraged.
- The working conditions at the electronic laboratory in the basement are rather poor. There is a need to invest in modern lab facilities in the near future
- More co-operation between the Electrical and Communications and Computer Science Engineering Departments should be introduced.

Good practice

- It is seen as a positive thing that the programme will be split in two. The evaluation team hopes that this will lead to more coherent programmes and manageable groups of students.
- Flexibility of studies and number of options available for the students
- Introduction programmes and tutoring organised by the student guilds

5.6 Kajaani Polytechnic (www.kajak.fi)

Information Technology (160 cu.)

Programme established: 1988. Number of students: 255. Number of teaching staff: 15. Teaching staff/Student ratio: 1:17. Proportion of visiting lecturers: 10%. Acceptance rate: 57%. Drop-out rate: 12.7%. Median time for graduation: 4.3 yrs. Average age of graduates: 23 yrs. Percentage of female students: 11%. Industry advisory body: Advisory Committee, but not yet active. Number of Industry partners 1. Funding from corporate services: none.

The Kajaani Institute of Technology was established in 1970. It was founded to meet the need for qualified technicians and engineers especially in the Kainuu region. Starting in 1992 the Institute took part in the experimental phase of polytechnics and in 1996, it was granted a permanent operating licence. Kajaa-

ni Polytechnic consists of four faculties: Engineering, Business and Administration, Health and Welfare, and Tourism and Catering Management. The number of students in the polytechnic is around 1 300.

The degree programme in Information Technology was set up in 1988. Today, there are 255 students in the degree programme. The annual intake of students has recently increased from 30 to 60. The number of teaching staff is 15. Part-time teachers and technical assistants are also used.

Currently, the programme has plans to focus on Digital Signal Dormation (embedded systems), Testing and Quality Control of Electronic Equipment.

Need for clear vision

The Polytechnic's vision is not clearly stated in the self-assessment report. The strategy for the next few years is currently under development. The Polytechnic has a great regional importance for the local community and industry. The area has suffered from heavy unemployment and decreasing population.

The Department Head has planned to initiate many changes in the near future. This will create increasing pressure for the programme staff. Not all teachers seemed to be willing to change. The situation creates big challenges for the programme. Therefore, it is recommended that the different interest groups in the programme should be involved in the planning process as early as possible.

Continuous up-dating of programme

The Head of Engineering has been in his position for one and a half years. He has initiated a lot of new areas of development in the IT programme in a rather short period of time. It is still too early to see the results of the development in practice. The evaluation team wishes to support the enthusiastic approach towards improving the quality of the programme.

The programme has been recently up-dated thoroughly by adding new specialisation courses. Teaching methods will also be up-dated. The plan is to encourage more group work opportunities for students.

The programme is going to focus on two main areas: embedded systems and testing of electronic equipment. These areas are based on the close needs of the local industries: wood and electronics. Application of signal processing is seen as an umbrella covering the specialising areas of the programme, e.g. machine vision. A multimedia programme is also being planned. The evaluation team hopes that the fact, that the Polytechnic is multi-disciplinary will also be taken into account in more broader terms.

Some problems with coherency

Students claimed that there is some overlapping of current courses. There also seems to be some gaps between the courses, some of the mathematics and other basic subjects needed in specialising professional courses are not taught in time, if at all. The evaluation team suggests that the Polytechnic promotes more co-operation among the teachers. At the moment there seems to be some lack of sharing the information on courses.

The studies during the first two years are rather fixed. After that, the students can choose between three and, in future, four majors. Only 10 credit units of studies are freely optional. Although it is possible to select courses from the other units in the Polytechnic, the students claimed that it was difficult to combine the studies from other fields.

There is a plan to improve the teaching in the programme as well as in the Department by introducing project-based learning methods in co-operation with local companies. However, teachers seem to be unaware of how their teaching should be improved. Additionally, the evaluation team noticed only limited signs of systematically trying to improve teaching in the programme. A lot was left to the teacher's own will.

Co-operation between teachers and students

There may be a need to encourage more co-operation between the teachers to share information on course contents. Teachers were not always aware what others had taught. In some cases, this has led to some overlapping or lack of information.

The evaluation team came to the conclusion after having heard both the students and the teachers, that some students and teachers are not fully motivated. Some teachers felt the pressure from outside to upgrade his/her own basic education level to licentiate degree unpleasant. Some students had little interest in learning – "they are not always willing to learn." However, the drop-out rate in the programme is about 12.7%, which is close to the average in the polytechnics in the field.

Traditional teaching methods

The programme is rather fixed. Partly due to the size of the programme, there are only limited optional studies available for the students. The modules are based on the needs of the local industry. The representatives of industry were, in general, satisfied with the courses. The actual freedom to choose between the units of the study programme is limited. Students have a feeling that studying is rather school-like and top-down organised.

The programme staff's ideas on learning and teaching methods seemed to be rather traditional in general. Lecturing is the main method of teaching. Com-

munication during lectures is not actively encouraged. Course attendance is not compulsory, although some teachers require it.

Some students find it difficult to follow the lectures. Students indicated that sometimes they just barely have time to write down what the teacher is presenting during the lecture. It was said that there is no time to 'think' or ask questions. Based on these comments, the evaluation team recommends close attention to developing new teaching methods.

The students wished for more practical orientation in studies, especially more laboratory work. It seems that some basic courses in mathematics and physics lack small group exercises that would support the conceptual understanding of the key concepts. Thus, students claim that many of the courses have been passed without necessarily understanding and learning.

This indicates that often most emphasis is put on content and external teaching arrangements. Less attention is paid to learning processes. Students seem to be in a position that in terms of education, the institution is not able to meet the expectations of the rapidly developing and very innovation intensive field for which it is preparing the students.

The students apply to the programme after completing studies in upper secondary school (65%) or in vocational school (35%). According to the teachers, the basic knowledge of mathematics and natural sciences for those coming from the vocational school varies considerably compared to those coming from the upper secondary school. On the other hand, students with a vocational background have better skills in electricity and electronics. The evaluation team suggests that the Polytechnic arranges some additional extra courses for those students who have difficulties in mathematics or in other subjects in the field.

Tracking students

The student club is responsible for the introductory courses for the new students. Second and third year students tutor newcomers during the first semester. Each tutor is responsible for tutoring a group of 15–20 students. Teacher tutoring is not widely used except for informing on current matters. The 2nd year students get guidance from the student counsellor on selecting the specialisation areas or optional studies. Selecting optional courses from the other units of the Polytechnic was said to be difficult due to the timetabling reasons. There could be more Polytechnic level co-operation to co-ordinate this.

It is not a tradition to collect feedback during the courses. It is recommended that a more structural way of handling the feedback from students be developed.

The Department is planning a tracking system for finding out the flow of students into labour markets after the graduation. It is not in place yet, but there is a plan to create one within the next few years. The evaluation team warmly supports the plans.

Co-operating locally

The programme is actively participating in the Socrates programme with about 10 universities, but the number will be reviewed. Student exchange is not as wide as it could be. Only a few students study abroad every year. Teacher participation in staff exchange programmes is also low.

The local municipal and regional authorities have indicated strong support for the Polytechnic. A steering group for the programme exists, however there is no clear evidence that the group is actively assisting the Department by providing sufficient industry feedback. According to the Department Head, the group had met only once or twice during the past year. It would be worth developing a better feedback system from industry. Overall, the co-operation with local industry could be more active.

Lack of computers for student use

As noted in the self-evaluation report and in the panel with the students, there are too few computers available for the students. In an information technology programme, this should be taken care of sooner than in the next two years as planned. The Internet is used to deliver some guidance material and assignments for the students.

Effective use of EU funding

In the other areas, the programme has adequate and good facilities. The Polytechnic has been successful in attracting EU funding for a variety of Department developments. A new production line laboratory will be opened at the Polytechnic next year, much expectation is also placed on starting a new Digital Multimedia laboratory.

Recommendations

- The programme should discuss its strategic priorities. The newly developed curriculum should be based more closely on the future plans.
- The attitudes of some teachers towards developing teaching methods deserve some self-criticism.
- It is recommended that more co-ordination between the different units be initiated. According to the students, in practice there are no real opportunities to select optional studies from other departments within the Polytechnic.

Good practice

- Efficient use of EU funding
- Good regional support and co-operation
- Plans to create a tracking system for finding out the flow of students into labour markets after the graduation

5.7 Lappeenranta University of Technology (www.lut.fi)

Information Technology (180 cu.)

Programme established: 1985. Number of students: 548. Number of teaching staff: 32. Teaching staff/Student ratio: 1:17. Proportion of visiting lecturers: 10%. Acceptance rate: 51.5%. Drop-out rate: n.a. Median time for graduation: 6.7 yrs. Average age of graduates: 27.5 yrs. Percentage of female students: 4.9%. Industry advisory body: no, indirectly through Telecom Business Research Centre. Industry partners n.a. Funding from corporate services 3.3%. Funding for R&D services 9.4%.

The Lappeenranta University of Technology was founded in 1969. At first, Information Technology was taught as a subject at the Department of Physics and Mathematics. A degree programme in Information Processing was established in 1985. Two years later the name of the department was changed to the current Department of Information Technology. In 1998, the laboratories of Physics and Electronics were shifted from the Department. The two laboratories formed a new department; Electrical Engineering.

Currently, the Department has eight professorship positions and 24 other teaching positions. Especially in the Information Processing laboratory, a large percentage of posts are filled by temporary staff. The annual intake of new students has doubled since 1994 and is now 100.

The Department of Information Technology consists out of three laboratories: Applied Mathematics, Information Processing and Telecommunications. The last two laboratories specialise in work in the area of intelligent information processing, computer vision, image processing, neural and molecular computing

Strong regional role

The Lappeenranta University of Technology has a strong regional role. Municipal authorities and local companies have been supportive. The University offers a highly educated work force for local industry and commerce.

The Head of Department has changed often in the past few years. The evaluation team noticed that the staff is not fully aware of the Department's vision. The current management stated that it is actively trying to improve the situation.

The management atmosphere in the Department is rather professor-centred. The researchers and the other members of staff were little involved in decision-making. There seems to be a communication gap between the professors and the rest of the staff. The Department management is taking less interest in developing the internal processes, but is heavily involved in research projects and in teaching. Better information flows are needed as well as the

creation of internal cohesion. The development of a common shared vision instead of one known only to the professors is needed.

Business orientation planned

In 1998, the Department of Electrical Engineering was founded and the laboratories of physics and electronics separated from the Department of Information Technology. They made up a new department. Since that time the Information Technology Department has remained relatively small. There is a plan to co-operate more with the Department of Business Studies in order to "exploit the cross-fertilisation and innovation opportunities" as described in the self-evaluation report. The evaluation team warmly recommends this practice. The industry members of the evaluation team believe that there is a good demand for experts having both technical and business knowledge. The opportunity to combine different types of studies may also attract new groups of students.

A group of teachers and students at the Department of Information Technology is currently designing a new structure for the studies. Especially in the current situation, it is important to revise the course plan. It is recommended that decisions and development of new initiatives are organised in a constructive way, giving upcoming staff more responsibilities to create new research and educational results.

Challenging improvements

Constant changes in staff have created some problems in running the programmes and customer projects properly. To improve this situation, the Department has put a lot of emphasis on the graduate school. The Department hopes to be able to attract most talented students to start working for them after he/she has completed his/her post-graduate studies. The evaluation team supports this and hopes that it will improve the situation in the long term.

Several improvements in the staff structure have been made recently. The establishment of new researcher-teacher posts has allowed some staff members to concentrate fully on teaching in the area where the teaching load has been the hardest. The active use of visiting professor posts has also provided some short-term solutions to some of the programme's problems.

The number of students graduating from the programme has decreased during the last three years. This was said to be due to the good employment situation. The average graduation time is currently 6.7 years.

Advanced students are mostly responsible for tutoring the first-year-students. A teacher tutoring-system has been started, but it is not yet in full use. Students said that they are not accustomed to asking for guidance and advice from the teacher tutor. The teacher tutoring should continue even after the introduction studies. Students felt that they themselves had full responsibility

for their own studies. The evaluation team also noticed that a systematic follow-up system to monitor student progression is not in effective use.

The lack of personnel leads to heavy teaching loads and makes it difficult to keep up with the personal development, which is very important in the field of IT. Several teaching positions are currently available for new staff.

Some teaching experiments

The Department has been successful in updating the programme continuously. The typical length of the courses is only 2–3 credit units, which may make the structure of the programme a little bit fragmented rather than coherent.

According to the students, some teachers have been active in introducing new teaching methods. However, most teachers favour lecturing over other teaching methods. Some teachers were actively using the Internet to deliver their lecture notes and other assignments for the students. Students appreciated the service and were actively using it.

The Department has established some joint courses with the universities in Joensuu, Kuopio and Helsinki. Some lectures have been delivered simultaneously to all places using a video conferencing system.

Although a lot of progress in the area of teaching has been made, there are still a number of courses where "traditional" teaching with less two-way communication is practised. It is recommended that more interaction between the teachers and students during the lectures be encouraged.

The number of students is increasing in Lappeenranta. The economics of scale should not only contribute to a small number of teaching staff, but could more easily improve the quality of basic studies as well. The students said during the interview with the evaluation team that often the basic courses are taught by "just somebody who likes to teach the subject".

