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Evaluation of Civil Engineering Education at Universities and Polytechnics

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Foreword

The evaluation of Higher Civil Engineering Education is the fourth Engineering Degree Programme evaluation project implement by the Finnish Higher Education Evaluation Council (FINHEEC). In line with the previous evaluation projects, i.e., those focusing on Industrial Management and Engineering, Information Technology, and Mechanical Engineering, one single External Evaluation Team was also in this case in charge of the evaluations of both university-level institutions (Technical Universities and Faculties) and Polytechnics.

The fact that the evaluation of Civil Engineering took place only now is based on the judgement made by FINHEEC on the current situation. There was pressure, expressed by many interested parties, to have an evaluation performed already earlier. The university-level education in Civil Engineering underwent considerable structural changes in the 1990s, and the impacts of that change have only now surfaced and become felt and visible. Likewise, the Finnish Polytechnic system was established in form and content mainly towards the end of the 1990s.

One of the difficulties faced in the work of evaluating Degree Programmes in Engineering is the relatively large number of these programmes, 19 in total. It was certainly possible to perform self-evaluations on all Degree Programmes but external evaluations made *in situ* could comprehend only half of them. In order to be able to draw maximal benefits from these external evaluations, the choice of the visits was object of careful consideration. The same – hopefully – applies to the way in which the results were presented. The purpose of the evaluation process is to constitute an instrument for the development of the education given by these units. The evaluation does not rank the Degree Programmes, nor is it the intention to classify them as "good" or "poor" programmes.

An evaluation project has been successful if it has contributed to the development of the administration, teaching and learning possibilities of a Degree Programme. The evaluation will reach its aims only if it has an impact. The impact, in turn, depends on the evaluation itself, on its level of expertise and impartiality, its follow-up and integration into the education system. We are convinced that this External Evaluation Team has met with these demanding quality standards and that it has been able to raise the essential questions.

We would like to thank all the Universities and Polytechnics and the Civil Engineering Degree Programmes for their involvement in this evaluation project. The evaluation process has required a considerable input in terms of their time and effort. We would also like to express our sincere thank to the External Evaluation Team, and to its Chairman and Secretary, in particular.

The preparatory and co-ordination work performed by the project Steering Group members was also greatly appreciated.

January 19, 2003

Professor Toivo Katila
Chairman of the Steering Committee

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Definitions

The following definitions are used in this report:

"Building and Civil Engineering" means here Engineering which is related to all types of buildings and real estate, civil infrastructure, industrial infrastructure, municipal infrastructure: water supply and sewerage systems, water resources, and environmental engineering. This includes both the private and the public sector.

"Construction and Real Estate Cluster" is a term used in the "Vision 2010" reports. It refers to a combination of all activities and stakeholders, productions and services connected with any types of buildings and civil infrastructure. The Construction and Real Estate Cluster includes both the private and the public sector.

"Higher Education in Civil Engineering" means education in the Technical Universities and Polytechnics in the field of *Building and Civil Engineering.*

Graduate Engineer means a person who holds a Master of Science degree of a Technical University Master of Science in Technology, M.Sc. (Tech.).

Engineer means a person who holds a Bachelor of Engineering degree of a Polytechnic (B.Sc. Tech.).

Summary

General

The Building and Civil Engineering branch plays an important role throughout the life (planning, design, construction, maintenance, renovation, rehabilitation, reuse and recycling) of all physical facilities which support living and working. This is the branch that also meets the infrastructure needs of society, and it contributes not only to the quality of the built environment but also to the natural environment and the ecosystem.

In the year 2001, the total output of Building and Civil Engineering was 44 billion Euro, accounting for about 10% of GNP. The total value of the facilities of this sector accounts for 70 to 80 percent (depending on the fluctuation of the price levels) of Finland's national wealth of 500 billion Euro. The branch employs more than 20 percent of our workforce, or 520,000 people.

The Finnish Building and Civil Engineering business is quite internationalised in terms of exports, ownership of firms, the design and construction of projects, and the ownership and operation of facilities.

This broad technology is based on an integrated application of natural sciences, technical sciences and practical knowledge. Both integrated systems, engineering skills and specialist expertise are needed in research and development, as well as in the practical activities within the branch. This is a particular challenge for the development of higher education in Civil Engineering.

Self-evaluation reports of all the institutes involved in this evaluation process were made available to the External Evaluation Team, and the Team paid one-day visits to 10 of the 20 institutes. The Team also used external information, published by working groups of the Building and Real Estate Cluster, Association of Finnish Civil Engineers as well as by the working group instituted by the Finnish Government for a programme on a national policy for the construction sector.

The self-evaluation of the institutes and the findings of the Team during its visits indicated that Civil Engineering education is generally of a reasonably good standard and it largely supported the current routine needs of practice. The quality and content of the education was judged to meet international standards in most respects.

The broad and extensive strategies, visions and analyses issued by the Building and Real Estate Cluster and by the working group of the Finnish Government include ambitious objectives. The External Evaluation Team concurs with these objectives and wants to stress that when met, these objectives would lead to improved quality and economy of physical facilities for living, working, industrial production, transport and other facilities needed by society. Meeting these objectives would also strengthen the international competitiveness of

Finnish Building and Civil Engineering firms in Finland and abroad. All this should take place in a harmony with the environment and nature. The challenge faced by the entire Building and Civil Engineering branch is to develop its capability for the materialisation of these objectives and visions.

In view of a continuing development and renewal of Degree Programmes in Civil Engineering, the above objectives are central starting points. The Technical Universities have a major responsibility for educating Graduate Engineers who will be needed to lead this development process, and for creating new technical knowledge and solutions at all levels of engineering, management, business and administration within the branch. All this is taking place in an increasingly internationalised context.

In the past few years, the Polytechnics have been able to make some successful changes, but further development is still needed. The main tasks of Engineers graduating from the Polytechnics are considered to be in design, site management, maintenance, repair, rehabilitation and the recycling of buildings, civil infrastructure and other facilities. These Engineers must also be able to apply new technical and organisational solutions within Finnish construction, but increasingly also in an international context.

All Graduate Engineers and Engineers must be capable of acquiring new knowledge and learning new skills as a part of their commitment to lifelong learning. This capability can be improved through changes in their undergraduate (degree) education.

There was a rather mixed reaction from the institutions towards the implications of the Bologna Declaration, and their responses expressed so far have not been uniform. Over the next few years, they will deed to develop their readiness to adapt to the Bologna process.

On the basis of the arguments presented above, the External Evaluation Team on Higher Education in Civil Engineering sets forth the following summarised recommendations for the further development of Civil Engineering Degree Programmes, their educational content and orientation and relationship with research.

Recommendations for the Technical Universities

1 The programmes in Civil Engineering should be further developed in accordance with the general principles of science-based university education. The educational content has to cover the synthesis, analysis, optimisation and management of broad concepts and narrow specialisations, as well as provide a foundation for lifelong learning. This requires strengthening of the scientific base, especially at the level of technical sciences and partly also in some fields of natural science. Currently, there is a large and growing need for specialists in structural engineering and road design, because

too few students have selected these specialisations in the past. There is also a perceived lack of cohesion between technical, managerial and economic skills.

2 Plans for developing the Degree Programmes should be made in close co-operation with other Departments having a relevance or synergy with Civil Engineering. This should cover Architecture, Building Service Systems Engineering, Production Economics, ICT and Industrial Management, but need not be restricted to these disciplines or departments. Relevant international contacts as well as contacts within the national industry, administrative organisations, research organisations and other client organisations could be used to support this work.

3 In the building sector the education of design and planning should be broadened to include the integration of all aspects of the technical design of buildings, including life-cycle design and maintenance, repair and rehabilitation planning, reuse and recycling. Examples of the need for this integration would cover issues such as internal air quality and healthiness of building occupants, energy-efficiency, whole-life economy, lifetime performance and environmental and ecological efficiency. ICT will be an essential tool in all these processes.

4 Education should be extended to understanding manufacturing processes and the management of factory-based as well as site-based production. Improved knowledge of building materials and components could be developed through the above-proposed strengthened base education in technical sciences. Education related to technical issues should be supported by education in scientific principles and methods of human, organisational and economic management.

5 Basic research should be strengthened in most fields by using and applying methodologies based upon natural and technical sciences. The extent of basic research supported at the European level, as well as that funded by the Academy of Finland has to be improved. Success in funding would lead to further activity and the reasonable expectation of follow-on funding.

6 The continuous and direct interaction of students with the business life could be strengthened through the use of more experts from business life in subjects that are dealing with professional practice. Connections with research in other institutions (i.e. Universities and VTT) could be improved through the exchange of lecturers and researchers in selected areas, i.e., where there is undoubted expertise that is lacking in the Department.

7 Existing co-operation with industry in areas of applied research is encouraging and should be continued and developed further. Special attention should be paid to applying the methodologies and results of science-based

research to the field of applied research, where this has the potential to modernise and extend the latter's effectiveness.

8 Internationalisation in education and research could and should be improved. In practice, this is likely to mean the exchange of academic staff and students and an increase in collaborative international research, especially in the context of the EC's Sixth Framework Programme. Special attention should be paid to increasing international contact with the most important export countries for the Finnish Building and Civil Engineering business, namely Germany, Sweden, the UK, Russia, Poland and the Baltic countries. In some fields other countries might also be important. Besides technical knowledge, these contacts should be used to raise awareness and knowledge of foreign markets, as well as national and business cultures, and languages. Success in export terms is more likely to be effective in the language of the target country. This means that students should be competent in English and at least in one other foreign language.

9 New teaching methods should be increasingly implemented, especially the use of more integrated exercises, seminars, etc. The use of more ICT tools, the Internet and software covering the natural sciences, technical sciences and professional methods is recommended. Funding should be directed to supporting the development or purchase of software, so that the Universities can make use of centrally updated software and ICT tools. Seminars and team-based activities should be encouraged, since these can have benefits in learning related to skills in leadership, communication and social interaction. The standard of pedagogical skills varies within the institutions and more should be done to ensure that all academic staff engaged in teaching duties is up-to-date in this respect.

10 The reintroduction of Civil Engineering education in Oulu University should be properly considered. The education could be limited into areas where the national and regional need is highest, that is, structural design of special structures, integrated technical design and maintenance, repair and rehabilitation planning and the management of buildings and other facilities. This education could be strongly supported by existing educational provision in the natural sciences, technical sciences, environmental engineering and architecture of Oulu University. Co-operation with the neighbouring University in Luleå could be established. Also local co-operation between Oulu University, Oulu Polytechnic and Oulu VTT could be developed in order to build a strong regional centre of excellence.

11 The funding of higher education and basic research for the Building and Civil Engineering sector should be increased to a level that is commensurate with the needs outlined above: the present provision is inadequate.

Recommendations for Polytechnics

1 Polytechnics have, as their primary goal, the education of practically oriented Engineers in design, site management, maintenance, repair and rehabilitation and business management. The rapid changes that have taken place and which will continue in Building and Civil Engineering need to be supported by the continual development of Degree Programmes in Civil Engineering. Most Polytechnics have robust strategies and visions for their future development.

2 One particular area of specific educational need (and, therefore, curriculum development) is leadership and the management of site works. This requires a deep understanding of the entire supply chain for building and construction and the production processes that form an integral part of it. A practical understanding of manufacturing processes and methods of factories, especially in relation to precast concrete and timber products, should be instilled in the students so that there will be a sufficient number of graduate engineers to deal with the specific challenges in these sub-sectors. Institutions should consider, in co-operation with contracting firms, means and actions for motivating and promoting the specialisation of students in site and production management, and for developing the attractiveness of site management as a lifelong career.

3 Most Engineers are presently working locally, but doubtless many will work internationally, or be subject to strong foreign influences, at some point in their careers. This points to a need for active international staff and student exchanges. All Engineers must be capable of following and understanding new developments of standards. European standardisation is a case in point, where the development of norms, standards and guidelines could have profound implications for Finnish industry.

4 Engineers must also be able to participate in the application and implementation of innovation processes in practice, and in bringing about a multidisciplinary approach to project-based work. All Engineers should have strong and practical technical skills, but should also be competent leaders and communicators, and be acutely aware of other social skills.

5 Most of the human and materials resources of Polytechnics are concentrated upon the educational process. Production and product development, materials testing for local firms and the condition assessment of buildings and Civil Engineering structures are useful activities, which are mainly connected to project works and final thesis works. The role of the laboratories within the Polytechnics is primarily to support education and, secondly, to

support the consulting and development services of the Polytechnics. Investment in laboratory equipment should be maintained at a moderate level, taking into account other available laboratory resources in order to avoid overlapping investments. Funding given to up-to-date software that can be used to support learning has to be increased.

6 Co-ordination between the Polytechnics could be increased on several levels, for example in unifying the technical curriculum, in unifying the mark levels between Polytechnics, in developing ICT support for learning and in the production of educational materials generally.

1 Introduction

1.1 Project premises

In 1998 the Finnish Higher Education Evaluation Council (FINHEEC) organised a preliminary enquiry to chart out the need of evaluation in the field of technical education. A questionnaire was sent to Universities, Polytechnics, and various federations of industry as well as to several companies. As a result, FINHEEC decided to launch evaluation processes and included them in its plan of action. The evaluations were to be performed, after the programme evaluation of Industrial management and Engineering, in the following disciplines in the field of technology: Information Technology, Mechanical Engineering and Civil Engineering.

The evaluation project focusing on Information Technology was made in 2000, followed by the programmes of Mechanical Engineering in 2001. The last object of evaluation was that of Civil Engineering.

Following considerations in terms of Civil Engineering were raised by FINHEEC:

- The branch has been faced with radical reorganisation.
- The branch has shown a new upward turn.
- What are the changes that have taken place in the education in this field?
- Over the past few years, the building and construction implemented on the basis of the education given in the institutions has met with a lot of criticism.
- Has the maintaining of manual skills been taken into consideration in the education?
- The education needs to enter in a new phase of development and requires a new incentive to take a leap forward.

1.2 Universities and Polytechnics in the Finnish educational system

Traditionally, the long-term objectives of Finnish education policy have been to raise the general standard of education and to promote educational equality. Efforts have been made to provide all population groups and regions of the country with equal educational opportunities. The Finnish education system consists of the comprehensive school, the post-comprehensive general and vocational education, higher education and adult education. The Government's goal is to streamline the system and develop it in accordance with the principle of lifelong learning, as well as to make it internationally compatible.

The Finnish higher education system includes two sectors: Universities and Polytechnics. The Polytechnics are more practically oriented, training professionals for expert and development posts. The higher education system seen as a whole offers openings for 66% of the relevant age group (Universities 29%, Polytechnics 37%). Polytechnics also arrange programmes for adult students.

University education

There are a total of 20 Universities in Finland: ten multi-faculty Universities, three Universities of Technology, three Schools of Economics and Business Administration, and four Art Academies. The basic mission of the Universities is to carry out research and provide education based on it. The underlying principle in university education is the freedom of research and university autonomy, which gives them extensive latitude for independent decisions. All Finnish Universities are state-run, with the government providing some 70% of their funding. Each University and the Ministry of Education conclude a three-year agreement on target outcome to determine the operational principles.

Universities select their own students, and the competition for openings is tough. All fields apply *numerus clausus*, in which entrance examinations are a key element. Universities offer openings for about one third of the age group. The annual number of applications is nearly 66,000, and only 23,000 candidates are admitted. The annual number of degrees in Finland is 16,000, of which 11,000 are Master's degrees and 1,000 Doctorates. The average duration of studies is 6.5 years.

Polytechnics

There are 29 Polytechnics in Finland; most of them are multidisciplinary, regional institutions that give particular weight to contacts with the business and industry. Polytechnics are developed as a part of the national and international higher education community, with special emphasis on their expertise in working life and its development. The Polytechnics also carry out R&D relevant to their teaching and to the practical working life.

The Polytechnics were created gradually over the 1990s. The standard of former higher vocational education was raised and incorporated into multidisciplinary Polytechnics. The national Polytechnics network was completed by 1 August 2000. Since then, all the Polytechnics have operated on a permanent basis.

The Polytechnics award professionally oriented higher education degrees which take 3.5 or 4 years to complete. A novelty is the postgraduate degree which has been experimentally formulated in the year 2002 for Polytechnics and for certain subjects only. The entry requirement is either an upper secondary school certificate or a vocational diploma. At present about 70% of all

entrants are matriculated students and 30% vocational graduates. The Ministry of Education confirms the Degree Programmes. There is no tuition fee for degree studies.

The Polytechnics have two categories of teachers: principal lecturers with a postgraduate (Licentiate or Doctorate) degree requirement, and lectures who must have a Master's degree. Both categories of teachers must have a minimum of three years of work experience in addition to pedagogical competence.

Finnish Polytechnics, which are either municipal or private, are co-financed by the government and the local authorities. The Ministry of Education and each Polytechnic conclude a three-year agreement on target outcome to determine the objectives, intakes, and project and performance-based funding.

There are 2 Universities and 17 Polytechnics giving Civil Engineering education in Finland. In the past, Technicians and Engineers were trained at institutes of technology, integrated into the new Polytechnics in the late nineties. This was part of the upper secondary and higher education reform in Finland.

2
Evaluation procedures

2.1 The framework of the project

The evaluation of the Degree Programme consists of self-evaluations undertaken by the higher education institutions and an evaluation carried out by the External Evaluation Team. The Degree Programmes to be evaluated are determined by the steering group.