Feedback system

The University has provided a service for students to give course feedback in the Intranet. Sometimes feedback was also collected on forms after lectures. However neither system was in active use. According to the staff, the students were reluctant to provide feedback after the courses. The evaluation team would like to highlight the importance of improving the current feedback system to meet the demands more closely. The current system is not serving anybody.

The Department has plans to use portfolios and learning diaries in the near future. The new method was not commonly used yet. The evaluation team hopes that new methods will provide additional information for programme development as well.

Co-operation

The University has been the first to start an International Master's programme in Information Processing and Telecommunications in Finland. Currently there are twenty students from four foreign universities participating in the programme. The programme has a lot of potential to expand its services especially to Eastern Europe.

The total number of international partner universities is said to be over 100. It is recommended that those most active be selected for more and closer co-operation. Maintaining effective contacts with all 100 partners might require more work than provide benefits.

The University has close contacts with the regional authorities. Establishing more links with industry and commerce is one of the Department's priorities at the moment. The Department could adopt a more active role in attracting more small and medium sized companies to Lappeenranta.

Sufficient resources

The facilities at the University are fairly good. The situation will improve even more in the near future. New buildings to meet the needs of information technology and electrical engineering are under construction at the moment. The construction work of the new buildings can be followed on the Internet.

The University library is up-to-date and actively used. The library has invested resources in the distribution of user-friendly services. There is adequate guidance and instructive material available for students to support independent use of various information sources and services.

The students in a nearby campus apartments have access to the University's intranet, Lnet. It is a good benefit for those students living nearby. The IT facilities are also sufficient and are equipped with adequate computers and software.

Helpful self-evaluation report

The self-evaluation report was viewed as honest. The evaluation team hopes that it will serve the programme with its future development work. The evaluation team recognised that the majority of its own concerns and suggestions had already been identified in the self evaluation-report as well.

Recommendations

- There is a need to build stable and effective procedures to facilitate recruitment of high quality staff and effective support services to retain them once they have been recruited.
- The current course feedback system needs to be improved and re-designed. This is especially important when the focus of the programme is constantly changing.

- The rather hierarchical management structure does not encourage open discussion and could be improved.
- Experiments with new and innovative teaching methods should be encouraged

Good practice

- Emerging interdisciplinary co-operation with the Department of Business and Administration.
- Initiating inter-university co-operation with other Eastern Finland universities
- International M.Sc. programme in Information Processing and Telecommunications

5.8 Oulu Polytechnic (www.oamk.fi)

Information Technology (160 cu.)

Programme established: 1985. Number of students: 511. Number of teaching staff: 22. Teaching staff/Student ratio: 1:23. Proportion of visiting lecturers: n.a. Acceptance rate: 42.9%. Drop-out rate: 5%. Median time for graduation: 4.5 yrs. Average age of graduates: 26 Percentage of female students: n.a. Industry advisory body: Programme Steering Group. Industry partners n.a. Funding from corporate services n.a.

The Lower Technical School of Oulu was established in 1892. The engineering education began in 1960. The B.Sc. in Telecom Technology was started in 1974. The institute of Technology joined to the Polytechnic in 1996. Today, Oulu Polytechnic is a rather large polytechnic and the current number of students is about 5 000. The Institute of Technology has 900 students.

The annual intake to the programme is 210 new students. There are 43 teachers who contribute 50% or more of their workload to the programme. 12 teachers are appointed fully to the programme. A great number of part-time teachers are also used.

The programme of Information Technology has five specialisation areas. They include Electronics, Computer Technology, Telecommunications and Automation Technology. Currently, nobody has chosen the fifth specialisation area; Measuring and Test Technology.

The specialising areas focus on Software design, Telecommunication networks, Real time systems, Radio technology, Microelectronics, Digital design, Process automation, and Automation equipment and software.

Own vision

The Department of Information Technology has adopted the overall strategy of the Polytechnic. It would be worthwhile to develop a more detailed strategy for the use of the Department, provided that there is a clear view of what the Department wishes to achieve. The programme aim is to provide a good general education for engineers. The programme has a rather broad and general focus regarding studies. As mentioned before this is the case in most of the polytechnics visited during the evaluation.

The programme has noticed the importance of taking into account the needs of local companies. In this respect, the programme might consider strengthening the clarity of its vision. Current one may make it difficult to communicate its work and focus areas to local companies.

The Institute could be more directed towards the future than it seems to be at present. It is recommended that it finds its own functional profile and core strength at the side of active enterprises and a strong university. There is a good Polytechnic level strategy to support this. The regional development plans provide a good backbone.

Strong traditions

The structure and organisation of the Department is rather traditional. The impression of a traditional and well-structured organisation may make it difficult to trigger some changes needed to encourage teamwork and introduce new teaching methods.

It was noted that a lot of time has been spent removing obstacles between the old institutes that form the Polytechnic. However, part of the Institute of Technology still wishes to be an autonomous unit rather than a part of the Polytechnic. More emphasis should be placed on developing a new identity. The polytechnic vision at the department level could deepened.

Links with industry are important. Industry representatives give advice on programme development. The programme has a steering group with representatives from industry and commerce. A student representative, the Head of the Programme and the Director of Strategic Development are also present in the group. According to the evaluation report the purpose of the steering group is to promote and enhance co-operation between the Polytechnic and work. It also revises the structures and implementation of the programme and, if it finds it necessary, it also recommends setting up new programmes.

Teachers and students

Some teachers still longed for the “good old days”, when the Polytechnic was a state owned Institute of Technology. There seems to be still some unconscious balancing between the old and new demands.

The number of teaching staff is satisfactory at the moment. The programme is using a large number of visiting lecturers from industry, too. The students especially enjoyed the visiting lecturers. Some companies, customarily collect feedback from the students about the course in question. The Polytechnic could consider collecting the course feedback more systematically as well.

The student numbers have increased sharply during the last few years. The intake is now 210 new students per year. The Polytechnic has had some problems with students applying to the Polytechnic and then dropping out after being accepted by the University. More collaboration with the University in this matter may help the situation.

Due to the rapid growth in the area, some industrialists held the general view that some graduates in the field expect to be promoted as soon as they start working for the company. They also expressed the idea that some students might need some more teamwork skills.

The programme has been successful in keeping the drop-out rates down. Close monitoring of students and providing additional support has helped to keep the drop-out rates low. The current drop-out rate is 5%.

Lecturing and laboratory work

In general, courses combine a mixture of lectures and laboratories. Students are not obliged to attend the lectures, however some teachers use the active attendance as one criteria for grading. The student expected the teaching to have more flexibility. They would like to change the teaching methods so they would not be so traditional.

Partly because of the traditional teaching methods, teachers felt that their workload is increasing. New teaching methods could be applied to ease the load. On the other hand, it is good to have a very clear and consecutive structure for providing basic education for the students. However, the Polytechnic might want to consider being more attentive to the need for a more flexible education structure. When some courses required only voluntary attendance, only a limited number of students showed up. Some teachers considered a threat towards their traditional profession to have only a limited number of students attending classes.

Some teachers expressed the idea of “tricking the students into attending classes”. They ask questions in the test the answers to which are available only during the lectures. This attitude needs to be addressed. The students, especially, wished for more freedom and use of the Internet for delivering the course material and assignments. In some cases, outside lecturers were preferred over permanent staff. This may indicate some problems with teacher–student relationships or interaction.

Continuous development of programme content

The evaluation team found it positive, that the programme is continually revised and small changes are made in accordance to the wishes of the industry. There are several new areas in the programme which will be introduced in the near future, such as UMTS and Bluetooth, wireless IP and LANs as well as new software solutions such as Wap, EPOC and Corba. There was also a plan to increase the number of expertise areas as soon as the number of students starts to increase.

Other parts of the programme provide a general basis for engineering studies with individual differentiation limited to 20 credit units of training, 10 credit units thesis work and 10 credit units freely selected optional courses. Some students wished for opportunities to include more foreign language studies in the programme. Currently, it was rather limited.

The programme staff has been actively developing distance learning projects. The evaluation team warmly encourages more effort in this direction and the use of modern technologies in the programme. There is also a need to more closely combine the theoretical studies and practice. At the moment, according the students, the two were mostly taught separately.

In the opinion of the evaluation team, the Polytechnic is to be congratulated on providing comprehensive, additional support for those students who enter the Polytechnic directly from the vocational secondary level. The students have more exercises in basic mathematics and physics than those entering from the upper secondary school. It is believed that this practice helps to keep the students from dropping out.

Students may make a personal study plan, but it seems that it is only seldom used in practice. The programme is rather fixed so that there is no real need for it in the current system.

Providing feedback

Students can give feedback to the teachers and sometimes it may affect the contents of the course in question. There is a formal way of collecting feedback from the students, but the practice seems to be rather rare. The centrally created system was not working well.

According to the teachers, the increasing number of students makes it difficult to provide individual feedback. Staff–student relations within the polytechnic are good although rather formal. Students wished for more personal contacts with the teachers.

Co-operation

Co-operation with industry was not clearly formed. The teachers described the links as active, but some representatives of industry and commerce claim that they were the more active side in seeking co-operation. The visibility of the

expertise that is available at the school for industry and commerce did not appear to be clear. Teachers were not aware of the jobs that the students had during their studies, yet half of the students were working in the field while studying.

Many of the industry representatives interviewed had given lectures at the polytechnic. They knew the students and were happy with the quality of the students graduating from the polytechnic.

The Polytechnic has been working actively with international partners, unfortunately only a few of the programme students take the opportunity to participate in study or trainee exchange programmes. According to the students, a boy-friend/girl-friend remaining at home limited the willingness to participate.

Links with other polytechnics were described as passive or dependent on personal contacts. It is recommended that more national co-operation be initiated.

Teaching equipment

A tour of the Department revealed that some of the equipment used to support teaching is old fashioned, which may be a clear threat to keeping teaching up-to-date in the future. It is recommended that at least some of the oldest equipment be renewed. The Polytechnic facilities were good and recently renovated.

During the evaluation process, the evaluation team learned, that the Department of Business and Administration was planning to benchmark its ITC programme against the polytechnic's Information Technology programme. This type of practice is warmly supported by the evaluation team.

Recommendations

- The Department vision could to be revised and clarified.
- Teaching methods need some renewing, more teamwork should be encouraged.
- The opportunities for studying more foreign languages should be improved.
- More co-operation with other polytechnics in the field should be initiated.

Good practice

- The Polytechnic has been successful in keeping the drop-out rate low. Student progression is closely monitored.
- Providing additional courses for those students who need to upgrade their basic knowledge in mathematics and physics.
- Distance learning projects under development

5.9. University of Oulu (www.oulu.fi)

Information Engineering (180 cu.)

Programme established: 1985. Number of students: 450 (dept. 1 555). Number of teaching staff: 71 (dept.). Teaching staff/Student ratio: 1:25. Proportion of visiting lecturers: 0%. Acceptance rate: 73.8%. Drop-out rate: 32%. Median time for graduation: 5.7 yrs. Average age of graduates: 31 yrs. Percentage of female students: 8%. Industry advisory body: Information Industry Group. Industry partners n.a. Funding from corporate services 8%. Funding for R&D services 31%.

The University of Oulu was founded in 1958. It is the largest university in the northern part of Finland. Information engineering was started in 1984 as part of the studies in the programme of electrical engineering. In 1988 the Information Technology degree programme was formed. The intake number remained between 30–40 until 1995. Since that time, the growth in the areas of information and electrical engineering has been rapid. Currently, the Department has 24 professorship positions (3 established in 1999). The annual intake of new students is 125 for the Information Engineering programme. At the end of 1998, there were 10 teaching positions linked directly to the programme. The number of students in the Information Engineering programme is 450 and in the up-grading programme 178.

The Department of Information and Electronics Engineering is made up of 7 laboratories. These are the Electronics, Information Processing, Microelectronics and Material Physics, Optoelectronics and Measurement Technology, Computer Engineering, Telecommunications and Mathematics.

Powering the region

The University has an important role in the economic and industrial development of the region. The programme strategy has a strong local focus. It sees the importance of being responsive to the needs of local industry. Links to the municipalities, regional councils and other local labour market agencies are also vital.

The focus of the Information Engineering programme has been on embedded systems and information processing. New multimedia related studies are currently under development to make up a third specialisation area. This has been supported by local industry, which is manufacturing a lot of applications, which need experts in this field. The programme aims at providing students with a sound basic knowledge in mathematics, physics and other related subjects. It also wishes to be able to offer knowledge, which is a bit ahead of current industry needs.

Students can select studies from other programmes. The selection of major courses is theoretically very wide, but students feel that their actual opportunities for choosing optional studies is rather limited. There was a clear emphasis on reducing the study period from six to five years.

The Department operates rather independently. It has only limited co-operation with other departments in the University.

Industry advice

The Department faces continual demands and expectations of the surrounding hi-tech industry. The procedures for obtaining the views of industry are currently under development. The University has set up a joint Information Industry Group, whose task is to co-ordinate the resourcing and development of the education in all programmes relevant to the information industry. According to the representatives of industry and commerce co-operative links have been developed, however, the University could play a more active role in maintaining the links.

The increasing number of students enrolling annually is creating a challenge to which the Department did not seem to have the operational means to respond. Students see the growing number of new students as a threat, due to the growing group sizes and decreasing availability of materials and personal support. The increase in students creates a lot of challenges for the pedagogic development as well. The present teaching methods are mostly traditional and professor/lecturer centred. Teaching was viewed as being the same as lecturing.

Both the University staff and the representatives of industry and commerce shared the idea of introducing an intermediate exam or a Bachelor's Degree. It would provide some additional motivation for some students. Later on it would be easier to pick up the courses again to continue to the Master's level. Currently, one-third of the students drop out of the programme.

Critical first year

The relationship between the professors and students seems to be good. Professors are qualified in their field. The intake of students is growing rapidly. Unlike the other universities visited, the increase is not expected to cause any major problems. The number of teaching staff is currently adequate and the graduate school students are also actively used for teaching.

After graduation almost everyone finds work in the Oulu region. Many students start working while still studying. Usually, they start after the second or third year of studies. It does not seem to cause an increased drop-out since most of this takes place during the first two years of studies. One staff member had calculated that if a students gets less than 6 credit units during the first year he/she is more like to drop out. However, if he/she gets 16 credit units, he/she is most likely to complete his/her studies within the next 5 years.

The evaluation team would like to emphasise the importance of providing proper tutoring and guidance during the first two years of studies. The University of Oulu has realised the importance of it. Still, it is recommended that

closer attention be paid to teacher tutoring arrangements and sufficient codes of conduct be created for all staff members.

The evaluation team found it positive that the Department was actively recruiting prospective students from high schools. Members of the Department staff and programme students regularly visited local schools and told about career opportunities in the technical fields.

Emphasis on teaching

According to the students most courses are taught in the traditional way by using lectures and exercises. Students wished for more interaction during the lectures. Most courses have their own web pages, which contain all the necessary information concerning the course. The Department has understood the importance of keeping the pages up-to-date. Some maintenance problems have been reported.

Most of the first year's basic courses are run in large groups. The Department does not have a cohesive plan for developing the pedagogic knowledge of the lecturers. The improvements rely on individual teachers. The courses focus mostly on content. It is believed by the evaluation team that more orientation to learning process itself would benefit some courses

Part-time teachers from industry and commerce are used occasionally in some courses. Their task is to provide specialist knowledge concerning the topic. The industry involvement in studies was generally considered to be low. The programme staff says it carefully listens to the industry needs when designing the courses. When the courses were being run, the co-operation was less active.

Feedback and assessment

The feedback is collected on a regular basis after the courses. However, students are not used to giving feedback.

Grading is based mostly on written exams. In some exercises the report is graded. According to the students, one credit unit often requires more than 40 hours of work. New things are often added to the courses, while often nothing seems to be left out from the previous one. The evaluation team noticed that more consistency in the programme is needed.

As mentioned earlier, there is a newly established service, "graduation calculator", available on the Net for the students. The service takes the credit accumulation and high school background of the student as input, and calculates the estimated graduation date and probability of graduating. The calculator enables the students to see the dependency of their progress and graduation, guiding them to avoid too slow studies that increase the risk of dropping out. The evaluation team were impressed by the innovative actions taken in the department in identifying some factors causing drop-outs. It is hoped that, based on the findings, some additional support and guidance will be provided for those students in the greatest danger of dropping out.

Co-operative issues

It should be mentioned at this point that the Faculty of Science provides similar courses in mathematics and physics to the Department of Electrical Engineering. The evaluation team gained the view that the collaboration between the two departments is rather limited and formal. Therefore, it is recommended that opportunities for closer co-operation between these two departments be carefully studied in the near future.

In the Oulu region, there has been a rapid growth of the Information industry. The University has co-operated well with the emerging industry from the early years. It has become a vital factor in the development of the area. Currently, the Department is trying to avoid too direct an industry influence. The programme wishes to have a stronger focus on basic research.

Building full of bright colours

The Department has good resources for providing the educational programmes they have planned. The facilities and teaching equipment seem to be appropriate for this kind of education. During the tour of the Department premises, it was noticed that optimisation of space could be an area for further development Small groups studied in large lecture halls.

Recommendations

- Teacher tutoring needs to be developed.
- There is a need to build procedures for collecting feedback from the students and industry after the courses have been designed.
- More co-operation between the Department of Mathematics and Information Engineering could be introduced.
- Greater awareness and support for renewing teaching methods is needed.

Good practice

- Emphasis on reducing the study period from six to five years.
- Active recruitment of prospective students in local upper secondary schools.
- Graduation calculator as an innovation and statistics collected for it.

5.10 Pohjois-Savo Polytechnic (www.pspt.fi)

Electronics and Information Technology (160 cu.)

Programme established: 1985. Number of students: 537. Number of teaching staff: 17. Teaching staff/Student ratio: 1:32. Proportion of visiting lecturers: 5%. Acceptance rate: 44.8%. Drop-out rate: 17%. Median time for graduation: 4.3 yrs. Average age of graduates: 28 yrs. Percentage of female students: 5%. Industry advisory body: no, indirectly through IT Center and other local networks. Industry partners 13. Funding from corporate services 25%.

The Kuopio School of Engineering was established in 1886. The institute was maintained by the State until 1995 when the municipal federation consisting of Kuopio, Varkaus, Iisalmi, Lapinlahti and Kiuruvesi took over the costs. The institute was granted a permanent polytechnic status in 1995. Today, it comprises 11 colleges, which are located in three different towns in the Northern Savo region.

The Polytechnic is multidisciplinary. It has 8 faculties. The faculties are Business and Administration, Engineering, Social and Health Care, Crafts and Design, Tourism and Catering, Rural Education, Forestry and Wood Technology and Culture.

The School of Engineering is the biggest in the Polytechnic. It has 65 teachers and 32 part-time lecturers and laboratory staff. The number of students is 1241.

The programme of electronics and information technology has a teaching and laboratory staff of 30 and 550 students. In the near future, the number is expected to increase to about 700. The areas of specialisation are telecommunications engineering, information technology, programming engineering, control and automation technology, medical engineering, electronic product development, multimedia and visualisation.

Strategy process

The Polytechnic comprises eleven colleges which are located in three different towns in the Kuopio region. There seems to be only limited co-operation between the different units. The Director of the Engineering programme was recently promoted to President of the whole Polytechnic.

The strategy process is based on a three-years cycle. The vision and mission is well described in the self-evaluation report. The objectives are based on the needs of local industry and business in the region but seem to be somewhat at a verbal level.

It was planned to revise the Department strategy during the current year but this was post-poned due to the changes in the top management of the Polytechnic. The present strategy is not completely accepted by the staff. However, the strategy was the basis for the self-evaluation report. The evaluation

team had the impression that the texts described in the evaluation report and in practice did not fully match.

However, when the strategy will be reviewed, the plan to link the institute strategy closely to the regional IT development strategy is good. This practice is warmly supported by the evaluation team.

The universities were seen as competitors by the Polytechnic. In this case, it seems that the Polytechnic has not yet established its clear role. Some staff members also expressed idea that the other polytechnics are their competitors. Co-operation with teachers in other polytechnics was not supported by the management. However, some exchange of materials and informal discussions were maintained at the personal level.

Curriculum needs up-dating

The curriculum needs to be updated as soon as the strategy is agreed upon. The evaluation team got the impression that it had remained more or less the same since 1996. Since then, individual teachers have improved the courses by themselves. A more coherent approach in the near future could benefit the programme.

The programme has a general focus; training professionals for all engineering fields. The selection of courses offered is rather general without any clear focus.

For example, a sound assembler course was included in the programme. The evaluation team did not see the relevance of running the course at the expense of other more important topics.

Based on the materials received and seen during the site visit, the evaluation team recommends that the curriculum for telecommunications be updated. Constant updating on the individual courses has been done, but the overall framework was seen to be lagging a little bit behind.

The programme lists optional advanced courses available for the students every year. Some of the courses can be run only every other year, due to financial reasons or because the number of students attending to the specialised courses is too small. This is a good way of providing a wider selection of courses for the students.

The programme is based on the needs of local industry. The industry representatives seemed to be generally satisfied with the courses. In some cases, they wished for a more rapid response to changes. Furthermore, the industry representatives suggested that the programme focus should be more on information technology issues and providing general programming skills.

Short courses cover wide areas

The typical length of individual courses in the programme is two credit units. According to the staff, short courses make it is easier to make sure all important areas are covered in the programme. Secondly, it is easier to attract visiting

lecturers from industry for the shorter period of time. Thirdly, the system of four periods favours short courses in planning. However, it is worth seriously considering combining the courses into larger entities.

There was some evidence that, due to the fragmented programme structure, some mathematics courses for example were not taught in time or possibly not at all, because they did not fit in the time-frame of a separate specialising course.

According to the students, courses do not always require the theoretical time of 40 hours per credit unit but can be passed with less effort.

The students had to work hard to pass the numerous tests arranged after each course. The number of tests per student per year was rather high (15-20 exams per year).

Relations between staff and students

In general, the students were motivated and the staff committed to developing the programme. The overall atmosphere in the Polytechnic was seen as positive. Students were mostly satisfied with the courses. Some materials used were not up-to-date. It is advised that all materials used in teaching be gone through more regularly.

The number of students in the IT degree programme is currently 550. There is a clear plan to increase the number to about 700 in the next two years. The majority of students wish to find work in the area after graduation. The information industry around the Polytechnic is still evolving and therefore, it was said to be rather difficult to find work locally. Representatives of industry and commerce appreciated the students' qualifications and found it easy to recruit students.

Many teachers have been there over the years. Most of them are middle-aged. There is a need to pay considerable attention to the generation shift among the staff in the coming years. Recruiting young staff into the Department will soon be necessary. Moreover, the number of teachers is not growing at the same rate as the number of students. There is a risk of an increased workload, which is already considered heavy.

Teaching and learning

The first two years are rather fixed for the students. After that, students can select from three majors. Only 10 credit units can be selected completely freely.

Finnish was mostly used in teaching. The students had some trouble expressing themselves in English. It is recommended that the Polytechnic pays more attention to developing the language skills of the students. The Polytechnic runs a parallel programme in information technology in English. This could offer a good opportunity for providing more integrated language learning.

The Polytechnic has been actively developing a virtual factory for teaching purposes. The development work was started three years ago. Although there is progress in virtual learning, the main focus in the Polytechnic is still rather hardware oriented.

The evaluation team gained the impression, that the teaching is still based a lot on lecturing and other teacher centred methods. The teachers control learning through tests. It was reported that the students have to pass 15–20 tests per year. The evaluation team would like to suggest some changes in this practice. It is hoped that the Polytechnic could put more effort into project work and other ways of enhancing learning.

A tour of the premises revealed that some of the equipment used to support teaching is old-fashioned. It may be a threat to keeping teaching up-to-date in the future. It is recommended that renew at least some of the oldest equipment be renewed.

The Polytechnic was actively trying to update and upgrade the skills of the teachers. Sabbatical leave was available for those upgrading their degrees to Lic.Tech. or Ph.D. level.

Co-operation

A research laboratory has been set up with the help of EU funding. One third of the final work is done in projects co-ordinated by the research laboratory. The rest is done directly for companies.

The teachers described the contacts with industry as lively and close. However, some industry representatives did not fully agree with this opinion and wished for more interaction and active co-operation.

International activities among the programme students were low, although the Polytechnic has 15–20 active links available and everyone who wishes to study abroad could participate in student exchange programmes.

Lot of local activity

The Polytechnic is currently involved in establishing an IT Education and Research Centre together with Kuopio University and local and regional authorities. In general there was a strong focus on regional and local co-operation and development activities. The Polytechnic wants to adopt a strong role in developing the IT industry in the region. The evaluation team supports the idea and believes that the Polytechnic has a fair chances succeeding.

The Polytechnic also has good opportunity to link the three different units in Kuopio, Varkaus and Iisalmi more closely together for more co-operation. Current links are still rather weak. The evaluation team also encourages the Polytechnic to build more co-operative links to other polytechnics in the field.

Recommendations

- Strategy needs to be updated.
- Retirement of qualified staff will create challenges in a few years. A comprehensive recruitment plan is needed to avoid possible problems in the future.
- Teaching methods need to be reviewed and new innovative methods adapted.
- Teacher–student interaction could be more open and monitored.

Good practice

- Promotion of teachers' self development by six month sabbatical leaves.
- Development of regional IT strategy and an IT Education and Research Centre.
- Development of virtual factory.

5.11 Satakunta Polytechnic (www.spt.fi)

Information Technology (160 cu.)

Programme established: 1985. Number of students: 480. Number of teaching staff: 13. Teaching staff/Student ratio: 1:37. Visiting lecturers proportion: 3%. Acceptance rate: 80%. Drop-out rate: 15%. Median time for graduation: 4.3 yrs. Average age of graduates: 25.5 yrs. Percentage of female students: 11.5%. Industry advisory body: Advisory Board. Industry partners 11. Funding from corporate services: 6%.

Satakunta Polytechnic was founded in 1997 bringing together 10 institutions in 5 cities in the Pori and Rauma region. The Polytechnic has about 5500 students.

Information technology is taught in both the Pori and Rauma units. In 1995, IT was one of the specialisation options of the degree programme in Electrical Engineering. In 1997, Information Technology became a degree programme of its own. The number of programme students is 310 in Pori and 171 in Rauma. The annual intake of new students in Pori has increased rapidly from 30 in 1995 to a current 130. The equivalent numbers in Rauma are 25 (1996) and 55 (1999). The number of teaching staff is 9 in Pori and 8 in Rauma.