In its self-evaluation, each higher education institution has evaluated its own Degree Programme and written a report for the use of the external team.

The major evaluation objects are in general:

- aims and strategies of the Degree Programme
- content and structure of the Degree Programme
- teaching staff
- Degree Programme students (assessment of students, student support and guidance)
- teaching and learning processes
- operational and economic resources
- international contacts and co-operation outcome (mobility)
- relations with business and industry
- internal quality schemes for developing the Degree Programme

The self-evaluation report, written in English, constitutes the most important source of information concerning the Degree Programme and the unit providing it. The study guide for the programme and the relevant teaching plan are attached to the report.

The External Evaluation Team made a site visit to the institutions in order to evaluate the Degree Programme in depth on the basis of the self-evaluation reports. During their one-day visit, the external team interviewed those in charge of the Degree Programme as well as the institution management, the teaching and other staff responsible for the Degree Programme, students, and representatives of local business and industry.

The Team also examined the facilities, the teaching methods, the textbooks used as well as students' assignments and projects. An essential feature of the process was the fact that at the end of their visit, the external evaluators gave the staff and students verbal feedback concerning their observations and tentative suggestions for development.

2.2 Reporting

Based on the self-evaluation material and the personal evaluation reports submitted by the members of the External Team, the Project Manager compiled a preliminary draft report of the outcome and conclusions of the project. This draft was sent for comments to the members of the Evaluation Team and later also to the representatives of the Degree Programmes which had been evaluated. Comments were taken into account in the final report.

The evaluation report has been publicised at a seminar for the representatives of the higher education institutions involved in the project. The purpose of the seminar was to collect feedback on the Degree Programmes evaluated and raise points to be taken into account in future evaluations.

2.3 Project plan

The following five principle areas were taken into account when Civil Engineering programmes were selected for the evaluation process: 1) Civil Engineering is one of the most traditional Degree Programmes; 2) There is a general concern about the image of the programmes and competitiveness and attractiveness of the programme among the students; 3) Civil Engineering programmes are taught all over the country; 4) the significance of building industry for employment.

The project started in September 2001 and the Steering Group of the project assembled for the first meeting in November 2001.

On a general level, the Steering Group represents FINHEEC and it

1 determines and approves the aims and the timetable of the project;
2 submits proposals to the Higher Education Evaluation Council (FINHEEC) concerning personnel and other resources, including the members of the External Evaluation Team;
3 is responsible for the supervision and practical implementation of the project;
4 approves the intermediate reports of the project; and
5 makes a proposal concerning the termination of the project to the FINHEEC.

The division of work between the Steering Group and the Finnish Higher Education Evaluation Council is as follows:

1 FINHEEC selects the field of education to be evaluated and appoints a Steering Group for the purpose.
2 FINHEEC appoints the External Evaluation Team on the proposal of the Steering Group.
3 FINHEEC allocates resources at its disposal to the evaluation.
4 The Steering Group, together with the FINHEEC secretariat, draws up the project plan.
5 The Secretary General decides on the publication of the External Evaluation Team's report in the FINHEEC publication series.

The Project Manager is responsible for the project: practical arrangements, planning, implementation, supervision and reporting. His or her primary tasks include the compilation a detailed project plan, the supervision, reporting and practical implementation related to the project, as well as acting as the secretary to the External Evaluation Team.

The External Evaluation Team evaluates the Degree Programmes. In general its members write their own reports of the evaluations in which they take part and contribute to the drafting of the final report.

The primary aim of this particular project was to support higher education institutions in assuring and improving the quality of Civil Engineering Degree Programmes as well as to encourage them to develop the evaluation of the education they provide and enhance its quality. To this end, the project aimed at:

1 providing an overall idea of the state of Civil Engineering education;
2 producing tools for quality assessment and assurance for the Degree Programmes;
3 generating proposals for national and programme-specific development measures; and
4 creating a culture of constant quality assessment.

In addition to this, the project had the following specific objectives:

1 to appraise the present situation in Civil Engineering programmes as compared with the needs and demands of society, business life and the labour market;
2 to identify the similarities and differences in the content of education provided by the Universities and Polytechnics;
3 to make qualitative and quantitative data available in view of international comparisons of Civil Engineering education;
4 to measure the satisfaction of employers recruiting from the Degree Programmes and other business and industry;
5 to ensure student satisfaction;
6 to ensure continuous quality assurance and updating in the Degree Programmes.

The following criteria were used to select Degree Programmes for the external evaluation:

1 the significance of the Degree Programmes as providers of Civil Engineering education;
2 the diversity and extent of the Degree Programmes, with a special focus on a diverse selection of Degree Programmes of different ages; and
3 the language of instruction; and
4 geographical location.

Based on these criteria, the Steering Group selected 10 Degree Programmes (19 total Degree Programmes) for the external evaluation.

3

Building and Civil Engineering in the EU and in Finnish society

3.1 Sectors and volume of the Finnish Building and Civil Engineering branch

Building and Civil Engineering is a synthetic branch with mutually overlapping areas with several other industrial sectors. The sectors of Construction and Real Estate Cluster and their volumes in numbers of employees are presented in Figure 1. The relation of Construction and Real Estate Cluster to other recognised Finnish Clusters is presented in Figure 2.

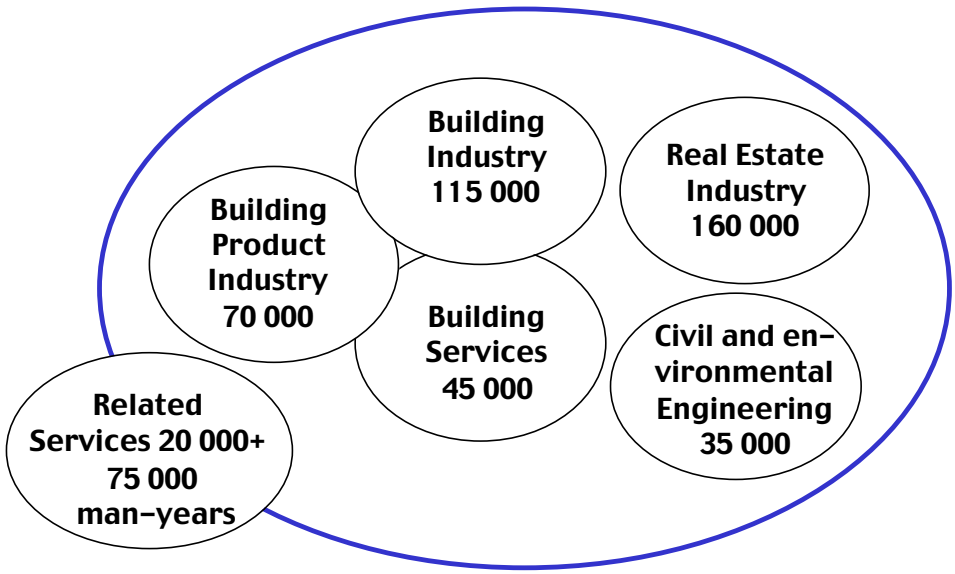


Figure1. Sectors of Construction and Civil Engineering Cluster (Total 520 000 Man-years)

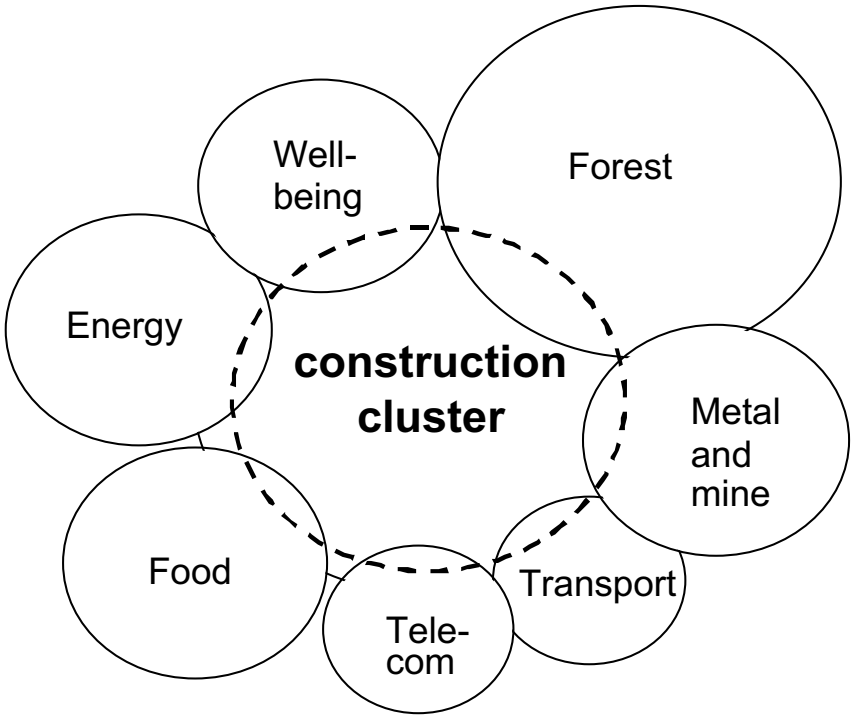


Figure 2. Major Clusters in Finland

3.2 Building and Civil Engineering in the European Union

Role of Building and Civil Engineering in European societies

Buildings and civil infrastructures are of enormous importance for the modern European societies. Infrastructures (including buildings, civil and industrial infrastructures) represent about 80% of national property in EU countries. Construction, operation (excluding traffic), maintenance, repair, modernisation and renewal of the infrastructure consume about 42% of all energy, and produce about 40% of all environmental burdens and wastes. The Building and Civil Engineering sector employs about 15% of all employees.

Housing has a great impact on the wellbeing and health of the citizens. Business buildings are important factors for the productivity of the work of various organisations, and they play an important role for the safety and health of people.

Infrastructures, especially the production and transport structures, are of major importance to the Regional Policies and Cohesion of EU within both the current and the future enlarged European Union, when a great amount of civil infrastructures of doubtful quality will be assimilated within the Union's trans-

port system. This creates a need for adaptation of existing infrastructure and of construction of new infrastructure. Moreover, a huge number of buildings in Eastern Central Europe will urgently need effective maintenance and repair, which has to be planned on a long-term basis and over a long time perspective.

Construction market in the European Union

The total annual value of construction in the EU amounts to 942 billion Euro (year 2001, Table 1.). Germany accounts for the largest share of the total, or for about 22%, followed by Italy, France and UK, each with a share of about 15%. The output of the Finnish construction market is about 2% of that of the entire EU construction market.

The volume of the EU construction market has been slowly growing during the past five years after the boom of the market seen in the Eastern *Länder* of Germany. The volume of building production has been quite constant and the growth has taken place in the Civil Engineering sector. Despite some minor short-term economic fluctuations, it can be anticipated that total production will continue its trend of very slow growth also in the future years. The growth will take place in the new Member States which will also provide some increasing markets for the old EU Member States.

Construction in some of Finland's neighbouring countries

The volume of the construction market in each of Finland's most important non-EU neighbouring countries (Russia, Poland, Norway, Baltic Countries, etc) is on the same level or slightly larger than that of the Finnish market (Table 1.). The market in Eastern Europe is not only growing more rapidly than the EU market, but there is also less competition. Therefore these countries are considered a high priority in current exports, especially in the export of construction projects, and the expectations on future development are quite high. It is fair to anticipate that the competition in these countries will become tougher and reach the EU level, with the criteria of the competition assimilating to those currently followed within the EU.

Table 1. Total Construction Sector Output in 2001 (€ Billion, 2001 prices)

EU Countries	**942.0**	**Neighbouring countries and some EU member candidates**	
Austria	24.0	Norway	18.7
Belgium	23.0	Russia	29.0
Denmark	20.1	Estonia	1.0
Finland	19.1	Latvia	0.8
France	147.2	Lithuania	1.1
Germany	207.1	Poland	24.0
Ireland	19.8	Hungary	6.5
Italy	150.1	Czech Republic	8.5
Netherlands	56.6	Slovak Republic	1.9
Portugal	27.3		
Spain	85.8		
Sweden	17.8		
United Kingdom	144.2		

VTT Source: Euroconstruct 06/2002

Intra-community trade

The trend internationalisation of the Building and Civil Engineering branch is a clearly visible trend in the EU common market. The internationalisation process is evident not only as concerns products, designs, construction projects, production, service firms, MR&R (maintenance, repair, and rehabilitation), but also facilities and real estate investments. Already today, the trading in building products is active and it is on a rapid increase. The construction projects are still mainly local; the share of international projects and services is less than 10% of the total in monetary terms. However, a slow increase is also seen in the number and share of international construction projects, especially as far as large projects are concerned. International ownership of building product firms is already considerable, and it is rapidly increasing.

Standardisation and product approval within the EU

A basic issue in developing the European market is the unification of norms, standards and product approval procedures. A wide renewal of standards is also needed in order to accelerate technical development. Current standardisation strictly defines the technical specifications of products, and this tends to prevent new innovations. Because these standards are still mainly national, they also prevent trade. For decades, following the type approval procedure has been the only way to sell such innovative products and technologies as do not meet the national standard specifications. This is a very expensive and time-consuming way of proceeding. However, it will remain in force for a decade or so, until the European norms and standards are comprehensively covering the entire field of Building and Civil Engineering. The first generation of European stand-

ards was mainly a compromise between traditional national standards. That is why they are so strict in defining the technical specifications, thereby preventing development. Now there are attempts to develop performance-based standards, more oriented towards the definition of properties, leaving the detailed technical solutions free for development and evolution. This development calls for European research to produce relevant knowledge, systematisation and pre-standards.

The European product approval system is now working, but the lack of common EU standards still limits the effective use of the system.

Research and development in the EU

The research and development input of Building and Civil Engineering in EU countries is in the mean quite similar to that of Finland. In most countries, the R&D input – in line with the construction business as a whole – is technically more traditional than in Finland, even though their methodological and knowledge levels are high. This is an opportunity for Finnish business within the EU, but Finnish technology has to be developed further and has to be modified to European requirements.

The development of productivity in construction is a key issue in EU countries, and there are demands for an increase of productivity in the construction sector. In all countries, the improving of productivity of work and capital on construction sites has been much slower than the development in other industrial sectors over the past few decades. This has led to an increase in the price level of buildings, especially in those countries which do not apply prefabrication technology, although the difference has been reduced through an effective organisation of the site works. In the building sector, the productivity of work and capital in factories of building materials, prefabricated components and other products has been close to the average of other traditional industrial sectors.

In the sector of infrastructures, productivity has improved thanks to the increasing use of machinery, and to the development of organisation and project management. A new trend seen in all sectors is combined design, construction and maintenance contracting, a new approach to face the challenges of managing the lifetime performance and economy of the facilities.

A general trend is the shift towards sustainable construction and management in the lifecycle framework. Energy efficiency of buildings and recycling technology are main issues in the building sector. The leading country in this area is Germany, with the most advanced energy standards and defined low energy level building requirements. This policy of energy standard requirements will continue, with even stricter requirements imposed every three to five years.

The introduction of waste fees has activated the reuse and recycling technology in many countries, the Netherlands, Germany and Denmark being the leading countries in this field. Now also Finland has followed lead.

Current and future trends in the development of all sectors of technology, including construction, can be found in the description of the Sixth Framework Programme. The programme will be carried out to further substantiate the objective set out in Article 163(1) of the Treaty, "of strengthening the scientific and technological bases of Community industry and encouraging it to become more competitive at international level, while promoting all the research activities deemed necessary by virtue of other Chapters of this Treaty". In order to achieve this more effectively, and in order to contribute to the creation of the European Research Area and to innovation, this Programme will be structured around the following three headings, under which the four activities as set out in Article 164 of the Treaty will be undertaken:

1 focusing and integrating Community research,
2 structuring the European Research Area,
3 Strengthening the foundations of the European Research Area.

The activities under these three headings will contribute to the integration of research efforts and activities on a European scale as well as contributing to the structuring of the various dimensions of the European Research Area. Coordination of activities carried out under these headings will be ensured.

Education

The so-called Bologna process aims at a unified education system in the EU. The Finnish Ministry of Education, other administrative organisations and the institutes of higher technical education are carefully following this process, and they are ready to implement the results into use as a local application which will be decided upon in the near future.

3.3 Current state and trends of Finnish Building and Civil Engineering

3.3.1 Current state

In the year 2001, the total output of the Building and Real Estate Cluster in Finland was 44 billion Euro (Appendix B, Table 1.), about 10% of the country's GNP. The total value of the facilities of this sector represents 70 to 80 percent (depending on the fluctuation of the price levels) of Finland's national wealth of 500 billion Euro.

Building and Civil Engineering is a synthetic area of production and services, with sectors overlapping with those of several other Finnish Clusters (Figure 1). The Cluster employs more than 20 percent of our workforce (Figure 2). The output of new construction is 21% of the total output, with the Buildings sector accounting for 70% and Civil Engineering for 30% of the whole. The

output of maintenance and renovation is 14%, and the facility upkeep 28% of the total upkeep.

The Finnish Building and Real Estate Cluster is quite internationalised, and this trend seems to be continuing. In 2001, international operations (export of products and services, as well as production of Finnish companies through their foreign subsidiaries and construction projects in other countries) totalled 12.4 billion Euro, i.e., 28% of the total output (Appendix B, Table 2). The largest export firms are Kone Ltd, Finnforest, Outokumpu Copper Products, the precast concrete company ADDTEK International (current Consolis Group), YIT, Lemminkäinen, Paroc Group and Skanska. Many Finnish companies own subsidiaries abroad, the annual output of these being 7. 4 billion Euro (Appendix B, Table 2). Likewise several big companies operating in Finland are subsidiaries of foreign companies (Appendix B, Table 3).