The programme of Information Technology has seven specialisation areas, Telecommunication, Software and Multimedia Engineering, Electronics Production, Information Logistics, Total Quality Management and Technical Journalism.

The two units in Pori and Rauma have a slightly different focus. The Pori unit focuses on Data Communication and Intelligent Networks, while the Rauma unit focuses more on Electronics Production Engineering.

Clear vision

The Polytechnic has a clear and well-articulated vision of its future, which has been developed by the top management. The evaluation team shares the view that involving the whole staff more closely in the visioning process next time would benefit the institute. The programme aims at educating engineers for the need of local (regional) companies. The students are supposed to have broad basic engineering skills after the graduation. The programme outcomes were not as clearly described.

At Pori, the programme concentrates on telecommunications, with a particular focus on Intelligent Networks. Two large companies have provided the Polytechnic with the necessary equipment and support in the area. It was acknowledged that over-concentration on Intelligent Networks (IN) was a risk, particularly with the likely long-term move away from traditional switching networks based on SS7 (Signalling System Number 7). This is being addressed by expanding into computer networks via some research and development into the integration of IN and the Internet, particularly for services such as Voice over Internet Protocols (VOIP).

Strong department management

The engineering education at Satakunta Polytechnic appears to rely on the personal involvement of the Director of Engineering. He provides leadership and makes decisions. There are obvious risks involved in this type of management. A greater involvement of staff in decision making is desirable.

There is a need for more structured approaches to industry involvement. At the moment it relies mostly on individual contacts, although an advisory council has been established. The council reviews the curriculum and gives advice concerning its structure. Changes to the curriculum can also be originated by the students and individual lecturers. According to the department staff, the whole curriculum is reviewed every other year. New development projects have been initiated, however, not all of them are fully visible yet.

Stable programme staff

The official student intake is 90 students annually, but because of a high drop-out rate, actually 130 students are accepted with the assumption that about 20–30% of them will interrupt their studies. This often takes place during the first year of studies.

The workload is high as in all programmes in the IT. This is partly caused by the fact that the teachers are supposed to participate in research and development projects and no new teacher posts have been founded lately in spite of the increasing number of students.

The programme staff is very stable. There has not been a need to hire new teachers for the past few years. The programme may have some difficulties

within ten years when a large number of the teachers will retire and many new teachers need to be hired simultaneously.

A staff development programme is available for those, who wish to upgrade their basic degree from Master's degree to Licentiate of Doctors degree. Continuation of one's studies is left up to the teacher. There used to be a programme which allowed teachers to take a leave of absence with pay and to work in industry for a while to refresh their practical knowledge. The opportunity to do so has been discontinued for financial reasons. During the interview the teachers said that supervising the theses helps them to keep up-to-date with the developments in industry.

The staff felt that perhaps, unlike in the university, people who come to work in the polytechnic environment prefer teaching and working with young people over research.

Teaching and learning

According to the students, teaching is still based mostly on traditional methods. In general, courses consist of a mixture of lectures and laboratories. Students are obliged to attend 75% or more of the lectures in a particular course. This was considered to be more strictly enforced at Rauma than at Pori. In practice, attendance is variable and depends on the individual teachers. According to the students, it is difficult to have more interaction with some teachers during the lectures.

There is a plan to use more project-based teaching methods. At the moment, only 10% of the fourth year students take part in project studies. Group sizes in lectures varies between 20 to 90 students with an average of about 30. The size of laboratory groups is usually 12 students with a maximum of 24, but sometimes, in practice, the groups are a little bit larger.

According to the students, the teaching was more or less the same as they had experienced earlier in vocational college or upper secondary school. However, the content was described as more interesting and the focus is more practical.

Students were able to contact staff personally, via e-mail or telephone, if they had some difficulties with the course. Those completing their final thesis met their supervisors about once a week. Students said that they are less likely to contact teachers over more personal difficulties. During the first two years of studies, peer and older students are said to be the best source for information on studies.

Teaching loads are set at a maximum of 24 hours a week for 32 weeks a year. The teacher–student ratio is around 1:37. The largest group size in any individual course is limited to 90 students.

Many students undertake their final projects in industry. The business representatives were generally happy about the overall quality of the students' project work. Cases where the work done had led directly into the development of new products were reported.

The business representatives wished for more emphasis on developing language skills. They also would like to provide larger topics for thesis work. The work would require students to work together. For assessment reasons the Polytechnic is not willing to accept a thesis done by a team. However, the evaluation team encourages the programme to reconsider this practice.

One representative of industry described a situation where his company had a small demand for graduates. In this case the company had provided topics for the students final project work and tried to attract suitable students to pick up the topics. Unfortunately the company was not successful in attracting students to work on the project. The representative wished that the staff would be more active in encouraging students to work on some company-tailored projects.

Feedback system needs to be improved

Providing feedback to the students is not customary in the programme. Feedback, from and to students, is mostly informal. Students have an opportunity to provide feedback electronically but do not generally use it, nor are they encouraged to do so by the teachers. According to the students, some of the more experienced teachers are not willing to accept feedback, but consider it criticism.

Feedback to students on submitted work is usually restricted to their grade, rather than any analysis of how it came about. Typical pass rates for individual courses were considered to be about 50%.

Co-operation with local industry

The polytechnic has a strong regional role. The Polytechnic sees itself as having a facilitating role in the economic development of the region. This is closely supported by the local authorities. The City of Pori has prepared a regional development strategy plan where the Polytechnic has an important role. The programme has good links to local industry and also to some companies outside the Satakunta region. The students get more involved in different projects with industry and commerce rather late. The first two years concentrate mostly on basic compulsory studies.

On the whole the representatives of industry valued the good and lively co-operation with the Polytechnic. Contacts were frequent and open. It was seen an advantage that the Polytechnic was willing to consult industry when developing new courses for the programme. The Polytechnic seems to be successful in addressing the needs of the major companies in the area. The informal networking was perceived to work well without the need to co-operate through formal structures with the Polytechnic.

The evaluation team did not visit the Rauma facilities. However, it was informed that the Rauma unit moved to new premises in 1998. A new IN laboratory was established in Pori in 1998. Both new facilities were welcomed by the staff.

Recommendations

- The co-operation between the Pori and Rauma units could be improved.
- A greater involvement of staff in management and decision making should be encouraged.
- Greater attention to improving the feedback system is needed.
- The opportunities of the Research and Enterprise Centre O'Sata could be developed further to support students' entrepreneur activities.

Good practice

- Programme has a clear focus and is active towards local industry.
- Good laboratory facilities
- A comprehensive staff development programme available for the teachers

5.12 Tampere Polytechnic (www.tpu.fi)

Electrical and Computer Systems Engineering (160 cu.)

Programme established: 1985. Number of students: 563. Number of teaching staff: 32. Teaching staff/Student ratio: 1:18. Proportion of visiting lecturers: 20%. Acceptancy rate: 21.7%. Drop-out rate: 8%. Median time for graduation: 4.1 yrs. Average age of graduates: 26 yrs. Percentage of female students: 9.5%. Industry advisory body: Advisory Board. Industry partners n.a. Funding from corporate services n.a.

The Tampere Institute of Technology was established in 1885. In 1995, the Polytechnic was formed. At that time the City of Tampere took over the ownership of the Polytechnic from the State. As a part of the process the Tampere Institutes of Business, Forestry, Art and Media were merged with the Polytechnic. Later on, the Institute of Natural Resources was also merged with it. Today, the Polytechnic has 3 900 students and a staff of 250.

The degree programme in Computer Systems Engineering was started in 1986 and the Electrical Engineering programme in 1992. Currently, both programmes are under development The specialisation areas in the Electrical Engineering programme are Electrical Power Engineering, Automation Engineering and Building Services Engineering. The Computer Systems Engineering programme specialises in studies in computer, electronics, software and telecommunications engineering. In 1999, the number of students in these programmes was 700.

Broad, basic engineering skills

There appears to be a cohesive understanding on delivering broad basic skills for all students. The importance of basic mathematics and natural science is

emphasised, even including course in chemistry. The first two years consist of mostly compulsory basic studies.

The programmes in the engineering studies are information technology, data processing and content production management. The focus is especially in embedded programming and in hardware and software planning and testing

The Department planned to increase the intake of new students in the technical fields a few years ago, but, unfortunately, it was opposed by the administration at that time. After some time the Polytechnic administration agreed to the plans. The programme has grown larger in the past few years.

In general, the programme, as seen by the evaluation team, is rather traditional. The titles and contents of the courses appear to have remained almost unchanged over the years. The evaluation team gained the impression that only minor changes are made from semester to semester. The importance of basic mathematics and science is strongly emphasised in the programme. Not all members of the evaluation team saw the relevance of keeping the course in chemistry as compulsory. It would be worth thinking of replacing it with studies in communication, project management or else.

The Department claimed that new courses are introduced if and when the demand arises. Students may make recommendations to the Department. The availability of new staff was given as a major reason for not actively developing new courses. It also remained a little unclear to the evaluation team what formal process is followed when new courses are to be developed and introduced.

Programme under development

In 1999, the programme of Electrical Engineering was split into two; Electrical Engineering and Information Technology. Both programmes are under the same management and run courses that appear to be similar, so it is not clear why the programme was split in two. There seems to be little evidence that it has lead to more responsiveness towards business and industry. It is advised that the Department makes it clear what it wants to achieve with the changes made.

In principle teachers have an opportunity to work in industry for a period of time in order to learn the latest developments in the field, In practice, it was said to be very difficult to get anybody to substitute for them during that period. This was perceived to be an important issue by the evaluation team; the Polytechnic should consider how it could provide more support in this area.

Staff and workload

The Department considers that it has a serious shortage of staff, although staff-student ratios appear to be lower than in many similar institutions. The Polytechnic has to compete for qualified people with local industry and the Tampere University of Technology.

The workload of the teachers is high, as is generally the case in the field. The semester is 32 weeks long. Teachers claim to work 40-60 hours/week

during the semesters. Outside the semester, time is spent preparing teaching for the next year and keeping up with the latest developments in the field.

Temporary teachers, who have contracts for only one year at a time, are used to deliver some of the courses. Their motivation to prepare courses and course material may not always be very high in these circumstances. The students thought that it was often easier to pass a course given by a temporary teacher than that of a regular staff member. The Department should consider the impact that the use of significant numbers of temporary teachers has on the consistency and development of courses from one year to the next.

Teaching focuses on technical studies

The first two years are mainly compulsory basic studies. Later on, the students can select courses, although the scope is rather limited. There has been a trend in recent years to make the courses more practical. There is little project work in the programme. Where it does exist, it appears to be limited in scope. It is suggested that more project work and larger projects combining several subjects would benefit the students.

The students considered the quality of teaching to be good, but also rather traditional. Teaching appears to focus mainly on the acquisition of facts rather than the development of transferable skills. Theoretical back up for learning could be available from the Teacher Education Centre that operates within the Polytechnic. The evaluation team noted that there is only a little co-operation. The Department should consider how the programmes could benefit from more lively contacts with the unit, e.g. developing teaching methods, attracting new teachers, offering distance education possibilities or on-the-job training to mention a few.

Foreign languages are seldom used in teaching. The department could adopt a more active role in developing teaching in English or other foreign languages to improve the language skills of the students. It is worth considering letting students use English when writing their final work. At the moment, the use of Finnish is the only option. Industry and commerce could benefit from more linguistically skilled and communicative students.

It was seen as a good practice that the Polytechnic arranges some additional support courses for those students who have difficulty in mathematics in other subjects in the field.

Feedback collected occasionally

The evaluation team noticed that it is not customary to collect feedback systematically for the courses. According to the teachers, “maybe one group out of five is asked to give feedback now and then”. The feedback, if collected, was in the form of traditional paper and pencil. The Department should make developing a formal feedback system a priority.

Live contacts with industry and international partners

There are live contacts with local industry and commerce. The students get more involved in projects during the last two years of study. Almost all students do their final project work supported by industry. Industry is active in recruiting the students while they are still studying.

There could be more co-operation with industry to address the shortage of teachers in important areas. A dialogue with the companies in this area should be initiated.

The Polytechnic has several foreign partners. It is not common for the students to go to study abroad while studying. It is more common to work abroad while doing the compulsory work experience required by the programme. 10-15 students annually go to work abroad. One or two staff members take part in staff exchange programmes every year. In such cases, they give lectures in a partner university or polytechnic. The duration of the visit is normally one week.

Renovated facilities

The laboratories and class/lecture rooms for the programme have just been renovated. At the same time, additional funding was received from the government to buy new equipment and furniture. The purchasing process was still under way during the site visit. In general, the facilities and equipment are in good shape.

Recommendations

- The basic studies form a firm basis of general knowledge in natural sciences. More emphasis could be placed on developing skills such as communication and team working.
- The curriculum needs to be updated. However, it was the view of the evaluation team that in practice the topics of individual courses were kept better up-to-date than the programme curriculum.
- The student feedback system needs to be improved to serve the needs of the staff and students better.
- It is recommended that the programme create more opportunities for students to use foreign languages during the studies.

Good practice

- Additional courses to support the students' knowledge on basic skills are arranged where required
- Tradition of encouraging students to work abroad during the compulsory work experience period.
- The Polytechnic has been successful in keeping the drop-out rate low.