Exports of the Building and Real Estate Cluster, especially the export of building products, grew rapidly in the 1990s (Appendix B, Fig 3.). The exports were mainly directed to the EU countries, the major export countries being Germany, Sweden and the UK. Important for Finnish exports are also the neighbouring countries Norway, Russia and Estonia. Poland has become another significant export target country.

3.3.2 Current state and trends of development

The Building and Civil Engineering sector spends less than 1% of its total output on research and development. This share is higher in building product industry, while the contracting firms fall short of the sector average. Some innovative building product firms spend about 2% of the output in R&D activities. When comparing these numbers with the numbers of other branches, we have to take into account the high volume of the outcome of the Building and Civil Engineering branch. Be it how it may, the investment in research and development should be increased in order to meet the current and future challenges of this branch. Research carries a special responsibility for this objective; it should produce new knowledge, system models and detailed results. Firms should development the skills to create and manage the innovation processes.

An asset of the Finnish Building and Civil Engineering has been the close co-operation between researchers and the practical operators – a tradition fruitfully followed for decades. This has produced good results in comparison to the low investments in R&D. A good example is prefabrication, the area in which Finnish firms are leading technology and machinery suppliers in Europe and global leaders in certain specific sectors. An important success factor has been the combination of different skills and fields of expertise, mainly the skills of building and mechanical engineering.

Great effort has been put into the compilation of visions and target programmes for the Building and Real Estate Cluster. These visions are mainly

focused on the building sector. Specific visions and target programmes are still missing as far as the Civil Engineering sector is concerned.

The central trends in the Construction and Real Estate Cluster are described in Vision 2010 as follows [*Vision 2010, (2001), Publishers: Finnish Association of Building Owners and Construction Clients RAKLI, Finnish Real Estate Federation, Confederation of Finnish Construction Industries, Finnish Association of Construction Product Industries RTT, Finnish Association of Consulting Firms SKOL, Finnish HEPAC Federation, National Technology Agency TEKES, [http://www.rakennusteollisuusrt.fi/english/etusivu]*:

> "Along with other sectors of business in Finland, the Construction and Real Estate Cluster is undergoing increasingly rapid changes. The business sector's successful development now requires more than merely basic strengths. Real estate and construction services must be able to predict other sectors' development in order to meet the needs of global corporations. This approach enables companies to find globally operating partners who want to use Finnish skills, products and services in their real estate and construction operations.
>
> The efficiency of the real estate and construction business is directly proportional to the profitability of the core operations of the buildings and infrastructure's users. Quality factors affecting buildings and the condition of residential, working and operating environments contribute to the appreciation of areas and, therefore, their economic value. Finland also competes with other countries in the effective use of the national constructed wealth.
>
> Markets will become increasingly international in the future, and the new business culture will also bring international investors to the Finnish scene. Corporations and public organisations will need to rethink their real estate and investment strategies. More often than before, ownership and renting will become real alternatives, and management solutions for them will be developed further. New flexible management forms and service concepts will transform the views of both the private and the public sector on the construction, use and ownership of real estate.
>
> The sustainability of development will become one of the most important values in developed industrialised countries. The real estate and construction sector has a central role in the successful implementation of sustainable development. Environmental issues and ecology must be taken into consideration in the development of both products and services, as well as in management processes within corporations. The integration of the ecological viewpoint with economic objectives poses a great challenge to business.
>
> In addition to fulfilling the traditional home function, a residence also serves as an interface that satisfies the many new service and communication needs that people have. Data transfer capacities of Finnish homes and residential areas of the future will be among the best in the world. Environmental values will also feature prominently in all housing-related operations. The quality and durability of housing, the ability of materials to be recycled, health considerations and especially the energy economy of buildings will become points of emphasis in all segments.
>
> In the new operating environment the traditional roles of construction companies will change. Large corporations will offer more extensive product and service packages while smaller companies focus on their own areas of specialisation. There will be demand for, for example, real estate and construction services that not only include the facilities themselves but their complete maintenance, servicing and repairs."

3.3.3 Current state of research

As stated above, researchers have contributed and are actively contributing to the development of practice, and the co-operation is mainly working well. There is also some co-operation between different disciplines, e. g. between experts of building service systems, structures and materials. The main platforms for this co-operation are the large R&D programmes which are organised by the Technology Development Centre. Important and often very innovative activities are also constituted by the direct product development projects of companies, in which researchers are participating. The Civil Engineering sector of the Finnish Road Administration has had a very fruitful long-term co-operation with researchers, including some large development programmes.

The strong focus of research on applied R&D works has led to the weakness of basic research in Building and Civil Engineering. The research activity of the Building and Civil Engineering sector under the auspices of the Finnish Academy is quite modest. Some traditional strong research areas are active, but many others are passive in basic research which would be competitive against other sectors of science and technology. The number of Doctoral theses is quite low. The Doctoral thesis works are of quite modest level and focused on some details, and they do not build enough focused processes which could produce nationally and internationally significant new knowledge. In order to increase the influence of research on practice, more synthetic and integrated research would be needed. The research should be strongly based on scientific methodology and methods in order to create new innovation processes.

3.4 Needs of Finnish society vis-à-vis the Building and Civil Engineering branch

The political decision-makers have recognised the importance of Building and Civil Engineering for the development of the society, starting a process for defining a national policy programme for the construction field. The memorandum of the working group was published in 2002 [Valtioneuvoston kanslian julkaisusarja 2002/1, Helsinki 2002, 30 s.]. On the basis of this memorandum, Finnish Government will make final decisions on this policy programme towards the end of 2002.

The memorandum deals with the working environment of Building and Civil Engineering, a good and ecologically sustainable built environment, the quality and productivity of construction and maintenance, and the realisation of the programme. There are a total of 63 recommendations given in the report. The issues of practical development are mainly concerned with the implementation of lifecycle engineering principles, ICT implementation and environmental issues.

Following recommendations are given for development of higher technical education:

- The preconditions of Technical Universities have to be improved with increased funding
- The Degree Programmes of Civil Engineers have to be renewed to correspond to the future challenges of information technology and construction. In addition to an in-depth competence also multi-skilled competence and competence in implementation of information technology will be central issues.
- The professional education system has to be developed also towards a training system.
- Investments must be made in the education of teachers of professional subjects.
- The officials have to support the Building and Civil Engineering aims to size the number of students onto right level.
- The interaction models between education and practice have to be increased and developed activating the advisory committees of education institutes to work regionally in co-operation with firms.

Following recommendations are given for the research:

- The needs for basic research in the field of Building and Civil Engineering will be identified, and a research programme will be activated in Finnish Academy.
- The funding of basic research will be guaranteed.
- A Doctorate programme will be organised.
- The research of this field will be diversified into cross-technical and qualitative development of the built environment. Reasonable public funding for research and development of this field will be secured.
- Demonstrative construction, e.g., through a state funding of 1.5 million Euro annually during next five years.

3.5 Visions and strategic objectives of the practice

After five years of work performed on a wide co-operation platform of almost 500 persons from companies and central associations of the Finnish Construction and Real Estate Cluster, a strong future vision *[Vision 2010] was* published in 2001 The vision for 2010 indicates the direction in which the industry would like to develop. The following general statement of the Construction and Real Estate Cluster has been expressed in this vision: “The real estate and construction sector’s vision for 2010 indicates the strong will of the whole cluster to build the foundations of their future success together. In addition to a common will, other central means of achieving the targets include the creation of a genuinely innovative business environment, technology programmes and measures to improve skills in the sector”.

Identification of global trends

Five global trends have been identified:

1 Growth of customer relationships into partnerships
2 Reshaping of the operating environment by technology
3 Transforming ownership and support functions
4 Increased emphasis on environmental values
5 Internationalisation of investment and business operations

Identification of changes and their content

Taking the needs of our society and the international trends into account, the five most central trends and the challenges for change contained in them are listed and defined, together with their principles of realisation in products, production and business environment:

1 Superior functionality and quality of facilities

- *Product*
  - Superior environments for work, business and production where the experience-orientation and productivity of a service society is realised.
  - High quality working environments whose added value and productivity to their customers' core businesses are measured. Office buildings are no longer the only work environments that are treated as products
  - these days whole service villages, where work and other aspects of life become intertwined, are also seen as products.
  - Models for commerce and social development have been developed to allow the modernisation of entire communities to meet the requirements of the experience-driven society.
- *Production*
  - Any boundaries between sub-sectors within the cluster have disappeared, integrated production chains that go through the whole sector.
  - The cluster operates in a genuine network economy in which competition is open and fair.
  - Partners and suppliers are chosen not only on the basis of price but also the quality factors of both their products and producers.
  - Companies with Finnish roots are renowned for their position at the forefront of service, technology and environmental performance.
- *Business environment*
  - New forms of real estate business and finance will have emerged. These will include mixtures of ownership and renting, as well as high-profile service packages.

– There will be no difference in service provision for the public and the private sector. For example, cultural, sport and social services are produced in a new way based on co-operation between different parties.

2 *Functional and physical infrastructure markets as a success factor*

- *Product*
  – New business areas that used to be in the margin of the infrastructure cluster have been identified, and in 2010 these have become significant business sectors in their own right.
  – These include the facilitation of wireless communication, a variety of applications for construction of e-infrastructure, energy infrastructure, and fault tolerance under demanding conditions and construction of infrastructure for cold temperatures.

- *Production*
  – Order functions have been developed so that it is possible to compete with product characteristics and quality.
  – Innovation has entered the infrastructure market through privately owned companies and the networking model.
  – Models for evaluating lifecycle costs, which are vital for optimising over all economic performance, have been developed in co-operation with all parties concerned.

- *Business environment*
  – Dismantling of monopolies, active use of PPP (public-private-partnership) models, and innovations have introduced new efficiency.
  – Increasingly market-based operations have also attracted operators who gain a competitive advantage from innovative financing solutions.
  – Networking has helped Finnish companies to achieve a central position in global turnkey deliveries of infrastructure solutions in selected areas.

3 *Significant added value to customers created in co-operation with the ICT Cluster*

- *Product*
  – Premises are equipped with sufficient capacity for ICT systems used by different professions. The user, the facilities and the service platform form one functional whole.
  – The user will often be mobile, possibilities for accommodating a variety of mobile workstations needed.
  – Users are also provided with ICT support and Help Desk services.
  – The user is able to supervise and control the property's conditions and consumption levels as well as produce reports thereof.
  – The recycling of construction components and materials will be optimised.

- *Production*
  - Close co-operation with the Information and Telecommunications Cluster. (The strong involvement of ICT in the planning and construction process (service concepts for the whole lifecycle of buildings and for their different functions
  - Operating methods that integrate the users' processes have been adopted.
  - The design process uses information technology widely.
  - Different parties use real time project databanks.
  - Management of information from the whole lifecycle of buildings brings large synergies (planning and implementing conversions) and enables an extensive application of principles of sustainable development.

- *Business environment*
  - Product component sales and networked operating models have become generally adopted as modes of operation.
  - Project and real estate portals that use global material and acquisition sources and natural customer relationships will be a reality.
  - Competitiveness has jumped remarkably as electronic business has been embraced and customer management solutions have been developed.

4 International leadership in environmental expertise

- *Product*
  - Environmental impacts of buildings are a competition factor.
  - Buildings are energy-efficient and new innovative systems for energy production, distribution and consumption have also been developed.
  - Environmental classification of buildings is widely used.
  - Successful product and service packages, requested by customers, have been developed using the cluster's environmental expertise and products.

- *Production*
  - Investment in research and development has multiplied.
  - A major part of development efforts is allocated to the promotion of sustainable development.
  - This element is included in all university education and research relating to the cluster.
  - The cluster competes successfully for the best students.

- *Business environment*
  - The environmental expertise of the Finnish real estate and construction sector is internationally renowned.
  - Lifecycle evaluations are part of public sector decision-making in finance and investment.
  - Ecological and economic targets are equally important.
  - Units describing environmental burden are used along Euros in evaluations.

5 *Housing market operates on occupants' terms*

- *Product*
  - The availability, quality and price of housing services and their integration with workplace and service structures are an essential asset for our national competitiveness.
  - Environmental values and high lifecycle efficiency also feature prominently in all housing-related operations (quality, durability, recycle materials, health considerations, energy economy).
  - Residence also serves as an interface that satisfies the many new service and communication needs that people have (many uses, adaptability, need for both a community and individuality).
  - Strong housing brands have emerged on the market.
- *Production*
  - Business opportunities have been effectively identified through a continuous process of interaction with customers, which aims to understand and chart their needs.
  - Quality of housing, increasing the flexibility, and the development of housing-related services and conservation.
  - Special attention has been paid to the use of new technology in production and service processes.
- *Business environment*
  - Public sector regulations have largely transformed into strategic co-operation between users, the authorities and business.
  - Town planning effectively meets the demands for land and different types of housing services.
  - The number of professional owners is considerably larger than before (attractiveness because of tax legislation and other conditions).
  - People have a variety of flexible housing alternatives to choose.
  - There are important actors on the market that focus on home financing and offer specialised widely used financing services.

As a conclusion it has been stated that in the development towards the vision, both business related and technology related actions are needed. In the business sector the trend is from customer service to real partnership, which means the following changes:

- A new operational approach is emerging that is based on customer relationships and the idea that in addition to offering good service, it is also necessary to forge co-operation in the form of a partnership between the customer and the supplier.
- As the service component becomes an essential part of core business, the traditional value hierarchy in the sector will be transformed.
- The reshaping of the operating environment will happen by technology.

Technology will transform both products and business processes following these principles:

- Management of information and knowledge will become central factors of competitiveness.
- Basic technology will be supplemented with new service concepts in which usability will have a decisive importance.
- Investment in information and communication technology and networking will increase strongly.
- Information management within buildings requires fixed broadband / fast Internet connections in all premises.
- Choices of material and the functionality of structures will be based on lifecycle considerations.

3.6 Analysis and prognosis of the Association of Finnish Civil Engineers

The Association of Finnish Civil Engineers has conducted extensive analyses on the "Development of co-operation between Technical Universities and industrial life" [RIL 219–2001] and the "Barometer of Civil Engineers" [RIL 220–2002]. They deal with the current and future needs of knowledge in Building and Civil Engineering, and the quantitative need of Civil Engineers (both Graduate Engineers and Engineers).

Main conclusions of these analyses and prognoses on the field of education and research are:

- The co-operation between Technical Universities and industrial life must be developed.
- The attractiveness of the Civil Engineering field has to be improved.
- The financing of Technical Universities has to be secured.
- The identified needs of knowledge of Graduate Engineer Engineers in industrial life have to be taken into account in development of the Degree Programmes of Technical Universities.
- The availability of Graduate Engineers in Northern Finland has to be guaranteed.
- The possibilities of basic research have to be improved.
- The elementary education of all Civil Engineers must be comprehensive including all areas of basic knowledge of Civil Engineers.
- The preconditions of sustainability and ecology must be taken into account in development of all processes of Building and Civil Engineering.
- The use of information and communication technology in Building and Civil Engineering has to be developed and applied in the education.
- Special attention has to be paid to a reasonable quantity of education in the building service sector, and into the integration of structural and building service knowledge in education.

- International networks and connections are of utmost importance for education and research.
- The industry has to support the postgraduate studies.
- High quality of professional training in Building and Civil Engineering has to be guaranteed in co-operation between industry and Technical Universities.
- The improvement of the attractiveness of Building and Civil Engineering is essentially based on the image and leadership culture of the branch.

The main conclusions on the quantitative and qualitative needs of Graduate Engineers and Engineers in Building and Civil Engineering are:

Graduate Engineer

- The need of Graduate Engineers towards the end of this and beginning of next decade will be slightly higher than the volume of current education. The estimated annual need is approximately 110 Graduate Engineers by the year 2007, but will grow to 175 along with increasing retirement rates. The current number of Civil Engineers graduating and entering the employment market is about 150 on an annual basis.
- Special concerns about the availability of Graduate Engineers regard the areas of most demanding structural design and building service system design, because very few students are choosing these areas. In structural design there is already now some lack of human resources.
- A special problem is the high rate of interrupted studies. The situation deteriorated radically during the recession years, but is now recovering. It seems that this problem has mainly been overcome.
- The Building and Civil Engineering needs not only experts with narrow specialisation, but also Graduate Engineers who can handle broader areas and entities.
- The most valuable skills for the Building and Civil Engineering are strong technical and economic skills.
- The industry has to take a joint responsibility for the training of Civil Engineers for new needs of knowledge.
- There is a large variety of research needs, and the resource need in research is high.

Engineers with Polytechnic education

- The volume of education generally seems to be quite in balance with the current and future needs.
- It seems that the site management works do not attract Engineers to a sufficient extent. In next then years the need of site mangers is high, because most of the earlier educated Technicians (rakennusmestari) will retire, the number of retired Technicians being about 350 in 2001, and about 600 in 2007. About 100 Engineers retired in 100, 250 will retire in 2007 and after that about 300 to 400 annually. The number of new Engineers is about 600 annually.

4
Findings of the External Evaluation Team

4.1 General findings

These findings are based on the observations derived from the 20 self-evaluation reports of the Technical Universities and Polytechnics, and on those made during the visits to 10 of these institutes.

General

The impression is of a higher education system in Civil Engineering that is, by and large, coping with the expectations of its students and society, and the demands from industry for suitably qualified graduates. There is a high level of commitment from academic staff and their institutions, although there are some specific concerns and these are raised under the respective institution heading.

Industrial employers are largely satisfied – some are very satisfied – with the quality of graduates in terms of their educational level, skills and preparation for a vocational career. More could be done, however, in the area of interpersonal skill development for students and management-related education.

Within the institutions, there is some evidence of Civil Engineering being regarded as somehow less valuable or worthy than other disciplines in the overall picture of higher education, so that it is seen in a few cases as a poor relation.

Impact of the Bologna Declaration and responses by the institutions

There was a rather mixed reaction from the institutions towards the implications of the Declaration and their response so far. In those cases where a conscious effort had been taken to comprehend the implications, the evaluation panel was provided with a coherent, albeit simple, statement.

The present arrangements within the Polytechnics appear to fall directly in line with the Declaration in that their pre-occupation is with the first cycle leading to a Bachelor's degree. The relationship between postgraduate provision and the intentions laid out in the Declaration is less clear. The position in the two Universities visited was also unclear. Attention must be given to justifying an undergraduate programme (3+2 years) that might actually last for seven years. Pursuing a Doctorate on top of this would extend the time commitment – and a loss of working potential – to a staggering 12 years. Such a time must surely act as a disincentive to any aspiring doctoral researcher. Moreover, it

begs the question of whether or not Finland is at a significant and self-imposed disadvantage when compared to its European neighbours.

Contributions to Finland and the wider international dimension

The general level of awareness of international customs, practices and R&D was found to be poor, although there are a few notable exceptions. Much of the focus as alluded to above is on satisfying a local (though not necessarily a national) needs. Too many institutions see internationalisation in terms of student placement abroad and the teaching of a foreign language, most typically English. Furthermore, there appears to be confusion amongst some academic staff and administrators between internationalisation and the teaching of English. In cases where the extent of international activities was low, a reason proffered was that there was insufficient teaching of English – because of a resource shortfall – and that one had to be competent in English to somehow understand what was happening in the world outside.

Another reason was that the students were not sufficiently motivated to seek placement for short periods abroad during their studies. In this latter connection, a principal cause was the failure of institutions to credit the students for this kind of activity, thereby creating a major disincentive.

Another worrying concern is that many academic staff is, for various reasons, unaware of their professional world outside Finland. Some even defend this position by claiming a concern for the needs of a local (sometimes regional) marketplace. Industrial employers sometimes do not help this situation by reinforcing their own prejudices as to the irrelevance of international experience in the context of Finnish construction activity. However, there are some pleasing exceptions, but too few to suggest that the problem will go away naturally.

The impression is, therefore, of programmes in some institutions becoming more and more out of touch with international best practice and R&D to the long-term detriment of Finnish society and industry. Corrective action is needed urgently to ensure that students are made aware of the world outside and how it is directly affecting their own lives and future careers.

A lack of support and active encouragement for academic staff to spend time abroad is evident and presents a serious impediment to the development of a strong higher education sector in this field.

Lifelong learning

Most of the institutions visited were enthusiastic about this area of activity in which adults may avail themselves of continuing professional development. This enthusiasm is, in some instances, tempered by concerns over resourcing and the need for academic staff to keep abreast of current best practice. Even so, the signs are that the area is receiving attention. However, there should be a

significant push to provide the resources within the institutions and promote awareness outside of available courses and career opportunities.

A national campaign, that is co-ordinated across the institutions, appears to be lacking. Its introduction could go some way towards addressing the growing need to retrain and/or re-equip a large number of Engineers and Technicians. Given the projected shortfall of qualified Engineers in some areas in the next 5–10 years, there is a case for action now to convert non-cognate degree holders to careers in Civil Engineering.

Quality of achievement and trends

The institutions visited are generally performing well and the overall quality of achievement, as judged in the attitudes of students and industrial employers, is of a system that is working well. Nonetheless, there are concerns that some current problems could hinder the longer-term development of good quality higher education and professional training. In too many cases, there is a failure on the part of most academic staff, students and some employers to recognise the major changes that are taking place in Europe and elsewhere and which are already beginning to impact Finnish industry, employment and society.

The prognosis is that, unless there is an active campaign to activate studies in international customs, practices and R&D, Finnish graduates will be less well equipped than their neighbours to deal with the challenges lying ahead.

Concluding remarks

The External Evaluation Team also makes the following concluding remarks:

- The education of Technical Universities and Polytechnics is mainly coping with the expectations of its students and society, and the demands from industry for suitably qualified graduates.
- The current and future challenges of the Building and Civil Engineering branch will require a basic change of the branch from a resource-based technology and business into a knowledge-based technology and business. It will be a responsibility of research to effectively produce new knowledge and systematisation for this change. The Technical Universities also have to educate Graduate Engineers who are able to create and manage innovation processes in practice. This means that especially the education of Technical Universities should be changed in several areas towards a scientific university education. This can be done by strengthening the scientific basis, especially on the level of technical sciences. The strengthening of basic knowledge in technical, economic and managerial sciences would serve the skills to handle both specific focused issues, but also to work with larger entities and systems, the co-operation with other disciplines, and the life-long learning. It would also improve the creative basic research as well as

the competitiveness of researches of Building and Civil Engineering in the European forum and in Finnish Academy.

- Implementation of new teaching methods is needed, especially using more integrated exercises, seminars, and ICT tools in forms of programmes in natural sciences, technical sciences and professional methods, database technology and Internet. Sufficient funding should be allocated to software. In Polytechnics, in particular, the purchasing of software should be preferred.
- It is seriously suggested that in Oulu region and in entire Northern Finland the consulting and construction branch, as well as the education of Oulu, Rovaniemi and Kajaani Polytechnics will loose their vitality without the education of Civil Engineers in Oulu University. Especially the consulting in structural and bridge design has reached a very high international level, and is mainly working for export of design services either directly or as an important support for construction project exports. We will risk loosing this position in the longer term because of the regional lack of Graduate Engineers. The Building and Civil Engineering branch has also lost an important source of student resources, because the students from Northern Finland do not want to come to study in Tampere or Espoo, but they choose other branches, or the Polytechnic.
- The reintroduction of Civil Engineering education in Oulu should be therefore seriously considered. The education could be limited to areas where the national and regional need is highest: structural design of demanding structures and integrated technical design and maintenance planning of buildings (including integrated lifetime issues: safety, health, comfort, economy and ecology: especially energy efficiency) applying corresponding methodology of traditional mechanical structural design, complemented with building physics, building biology and methods of system engineering for analysis, optimisation and decision making. The education could find strong support in the education of natural sciences, technical sciences, environmental engineering and architecture given by Oulu University. The whole Degree Programme, including the specific professional education, should be given in Oulu, in order for the education to assume a profile of its own. As far as new issues are concerned, it would be partly complementary to the education given by other Technical Universities.

4.2 Specific findings from the institutes which were visited

The observations deemed to have more general interest value are presented under the chapter on the general findings. The following institute-specific findings are based on the self-evaluation reports and on the findings which the External Evaluation Team made during the visit to the ten chosen institutes.

4.2.1 Helsinki University of Technology (HUT) *(www.hut.fi)*

General

Helsinki University of Technology (HUT) is a broadly based university representing almost all sectors of technology. The University is divided into five department groups: Information Technology, Electrical Engineering, Mechanical Engineering, Process Engineering, and Building and Environment. HUT also houses separate institutes, research institutes, and the administrative department. The department groups comprise 12 Departments, which are responsible for 16 Degree Programmes in Technology and Architecture.

When the Helsinki Polytechnical Institute received university status and became Helsinki University of Technology on the basis of a decree enacted in 1908, the name of the department was Department of Engineering.

Civil and Environmental Engineering, Architecture and Surveying form the department group of Building and Environment. The Degree Programmes of the department group include Architecture, Landscape Planning, Geomatics, Real Estate Management, and Civil and Environmental Engineering.

Earlier the Department has served in the field of Civil and Environmental Engineering and in 1999, the name was changed into the Department of Civil and Environmental Engineering. The Department has three study lines: Structural Engineering and Building Technology, Transportation and Environmental Engineering, and Real Estate Management, each of which have their separate student entrance exams. There are 12 professorships/Chairs and 19 professors. By the end of 2001, a total of 4,579 Master's degrees, 245 Licentiate's degrees and 121 Doctor's degrees had been completed in the Department. Owing to the restructuring of higher education in Civil and Environmental Engineering carried out in the 1990s, HUT is the only University in Finland offering diverse education in the Civil and Environmental Engineering sector.

Mission and objectives

The Universities Act and the basic strategy of HUT define the general operational policies of the University. On the proposal of the working group set by the Rector, the Council of HUT adopted the mission of HUT at its meeting on 28 September 2001:

- The basic task of Helsinki University of Technology is to conduct scientific research, provide teaching of the highest level based on and supporting research, and promote education in science and the arts.
- Helsinki University of Technology operates in fields in which research may have both scientific and technological significance.
- Helsinki University of Technology shall be an internationally significant promoter of science and technology.

The mission of the Degree Programme is to provide students with knowledge in the main fields of Civil and Environmental Engineering, and equip them with the scientific foundation and skills to work in tasks requiring expertise in construction technology and industry, as well as in public tasks requiring expertise in Civil and Environmental Engineering.

The scientific objective of the programme is to provide the students with skills to study and analyse systems, plants, and products which belong to the fields of structural engineering and building technology, transportation and environmental engineering and real estate management as well as their construction, technology, and economics and to provide them with skills to engage in research, postgraduate studies, and to work at expert tasks.

The professional foundation of the Degree Programme comprises tasks requiring expertise in the research, design, implementation, use, and monitoring of systems and products in the fields of structural engineering and building technology, transportation and environmental engineering and real estate management.

Findings of the visit

Teaching

The Department includes in principle the entire field of Building and Civil Engineering, but in practice some parts of Building Technology, e.g. the design related to the building service systems, is mainly outside the Department.

The students regard some components of the early stages of the curriculum as something they have to do for the sake of learning. The students understand perfectly the role of Universities in their academic orientation and focus on more theoretical aspects, but with application to practice. However, they show concern for the balance between purely scientific and more applied subjects. Information early in the programme on what goes on in industry and the work opportunities therein would be helpful and assist in orienting the students towards their intended vocations; and might perhaps help to explain the relevance of the more scientific subjects.

In the opinion of students, there are examples of good practice in teaching, but pedagogical considerations are not always well addressed. Some seem to be reluctant to update their material and use modern audio-visual equipment. Nonetheless, efforts are being made to improve the quality of teaching and the level of satisfaction of the students. There is an excellent example of innovative teaching in the use of the web. This shows promising opportunities of web-based teaching. There are also attempts to engage the students in providing feedback that can be used to improve teaching. Short courses can be more effective for learning than longer courses, because participation of students is more active.

There is strong evidence of an 'us and them' attitude within the programme, where the 'professors are the professors' and the 'students are the students': there is not a proper meeting of minds.

The inclusion within Civil Engineering of building services engineering is being considered, but there appear to be practical barriers to bringing this about. That said, the Department generally believes in a network concept within the University and that there is a critical mass for performing research – the 'core business' of the University - that must be met. Inclusion of services is not thought necessary.

Industry representatives' views include concern for a lack of skill on the part of graduates in their ability to undertake research-type studies. Also, there is a lack of awareness of the business environment, within which many of them will work.

Learning

Learning objectives seem to be clear enough, according to the views of the students. They are confident in that what they will know by the end of their programme will equip them for a career in the sector. That said, they feel that sometimes they need to be made aware of where the various topics fit in.

Research

There are many research projects ongoing, both laboratory-based and desk-based. A comprehensive figure of the ongoing research was not available during the short visit. More is likely in the future from the extensive facilities that are available, but there is a danger of lost opportunities if steps are not taken to secure funds.

Generally, the students understand and appreciate the need for research and its place in the educational process. They recognise that this colours the kind of education they will get and are content with that.

Personnel, resources and facilities

In the opinion of students some staff needs to improve their teaching skills. Despite attempts to re-focus and re-skill staff, some are dedicated to old ways.

Use of external lecturers from research and practice has been low during the past few years.

The laboratories are generally well established and often well equipped. That said, staffing levels are modest and may need to be increased if students are to benefit from the facilities.

International dimension

The staff believe that they are sufficiently informed about what is going on in different countries regarding the education of Engineers. However, some sub-areas are more active, more interested and more engaged in continuous international co-operation in teaching and research than others. Use of international lecturers is rare and international student exchange is not very active. The capacity to communicate with different cultures requires, in addition to language skills, a broader knowledge of the technical, communication and general culture of the countries in question. This knowledge should be increasingly included in education, for example through the means mentioned above.

Evidence of best practice

There are examples of excellent research. However, the level of research seems to vary.

Conclusions

- Consideration should be given to increase the use of good lecturers from industry and abroad.
- There is a lack of a shared understanding (with all stakeholders) on the education and training of Engineers and lifelong learning.
- The students need to be able to see how their studies in basic science, etc. are necessary to their later work.
- Information to enable confident decisions by students on choosing options is lacking.
- The relationship between professions and the marketplace needs to be discussed.
- Tutoring of students is not working so well, especially between professors and students.
- The students are well motivated.
- There appears to be a feeling of 'us and them' between students and staff and staff and students.
- Despite attempts to modernise educational methods, to re-focus and re-skill staff, some are dedicated to old ways.
- In terms of the evaluation, there is a significant mismatch between the self-assessment and impressions given by the staff. The tone of the self-evaluation was a bit pessimistic.
- Overall, there is an impression of a Department that feels under-resourced and over-looked in the wider University. Allocation of funds is a matter for the Department.

Recommendations

- Continuing development of the strategy and Degree Programme, taking into account the strategy of HUT, and the challenges of the development of Building and Civil Engineering, especially the integration of technical sciences and technologies.
- Increase the vital internationalisation in research and teaching, as well as the mobility of student exchange.
- Increase the use of teachers from Finnish practice and research for filling the gaps in expertise of practice and some new research areas.
- Take steps to replace the 'us and them' attitude in the programme, between professors and students, and implement a more open, consultative working environment.

- Modernise some areas of teaching to provide real learning. For example more intermittent courses. Less routine lectures, instead short introductory lectures, then reading and exercises, discussions to break the reading (= interactive lectures).
- Find ways to increase funding and re-evaluate the allocation of funds within the Department to better support areas in demand. This can be done as a part of the first recommendation.

4.2.2 Tampere University of Technology *(www.tut.fi)*

General

Tampere University of Technology was founded in 1965 as a branch of Helsinki University of Technology. The Degree Programme in Civil Engineering was established in 1965. TUT became independent in 1972. In 1997, under the guidance of the Ministry of Education, agreement was reached on the division of tasks and development plans for university level education in Civil Engineering. The study programme was revised in 1999 to correspond to the core areas of the Department and the demands of commerce, industry and the public sector. The University Board, the Education and Research Council and the Rector are responsible for the administration of Tampere University of Technology. Other administrative bodies include the Advisory Team and Department councils.

The Department of Civil Engineering consists of two Institutes: Structural Engineering and Construction Economics. The Institute of Structural Engineering consists of five laboratories: Engineering Geology, Foundation and Earth Structures, Geoinformatics, Structural Engineering and Structural Mechanics. The laboratories focus on technical construction know-how in research and education. The Institute of Construction Economics operates in the fields of construction management and economics, construction production techniques, building processes and facility management. The Institute also educates students of the Department of Industrial Engineering and Management.

The Institute of Environmental Engineering and Biotechnology is part of the Department of Environmental Engineering while the Institute of Transportation Engineering operates under the Department of Industrial Engineering and Management. Both Institutes were earlier directly, and since 1995 indirectly, under the Department of Civil Engineering providing education in the field of municipal technology. The fields of research and education of these Institutes are closely connected to Civil Engineering and, therefore, the Institutes are important also from the viewpoint of the Degree Programme in Civil Engineering.

Mission and Objectives

Tampere University of Technology provides highest level education in technology and architecture and conducts scientific research in these fields. It operates in close collaboration with industry and produces high quality research, product development and continuing education services within the fields of its mission.

Decisions concerning strategy-based operational guidelines are made every year in connection with operational and financial planning and the results-agreement negotiations held with the Ministry of Education. Operations are steered in the direction set in the strategy by means of financial decisions on personnel recruitment, student intake and significant initiatives.

Operational development, and its relationship with strategic plans, is evaluated in annual reports.

The realisation of the strategy is monitored by indicators derived from agreed critical success factors. Indicators to support management in different areas of operation are developed as needed.

The general performance indicator for the whole University and its units also serves the allocation of unit-specific results-based funding. The content of the indicator is evaluated yearly, and necessary adjustments are made to support strategic areas of emphasis.

The law on TUT, issued in 1972, defines the tasks of the Department as education and research and product development in co-operation with commerce and industry.

The field of Civil Engineering covers a wide range of areas. The aim of the undergraduate education is to produce competent Master -of-Science level Engineers, with broad knowledge across the core areas of Civil Engineering and deep-going knowledge from at least one area of specialisation. Holders of the degree of Licentiate of Technology are supposed to possess the highest national knowledge in their special field of research and have the ability to apply the knowledge. The degree of Licentiate of Technology is a useful stage before earning one's Doctorate and should be retained. Holders of the degree of Doctor of Technology are supposed to have internalised the principles and methods of scientific research and reached the international leading edge of their field of research.