5.13. Tampere University of Technology (www.tut.fi)

Information Technology (180 cu.)

Programme established: 1985. Number of students: 1 477. Number of teaching staff: 110. Teaching staff/Student ratio: 1:13. Proportion of visiting lecturers: n.a. Acceptance rate: 77.5%. Drop-out rate: 12%. Median time for graduation: 4.9 yrs. Average age of graduates: 27 Percentage of female students: 10%. Industry advisory board: at university level, indirectly through Digital Media Institute. Number of Industry partners 76. Funding from corporate services 43.3%. Funding for R&D services 11.4%.

Tampere University of Technology was founded in 1972. The University offers eleven different degree programmes. The degree programme in Information Technology started in 1985, initially under the Electrical Engineering Department. The Information Technology Department was established in 1993. The Department has five laboratories. They are the laboratories of Mathematics, Software Systems, Signal Processing and Telecommunications as well as the Information Technology laboratory located in Pori.

Currently, the Department has 30 professor positions and 80 other teaching positions. The annual intake of new students in the programme is 285.

The programme offers a wide selection of major and minor topics for the students: Digital and Computer Engineering, Electronics, Hypermedia, Multimedia, Computer Science, Software Engineering, Learning and Intelligent Signal Processing, Signals and Systems Engineering, Signal Processing, Embedded Systems, Engineering Mathematics, Communication Networks and Protocols and Communication Systems.

Clear focus

The programme has a clear focus on Signal Processing and Computer Engineering. Once a year, representatives of industry are invited to the University for an exchange of views on programme contents. A minor in Information technology is also available for students of other degree programmes.

It appeared from the interviews that the vision of the Department is not clear to all staff. Every laboratory operates rather independently. The Institute of Mathematics closely supports the programme and, also, the whole University by providing all basic courses in mathematics for students. The other side of the coin is, that this has lead to large crowds in lectures in the basic courses. Individual students do not necessarily have sufficient tutoring when they run into problems in these courses.

The current funding system did not encourage the mathematics Department to change the approach. The funding within the University is distributed

more often directly for the institutions according to the performance indicators, which focus more on completed degrees.

Managing the students

The management style at Tampere University of Technology relies heavily on individual professors. The Rector's office distributes budget money for the different departments according to a complicated formula, which is not very clear to the staff. At the department-level, decisions are often made in semi official meetings. The Department Council's role seems a little unclear at present.

A large research support organisation, Digital Media Institute (DMI), is connected to the Department through a matrix organisation. The outcome of such a two-dimensional structure depends heavily on strong individual leaders. The evaluation team got the impression that the Department (and the University) has those leaders.

Both students and employers were happy about the quality of the courses. Local industry gives a lot of feedback on course contents. Teachers have a good relationship with industry members and the student guild. The communication between the parties is informal and positive.

Support from Digital Media Institute

The evaluation team was happy to learn of the role of Digital Media Institute (DMI) in assisting the different departments within the University. It helps with all administrative work related to external projects. The experts working for DMI help to reduce the daily administrative work in project management. It has been successful in reducing related workloads. A lesson learned is that in a rapidly changing, project-based environment, it is an advantage to systematically provide organisation-level support for the different projects.

Staff and students

A significant percentage of the student enrolment comes from the region. The University has also been successful in recruiting students from different parts of the country.

The students seem to be motivated and proud of their university. They appreciated the wide selection of courses available. Since the evaluation visit took place during a week with no teaching going on, it was not possible to analyse the actual working in progress at the Department.

The student intake has been increasing during the last few years. There is, however, no clear indication that the number of graduates will increase at the same ratio. There was no clear system for following student progression at the University. In this sense, the students were left on their own with their progress in studies. The evaluation team believes that a more careful follow-up of student progression would help the Department to focus on their process development.

The industry representatives were happy about the quality of both professors and graduates from the University. They also shared the opinion that the graduates from Tampere University of Technology have skills well-matched to the needs of industry. There was a clear opinion that students should complete their studies within a reasonable time frame. This opinion is, however contradicted by the fact that companies hire most students early in their studies.

Mass lectures in basic studies

The increased number of students has created some mass lectures. The group size in the laboratories was also considered rather big.

The relationship between the students and teaching staff was informal. According to the students, the staff is easy to approach and helpful. This has helped to create a good spirit in the Department.

There was a wide variety of different optional studies available for the students. Every student had in practice, an opportunity to collect courses from a broad variety available at the University. Some links also exist with the Tampere Polytechnic, but the exchange of studies is not working properly. Although allowing for a broad individual selection of courses the average time to graduate was a rather modest 5.7 years. This might indicate that, in this case, if the students are freely allowed to select their courses, they also tend to select courses they are most interested in. This, in turn, helps the students to pass all courses in time.

The increasing number of new students has created a heavier workload for the staff. The people hired for research also taught some courses. It has become more difficult to find staff for the University to teach the technical courses. It has been more difficult for students to select and attend courses where for example negotiation and team management skills are taught. Number of seats available in these courses are limited.

The students from Tampere have a tradition of competing against students of Helsinki University of Technology in embedded programming skills. A “toy car” was used to illustrate the outcomes of good programming skills in practice.

The learning materials are readily available on the Net. This is very useful since most of the students are working whilst studying. Another area for development would be the use of the web for staff development.

Centralised quality control

The University has created a centralised quality control assessment for courses. The system was not working well and was not seen as suitable for the Department. Quite often, feedback is asked for connection with the final exam of the course in question. The system did not motivate the students well enough to give feedback. In most cases it is not the best time to ask for feedback. It is strongly recommended that the Department plans its feedback and quality assurance procedures and practices so they well fit the purpose.

There seems to be good and active communication between the teachers and students although mostly in an ad hoc manner.

The University has noticed the importance of an introduction to studies period. Extra effort has been paid to tutoring the new students. Since 1998, teacher tutors have been appointed for all new groups of students. The student guilds also play an active role in tutoring. In 1999/00 a system of "laboratory tutors was introduced. According to the students, the results of the experiment have not been too good so far. They prefer the "old" system more.

Tradition of industry co-operation

There is a long and well-established tradition of working closely with industry. The University has been very active in helping to provide a bridge between the University and the companies in the region. There is close contact between the professors and industry. Alongside the formal university structure, there is also a lively informal networking with the companies in the region and with professors in other universities.

Almost all Master's theses are carried out in collaboration with the local industry. The University is clearly perceived by the industry representatives as producing high-quality graduates for industry. Almost all graduates will start working for the companies in the region at the latest when they graduate.

International student activities

Student participation in international student exchange programmes was low compared to incoming exchange students. It is recommended that the University evaluates its present links. The student exchanges should be assessed in the light of mutual, rather than one-way, exchanges. It may be necessary to examine more closely some of the reasons for reluctance to participate in these exchanges.

In research, the University is actively utilising funding for different European research projects.

Lack of space

The Department is located in a building, which is in active use. The increasing number of students has created problems with space. The building is becoming too crowded. A new building will be built in two years. However, more rapid response is needed. It was reported that in some cases the students could not attend some courses because of the lack of space. Top priority should be given to solving the problem while awaiting the new facilities.

The University library is the second largest engineering library in Finland. It has about 120 000 volumes, various works of reference and receives 1 200 print periodicals. The library has also several PC -rooms for students to use for their studying.

Recommendations

- The University should have a plan for international activities that would generate more attractive study opportunities abroad among the students.
- There could be more emphasis on providing teacher tutoring for students.
- The monitoring system of student progression needs to be improved.
- The lack of space needs to be addressed quickly.

Good practice

- Digital Media Institute supports the programme projects well and helps to build bridges between industry and research
- A lot of informal communication between students, staff and local industry.
- Illustration of programming skills in practice.

5.14 Vaasa Polytechnic (www.puv.fi)

Electronics and Information Technology (160 cu.)

Programme established: 1985. Number of students: 368. Number of teaching staff: 21. Teaching staff/Student ratio: 1:18. Proportion of visiting lecturers: n.a. Acceptance rate: 44.5%. Drop-out rate: 12%. Median time for graduation: 4.0 yrs. Average age of graduates: 26 yrs. Percentage of female students: 8%. Industry advisory body: through personal contacts. Industry partners 10. Funding from corporate services 1%.

The Vaasa Polytechnic was granted permanent a polytechnic licence in August 1999. The Polytechnic has three units: Technology and communication, Business Economics and Tourism, and Health Care and Social Services. The number of students in the degree programmes is almost 3 000. The number of teaching staff is 121.

Engineering education in Vaasa started in 1849, when the Vaasa Technical Real School was established. The Vaasa Polytechnic was initiated in 1996. The total number of teaching staff in the programme is 36, including 15 visiting lecturers. The number of students is 368 in the youth programmes and 86 in adult education.

The programme has five specialisation areas, they are Industrial Electronics, Embedded Systems, Software Engineering, Telecommunications and Production Economics.

Radical changes initiated – prioritising needed

The governance of IT-education has been radically changed since autumn 1999, when the Department of Electrical Engineering and Information Technology was split in two: The Department of Electrical Engineering and Depart-

ment of Information Technology. Therefore, it is rather difficult to assess some of the long-term effects for the programme. Development work is just beginning to show at the Department level. A lot depends on the next steps taken.

At the time of the evaluation team's site visit, there was no documentation available on Department strategy. However, the Department Head had many ideas concerning the role and mission of the Department. The Department wishes to play an active role in supporting local industry by educating professionals for their needs. The Department plans to also play an active part in attracting new companies to the Vaasa region, especially in the field of telecommunications. The evaluation team regarded the regional development processes supporting the programme active.

To keep the Department and programme on this positive track, the institute should support the Department in formulating a long-term strategy and operational plan. The Department Head is currently heavily involved in daily activities, which focus on ad hoc problems. It is also recommended that future plans be documented in written form for more clarity.

Clearer prioritisation is needed in daily management. More staff members should be involved in the development work. The Department had just moved the whole staff into an "open office" in the basement of the building. It might help with the daily informal discussions, however, it was recorded that the facilities are not really sufficient.

There seems to be some contradiction between the Rector and Department Head on the programme vision. The Polytechnic Rector favours the national needs and, at the same time the Department is strongly focusing on regional needs.

Enthusiastic development of programme

One might have the idea that the programme development is "just plans and talks", but, on the other hand, the staff we met during the evaluation visit was enthusiastic and agreed on the plans – they were young and the Head of the Department had gathered them as a team.

Students were happy about the programme contents. They complained little about the number of compulsory courses. Later on in the studies, the freedom to choose improves. More options are available. The drop-out rate has been about 12%.

Committed staff

Most of the programme staff have a good level of education (PhD, Licentiate or at least M.Sc.). Post- graduate students from Tampere University of Technology are used as visiting lecturers. The teachers met during the evaluation visit were all committed to work planned and done at the Department. However, we did not meet the older and more experienced staff members. Surprisingly, and to evaluation team's delight, shortage of qualified staff was not reported to be a major problem in Vaasa.

Higher education level study opportunities in Vaasa are good. Study places are provided and available for 88% of the youth in the Ostrobothnia area. The quality of the students varies, but basically it was seen to be good. It was recorded that the Polytechnic has to actively attract students not only from the region but also from other parts of Finland.

More learning opportunities later in the studies

The overall quality of teaching is good but could still be improved. Students wished for more activity in real-world-projects starting early on. A lot of the teaching is still lecturing with less interaction between teacher and students. There was a clear intent to increase the use of project and team-based learning methods at least during the 4th year of studies. According to the students, the teachers are supportive and are easily available for help and advice outside the classes.

Project-based learning methods have been experimented with, but only by the "most capable third of the students". The reason for limiting the number of students in project groups is understandable in view of the limited teacher resources to guide the projects. It should be noted, however, that it may lead in the long term to dividing the students into two categories which is not an advantage. It also reveals the need to create staff development programme in the area.

All students have to complete 60 credit units worth of compulsory studies in mathematics, physics, languages and the basics of engineering subjects. After that students are allowed to select specialisation studies from four specialisation areas.

The education is currently strongly concentrating on embedded systems, software engineering and telecommunications. Teaching in analogue electronics has been greatly reduced. The courses in telecommunications, at least were considered up-to-date. Information available from the other courses was limited.

The Department has two parallel programmes in information technology. One in Finnish and the other in English. In the international degree programme, most of the students are from China. It was not quite clear whether the quality is as good in both programmes. There was hardly any co-operation between the two programmes. It was also admitted that due to the language problems the Polytechnic can not offer the same selection of courses for those participating in the international programme as those in the Finnish programme.

Lot of confidential projects

The Polytechnic had accepted five-year confidentiality for most of the students final work. As they were not shown to the evaluation team, it is difficult to judge whether it is worth doing so. If compared to the other universities and

the polytechnics in the field, the period of keeping some work confidential varied between one to three years. It should be worth discussing whether all the work is worth the secrecy period or is it just a habit of the Department.

Co-operative matters

At the request of local business life, the Polytechnic has increased the supply of degree programmes in electronics, information technology and information processing. The local authorities strongly support the institute which acts as a local motor for development. The Department Head appears to favour ad-hoc collaboration, based on personal contacts and individual initiative, rather than being planned, shared and structured within the larger framework. The Department reports good relationships with informal working methods. The lack of a more formal industry advisory board could cause some misunderstandings in the near future. It would be worth considering the benefits of a more structured approach. The importance of personal communication was emphasised, "people communicate, not companies and institutes".