The Department of Civil Engineering focuses on the following core areas:

- repair and facility management,
- Industrialised construction and building processes,
- structures and design of structures and
- information technology in Civil Engineering.

During last years, the importance of postgraduate degrees has increased in Finland. With respect to the number of students, the Department produces more Doctorates than the other Departments of the University.

Findings of the visit

Teaching

TUT is strongly oriented towards the requirements of the practical employment sector. Rather than the scientific basis, the practice seems to be setting the direction of the education.

The length of studies – seven years or more – seems very long for a first degree in Civil Engineering. Is there some way to accelerate studies? The students believe that it should be possible to complete them in less time, say, five years, but doubt if there is the will to promote this idea within the University. The teaching of basic, academic subjects is, in the eyes of the students, necessary to their later studies.

There is a good atmosphere of co-operation between the staff and students generally: the students are not afraid to discuss concerns and other matters with the staff. However, they are not convinced their concerns are always acted upon. There is limited use of the University's student feedback system; the students' motivation to give feedback is low, because it is given at the University level.

The use of personal study plans is an effective basis for students' development.

The timetables are dominated by time for lectures and practical work. There is a high workload, especially in the third and fourth years: some students claim to have to work 6.5 days per week.

Guidance on specialisations (options) could be developed more to inform the students about the subjects and careers ahead of them. Course 'books' are considered to be of a variable quality by the students: some are very good, but others are poor.

The students feel they are not exposed enough to the research that is ongoing in the Department (and elsewhere), prior to the point they begin their thesis work.

Industry regards TTKK's graduates highly: they are 'thinkers', 'rounded', competent and develop quickly (in some cases, to assume senior positions).

Building Services Engineering – particularly in the context of the quality of the inner environment – is weak in the present curriculum. The facilities management subjects are taught within the Construction Economics programme, which is fine, but there seems to be not enough services teaching.

Civil Engineering draws on many basic (scientific) subjects that in their own ways are expanding and creating the need for students to accumulate more knowledge. There is, at least, an argument for redefining the scope and content of basic subjects so that they do not add unduly to the workload of the students.

It is not clear how the 'quality system for teaching…' operates.

Learning

The students believe that their programme equips them for their chosen career in the construction sector: it provides them with the necessary skills and confidence.

Learning is accomplished through exercises and, of course, lectures, but exercises tend to be the primary vehicle for learning. There appears to be not enough time for tutorials to back-up exercise work and to provide individual feedback to students. Improvement is possible if course 'books' are converted into web-based learning materials. There is an opportunity here for using these learning materials to support courses as part of a lifelong learning initiative for industry training.

Research

The staff is very active in research and this covers many areas. Crosscutting issues, for example energy efficiency and health of buildings, as well as environmental impact, are important today and have both a research and teaching dimension.

The research is practically oriented and it is often made in close co-operation with firms. Basic research is quite rare.

The students should be exposed more to research during the earlier stages of the programme. Staff should actively consider ways in which to involve the students more in the research made by the Department.

Personnel, resources and facilities

There is a move to develop further areas of research and teaching, though financial constraints have to be taken into consideration.

The development of good quality learning materials could be undertaken as a Department project. This could consider taking 'teachers' materials and turning them into even better web-based learning materials. Regular updating would be an important requirement, but this ought to be easier when working with electronic media.

The laboratory facilities are better than adequate, with some areas well supported.

International dimension

There a many links to Universities abroad, but exchanges of staff are not significant enough, especially as concerns bringing eminent international scientists to Finland. More could be done to encourage mobility of staff as well as that of students. Skills for communicating with different cultures and in different languages (English, German, etc.) could be improved.

Evidence of best practice

Individual study plans support the students very well.

Conclusions

- The length of studies – seven years or so – seems very long for a first degree in Civil Engineering. Is there some way to accelerate studies? Could there be resource savings without compromising quality?
- There is good co-operation between the staff and students generally: the students are not afraid to express their concerns and other matters with staff. However, they are not convinced their concerns are always acted upon.
- There is limited use of the University's student feedback system; the students' motivation to give feedback is low, because it is given at the University level.
- The use of personal study plans is an effective tool for supporting students' learning and development.
- For the focus area of industrialised engineering, the advanced skills of industrial engineering and management have been used already and is highly recommended to be developed further.
- The timetables are dominated by time for lectures and practical work. There is a high workload, especially in the 3rd and 4th years, with little time for social life.
- The Department's quality system should be reviewed to be sure that it is working effectively, i.e., whether it is ensuring a consistently high level of achievement in all areas of the Department's work.
- Crosscutting issues, for example environmental impact, are important today and have both a research and teaching dimension. Greater attention could be paid to this aspect.
- The Department is pursuing the incorporation of building services engineering teaching and research: this is a vital component for the future. There are, of course, resource implications.
- The Department might consider undertaking a development project for creating high quality learning materials in teaching and industry training.
- Is there a better combination of teaching methods that could improve the learning process?
- There is a doubt, if the splitting of the building and Civil Engineering education into three Departments is an optimal solution. The co-ordination of the roles of Municipal Engineering, Environmental Engineering and Transportation Engineering in the education of Civil Engineering might be difficult in longer term.

Recommendations

- Continue the development of the strategy and Degree Programme taking into account the general recommendations of this report, especially the integration and strengthening the scientific basis with the help of technical sciences.

- Increase the vital internationalisation in research and teaching, as well as the mobility through student exchange.
- The Department should consider promoting and funding a development project for the creation of high quality learning materials.
- The basic research should be further developed.
- More close integration of the entire Civil Engineering field into the Department of Civil Engineering could be considered. The roles of research and education activity on water resources and hydraulics, water supply and sewage technologies could be clarified in this connection.
- The profile of Building Services Engineering within the programme needs to be raised and it is understood that efforts are being made in this respect. Related to this point is the question of 'space in the timetable' for its introduction.
- The Department's quality system should be reviewed to be sure that it is working effectively, that is, it is ensuring a consistently high level of achievement in all areas of the Department's work.

4.2.3 South Carelia Polytechnic
(www.scp.fi)

General

The Civil Engineering programme of South Carelia Polytechnic is based on that of Lappeenranta Technical School which was founded in 1945 in order to safeguard the interests of large-scale industry and Civil Engineering activities in the Lappeenranta–Vuoksi area and to satisfy the growing need of Technician Engineers. The training of Engineers started within the training programme of Civil Engineering in 1961 when Lappeenranta Technical school was founded.

The vision of South Carelia Polytechnic is that by 2010 the Polytechnic will have developed into a strong player in South Carelia and at the same time it will be known and highly appreciated in strategically significant specialist areas all over Finland.

Mission and objectives

The Mission is as follows:

– to develop the region – its business life, welfare and culture – on the basis of the regional development strategy through basic and continuing education as well as research and development
– to respond to the education needs
– to make the young committed to stay in South Carelia
– to increase expertise in Russia
– to evolve into a modern learning community

Findings of the visit

Teaching

The teaching of construction management and project management is an obvious omission. If one strips away the word management and replaces it with programming, control, co-ordination and communication, there is little trace of these subjects within the Civil Engineering programme. This weakness fails to recognise the way in which the world has changed in focusing concern away from solely products and technology towards recognising the importance of managing the process and environmental questions.

Virtually all of the ingredients that are needed to strengthen Civil Engineering, as implied above, are available elsewhere within the Technology and Business Administration programmes. However, there seems to be a blockage at the management level in SCP (or a will within the programme team) to make this happen. Some co-operation with the University exists, but there is evidence of a lack of communication on what is and what is not possible.

There is an implied contradiction in the philosophy behind Civil Engineering as compared with other programmes in terms of what needs to be learned in the classroom and what can be obtained by experience in industry.

The use of web-based learning materials is minimal and little real support is provided for distance learning. The examples shown of course materials confirm the lack of support and guidance in this important area.

Preparation of final year theses needs some attention. More and better instruction needs to be given on how to undertake what is essentially a research study, albeit a minor one. Furthermore, the industrial 'supervisors' should be 'educated' as to the benefit of a properly structured thesis in which the results of the research can be presented, without compromising the value to the company and the academic assessment.

Learning objectives are not defined for individual courses or, at least, are not evident. These need to be provided as statements of the competencies that students will possess when they have graduated. It provides a useful focus and checklist for lecturers and informs industry of what to expect from graduates.

Personnel, resources and facilities

High variability is reported in teaching and lecturer quality. The students report a lack of availability of lecturers, but there appears to be some confusion as to who is and is not expected to be available as a 'full-time' lecturer. The students appear to be in the dark about the official arrangements in place concerning personnel appointments. The use of the web to support some areas of teaching lacks a coherent strategy and operational plan. SCP has *WebCT*, but its use is a little unclear in the context of the undergraduate programmes. It is, however, recognised that the time and effort needed to prepare learning materials is substantial.

The laboratories are well equipped, if appearing to be under-utilised. A lack of technician support was claimed as part of the reason for this shortcoming. The information systems are well developed and comprehensive.

International dimension

There is a lack of urgency regarding the exploitation of opportunities within Russia. SCP's strategy includes a focus on the Russian market, yet there is a weak connection between the operational activities within Civil Engineering and the opportunities in Russia. However, many of the subjects within Civil Engineering could probably be found within Russian Universities, thereby limiting the opportunity for exploitation of SCP's competence areas. For SCP to succeed, it should look closely at the skills needed in this eastern marketplace, as well as locally, and align its expertise to them.

Evidence of best practice

There is limited evidence of best practice, except to note the use of state-of-the-art industry tools, for instance, the use of WinTaku and AutoCAD in teaching.

Conclusions

- There does not seem to be common view about mission or strategy.
- SCP's Civil Engineering programme is very much a follower and needs to modernise to provide a more rounded education.
- The understanding of the objectives of education of SCP in Civil Engineering between the staff and the industrial representatives do not meet clearly: industrial representatives want to get "good Engineers for the practice".
- There is a rather traditional approach to the curriculum and teaching of Civil Engineering.
- According the students the internationalisation is without any real content.
- There is no apparent exploitation of courses under other programmes to provide a better-equipped graduate.
- Support for web-based teaching is lacking in terms of developing course (learning) materials and is a barrier to progress in this area.

Recommendations

- Strengthen the Civil Engineering curriculum by teaching aspects of modern management theories and applications, especially those with scientific underpinnings, and environmental matters.
- Consideration should also be given to acquainting the students with modern production theories, applications and practices – these are available under other programmes within Technology and Business Administration. Create access to a broader range of subjects for study, especially those mentioned above.

- Establish a clear plan for web-based study and milestones for its implementation, and provide adequate resourcing for preparing course (learning) materials. Build further links with industry wherein the role of SCP is better explained and where the opportunity exists to attract support in different forms – technology transfer, thesis work, visiting lecturers etc.

4.2.4 Helsinki Polytechnic – Stadia
(www.stadia.fi)

General

Helsinki Institute of Technology became an educational establishment maintained by the City of Helsinki on 1 August 1995. A provisional Polytechnic, part of which was the Institute of Technology, began to operate on 1 August 1996.

The Degree Programme in Civil Engineering offered by Stadia continues the technology-training programme of the Helsinki Institute of Technology. This, in turn, originated in the training centre for 'machine operators and building site foremen' of the Finnish Association of Industrial Arts, founded in 1881. The education of Engineers (higher education) in Civil Engineering was started at Helsinki Institute of Technology in 1987. At that time, the only study programme was Building Engineering. The admission of students to Technician studies took place for the last time in 1996.

In the following year, the provisional Helsinki Polytechnic launched a trial training programme to replace the education of Technicians. The requirements of this education were changed to meet the requirements of the Engineering education, i.e. 160 credit units, and the title was 'rakennusmestari AMK'. Another option was started simultaneously which filled the gap left by the elimination of Technician education in Urban and Environmental Construction. The Ministry has later eliminated the degree title 'rakennusmestari AMK' and now all options have the same degree title 'insinööri AMK'.

Mission and objectives

Helsinki Polytechnic Stadia is a multidisciplinary applied science institution, where professionals are educated in an open learning environment. The Polytechnic aims to meet the unique challenges of the capital region and interests of national economic and industrial life through its operations: education, professional know-how as well as research and development.

Helsinki Polytechnic Stadia envisions to be internationally acknowledged by its high standard of education. The students find employment immediately after graduation.

Civil Engineering is a highly valued and interesting study option, especially for young people interested in the field of construction in the capital region but also on a national level. The construction companies and organisations in the capital region are very eager to work in co-operation with the Degree Pro-

gramme. After all, these companies and organisations are the ones to employ all the Engineering graduates by offering them jobs that correspond to their education. The Degree Programme is a very active and influential agent in the co-operation with the nation's other Polytechnics. It also benefits from good models for activating students and teachers to get involved in international exchange programmes with foreign institutions.

During the past five years, the Civil Engineering Degree Programme has offered an increased opportunity to gain professional expertise, as well as to engage in good partnership and teamwork through business-oriented study methods. The development of urban culture is a natural part of the activity in the Civil Engineering Degree Programme, as renovation has been chosen for a central area of focus in all study programmes. International activities are also increasing.

The task of the Civil Engineering Degree Programme is to promote sustainable development and improve the built environment together with the companies and organisations in the capital region by offering high-level education and by participating actively in applied research and development.

Findings of the visit

Teaching

Sometimes the students are unable to access a teacher's knowledge. Some teachers need to develop their pedagogical skills further. Students on the PM specialisation, within the Building Engineering option, question the need for so much maths and science since they are going to have management roles within the industry. They believe there is an over-emphasis on maths and science, at the expense of management topics. This is known to be a long-standing problem in Engineering courses elsewhere.

There is a lack of social science/humanities teaching to equip them to deal with human factors in industry. This must cover the principles and theories underpinning modern management thinking, applications and practices. These are key skills within construction project management and appear not to be properly addressed. Attempts to address this problem should not rely on experience-based examples, but have theoretical underpinnings. That said, the students feel they are able to cope with the challenges presented in industry.

The subjects covered and their content appear to fit the expectations of industry. Insufficient encouragement is given, however, to critical review and original thinking about how 'things might be done differently' within industry.

There is a marked mismatch between the higher order goals (strategies) of the programme (and institution) and the lower level, detailed course descriptions. This suggests, in the absence of evidence to the contrary, the requirement for a rational plan (or policy) for instilling the relevant competencies targeted at the strategic level into the 'basic building blocks' of individual courses. In some quarters, the term 'roadmap' might be used to describe how higher

order goals could be logically and reliably translated into courses and learning situations.

The use of modern ICT in teaching appears limited. Distance learning is not practised. Trends in the use of the web and the Stadia Intranet suggest that the institution will probably need to derive a policy for web-based learning.

Learning

The students have confidence in what they are learning and how that will equip them for a career in the construction sector. They see that there is a good alignment between their perceptions and those of teachers and employers.

A few teachers fail to provide feedback on exercises, thereby impairing the effectiveness of learning. Moreover, the amount of work moved to home study seems to be excessive at times, according to student reports.

Personnel, resources and facilities

The evaluation would have benefited from descriptions about the staff. Short biographies would have been helpful.

The skills needed to teach the fundamentals of management related topics may not exist within the present establishment and may have to be brought in, perhaps from other institutions.

The laboratory facilities are excellent, despite a limitation on space. The technical staff give good account of the practical value of laboratory experiments and related work.

International dimension

Little information provided on the extent or interest in this area to enable an evaluation to take place, apart from noting some European student exchanges.

Other

The Advisory Board, which has a key role in the direction of studies, appears to be disconnected from the student body and, perhaps, other areas. There has been a temporary break in the activity of the Advisory Board, but the activity has been revitalised after electing new members.

Evidence of best practice

There is a well-developed understanding of the needs of industry.

A quality assured procedure exits for thesis work.

Laboratory work is supported by excellent facilities, in terms of equipment.

Conclusions

- Basic teaching is of a good standard.
- There is a good team spirit.
- Students are generally satisfied and confident. A ‘roadmap’ is needed to make it clear how the strategic vision can be translated into an achievable work programme for course delivery.

- This needs to start with the strategic goals and, through the mapping of competence areas, should point to the particular courses that will deliver (or instil) the desired competencies, skills and preparation for the students careers: this will also help to achieve good programme management.
- This exercise should be a joint affair between the programme management, students and industry through a reconstituted Advisory Board.
- Laboratories are well equipped, especially for condition assessment of structures and surveying, which are suitable skills of the Polytechnic.
- Library and information services are on a satisfactory level.
- Good co-operation with others in project work, especially building services, but there is a need to accelerate.
- A quality assured procedure exits for thesis work that all parties understand.
- The international dimension is weak.
- The Advisory Board will be a good arrangement now when it is again properly organised.
- Map out the competencies that link strategic goals with course content.
- Information support is encouraging.
- Well-developed understanding of industry needs.

Recommendations

- The links between the institution's strategic goals and course delivery need to be formalised and made explicit. This should cover the mapping of competencies and their connection with the 'basic building blocks' of courses that instil the competencies and which aggregate to form the programme and the options.
- Certain administration and feedback practices to students should be tightened-up. Greater student participation in decision-making is needed.
- International dimension could be vitalised inviting foreign lecturers and activating student exchange. Skills for communicating with different cultures and in different languages (English, German) could be improved.
- The Polytechnic has chance for contributing lifelong learning in new issues for older staff of firms and other organisations.
- The newly activated Advisory Board will be effective in continuous interaction between Polytechnic and firms.

4.2.5 Jyväskylä Polytechnic
(www.jypoly.fi)

General

Jyväskylä Polytechnic, established in 1992, is a multidisciplinary institution of higher education, which obtained a permanent status in 1997. The Polytechnic includes eight fields of study: the School of Natural Resources, the School of Engineering and Technology, the School of Information Technology, the School

of Business, the School of Tourism and Services Management, the School of Health and Social Welfare, the School of Cultural Studies, and the Vocational Teacher Education College. The Degree Programme in Civil Engineering is one of the eight Degree Programmes of the School of Engineering and Technology.

Mission and objectives

The mission of Jyväskylä Polytechnic is to promote welfare in the increasingly internationalised Central Finland through the development of its working life and the advancement of the educational opportunities of the entire population.

The Degree Programme in Civil Engineering admitted its first students in 1997, when it was still called the Degree Programme in Real Estate Technology and Project Management. The content focused on building production, project management, facilities maintenance and management. The emphasis of the Degree Programme was on production, and it replaced the abolished Technician education. As a result of a reform in 2001, the Degree Programme obtained its present name (Civil Engineering), and also its structure changed: the students graduate as Engineers specialised in the structural design of building construction and/or building economics. The content of the Degree Programme was planned paying special attention to future requirements on the number of credits and potential contents, which now have been registered in the new document SRakMK A2 (Building Designers and Designs A2) and SRakMK B11 (Persons in Charge of the Performance of Works on Bearing Structures, draft 2001).

Findings of the visit

Teaching

The Civil Engineering programme has no specialisations or options: the students must study a fixed programme of subjects. Even so, communication of information on what lies ahead for the students could be improved.

The switch from a programme in 'Building Services Technology and Project Management' to Civil Engineering might appear to be regressive. However, the school is able to justify this change on educational and vocational grounds.

The final dissertation is an important component of any Degree Programme for students: it should not be subject to company approvals and then locked away from the view of other students in subsequent years.

The breadth of subjects offered across the different schools in the Polytechnic offers a rich learning environment for students. This raises the prospect of combined degree studies capable of producing graduates with skills that are attractive to new kinds of business enterprise. This could help to realise the competitiveness objective within the Polytechnic's strategy.

In the second year, there seems to be a semester during which contact hours are excessive, at least in comparison to other times. It would be better to smooth out such peaks if at all possible. The students understand the need for maths, mechanics and related academic subjects, but the timing and the inten-

sity of study gives cause for concern. The subjects are demanding in themselves, on top of which the time commitment is perhaps more a test of stamina than ability.

Communications between students and staff are good. The students are comfortable with the feedback system in operation. Feedback is generally given face-to-face rather than in writing, which the students feel does not work so well. The BEng programme is certified to ISO 9001:2000.

The pedagogical skills of some of the part-time staff are not good, though they generally make up for this shortcoming by their knowledge of current best practice. The permanent staff is regarded as better, but may be a little out-of-date in some areas.

Study materials are essentially handouts from the teachers: some textbooks are used. The school has site licences for technical software. However, it is not clear if the students have proper access to current industry standard software; for example, WinTaku or anything for handling lifecycle calculations.

The students' exposure to foreign customs, practices and (construction) professionals is limited, as is their appreciation of the differences between countries. The motivation to introduce something that has an international flavour, for example, to show how things are done/might be done differently is generally lacking. The students seem destined for the local or domestic market.

The students do take advantage of courses in other schools and in the University and can have their credits transferred.

Industry representatives are aware of what they are getting in terms of the abilities of students and are satisfied with them.

Learning

The balance between formal studies and private studies seems to be right for the students. The students are confident in that what they learn will prepare them for a job in industry. However, they see some shortcomings in the skills and competencies they will acquire, which can be best described as equipping them for work on job sites.

Work possibilities in design offices require a higher level of competence in structural engineering, and this aspect is being addressed. The intention is that half of the cohort will go to site-based work and the other half to design offices.

Personnel, resources and facilities

The number of permanent teachers seems to be under the critical mass in longer term. Part-time teachers are considered to be more able to update their knowledge than the permanent staff.

Communications within the school can occasionally break down, for instance regarding part-time staff and also in terms of work experience opportunities. Also, there appears to be a gap in understanding between the strategic management in the Polytechnic and the operational level (teaching).

The school's ICT equipment is outdated and an impediment to effective teaching and learning.

International dimension

With a large student population, the city of Jyväskylä is a thriving centre of learning in Finland. Against this background, the Polytechnic needs to continue efforts to widen its horizons in the field of Civil Engineering if it is to ensure a healthy international outlook. Evidence from the day's evaluation suggests a low level of internationalisation that is to the disadvantage of the students and staff.

Evidence of best practice

None, other than the quality system certificate.

Conclusions

- The school is not fully resourced. Some facilities are less than adequate, for instance ICT and some laboratories.
- The library and information service of the Polytechnic is adequate.
- The atmosphere in teaching and learning is enthusiastic and effective.
- Communications between students and staff are good. The students are comfortable with the feedback system in operation. Feedback is given face-to-face and in writing to comply with ISO 9001.
- The students understand the need for maths, mechanics and other academic subjects, but the timing and the intensity of study gives cause for concern (especially in year 2). The subjects are demanding in themselves, on top of which the time commitment is more a test of stamina than ability.
- The pedagogical skills of some part-time staff are not good, although they generally make up for this shortcoming by their knowledge of current best (site) practice.
- The permanent staff is regarded as effective teachers, but because of the small number of teachers, the may be in longer term out-of-date in some areas. There needs to be more of a 'futures' orientation within the Department and programme.
- The breadth of subjects offered across the different schools in the Polytechnic offers a rich learning environment for students. This raises the prospect of combined degree studies to produce graduates with skills that are attractive to new kinds of enterprises. This could support the competitiveness objective within the Polytechnic's strategy.
- The students' exposure to foreign customs, practices and (construction) professionals is limited. The international dimension needs to be strengthened in ways that are easy for the staff to accommodate without increasing their workload.
- The balance between formal studies and private studies seems to be right for the students.
- Teaching in environmental subjects needs to be strengthened to deal with sustainability questions: collaboration with industry in research is important.

- The school is not adequately resourced. Some facilities are poor, for instance ICT and certain labs.
- The school has site licences for technical software. However, it is not clear if the students have proper access to industry standard software; for example, calculation programs or lifecycle cost appraisal.
- The final dissertation is an important component in any Degree Programme.
- There is an Advisory Board that has been recently reconstituted to help guide the programme: it is essential that membership includes student representatives.
- Industry representatives are aware of what they are getting in terms of the abilities of students and are satisfied with them.

Recommendations

- Develop a strategic plan for development of the Degree Programme, considering also a widening of the programme in order to reach a critical mass of students.
- The number of permanent staff does not exceed the critical mass for teaching and long-term development and updating of the Department. It is recommended that the number of permanent teachers be increased together with possible increase of students.
- There needs to be investment in modern laboratories and ICT.

4.2.6 Tampere Polytechnic
(www.tpu.fi)

General

Tampere Polytechnic has been formed of four separate institutes and a teacher education centre in 1995. The Degree Programme in Construction Technology has its roots in the old Tampere Institute of Technology that was founded in 1886 by the name of Tampere School of Industry.

Mission and objectives

The mission is as follows. The Department of Construction Technology offers a wide specialist education to meet the needs of construction industry. The Department operates as a responsible partner in the institutional and entrepreneur network. The Department develops interdisciplinary activities and IT expertise in the field. The operation of the Department comprises youth and adult education, projects, research and services.

The vision is that the Department is locally, nationally and internationally appreciated, magnetic, developing, innovative, outstanding. The values are responsibility for the quality of construction, sustainable development, customer orientation, high professional skills, business-minded way of operating.

Findings of the visit

Teaching

Recruitment of teachers to full-time positions involves close scrutiny of their teaching and pedagogical skills. The same does not necessarily happen with industry-based teachers of whom there is a large number in proportion to the full-time staff.

The feedback from students suggests that the arrangement for bringing in such a large number of industry-based teachers does, in fact, work well. They are well respected by the students and understand how to get their subject across. However, the Department needs to be sure that in each year and in each course there is a clear understanding of the relationship between theory, application and practice and who is responsible for the respective teaching.

The staff is willing to spend time with the students and the level of co-operation between staff and students is considered to be genuinely high. The staff are approachable and are respected for their knowledge. The Head of Department works hard to maintain a positive and co-operative climate and succeeds at this.

Some full-time (permanent) staff needs to keep themselves up-to-date. There is an argument here for some probing by the staff of the blend of skills and knowledge that are required for effective teaching (learning).

Discussion between staff and students is common; moreover, the staff will engage the students in discussion about courses before they begin. However, there appears to be no formal input into the planning of the programme. Students are consulted on the effectiveness of their programme, in the 4th year. Some comments have been acted upon to the betterment of the programme/courses.

Opportunities exist for lifelong learning and access is relatively easy for adult learners. Even so, the courses can be intensive, over long hours, with home study adding to the burden.

The content of management-related teaching in terms of inter-personal skills appears adequate, with recognition that the industrial placement period (and that after graduation) will help them to develop the necessary practical skills.

Reported difficulties in developing a strong education base in HVAC (LVI) studies are being addressed: they are being given a high priority.

Learning

The working environment is extremely conducive to learning. Students come to the Polytechnic because of the high regard that people have of it.

The integrative aspects of the programme and courses seem to work well and the students generally feel confident they will be equipped to cope with life beyond graduation. The work placement period is very useful in this respect and well managed.

Personnel, resources and facilities

The Polytechnic relies on local facilities within the city for extra-curricula activities, which causes some concern on the part of the students.

The general facilities are modern, but some of laboratories are not. The equipment support is generally good, especially for ICT, but web-based learning appears minimal.

Other

The Polytechnic is working towards collaborating with other institutions in the region: Universities, companies, VTT, etc. The senior management of the Polytechnic takes a close interest in the work programme of the Department.

International dimension

There is a significant and valuable opportunity for all students to study overseas. International co-operation is active. Most exchanges are short term, perhaps of a week or so, but are nonetheless considered to be beneficial.

There is a strong ambition to become involved in EC-funded RTD projects in collaboration with other local institutions and industry.

Evidence of best practice

The integrative nature of teaching, in which industry-based teachers combine with full-time (permanent) staff, creates an effective learning environment (but is not without risks). Practical training is thoroughly managed and evaluated.

Leadership is shown from the Polytechnic's senior management, down through the Head of Department, to the staff and the students.

Conclusions

- There is an effective working relationship between staff and students.
- The integration of industry-based teachers combined with full-time (permanent) staff appears to work well, but the Department needs to be sure that the relationships between theory, application and practice are not overlooked.
- Many activities are going on, and there is some doubt how they can be managed properly.

Recommendations

- There should be a clear procedure for ensuring that theory, application and practice within subjects/courses are properly integrated.
- The activities might need some focusing.
- The co-operation between students and firms during the studies could be improved and systematised.

4.2.7 Turku Polytechnic
(www.turkuamk.fi)

General

Originally the teaching of Engineering dates back to the year 1849 when Turku Technical School was founded. Turku Polytechnic was established in 1996, when the four-year experiment was extended to other fields. There were 90 students starting in the Civil Engineering Department, including Technicians until the early 1990s. Currently the number of starting students in the field of Civil Engineering is 65 including production management and real estate management alternatives.

Mission and objectives

The main concept of the mission is that Turku Polytechnic takes the responsibility for the development of higher professional education and expertise in Southwest Finland. Moreover, future-oriented education and R&D measures will contribute to prosperity and wellbeing based on ecologically and ethnically sustainable development. The vision is that in 2005 Turku Polytechnic will be a renowned and influential force. Also the clients of the leading Polytechnic in Finland will be provided with prospects of growth and success. At the same time Turku Polytechnic will produce new appliances of nation-wide significance and publicity whereas R&D will obtain at least 10% of the total financing.

Findings of the visit

Teaching

All Engineering studies are ISO 9001:2000 and 14001 certified. Students are regarded as clients and are actively engaged in the process of education.

The Real Estate Management option is a recent edition to the curriculum and appears not to be fully defined (at least not in the documentation provided).

The courses taught early in the programme – the general or basic courses – are not so attractive to students. However, as they progress through their studies they see and appreciate better the applied aspects. The courses have a strong applied mathematics content, which is good if the graduates are to work in engineering design. However, this may not suit everyone.

The students have a strong motivation to practical Civil Engineering.

There is onus on the students to undertake homework to build on what they learn in the classroom. Some teachers are better than others in guiding the students on their homework and can be left entirely on their own. The imagination of some of the teachers in creating examples or exercises and the choice of which to undertake at home is limited.

The student's involvement in programme and curriculum development is unclear. They are expected to provide feedback at the end of a course, but they

do not appear to be involved in the planning of new programmes. That said, they are able to influence the delivery of their courses.

Feedback is sought from students twice a year on their courses, but this is not a complete exercise: not all teachers and students undertake the exercise. Furthermore, the exercise itself does not seem to search for the kind of answers that would really help the management of the programme. The student feedback system needs to be looked at and probably improved.

An integrative approach to structural engineering design is lacking. Competence in discrete areas is achieved, but not necessarily a holistic understanding. Other aspects that must be taken into account when designing structures, such as economics, thermal and other performance criteria, are covered.

The employment of teachers from industry is valuable, but they are not necessarily trained to teach and sometimes are unable to get their message across. This may be because they are not sensitive enough to the backgrounds and abilities of the students.

An induction course (or remedial) maths course prior to formal start of studies could be beneficial.

The Polytechnic is good at organising work placement for the training period.

Learning

The programme appears to impart the skills needed to serve the students well in their careers. The students interviewed were motivated to learn new skills and thinking to enable them to go beyond purely practical work.

Communications between some teachers and students could be improved: there is evidence of some teachers – especially those coming from industry – failing to understand students' learning needs (and thus, difficulties). The students are motivated to tutor themselves – in teams – to reinforce learning.

Too few are selecting the Site Management option in relation to the need, which is a common problem of Polytechnics.

Personnel, resources and facilities

- The Polytechnic has a clear client focus: students, employers and research sponsors.
- The dropout rate in Civil Engineering is below the average for the Polytechnic, which is a consequence from the high motivation of students.
- The laboratories are versatile and well working – a good example of co-operation with a firm was the geotechnical laboratory.
- Work has begun on providing web-based courseware for courses.

International dimension

There is evidence of internationalisation, but the impression is that more could be done to expose the students to the world of construction in the classroom.

Evidence of best practice

The teachers are very good at helping the students to 'put it all together'.

Conclusions

- The education process succeeds at helping students to integrate the different facets of construction process and product.
- The information service and library well on a high level.
- The pedagogical skills of some teachers, especially those coming from industry, need to be developed. There is little doubting their knowledge and experience, but they can lack sensitivity for students' learning needs (and difficulties).

Recommendations

- Develop the participation of students in the development of the Degree Programme and in other long term planning.
- Review the workings of the student feedback system to improve its effectiveness in programme and curriculum development.
- Develop the pedagogical skills of some teachers, especially those coming from industry.

4.2.8 Pohjois-Savo Polytechnic (TeKu) *(www.pspt.fi)*

General

Pohjois-Savo Polytechnic was established in 1997 and its status became permanent in 1998. Its administration is a Municipal Federation including the cities and municipalities of Kuopio, Varkaus, Iisalmi, Kiuruvesi and Lapinlahti. Pohjois-Savo Polytechnic and the School of Engineering can trace its roots back to the year 1886, when the first industrial schools started in Helsinki, Tampere and Kuopio. Education in Construction Engineering started in 1960's.

Mission and objectives

The main task of Pohjois-Savo Polytechnic, Municipal Federation is to serve the province of North-Savo by educating multi-skilled and initiative-minded persons, to start development projects supporting education and competence and also to participate in other provincial, national and international projects.

Findings of the visit

Teaching

The Polytechnic's aim is to develop multi-skilled, enterprising (i.e. innovative, inventive or creative) individuals.

The students are satisfied with their studies. The classes are interesting and impart real knowledge. However, the scope of subjects seems very broad to the students and they are not so sure they are truly benefiting by having just a little knowledge in certain areas.

Some of the basic subjects seem irrelevant to the students for their longer-term development. More effort could be put into showing clearly how these basic building blocks support or contribute to the students' later studies. The Department appears to differentiate between the backgrounds and abilities of new students and reflects this in the way it teaches maths and sciences.

Some of the lecturers have old learning materials, but this appears to be less of a problem as time goes by. Even so, steps should be taken to ensure that all learning materials, irrespective of subject, are up-to-date.

The students have no difficulty communicating with the staff. If they need to reach them about a matter, they tend to use email: this is an acceptable practice for the students. Students concerns are handled by direct discussion with staff. When changes are needed to the arrangements for classes or delivery of course materials, the students approach the staff directly, who generally act upon their concerns.

A system for formal feedback is available, but not necessarily used by students to the extent that staff might wish. The students are more likely to approach staff directly on any matter that concerns them.

The use of technical software in teaching is limited. The students recognise that they need to understand the basics (manually) and then can go on to use technical software, for example design packages.

Industry representatives would like to see more management and economics teaching. Environmental aspects are also important and more could be done here.

Learning

The students are unaware of the customs, practices and even the opportunities abroad. According to the students, they are not able to learn much about what happens outside Finland within their formal studies.