Even though the programme focuses on serving local companies and industry, it is unclear what it is doing differently in practice. It is the shared opinion of the evaluation team that the University has more or less the same goals. If this is the fact then the programme should seek closer co-operation with similar programmes.

The Department encourages the students to take part in international exchange programmes – but the students are not interested in them. It would help the situation if the Department would arrange some short study trips such as one week to some of the most interesting places abroad.

There is also a very good opportunity for co-operation with the University of Vaasa. This opportunity should not be missed. There is some teacher exchange on some special courses but to a rather limited extent. The students were not aware of the possibility of taking some courses at the University while will studying. After graduation the students get 60 credit unit from the B.Sc. degree if they are accepted by the University to continue their studies. Some Ph.D. students from the Tampere University of Technology also give lectures in Vaasa Polytechnic.

Resources

The Polytechnic has excellent conditions for collaboration in the Technology Research Center, Technobotnia. The Centre is located between the Polytechnic and the University. It has been financed with Regional and EU funding.

It was expected that the students would be closely connected to the self-evaluation process. During the site visit, the evaluation team found, that the students had not participated in the process at all. The self-evaluation process itself would provide useful information for the programme staff if used as a tool for development.

Recommendations

- It is strongly recommended that a broader range of department staff and students be involved in the programme development processes. The Department Head should put more emphasis on long term planning activities than on ad-hoc measures.
- There could be closer relations with the IT programme in English.
- More experienced staff members should be encouraged to change some traditional teaching methods.

Good practice

- The Technobotnia Technology and Research Center provides excellent potential for programme development.
- Open office environment creates the potential for open communication between staff.
- Activity in international fields

5.15 Åbo Akademi (www.cs.abo.fi)

Computer Science (160 cu.)

Programme established: 1985. Number of students: 247. Number of teaching staff: 15. Teaching staff/Student ratio: 1:16. Proportion of visiting lecturers: 0%. Acceptance rate: 72.7%. Drop-out rate: 45%. Median time for graduation: 6.0 yrs. Average age of graduates 28 yrs. Percentage of female students: 7.9%. Industry advisory body: through personal contacts. Industry partners: none. Funding from corporate services 0%. Funding for R&D services 43%.

Åbo Akademi University was founded in 1918, first as a private enterprise and a gift from the active citizens of Åbo. It primarily serves the educational needs of the Swedish-speaking population in Finland. The first course in Computer Science was started at the University in the mid 1960s. In 1968, it was possible to select Computer Science as a separate subject and two years later the subject got its first half professorship. Major subject status was achieved in the middle of the 1970's. The first full professorship in Computer Science was filled in 1983. In 1995, the Department also established a degree programme in Computer Engineering. The two programmes, Computer Science and Computer Engineering are closely connected.

Currently, there are 13 teaching positions consisting of 9 professorships and 4 lecturers. The number of students is growing rapidly. In 1999, 35 students were accepted into the Computer Science programme and 20 in the professional up-grading programme (and an additional 45 in the Computer Engineering programme). The total number of students in the Department will increase dramatically during the next 5–6 years, from 200 to some 700.

Optimistic about the programme future

The future outlook for the Computer Science programme is optimistic. The rapid increase in the intake has created a lot of new challenges for the programme. Currently, the Department has three professorships open for recruitment and two more will be founded in the near future.

The Department is planning to add more applied courses to the programme. On the whole, the programme is considered very theoretical. The University offers a fairly general selection of courses. Because of the current size of the Department, it can offer majors only in two specialist areas: Programming Methods and Software Engineering. The programme is planning more co-operation with the University of Turku in the near future. Plans include additional specialisation opportunities for students: Embedded Systems, Electronics, High Performance Computing and Telecommunications.

Minor changes in the programme

The programme is strongly focused on programming languages and programming skills in general. The evaluation team found the programme contents rather traditional. Annually for every course, a contents description is reviewed by some member of the teaching staff and minor changes are often made. However, there is a need for a more coherent review in the near future. The representatives of industry and commerce hoped for more practical software process skills.

Friendly relationship between staff and students

The size and the culture of the University allows for good co-operation between the different departments. The relationships between the students and staff are very informal and open. According to the students it is easy to communicate with the teachers. One example of the good co-operation is an end-of-term party twice a year, which both staff members and students attend and where any topic, studies, programme, social or other matters is freely discussed.

For many years, the proportion of women starting studies was close to zero. In 1997, the Department started a special project to attract more women to study Computer Science and Engineering. The increased access of women to the programme was facilitated by a number of factors. Changes in teaching style and other practical arrangements were initiated. Moreover, special attention was given to prevent the rise of a “macho” culture often related to technical studies and computer halls. Instructions on how to use the computer halls were renewed. The evaluation team encourages the Department to continue the project and share some of this good practice with other universities in the field.

Within the next 3–5 years, it is planned that the total number of students will rise up to 700 students. The increase creates immediate pressure to manage the big student flows. It is recommended that the Department creates sound systems for record keeping and monitoring student progress. The Ph.D. school creates a lot of opportunities for attracting qualified staff to meet future needs.

Traditional lecturing and minor teaching experiments

First year basic courses are mostly taught by lecturers and after the second year professors participate more in the teaching. The teaching is based mostly on lecturing at least during the basic courses. Some exercises are undertaken in smaller teams. Experiments in changing some teaching have been initiated by individual teachers.

Course material is good and generally available in electronic form on the Internet. The use of the web is a good practice and it is hoped that all staff will be involved in using it and delivering course materials via it.

It was also seen as a good practice that the teachers were responsible for running certain courses, rather than delivering a fixed number of lectures. It is believed that the teachers are more committed to their teaching when the "reins are kept loose" enough. This might, in turn, create extra work for those lecturers running the most popular courses, therefore, it is recommended that the Department pays attention to creating more incentives for good work.

Professors are active in the teaching. The graduate school also provides good support for the programme. Åbo Akademi should take the opportunity to use the graduate students to deliver the latest knowledge to the undergraduate students.

Research is closely connected with teaching and the role of research as a basis for education is emphasised. It was seen as positive, that the Department is paying attention to the lack of applied research and has plans to shift the focus more to the applied side in the near future.

The students learn some basic software programming (JAVA, C++) early in their studies. The industry is eager to offer jobs to them as soon as they know the basics. It is realised that some students move to the labour market and delay their studies at an early stage. The drop-out-rate in the programme is also alarming. The Department should address the issue urgently, try to identify the factors causing it and take any necessary corrective actions.

Information flows

Due to the size of the Department there seems to be a culture of giving personal feedback to the students. The students were also given an opportunity to provide feedback to the teachers during the courses. However, the students complained that not all feedback was acted on.

The Evaluation Team was delighted with the web-pages created by a laboratory engineer. These allowed each individual staff member to easily update information about his/her courses, links to lecture materials and exercises. The students were also satisfied with the use of the Internet.

The evaluation team briefly reviewed the theses prepared at the Department. It was noticed that the Department does not require an abstract as the first page in the student's Master's thesis. As the purpose of an abstract is to provide easy access to information, it is strongly recommended that the programme/Department requires abstracts in accordance with the international and national academic standards for the Master's theses as well as for the Doctoral theses.

Industry links are weak

The size of the programme limits its opportunity to focus on more than two areas. The intake of students will increase rapidly in the information industry fields and will create the possibility of broadening the areas of expertise. Co-operation with the University of Turku may also prove fruitful in the near future. Åbo Akademi is a partner in a research centre and a graduate school, TUCS, (The Turku Centre for Computer Science) together with the University of Turku and Turku School of Economics and Business Administration. The graduate school runs some advanced courses for undergraduate students. The co-operation seems to be working well and it allows students to choose courses across institutional borders, without much additional administration being involved.

Despite of the co-operation through TUCS, there is room for more solid regional co-operation between the higher education institutions in the Turku region. National co-operation with other universities could also be improved.

Programme links with industry are weak. Students may take part in only small-scale projects applied to industry needs. The use of visiting industry lecturers is said to be increasing, although currently only two courses are offered by visiting lecturers. It is recommended that the programme pay more attention to creating more active industry links. Some representatives of industry and commerce interviewed during the site visit provided clear ideas for future improvements.

The representatives of industry and commerce underlined the importance of local production of engineering graduates. The Department was involved with some smaller projects with industry. It was hoped that the Department would be involved in some bigger projects as well. As one industry member put it "the real life projects are often much bigger. It would be useful to have some experience of them while already studying."

The programme staff were active in arranging a summer school for the graduates in the field. The Department has good contacts with similar programmes in Europe. Most of the links are in active use through the graduate school. As an asset, the programme students were very fluent in languages.

The University has a long history of serving the needs of the Swedish speaking population in Finland. As the only provider of education for its target audience in many fields, the University has been relatively protected from outside pressures before. In the coming years the Department must accept the challenge to respond to the demands of industry and society in general.

Need for new facilities

There is a strong need for larger and more modern facilities in the near future due to the increased intake of students. The size of the Department will increase from 200 students to 700 in next few years.

Unlike the other institutes visited, the computer rooms and study halls are open for students 24 hours a day. The Department is closely monitoring the use of computers and has not had any problems so far. The Department trust in its students seems well-founded.

Recommendations

- Larger facilities and a staff recruitment plan should be prioritised in the Department's strategic plan for the coming years.
- More Department level attention should be given to analysing and addressing the high drop-out rate.
- It was noted that co-operation with industry and nationally with other universities is weak and should be actively improved.
- The lack of an abstract text in the beginning of theses work needs to be addressed.

Good practice

- Every semester a 'feedback party' is organised for the whole staff and all the programme students.
- Determined measures are planned to attract more female students.
- Active use of graduate students to deliver latest knowledge.
- Teachers responsible for running the courses rather than a fixed number of lectures.
- Easy-to-use web pages for the use of the whole staff.

6

Universities and Polytechnics in the Finnish Education System

The Finnish higher education consists of two parallel sectors: universities and polytechnics (dual system). Universities and Polytechnics are complementary in their respective areas of strength and both sectors have their own profiles. Universities emphasise scientific research and instruction based thereon. Polytechnics are high-quality experts in working life and its development. Compared to the universities, the polytechnic studies are more practically oriented.

The mission of the universities is to promote free research and scientific and artistic education, to provide higher education based on research and to educate young people to serve their country and humanity. Furthermore, the universities shall seek to co-operate amongst themselves with a view to a viable division of work. (OP 206 University Act, 27.6.1997/645)

The aim of university level engineering education is to provide M.Sc. (engineering) for the needs of industry and commerce, research and teaching organisations and society in general. The university degrees correspond to Bachelor's, Master's and Doctor's degrees, though degree programmes in the technical universities do not include a Bachelor's degree.

The aim of polytechnic education is to provide students with the practical skills and theoretical knowledge needed in a variety of professions in their working careers. The polytechnic degrees correspond to a Bachelor's degree, though this degree only partly corresponds to the university B.Sc. degree.

The polytechnics form a non-university sector that operates alongside the university sector. The principles underlying polytechnic education derive from the need for a highly-trained expert work force in the labour market, This is why the polytechnics are more professionally and practically oriented than the academic universities.

The provision for higher education in Finland is extensive. Within the entire higher education system the intake for 1999 accounts for 66% of the average size of the relevant youth age group. Of this, universities and polytechnics account for 29% and 37%, respectively. Participation in university-level education is higher in Finland than in other EU countries. The Ministry of Education has set a target to provide higher education study places annually for 70% of the relevant youth age group.

Universities

Finland has 20 universities located in different areas of the country. Half of the universities are in the metropolitan region and the remaining half in relatively small towns.

Most of the students admitted to the universities choose courses leading to a higher university degree (Master's degree). The higher university degree is designed to take 5–6 years to complete. In a university of technology, a M.Sc. degree requires 180 credit units and in other universities 160 credit units.

Students who have completed a higher degree may go on to take a doctorate-level degree. In most fields, students can also take an optional Licentiate's degree before going on to a doctorate.

In 1998 the universities had 143,000 students. The number of students has grown at a rate of about 3.4% a year on average during the 1990's. Engineering is the biggest field of study, accounting for one fifth of all students in 1998. This is followed by the humanities and natural sciences.

In the university sector the students are on the average 26 years of age and 52% of them are women. Engineering is the only field of study in which less than 20% of the students were women (18%). (Statistics Finland 1998)

Polytechnics

The development of the polytechnics began as an experiment in 1991. Studies for a degree at a polytechnic take 3.5 to 4.5 years after the matriculation examination or the equivalent. The qualification ranks as a higher education degree (Bachelors).

The aim of the reform since 1991, has been to build up a non-university sector of higher education consisting of polytechnics. Polytechnics are being formed by upgrading the specialised institutions, which previously offered vocational higher education and by merging them to form new multi-field institutions. The reform of vocational higher education has been implemented as a gradual process of experimentation and development.

Parliament passed an Act on a system of permanent polytechnics in 1995, and the first permanent polytechnics commenced work in August 1996. By autumn 2000, the polytechnic network will be complete. The total number of polytechnics will be 31. There are 29,000 places available for the 1st year students. The total number of students in polytechnics is 82,000. The size of the polytechnics varies from 1,000 to 7,000 students. Most of them are multi-field and regional institutions.

About a third of the students are studying engineering, manufacturing and construction, one third business and administration and a good fifth health and welfare services.