The students are confident that what they are learning will equip them for a career in industry.

Industry representatives are satisfied with the graduates. They expect the students to have a broader view than those imparted by technical studies. Students must also be aware of societal aspects and have management and interpersonal skills.

Personnel, resources and facilities

The students express the need for more contact hours with the staff. Part of the reason for the lowering of contact hours is that some staff have 'gone' and others have been moved to research 'duties'.

The relationship between teaching and research is proving problematic to manage. There is uneasiness in the Department and a mismatch between it and the Polytechnic's management in terms of 'futures' orientation.

The laboratories are various and generally well equipped.

Other

The Polytechnic has a forward looking and ambitious work programme. This creates a dynamic environment within which Construction Engineering is set.

International dimension

There is limited exposure to international customs and practices. There is recognition of the need to internationalise more the work of the Department and the courses. It is NOT a matter of learning English, despite the persistence of this view. Understanding the wider (i.e. international/European) context within which Finland and its construction sector (or cluster) operates does not require the teaching of English.

A corollary is that the Department does not have a noticeable 'future' orientation.

Evidence of best practice

The organisational aspects of the programme and courses are well practised.

Conclusions

- The general atmosphere is positive, and at the communication between students and teachers works well.
- The programme produces well-motivated and competent graduates who are appreciated by industry. However, graduates need to be more rounded.

Recommendations

- The feed back system is well organised in Internet, but the use of the system by students should be activated.
- The Department needs to develop to become more international in its outlook.

4.2.9 Oulu Polytechnic
(www.oamk.fi)

General

Lower Technical School of Oulu was founded in 1894. It had two Departments: Mechanical and Chemical. Training in Civil Engineering started in 1899 when the Housing Department was founded. In the same year, the school's name was changed and it became the Industrial School of Oulu.

Oulu Polytechnic is maintained by the Oulu Region Joint Authority for Vocational Training, and the highest authority is exercised by the General Assembly of the Joint Authority with the Executive Board operating under it. Six units of different fields of education operate under the Rector of Oulu Polytechnic. Of these units, the Institute of Technology provides training in technology and communications. The Degree Programme in Civil Engineering is one of the

nine Degree Programmes of the unit, of which seven are located in Oulu and two in Raahe.

Mission and objectives

The Oulu Polytechnic strengthens the intellectual and material wellbeing, and regional development in North Finland by organising post-secondary education that anticipates and serves the needs of working life, as well as research and development in co-operation with the business life and other post-secondary educational institutes in the region. OAMK's objectives and strategy are in harmony with the objectives of the Institute of Technology and the Civil Engineering Department, and they support the activities of the Civil Engineering Degree Programme.

- The Institute of Technology will offer up-to-date training for the needs of business life and public administration.
- Training will be founded on vigorous connections with business life. Training will be focused and its extent dimensioned in accordance with the anticipated need of labour.
- Training and research and development closely relating to it will be used to strengthen and develop the business structure in North Finland.
- International activities will support the operation requirements of export carried on by business life and maintain the professional expertise of personnel.
- The Civil Engineering Department will be a leading educational unit arranging post-secondary Civil Engineering training in North Finland responsible for the development of the training, as well as research and development in the study line.

Findings of the visit

Teaching

The importance of lifelong learning is emphasised and recognised by the students. However, the teaching of basic courses in maths and sciences early in the programme could be assisted by more insights into the later applications of these key skills.

The students benefit from an induction week prior to the official start of their courses. Different courses are given at the beginning to enable students from different backgrounds to come up to the same level. The evidence suggests that students are later working at the same level as a result of this early action.

Management teaching is not sufficiently evident across the breadth and length of the curriculum, although it is noted that a course in project management is now to be taught in the first year. Even so, there is little hard evidence of dealing with the key skills in the area of management, for example planning, control, co-ordination and communication. Other topics appear not to be ad-

dressed, for example teamwork and leadership. If these skills are now to be covered then the question arises of how others can benefit from the skills in these courses.

The quality control of the practice component in the programme credits is sufficient, with a training plan used to ensure that relevant experience is gained. If the work placement is suitable, this can be one of the best parts of the programme for the students.

Discussion with teachers is easier, in terms of student feedback, with younger members of staff. Overall, there is reasonable satisfaction with feedback mechanisms in terms of their influence on the programme, i.e. if changes need to be made and these are communicated the staff respond.

Some of the older teachers are using old materials and teach in an old-fashioned way. There are communication problems with one or two teachers.

There is some use of the Internet to support teaching and a little distance learning is possible, but not good access from outside. The ICT skills of the students are regarded as very good by industry.

One member of staff is completing a Doctorate and about four others are working on their Licentiate studies.

Learning

The students feel confident about the learning opportunities they are presented with and see the connections to the workplace and their career development: they feel they are being well equipped for employment.

Some learning is frustrated by a small element of poor communication between teachers and students.

Personnel, resources and facilities

The size of the first year intake is considered to be too large by the students, with perhaps too many then dropping out for one reason or another.

Access to Polytechnic resources, especially informational and learning materials, outside of normal working hours is severely limited. If students are expected to work from home, at least for a small part of their overall studies, they should be provided with access. The use made of the web to support teaching and study is disappointing. The laboratory facilities are adequate for now and will get better.

There is a strong doubt in getting difficulties with competent teachers in future because of the lack of university education of Civil Engineers in Oulu.

The library and information services are adequate.

International dimension

There is evidence of international activities, although these could be expanded especially through arranging medium term visits (e.g., three months) from international teachers. In terms of overseas study, the students see too many problems, for instance language and curriculum, and a time penalty in graduating, if they study away from Oulu. The credit system in other countries is different and creates a further problem.

Evidence of best practice

The staff have a good understanding of the needs of local industry and the goals of the region. Industry rates the Polytechnic and the programme highly.

There is close co-operation – largely informally – between employers and the Polytechnic, and a strong focus on the locality.

Conclusions

- The programme appears to function well, with the students acquiring the necessary skills to support them in their chosen career. The co-operative process in developing the programme is progressing well.
- Dropout rates from year 1 appear high – how can this be reduced?
- Lifelong learning is evident, with staff here contributing to in-company training.
- The students feel they are being well equipped for their careers – employer concerns about site work.
- Industry sees the need for (some) more practical education and more in structural steelwork design.
- Collaboration with other disciplines has begun.
- The closure of the University programme has had a mixed impact on the Polytechnic and its program.
- For the students, there are communication problems with one or two teachers.
- There could be greater internationalisation of the programme – this involves more than the Polytechnic providing placement opportunities abroad. Furthermore, staff should be encouraged to take study leave abroad and should be supported by the Polytechnic in this activity.
- The students would appreciate a greater amount of open and less formal discussion about the curriculum and teaching methods.
- The focus is upon technical skills, though not necessarily including planning, co-ordination and control; softer skills, for example communications and teamwork are not sufficiently addressed. Greater use of ICT in teaching might help here.
- Some of the teachers are using old materials and teach in an old-fashioned way.
- Key skills in the management area, for example planning, control, co-ordination and communication, and teamwork and leadership are not properly addressed.
- There is some use of the Internet to support teaching and a little distance learning is possible, but not much access from outside.
- The student's ICT skills are regarded as very good.
- The laboratory facilities are mainly well equipped and the rest (structural laboratory) is improving.
- There is close co-operation – mostly informal – between employers and the Polytechnic, as well as a strong focus on the locality.

- Industry rates the Polytechnic, its programme and graduates highly.
- There is evidence of international activities, although these could be expanded especially through arranging medium term visits (e.g., three months) from international teachers.
- Upgrading of the skills, both technical and pedagogical, of some members of staff is needed on the evidence presented: it is understood that action is being taken.
- Work placement is one of the highlights of the programme for the students, but not all good news.

Recommendations

- Practical steps are proposed to be taken to improve the internationalisation of the programme beyond encouraging placement abroad. This could, for instance, take the form of visiting teachers from abroad and study leave for permanent staff.
- Upgrading of the skills, both technical and pedagogical, of some members of the staff is needed on the evidence presented: it is accepted that steps are being taken.
- The focus is upon technical skills, though not necessarily including planning, co-ordination and control; softer skills, for example communications and teamwork are not sufficiently addressed. Greater use of ICT in teaching might help here
- Consider ways to reduce the currently high dropout rates from year 1.

4.2.10 Svenska Yrkeshögskolan
(www.syh.fi)

General

Technical education in Vasa/Vaasa has a long history originating in the year 1849 in which the Technical Junior High School in Nikolaistad (Vaasa) was founded. The education was bilingual (Swedish and Finnish) for nearly 80 years. In 1967 the two schools were separated.

The Swedish Polytechnic consists of five different institutions located in Vaasa (Vasa), Pietarsaari (Jakobstad) and Uusikaarlepyy (Nykarleby). The organisation is divided into three sectors. The Degree Programme in Construction Engineering is a part of the sector of Technology and Communications. The sectors are organised in matrices, further divided into Departments and Degree Programmes.

Mission and objectives

The aim and mission of the Swedish Polytechnic is to become one of the leading Polytechnics within its fields of education and to win international recognition within its target areas. The slogans ‘a lasting development’ and ‘lifelong learning’ will become more and more recognised.

Findings of the visit

Teaching

The institution emphasises the need for good quality thesis work, social competence and entrepreneurship. It aims to produce Engineers with managerial as well as professional/technical skills.

The programme appears to be well managed and closely supervised. The students are generally satisfied with their courses and the programme.

The institution operates a quality system to ISO 9001:2000. This allows, of course, the opportunity for formal feedback, which students generally give. However, dissatisfaction with a particular course is dealt with directly in discussion with the programme director. Action is forthcoming and generally to the students' satisfaction.

The students are not aware of how they are represented in programme and course development within the institution. The formal involvement of students in these matters is important to the future development of the programme.

The students have found that the first year and the second year are very intensive, with sometimes too little time for private study to enable a thorough understanding of the subject to be gained.

Some steps have been taken to help those students with a lower level of ability in basic subjects to be brought up to speed.

There can be periods when there is too much homework.

In the beginning of the course, informational needs may not be adequately addressed. Communications could be improved according to the students: tracking down staff can be problematic in the early days and is time-consuming.

In the third and fourth year, the reliance upon part-time, industry-based teachers means that many classes are held later in the day. The days can be long, occasionally 8 to 8.

The pedagogical skills of the teachers are variable. There is no particular pattern; however, some of the part-time evening teachers can be a little unimaginative in the way they teach.

The students have had many site visits. The course in project management (projektledning) provides a broader treatment of the subject than is often the case. Relationships within the project team and with the client are covered.

ICT tools and teaching through the use of technical software are well developed. One member of staff is a particular enthusiast and very effective.

Learning

The students are confident in that what they are learning will equip them for a career in the construction sector.

The teachers understand the learning needs and difficulties of the students

Personnel, resources and facilities

Resources generally are quite limited given the size of the programme. There is small scope for staff development, whose numbers are low – one full-time member of staff with the rest all part-time. Allowing time off for personal or professional development would be infeasible without a higher level of resourcing.

There is a common laboratory, the use of which is shared between three schools, and which is well established with good equipment.

International dimension

The internationalisation of the programme is in its early stages. More could be done to ensure that the wider context in which Finland's construction is undertaken is properly addressed.

There is some evidence of international studies. The students are made aware of the wider context through some topics in fourth year studies.

Evidence of best practice

The integration of ICT into teaching figures strongly in problem solving, particularly where the problem must be solved first by hand.

Conclusions

- The institute has a clear mission in serving the provincial business life.
- Co-operation with institutes in Sweden is active and fruitful.
- The courses and the programme are generally well received by the students and both aspects appear to be well managed. Improvement can be made, especially to the intensity and timing of some of the earlier courses. The pedagogical skills of the teachers are variable. There is no particular pattern; however, some of the part-time evening teachers can be a little unimaginative in the way they teach.
- Time off for personal and professional development is a moot point, given the present level of resourcing. More resources could be actively provided to the course.

Recommendations

- Co-operation with Vaasa Polytechnic and connections to other Polytechnics could be increased.
- The use of building laboratories could be activated.
- Advisory Team is needed.
- Ensure that all teachers, including infrequent part-timers, are aware of 'how to teach effectively'. A review of the timetable is needed to ensure a correct balance of time commitment across the programme for the students.

4.3 Short descriptions of the Polytechnics which were not visited

4.3.1 Seinäjoki Polytechnic
(www.seamk.fi)

General

Education in the Engineering field (Technician Engineer, 3 years) started in Seinäjoki on 1 August 1967. The teaching was launched with Construction Engineering and Automobile and Agricultural Machinery lines. Studies in Wood Technology began in 1973 and Food Engineering in 1983.

Engineering programmes (B.Sc.) in Construction and Food Engineering started in 1991. The Polytechnic experiment commenced in Seinäjoki in 1992. Seinäjoki Institute of Technology was involved with the Polytechnic from the very beginning with Construction, Food and Wood Engineering programmes. Industrial Management studies started in 1993, Building Conservation in 1995 and Mechatronics in 1996. Seinäjoki Polytechnic was among the first nine Polytechnics to be awarded permanent status as of 1August 1996. Automobile and Vehicle Engineering started in 1999.

Today Seinäjoki School of Engineering forms a part of Seinäjoki Polytechnic as its own profit centre. Besides teaching, another important activity is Technology Transfer, which plays a role in providing the prerequisites in the province's entrepreneurial development. Moreover, Technology Transfer has significance for the joint activities between different businesses and engineering studies.

Mission and objectives

Seinäjoki Polytechnic is a provincial Polytechnic, with a central role in improving the educational standards in Southern Ostrobothnia. Also nationally, Seinäjoki Polytechnic contributes to the development of higher level vocational education. The Polytechnic actively participates in improving the province's industrial structure, economics and general wellbeing through education. Seinäjoki Polytechnic is developing into a centre of studies and research relevant to the most significant fields in the province's economic structure, both in the private and the public sectors. The Polytechnic also has an important role in developing and maintaining international contacts in the Nordic and EU Countries, as well as some other countries relevant to its educational activities.

The mission of the Construction Engineering Degree Programme is to develop and maintain the construction and environment of the surrounding areas together with trade and industry.

The vision of the Construction Engineering Degree Programme is to develop it into a Degree Programme attractive education that is responsive, explorative, developing, international and co-operative with business life. Professional

know-how, responsibility, innovation, customer friendliness and traditional and sustainable development are the essential values.

According to the strategy for the years 2001–2005, the key mission is the following: The leading idea is to educate and train professionals to meet the needs of working life. The education creates prerequisites to strengthen and develop the industry characteristic of the province and to increase and grow the entrepreneurship. Preserving the heritage is supported by cultural education. The activity is being developed as follows: High-quality teaching, qualified staff, modern facilities and equipment and education meeting the needs of the students and employing the graduates is the answer to the increasing competition of training and education.

In the strategy of the Construction Engineering Degree Programme for the years 2001–2005 following objectives are defined:

The construction industry of the province will be strengthened and developed by the Construction Engineering studies. The emphasis of the Degree Programme is the design, industrial engineering and entrepreneurship of modern construction technology. The central know-how areas are timber and steel construction. Lifecycle thinking (LCC, LCA) related to the buildings will be increased.

Conclusions

- The self-evaluation has been done carefully in a co-operation between different actors of the institute.
- The current state of the teaching and learning seems to be on a good level.
- The objectives and tasks for reaching the objectives are well defined.
- The actions which are defined are generally compatible with the proposals of the Team.
- Reference is made to the general findings and recommendations for Polytechnic Institutes which are presented in this report.

4.3.2 Rovaniemi Polytechnic
(www.ramk.fi)

General

The Rovaniemi Technical School was established at the beginning of the 1960s. Training of Engineers began in the mid-1980s and the name changed to the Rovaniemi Technical College. In the 1990s, the construction study programme was integrated along with the Rovaniemi Technical College into the Rovaniemi Polytechnic.

The main objectives of the Polytechnic are to develop teaching and contacts with working life as well as to increase internationalisation. The strategy of the Polytechnic will strongly focus on the regional impact of the Lapland area.

Mission and objectives

The Rovaniemi Polytechnic shall attend to the polytechnic-level teaching of the pivotal branches of industry in Lapland and to applied research throughout the entire province. The Polytechnic shall serve as a driving force for the development of the region and as a support for companies in the sphere of traditional livelihoods and for those starting in new fields as well as to tend to the sustainable development of the health and social well being of the population. In its activities, it shall emphasise the profiled fields in accordance with the strategies of the rural district and the province. The central principals of activities shall be internationalism, a multidisciplinary approach, internal and external cooperation, and networking.

4.3.3 Kymenlaakso Polytechnic
(www.kyamk.fi)

General

The history of the Construction Engineering Department of the Kymenlaakso Polytechnic extends more than 100 years back in time:

- Wiipuri Industrial School 1898– 939 (Building Technician)
- Kotka School of Technology 1945–1962 (Building Technician)
- Kotka Institute of Technology 1962–1991 (Building Engineer and Technician)
- Kotka Polytechnic, temporary 1991–1995 (Building Engineer and Technician)
- Kymenlaakso Polytechnic 1996– (Engineer (B. Sc.)

The Kymenlaakso Polytechnic is operated by Kymenlaakso Polytechnic Ltd, which is owned by the City of Kotka (51%) and the Kouvola Region Federation of Municipalities (49%). The operations of the Polytechnic are headed by the Board of Management, Pedagogical Board, Advisory Board, the Rector and Associate Rectors.