For more information, please visit http://www.minedu.fi/minedu/education/index.html

References

Dill D.D. (1999) Designing Academic Audit: Lessons learned in Europe and Asia. Paper presented at the CRE Institutional Evaluation Programme Induction Course Antwerp, Belgium 1.–3.10.1999 (Tampere 28.1.2000).

Higher Education Evaluation Council (1998) Programme Evaluation of Industrial Management and Engineering in Finnish Higher Education Institutions. Publications of Higher Education Evaluation Council 9:1998. Edita. Helsinki

Jokinen J. (1999) New Partnerships to Close Europe's Information and Communication Technologies Skills Gap. Presentation by Jokinen Jari in Future skills of tomorrows world 25.11.1999 in Espoo, Finland.

Lammela P. et al. (2000) Palautteet puntarissa. Opintosuoritukset ja kirjallinen palaute. Turun yliopiston täydennyskoulutuskeskuksen julkaisuja A: 75. Painosalama Oy.

Michelsen K-E. (1999) Viides sääty. Insinöörit Suomalaisessa yhteiskunnassa. Vammalan kirjapaino Oy. Vammala.

Ministry of Education (1998) Higher Education Policy in Finland. Nykypaino Oy. Helsinki.

Ministry of Education (1999) Yliopistot ja koulutusalat 1998–2000. Tilastollinen analyysi, OPM koulutus ja tiedepolitiikan osasto.

Pratt John (1997) The Polytechnic Experiment 1965–1992. The Society for Research into Higher Education & Open University Press. Edmundsbury Press Ltd. Suffolk.

Salo A., Pahlavan K., Salmenkaita J-P., (2000) R&D Programmes in Electronics and Telecommunication ETX, TLX, INWITE and Teletronics. Mid-term Evaluation. Technology Programme Report 5/2000. Tekes, Helsinki

Teichler U. (1999) Higher education policy and the world of work: Changing conditions and challenges. Higher Education Policy 12 (1999). International Association of Universities. Pergamon.

Tietopiste (1998) Artikkeli: Tietoteollisuusalan koulutusta lisätään voimakkaasti OPM:n toimenpideohjelmalla. 5/1998. OPM:n tiedotteen 11.3.1998 mukaan.

Tilastokeskus (1999) Tiedolla tietoyhteiskuntaan II. Yliopistopaino, Helsinki.

APPENDIX 1:
Problem Based Learning
– Lessons Learned in Aalborg University

– Integration of engineering education and productive engineering by Flemming K. Fink

Even though there is some co-operation between industry and engineering schools/ universities, working life and education are still by definition two independent worlds. The observed situation in Finland encourages one to re-think this "law" and develop a new concept, not just integrating learning and working, but integrating formal education (with grades) and productive working.

A very common feature of the context of Finish engineering educational institutes is that the (local) industry is eager to attract the students as soon as they can be productive (often after the second year of studies). At first this is very positive for the students, as they earn their living costs and for Finnish industry, as it is supported with dynamic and inexpensive staff members, willing to work whenever needed. Some companies also invest in these young staff members by letting them attend to additional personnel training.

But there are also severe drawbacks with this trend concerning the students, companies, universities and polytechnics and the society as such. For the students it can be difficult to foresee the consequences, but far too many never graduate. Major companies invest in educating these students to be good staff members, but small and medium enterprises (SME's) do not have the resources for doing so, and they might be the losers. Universities and polytechnics waste a lot of resources on students who never graduate. It was observable at the visits that this was a great burden for many of the institutions. The wasted resources could have been used to improve the content of the engineering programs i.e. to increase the professional level. In the long run the present situation will result in more company based education (such as Corporate University etc.) resulting in less flexibility of the engineering profession, less usable staff for SME's and survival troubles for some polytechnics and universities.

Developing a new engineering educational set-up, which integrates formal education and productive work is a new challenge that we have to face sooner or later. In the information society more and more (consumer) products contains an increasing amount of knowledge. Knowledge and competence has become one of the most competitive parameters in the IT-industry, and therefore life long learning is very important for engineers in that business. Life long learning includes developing your professional theoretical skills in addition to your work i.e. this is also a combination of engineering education and productive engineering.

First of all it is very important to change focus from teaching to learning. We all know that the best way to learn and understand a theory is by trying to see whether you can apply the theory. Engineering is problem solving – by applying results from engineering research. Therefor it is obvious to try to combine the fundamental learning process and engineering problem solving. This has been some of the fundamental reasoning for the existing educational concept called Problem Based Learning (PBL).

It is also important to face the fact that engineers are not working in isolation – real life engineering problems are solved in teams, teams of well skilled individuals integrating their capabilities into solving huge and complex problems.

The main principles of project organised problem based learning are described below in figure 1.

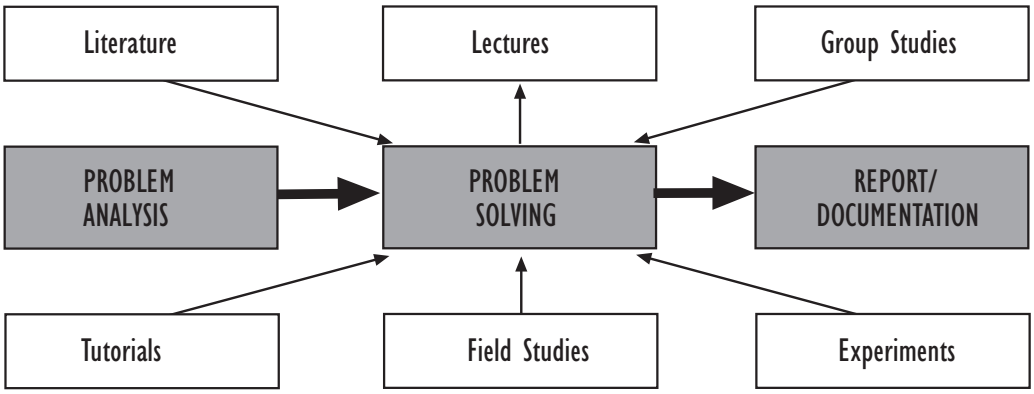

Figure 1. Principles of project organised problem-solving.

This pedagogical concept has been implemented for 25 years at Aalborg University in Denmark. With take-off in the experiences from this concept some further development would make it possible to integrate productive engineering into engineering education. The basic elements will be described shortly:

Each semester is composed of 1) a project, 2) courses covering topics needed for the project and 3) some fundamental courses such as mathematics preparing for the level of next semester. There are some very fundamental issues that must be faced:

- The project must be a major, real-life, cross-disciplinary project involving application of several courses. Around the world many attempts to implement team working are taken with a one-week project ending a course – this is not a realistic situations and does not motivate the students. More realistic are projects occupying the student for at least half of the time, and only one project per semester. That means approx. 500 hours of work per student in each project
- The students must go through all steps shown in figure 1 – problem analysis, problem solving and documentation. Problems to be solved are fundamentally not defined in engineering terms but must be transformed into that. Therefore problem analysis and problem definition is very important.

A first year example from electronic engineering: Equipment used in medical examinations of people in an AIDS campaign in Africa must be sterilised – can you design and implement a control system for that using solar energy for heating?

A third year example from signal processing: Profoundly deaf children do have a residual hearing below 500 Hz – can the information necessary to understand speech (up to 2500 Hz) be presented in this range?

Integrated in the problem solving will be literature studies, field studies, laboratory experiments and simulations, group discussions etc.

To be able to handle the situation and choose the right problems for each semester, each semester can be planned according to a theme such as SW Development (2rd semester), HW-oriented programming (3th semester), Real-Time Communications Systems (4th semester) etc. In this way it is possible to plan, which courses students must take to be able to deal with real life engineering problems at a realistic level.

This organisation of the curriculum implies that students learn to apply the theoretical courses from the very beginning and on the other hand that mathematics and other fundamental courses are spread out on several semesters – in due time before the theories are needed.

Each project group is assigned a supervisor or facilitator. The facilitator meets with the group approximate once a week to discuss the progress of the project, to guide them back on track if necessary and to read and discuss drafts for their documentation. It is very important that the facilitator is aware of not being a problem solver, but a facilitator. At the end of the semester he is responsible for the final examination of the project together with external examiners appointed by the minister of education.

Supervising a group of students in engineering education is a very professional demanding job – lecturing is much easier. Giving a lecture the professor can be well prepared, and he or she decides what to talk about. Questions must always be relevant to the topic in order to be answered. Discussions with a group of students trying do define an engineering problem or trying to find the right solution, can lead to a great diversity of questions. Solving engineering problem calls for interdisciplinary knowledge, which is why the professor supervising the students must learn to admit his professional limitations and call for colleagues to assist.

The project work must be documented by means of a report, a paper, a poster etc. plus HW and SW. This material can form the basis for an examination such as an oral examination on group basis, where each student can be asked about everything relevant to the problem and their chosen solutions. To make a thorough evaluation of their work, such a final discussion on the basis of the documentation will take several hours and end up with individual marks. Such evaluations are not just measuring the student's knowledge; they are also part of the learning process. Whether the student is capable of applying some course material is evaluated via the project, and therefore no additional exams in these courses are needed.

Teachers must be trained to cope with this new challenging pedagogical situation. They must be able to guide the students in the problem solving, which also means being able to discuss topics outside their own course and they must be able to co-operate and run a semester as a team. On the other hand this is a good opportunity for teachers to broaden their minds and become familiar with new applications of their theoretical knowledge every year.

Dynamic curriculum

The structure of the curriculum implies a large degree of flexibility. Within a specific theme projects can change from year to year. A theme like "Stochastic Signal Processing" will involve a great variety of engineering problems – and as the projects selected can be a combination of 1) proposals from industry, 2) interests among students, and 3) interests among supervising staff etc. new problems will always be in focus. Therefore even though the *purpose and the content* of the theme is well prescribed the curriculum is very flexible and can follow the development in technology and integrate application of new research results. The semester-organised programme has proven to be a very dynamic organisation for implementing new engineering applications in the project work. This means; it is a good tool for co-operation with industry and for updating the professional content of the curriculum

A great variety of projects at all professional levels will always be accessible, and co-operation between university (students, researchers) and industry will increase with benefit for all partners.

It can be claimed that this educational system is innovative as such.

Results of the pedagogical model

The pedagogical model centred on problem based, project organised group work is evaluated to be an absolute strength of the educational system. The problem based part – the *Problem Based Learning* concept allows the students to develop excellent analytical skills and they add up with good experiences in coping with and attacking complex engineering problems. In addition to a thorough theoretical insight the students become experienced in applying the theoretical elements from the lecturing in practical engineering problem solving.

The *group based project organised team working* is also a very important element in the learning process. It increases the students' skills in professional argumentation, presentation of own proposals for solutions and critical evaluation of proposals from the other students. Preparation of documentation in form of reports, scientific papers and posters together with the oral presentation is exercising the students for future production of written material and preparation and performance of oral presentations.

Because of the size of the projects (500 person hours per student) the students get some insight in combining engineering material with applications, and they get used to seeking and delimiting new information/knowledge on their own.

Being part of a team the students learn how to co-operate in solving major engineering problems. They learn how to deal with professional discussions in situations like problem definition and argumentation for their choice of solution. Students learn how to argue about and explain in scientific terms what they believe is the right solution – it is not enough to claim you are right, you must be able to convince other group members. *Argumentation is a god way of learning*.

They learn how to organise teamwork, learn that a team does not work if not everybody is doing his or her part of the job. In this way the students assimilate an attitude to work different from what is possible for students doing traditional university study on their own. In return to this the students will get the feeling of safe social surroundings, the other students expect them to show up every morning, and if they do not, they will probably be contacted to find out what is wrong.

The teamwork also has the effect that students push each other. Of course the students go for solving the problem – engineering is problem solving, and they define some sub-tasks for each member of the group. To succeed with your task, you have to read the book, seek out some extra information, read some scientific papers, search the Internet, do some programming or whatever is needed. And as no student want to end up with a bad solution, they work very hard with their project. The project is the key element in the curriculum; the students apply the theoretical courses in problem solving, they can via the project reflect on their professional work.

The challenge in Finland would be to change this PBL-concept like:

- exchange (some of) the university based projects with company based projects
- exchange (some of) the teams of students with company based teams
- re-arrange the curriculum into less courses so that courses supports the projects
- achieve acceptance among staff and management at the university/polytechnic
- achieve support in industry for the students learning process in the teams
- obtain co-operation between industry and university/polytechnic about projects that guarantee the learning context for the students beneficial for both student, company and university/polytechnic.

Flemming K. Fink, Aalborg University
fkf@kom.auc.dk

APPENDIX 2:
Guidelines for the self-assessment

A. DESCRIPTION: QUANTITATIVE AND QUALITATIVE INFORMATION
(max. 15 pages)

1 THE FRAMEWORK
- Historical background of the university/polytechnic and the programme
- The organisation of the university/polytechnic and the position of the programme within it
- Aims (broad purposes), objectives and strategies of the university/polytechnic and the programme (how, by whom, when)
- Financial resources of the programme *[koulutusohjelman rahalliset resurssit]*

2 PROGRAMME
- The present situation of the programme and oncoming changes
- Major changes and improvements during the past five
- Curriculum and content in 1998–1999
  Appendix on curriculum and course contents in English
- Connections between research and
  Appendix on research and development projects since 1.1.1998

3 PROGRAMME/DEPARTMENT STAFF
- Staff profile
- Staff development programme
- Part-time teachers from industry and commerce
- Incentives

4 PROGRAMME STUDENTS
- Student profile and recruitment of students
- Graduates and their employment
- Interaction between programme and alumni (depth, breadth)

5 TEACHING AND LEARNING
- Teaching methods, student engagement and participation
- Use of learning resources
- Skills achieved (e.g. transferable, cognitive, subject-specific, practical/professional, language, personal)
- Latest innovations in teaching

6 ASSESSMENT OF STUDENTS
- The range of assessment methods (e.g. written exams with essay questions or applied problems, continuos assessment of coursework, laboratory work, projects, use of learning diaries and portfolios)
- Criteria (e.g. clarity, students' understanding of criteria and assignments)
- Marking/grading policy
- The use of students' self-assessment (e.g. examples how students evaluate their own learning)
- Feedback to students and/or curriculum/course design
- Monitoring of student progression

7 STUDENT SUPPORT AND GUIDANCE
– General (e.g. strategy for support and guidance, written guidance on the programme/course level)
– Academic guidance (e.g. concerning course options, study skills
– Tutoring and welfare support
– Career information and guidance

8 LEARNING RESOURCES
– Relevant library services (e.g. course book and periodical stock, study space)
– IT facilities and equipment
– Laboratories and other special educational facilities

9 CO-OPERATION AND NETWORKING
– Programme co-operation with other institutions (national, international)
– Programme interaction between industry and commerce (e.g. projects, thesis-work, advisory groups)
– Teacher and student exchange

10 QUALITY MANAGEMENT AND ENHANCEMENT
– Internal arrangements for monitoring and evaluating strategies
– Revision of objectives, curriculum and course contents
– Recognition of educational requirements in industry, commerce and public life
– Assessment of course feedback

11 PRACTICAL ARRANGEMENTS
– Organisation of the self-assessment process (timetable, names and positions of participating persons)

APPENDICES

B. SELF-ASSESSMENT: THE EVALUATION OF THE QUALITY OF THE PROGRAMME (5 to 15 pages)

12 THE FRAMEWORK

13 PROGRAMME

14 PROGRAMME/DEPARTMENT STAFF

15 PROGRAMME STUDENTS

16 TEACHING AND LEARNING

17 ASSESSMENT OF STUDENTS

18 STUDENT SUPPORT AND GUIDANCE

19 LEARNING RESOURCES

20 CO-OPERATION AND NETWORKING

21 QUALITY MANAGEMENT AND ENHANCEMENT

22 PRACTICAL ARRANGEMENTS

APPENDIX 3:
Evaluation of Programmes for Information Industry

Originaali ohessa

suorakuvataan EDITASSA tilaan sopivaksi

APPENDIX 4:
Basic capacity and the increased intake of new students in the Programme for Increasing Education for the Information Industry fields between 1998–2000

		Increased intake of new students 1998–2000			
Universities *	***1998***	***1998***	***1999***	***2000***	***2000***
	Capacity	***Places***	***Places***	***Places***	***Capacity***
University of Helsinki	240	+15	+30	+15	300
University of Jyväskylä	185	+20	+20	+10	235
University of Oulu	235	+55	+60	+40	390
University of Joensuu	50	+10	+10	+10	80
University of Kuopio	40	+10	+10	+10	70
University of Turku	170	+15	+25	+10	220
University of Tampere	70	+15	+10	+10	105
Åbo Akademi	30	+10	+20	+25	85
University of Vaasa	98		+45	+10	153
University of Lappi					
Helsinki University of Technology	1 024	+80	+70	+50	1 224
Tampere University of Technology	465	+50	+60	+40	615
Lappeenranta Univ. of Technology	110	+20	+30	+30	190
Helsinki School of Economics and Business Administration	30			+15	45
Helsinki Swedish School of Economics	-			+10	10
Turku School of Economics and Business Administration	20			+15	35
University of Fine Arts, Helsinki	-		+10		10
Total	2 767	+300	+400	+300	3 767

Source: Tietopisto 5/1998

* Professional Upgrading Programmes not included to above figures.

		Increased intake of new students in 1999	
Polytechnics *	**1998**	**1998**	**2000**
	Capacity	**Places**	**Capacity**
Arcada	60	+20	80
Espoo–Vantaa Polytechnic	72	+30	102
Evitech	125	+140	265
Etelä-Karjala Polytechnic	76	+20	96
Helsinki Polytechnic	288	+140	428
Helia	120	+60	180
Häme Polytechnic	130	+20	150
Jyväskylä Polytechnic	84	+110	194
Kajaani Polytechnic	90	+40	130
Kemi-Tornio Polytechnic	151		151
Keski-Pohjanmaa Polytechnic	65	+20	85
Kymenlaakso Polytechnic	80	+20	100
Lahti Polytechnic	66	+50	116
Mikkeli Polytechnic	100	+60	160
Oulu Polytechnic	256	+170	426
Pohjois-Karjala Polytechnic	70	+20	90
Pohjois-Savo Polytechnic	205	+120	325
Rovaniemi Polytechnic	88	+20	108
Satakunta Polytechnic	158	+80	238
Seinäjoki Polytechnic	25	+20	45
Svenska Polytechnic	52	+20	72
Sydväst Polytechnic	30		30
Tampere Polytechnic	160	+130	290
Turku Polytechnic	162	+110	272
Vaasa Polytechnic	170	+100	270
Varsinais-Suomi Polytechnic	-		
Åland Polytechnic	-		
Total	2 883	+1 520	4 403

Source: Ministry of Education (2000)

PUBLICATIONS OF THE FINNISH HIGHER EDUCATION EVALUATION COUNCIL

POB 20, FIN-00501 HELSINKI
Tel +358-9-7748 8410 Fax +358-9-7748 8414
http://www.minedu.fi/asiant/kka.html

1:1997 Virtanen, A. (toim.): *Armottomat ammattikorkeakoulut – matkalla kehittyneisiin arviointijärjestelmiin.* Helsinki: Edita.

2:1997 Liuhanen, A.-M. (toim.): *Yliopistot arvioivat toimintaansa – mitä opitaan?* Helsinki: Edita.

3:1997 *Korkeakoulujen arviointineuvoston toimintasuunnitelma vuosille 1998–1999.* Helsinki: Edita.

4:1997 *Finska rådet för utvärdering av högskolorna: Verksamhetsplan 1998–1999.* Helsingfors: Edita.

5:1997 *Action Plan of the Finnish Higher Education Evaluation Council for 1998–1999.* Helsinki: Edita.

1:1998 Virtanen, A. (toim.): *Korkeakoulutettu poliisi. Poliisiammattikorkeakoulun ulkoinen arviointi.* Helsinki: Edita.

2:1998 Kantola, I. & Panhelainen, M. (toim.): *Kansainvälistyvät ammattikorkeakoulut. Jyväskylän, Tampereen ja Turun ammattikorkeakoulujen kansainvälistymisen asiantuntija-arviointi.* Helsinki: Edita.

3:1998 Junge-Jensen, F., Lundin, R., Nyman, G. & Wahlroos, B.: *Vart är Hanken på väg? Rapport av en extern utvärderingsgrupp.* Helsingfors: Edita.

4:1998 *167 syytä korkeakouluksi. Ammattikorkeakouluhakemusten arviointi 1998.* Helsinki: Edita.

5:1998 *Yliopistokoulutuksen laatuyksiköt. Arviointineuvoston esitys korkealaatuisen koulutuksen yksiköiksi vuosille 1999–2000.* Helsinki: Edita.

6:1998 Hämäläinen, K. & Moitus, S. (toim.): *Laatua korkeakoulutukseen – teoriaa ja käytäntöä.* Helsinki: Edita.

7:1998 *Pilot Audit of Quality Work in Kajaani, Turku, Lahti and Häme Polytechnics.* Helsinki: Edita.

8:1998 Dahllöf, U., Goddard, J., Huttunen, J., O'Brien, C., Román, O. & Virtanen, I.: *Towards the Responsive University: The Regional Role of Eastern Finland Universities.* Helsinki: Edita.

9:1998 *Programme Evaluation of Industrial Management and Engineering in Finnish Higher Education Institutions.* Helsinki: Edita.

10:1998 *Quality Label? EQUIS Evaluation Report. Helsinki School of Economics and Business Administration.* Helsinki: Edita.

11:1998 *Three Finnish Universities in the International Perspective. CRE Institutional Review of Helsinki University of Technology, Tampere University of Technology, and Åbo Akademi University. CRE Reviewers' Reports.* Helsinki: Edita.

1:1999 Virtanen, A. (toim.): *Viittä vaille valmis? Ammattikorkeakouluhakemusten arviointi 1999.* Helsinki: Edita.

2:1999 Vähäpassi, A. & Moitus, S. (toim.): *Korkeakoulut alueidensa vetureina. Viisi näkökulmaa vaikuttavuuteen.* Helsinki: Edita.

3:1999 Booth, J., Erlhoff, M., Jones, A. & Paasikivi, P.: *Strategies for the Future. Evaluation of University of Art and Design Helsinki UIAH.* Helsinki: Edita.

4:1999 Kähkönen, J. & Lipponen, M. (toim.): *Laadun lähteillä. Itä-Suomen ammattikorkeakoulujen itsearvioinnin kehittäminen.* Helsinki: Edita.

5:1999 Tella, S., Räsänen, A. & Vähäpassi, A. (Eds.): *Teaching Through a Foreign Language. From Tool to Empowering Mediator.* Helsinki: Edita.

6:1999 Cheesmond, R., Grede, K., Lonka, K. & Román, G.: *From the Cherry Orchard to the Future. The Report of the Peer Review Team of the Theatre Academy of Finland.* Helsinki: Edita.

7:1999 Davies, J., Lindström, C.-G. & Schutte, F.: *Five Years of Development. Follow-Up Evaluation of the University of Oulu.* Helsinki: Edita.

8:1999 Perälä, M.-L. & Ponkala, O.: *Tietoa ja taitoa terveysalalle. Terveydenhuoltoalan korkeakoulutuksen arviointi.* Helsinki: Edita.

9:1999 *Audit of Quality Work. North Karelia and Mikkeli Polytechnics.* Helsinki: Edita.

10:1999 *Audit of Quality Work. Seinäjoki Polytechnic.* Helsinki: Edita.

11:1999 Jussila, J. & Saari, S. (toim.): *Opettajankoulutus tulevaisuuden tekijänä. Yliopistoissa annettavan opettajankoulutuksen arviointi.* Helsinki: Edita.

12:1999 Virtanen, A. & Mertano, S. (Eds.): *Learning by Comparing. The Benchmarking of Administration at the University of Helsinki.* Helsinki: Edita.

13:1999 Kuusinen, I. & Nurminen, M.: *Korkeakoulukirjaston asiakaspalvelun arviointi. Kymenlaakson ammattikorkeakoulun, Helsingin kauppakorkeakoulun ja Leeds Metropolitan Universityn kirjastot.* Helsinki: Edita.

14:1999 Kuusinen, I. & Nurminen, M.: *Evaluation of Customer Service in the Academic Library. Libraries of Kymenlaakso Polytechnic, Helsinki School of Economics and Business Administration, and Leeds Metropolitan University.* Helsinki: Edita.

15:1999 Kristensen, B., Lindfors, T., Otley, D. & Stenius, M.: *TSEBA as a Learning Organisation. Evaluation of Turku School of Economics and Business Administration.* Helsinki: Edita.

16:1999 Lyytinen, Heikki K.: *Työelämäyhteistyön arviointi. Jyväskylän, Tampereen ja Turun ammattikorkeakoulujen työelämäyhteistyön ulkoinen arviointi.* Helsinki: Edita.

17:1999 Pehu-Voima, S. & Hämäläinen, K. (toim.): *Opetusta kehittävää arviointia.* Helsinki: Edita.

1:2000 Lehtinen, E., Kess, P., Ståhle, P. & Urponen, K.*: Tampereen yliopiston opetuksen arviointi.* Helsinki: Edita.

2:2000 Cohen, B., Jung, K. & Valjakka, T.: *From Academy of Fine Arts to University. Same name, wider ambitions.* Helsinki: Edita.

3:2000 Goddard, J., Moses, I., Teichler, U., Virtanen, I. & West, P.: *External Engagement and Institutional Adjustment: An Evaluation of the University of Turku.* Helsinki: Edita.

4:2000 Almefelt, P., Kekäle, T., Malm, K., Miikkulainen, L. & Pehu-Voima, S.: *Audit of Quality Work. Swedish Polytechnic, Finland.* Helsinki: Edita.

5:2000 Harlio, R., Harvey, L., Mansikkamäki. J., Miikkulainen, L. & Pehu-Voima, S.: *Audit of Quality Work. Central Ostrobothnia Polytechnic.* Helsinki: Edita.

6:2000 Moitus, S. (toim.): *Yliopistokoulutuksen laatuyksiköt 2001–2003.* Helsinki: Edita.

7:2000 Liuhanen, A.-M. (toim.): *Neljä aikuiskoulutuksen laatuyliopistoa 2001–2003.* Helsinki: Edita.

8:2000 Hara, V. , Hyvönen, R. , Myers, D. & Kangasniemi, J. (Eds.): *Evaluation of Education for the Information Industry.* Helsinki: Edita.