The educational departments have been divided into two administrative sectors: the industrial sector and the service sector.

Mission and objectives

The Kymenlaakso Polytechnic produces internationally competitive know-how, expertise, and professional renewal in co-operation with the industries and employers of the region. By such means, the Polytechnic promotes the development strategies of the Kymenlaakso region and, in certain key fields, the industries at a national level.

The core strategies ratified by the Board of the Polytechnic are:

1 the overall strategy for 2000–2003
2 the research and development strategy for 2000–2003

The core strategies are supported by:

1 the business service strategy
2 the adult education strategy
3 the internationalisation strategy
4 the communications strategy

Focal areas in the overall strategy concern maintaining and developing high-level learning environments and the promotion of research and development and the associated services.

The degrees of Construction Engineer (B.Sc.) have already corresponded well to European degrees as the content and scope of the studies is uniform. Studies taken abroad have primarily corresponded to courses arranged in Finland; the courses have been compared by assessing the contents and requirements of courses against each other.

The two options available in teaching and R&D within the Degree Programme are:

1 Renovation and Facility Management
2 Wood Constructions and Construction Design

Moreover, a student can specialise in building export during advanced studies. In this case, the specialised professional studies are drawn up on the basis of a personal study plan, and the studies are taken in co-operation with an exporting construction company and a foreign Polytechnic. Some of the studies can also be taken on the job.

4.3.4 Häme Polytechnic
(www.hamk.fi)

General

Häme Polytechnic is a leading developer of expertise and promoter of business strategy in its operational area. It holds a key position in developing Finnish Polytechnic education, vocational teacher education and driving instructor training.

The successful activities of the Häme Municipal Federation for Vocational Higher Education are based on its diversified and high-level know-how in the field of renewable natural resources, environmental development and high technology, and on wellbeing of people and communities. These all generate new innovations for regional, national and international development.

Mission and objectives

The objective of Häme Polytechnic is to promote wellbeing by enhancing the competence and internationalisation of individuals, society and companies and by promoting innovations and the creation of new companies with the aid of high-level and up-to-date vocational education and closely related research and development.

4.3.5 Vaasa Polytechnic
(www.puv.fi)

General

Vaasa Polytechnic started as a temporary polytechnic on 1 August 1996 and obtained a permanent status on 1 August 1999. The Degree Programme of Building Engineering is based on the Degree Programme of Building and Environmental Engineering in the previous Institute of Technology. The current yearly intake is 30 students. In 1995–1997 a yearly intake of 15 students was admitted for the English medium Degree Programme. An ongoing English medium Degree Programme is the Degree Programme of Design of Built Environment, which will, however, end: the last intake for the programme was in the autumn of 2000.

Mission and objectives

The mission of Vaasa Polytechnic is to organise in all its fields multi-lingual, high-level theoretic-practical education and relevant applied research and other related services. For this reason Vaasa Polytechnic develops its tuition and other activities to comply with the internationally competitive requirements on degrees. The Polytechnic fulfils the international requirements on quality in all respects. The education and the supporting activities are planned and implemented in close co-operation with industries and other working life, with the graduating experts' excellent employment opportunities as a special aim.

The objective of the Degree Programme in Building Engineering is to provide the Engineer with qualifications for building management of house building projects, building and structural design, as well as new building production and maintenance of buildings. A Civil Engineer has required skills to work in Finnish and international assignments related to design, supervision, production, product development and sales for consulting companies, in building industry or public sector, or as a private entrepreneur.

The main areas in the specialised studies are the structural design and computer aided design. In the specialised studies of building projects the main emphasis lies on building production engineering, project management and computer aided production design, which are partly completed as work placement in companies. In the specialised studies of building design the main areas are architectural design and CAD.

The vision and strategy of the Polytechnic have been set by the Board and the Management Group of the Polytechnic. The general objectives of the Degree Programme in Building Engineering have been defined in co-operation by the staff of the Department based on estimates on the needs of building business and on the areas of special knowledge of the staff. The basis for the curriculum is the views of the Advisory Board representing working life in building business concerning the objectives of the education.

4.3.6 Sydväst Polytechnic
(www.sydvast.fi)

General

The Degree Programme in Construction Engineering at Sydväst Polytechnic has its origin in a school for vocational diplomas founded in Helsinki in 1881. In 1978 the college was moved to Ekenäs (Tammisaari) about 90 km west of Helsinki. The college was rather small with 180–200 students in three Departments – Mechanical Engineering, Construction Engineering and Electrical Engineering

In the middle of the 1990s the higher vocational institutions for the Swedish-speaking population of the South-westerns part of Finland decided to create a Polytechnic to complete the operation of the two other Swedish Polytechnics in Finland (Helsinki and Vaasa).

Mission and objectives

In Sydväst Polytechnic students are trained to know how and why. In the education the consideration of environmental issues are emphasised. Although the education is focused on providing for the needs of the Swedish-speaking coastal and archipelago population the international orientation with special emphasis on the Nordic countries is highly considered. The focus of the programme is on giving a general education in the field of construction and providing an opportunity to specialise in structural engineering and construction economics or architectural engineering and building design based on our earlier Degree Programme for Constructing Architects.

4.3.7 Satakunta Polytechnic
(www.spt.fi)

General

The education of Construction Engineering in Pori started in 1899 in the Pori private industrial college. Satakunta Polytechnic was officially established in 1997 but had already a year earlier found its present form when different educational institutes joined together. Satakunta Polytechnic is a multidisciplinary Polytechnic with ten educational units in three sectors. The Degree Programme in Construction Engineering belongs to the sector Technology and Maritime.

The vision is that the Polytechnic is a significant European institute in higher education producing knowledge appreciated by the working life.

Mission and objectives

The mission premise is that education and R&D are working together, especially as concerns the development of the Satakunta area and its business life. The

Polytechnic supports lifelong learning and entrepreneurship. The Polytechnic is also acting as a learning and knowledge centre in a networking environment.

According to the technology strategy, the focus areas are automation technology, telecommunication, electronics and energy and environmental technology. Construction Engineering has connections to these focus areas, e.g. via energy and environmental technology and automation technology. The focus areas inside the Construction Engineering mentioned in the strategy are structural technology, building services, IT systems, energy and building production.

4.3.8 North Karelia Polytechnic
(www.ncp.fi)

General

North Karelia Polytechnic started its operation as a temporary Polytechnic in 1992. The Polytechnic was granted a permanent licence among the first ones in 1996. Originally, Engineering education started in Joensuu in 1961 at the Wärtsila Institute of Technology, with Mechanical Engineering and Civil Engineering.

Mission and objectives

The operational philosophy is that North Karelia Polytechnic trains professional for the needs of the surrounding society with the means and methods of modern education, research and development. In regional development the Polytechnic generates – independently and together with its key partners – internationally competitive know-how and promotes entrepreneurship. The Polytechnic values interdisciplinary expertise and know-how in its activities.

The vision is that in education, research and development North Karelia Polytechnic is an internationally renowned and inspiring learning and working environment and partner. The Polytechnic is a regional player that actively enhances the prosperity of its operational environment.

The aim of North Karelia Polytechnic is to provide young people with an internationally competitive alternative of higher education, to further the success of North Karelian companies and working life in a customer-oriented manner in the regionally acknowledged areas of strength, and to actively create new competencies in entrepreneurship and expertise. In this mission North Karelia Polytechnic participates actively in the development and renewal of regional business and working life, economy and welfare.

4.3.9 Kajaani Polytechnic
(www.kajak.fi)

General

Before the foundation of the Kajaani Polytechnic Department of Engineering, a programme for Construction Engineers did not exist but Kajaani Technical College provided construction training in a three-year training programme. In the mid-1990s, that programme taken over by the Polytechnic and offered for the students admitted to the four-year study places. However, there was a need for a new Degree Programme because the volume of conservation building had clearly been growing compared to new construction since the beginning of the 1990s. Moreover, the significance of long-term property maintenance and life-span thinking were increasingly taken into account in property management.

Mission and objectives

For these reasons it was decided that the new Polytechnic Degree Programme should concentrate on facilities management and provide training in the long-term maintenance of properties. The Degree Programmes was called 'Facilities Management' because it provides both a technical and financial outlook. According to a Ministry of Education Stipulation in 2001 all Degree Programmes specialising in new and conservation construction, building production and facilities management are to be called 'Degree Programmes in Construction Engineering'.

The vision is that Kajaani Polytechnic will be one of the most distinguished Polytechnics in its chosen fields providing training for internationally minded self-confident experts and promoting enterprise, industry and commerce.

5

Ideas for development of Civil Engineering education and research for meeting the challenges

5.1 Conclusions on challenges

The European and Finnish strategies and visions of Building and Civil Engineering (the sectors of buildings and real estates, civil infrastructures, industrial infrastructures, water resources and environmental engineering) are very demanding and ambitious, and they are posing high challenges to higher education of Civil Engineering, and to the research of this field.

Finnish Building and Civil Engineering has good possibilities to reach these demanding objectives with great success, both in the domestic and the European market. At present there is a clear gap between the strategic objectives and visions, and the current reality of practice, development and research. It will be possible to bridge this gap only by implementing changes in the education and research field.

We can make the following detailed conclusions based on the strategies and visions of the society and stakeholders of the building, civil engineering and real estate cluster:

- This cluster will face a great change already during this decade, and the change will continue in the following decades.
- The strategies and visions are very ambitious.
- The visions will be reached through a process of interaction and learning.
- There is potential to reach these goals, but a significant and real increase in knowledge on many sectors is needed.
- One of the cluster's most important future objectives is to make the sector more interesting and attractive to young people.
- Education, academic research and applied R&D works of researchers and industry have to play an important role in advancing towards these goals.
- Higher education has to be developed, taking the following principles into account:
  - Higher education, research and development have to be able to create and support innovation processes and to plan and carry out integrating multidisciplinary entities.
  - Besides the integrating and synthetic research, we will also need development and business management expertise and narrowly focused expertise of the highest technical level on all sub-areas.

- A significant part of the Graduate Engineers and Engineers must be able to enter the international working life with a competitive level of professional knowledge, communication and social skills.
- The highest international level of the skills mentioned above have to be reached both in University education and research.
- Academic education and research has to be much more international than is the case today.
- Polytechnics have a main goal to educate practically oriented Engineers for design, site management, maintenance, repair and rehabilitation (MR&R) and business management.
- Polytechnic Engineers must have partly more specific skills, partly skills or a wide scope.
- Most of the Polytechnic Engineers will focus on local working, but they must also master international technology developments,, and they must be able to keep up with and learn new Finnish and international knowledge, especially the European standardisation.
- Some of the Polytechnic Engineers must be capable of participating in international activities in their area of expertise, especially in product development, design of building structures and civil infrastructures, site production and manufacturing of materials and components in factories.
- In particular, the development of European norms, standards and guidelines should be carefully followed in teaching in order to be always updated in this important issue.

5.2 Some ideas for development of the Civil Engineering Degree Programmes in the Technical Universities

5.2.1 General principles

The External Evaluation Team has analysed the current education and the self-evaluation reports of the institutes in the context of the current state, development trends and future visions and objectives in Europe and Finland.

The role of this Team has been to analyse the current education and research in the context of European and Finnish practice, development trends, visions and targets, and to present conclusions of the findings as well as ideas and recommendations.

In this chapter some ideas and viewpoints for continuous development of the education and research especially in the Technical Universities will be presented, for the use, in particular, of the Technical Universities which have the right and duty to plan and realise the changes under the guidance of Ministry and Education.

5.2.2 Ideas for development of the education of Graduate Engineers (M. Sc. Tech.)

Graduate Engineers have their main responsibilities on the highest level of specific expertise areas, R&D leadership and works, as well as management of firms and business leadership in all fields of the Building and Civil Engineering cluster. Moreover, the skills for lifelong learning have to be guaranteed with good basic knowledge. The following schedule of skills and their main contents can be presented:

- Good knowledge on technical sciences (including technical, economic and managerial theories) in order to be able to learn, apply and implement new and innovative technologies, management and business ideas in a controlled way. Most of these knowledge areas should be included in the education of all branches of Civil Engineering, but partly on different levels (approbatur or cum laude approbatur). These technical sciences include, for example:
  - mechanics of structures
  - building physics
  - building chemistry
  - building biology
  - system engineering, also including risk analysis and control and decision making
  - logistics
  - fuzzy systems and neural networks
  - economy, management and business theories
  - theory of production and manufacturing processes
  - theory of innovation processes.
- Reasonable knowledge on natural sciences which the technical sciences are based on, in order to be able to understand and use the methodology and methods of technical sciences. All these natural sciences have to be taught to all students, but on different levels on different branches. The following natural sciences are needed:
  - mathematics (e.g., analytic geometry, differential calculations, probability theory, tensor analysis)
  - physics
  - chemistry
  - biology
- Professional frameworks, processes, methodologies and methods of design, production management and leadership of firms and organisations.
- These methods include their applications to new construction and maintenance, repair and rehabilitation (MR&R), and they have partly different applications to the Building, Civil and Environmental Engineering sectors.
- Numerical methods of mathematics with IT applications (Mathcad or corresponding programs) are also included.

- All education can be based on an integrated lifecycle principle, thus integrating different phases and methods
- Supporting skills:
  - managing human resources and projects in the constantly changing world
  - clear presentation verbally and in writing, also in foreign languages
  - social and communication skills in the home country and in foreign cultures.

This seems to be a very wide range of education. However, reasonable basic knowledge in natural sciences makes the learning of methods of technical sciences easy, while the latter provide efficient and direct support for learning of professional methods. This means that some time could be taken from the current, very detailed and diversified professional parts of the educational programme, and moved into the education of technical sciences. This will result in a slight increase of practical starting guidance needs at the first working place, but the benefits in terms of future level of skills and lifelong learning capabilities are much bigger than the minor starting difficulty. This difficulty can be partly eliminated with short working periods during the studies.

In applying this kind of Degree Programme the following application principles are decisive:

- The education of natural sciences and technical sciences (including technical, economic and managerial theories) can take place in terms of shared courses offered for several branches of the Technical University. Probably all of these courses are already now given at Tampere and Helsinki Technical Universities.
- The education to cross the borders between natural sciences, technical sciences and professional methods is of utmost importance, but currently this is often a weak and very de-motivating point. This crossing can be realised through the use of exercises and group works which serve as links between these sub-areas. All exercises have to be specifically focused on the applications of the upper level; this means that
  - exercises and group works in natural sciences are direct applications to methods of technical sciences;
  - exercises and group works of technical sciences are direct applications to methods of professional methods;
  - the teachers of the upper level guide the exercises of the lower lever;
  - to quote an example, there is already now a chain: mathematics – mechanics of structures – static and dynamic design of structures.
- The supporting skills mentioned above can be educated as a “by-product” of teaching methods during exercises, group works and seminars.
- International connections in the form of continuous co-operation in research and education, including the operation by both teachers and students, would bring in the knowledge on foreign cultures and knowledge.

This kind of education model would bring also following benefits:

- The capability of Civil Engineers to multidisciplinary work with other technical professionals, and even outside the field of technology would be strongly promoted through the improved common bases on technical and natural sciences.
- The improved level of knowledge in scientific methodologies and methods would greatly improve the skills and competitiveness of researchers in the construction cluster to meet the competition with other branches in Finland as well as with other European researchers.
- The improved level of knowledge in scientific methodologies and methods would greatly improve the capacity to produce new innovative results and innovation processes into Building and Civil Engineering, mainly in close international co-operation.
- The increased knowledge of Graduate Engineers in technical sciences would greatly improve the fruitful co-operation between practice and research.

5.2.3 The Education of Civil Engineers and related professions in the UK

The education in the UK has been changed ten years ago into a unified form, where all educational institutes are Universities. This system has been described in Appendix A.

5.3 Development of the education of Engineers (B. Sc. Tech.)

The education provided by the Polytechnics has been actively developed during the past few years in connection with the overall renewal of the education in these institutes. It seems that this education is quite well updated vis-à-vis the requirements placed on Engineers. However, some principles, already presented above in relation to the Graduate Engineers, could in a limited range, be also applied to the education of Engineers. In most cases the Polytechnic includes also other branches of technology and economy, which can be utilised for the purpose of these necessary improvements.

The main objective of the development of Polytechnic education is to improve the readiness of Engineers for lifelong learning and for implementing new research results into practice.

A specific area is the leadership and management of site works, which has to be motivated in education. However, but this motivation has to be supported by the development of the productivity and working conditions of site Engineers through the development of site processes and organisations.

The structural components and other building products are mainly manufactured in factories, where Engineers lead the manufacturing processes. There-

fore the skills of manufacturing processes and methods, especially in precast concrete and wood product factories should be included in the education of Engineers of this sector. The factory production of steel products is mainly taken care of by Mechanical Engineers, and this is the reason why most of this sector falls outside the scope of the Civil Engineer profession.

Most Engineers are working in local production, but a certain share of them will also work in international environments and in R&D works; in these areas the necessary supporting skills are mainly the ones mentioned in the section on Graduate Engineer education.

5.4 Challenges of research and development

5.4.1 Research in the Technical Universities

The co-operative research with firms has grown in the Technical Universities, and it has been quite successful for practical development. This has caused also serious problems for research in several areas, because it has let to dominance of very short-term research, and creative and basic long-term research has been reduced with reduced direct state budget funding into Universities. This situation is sometimes leading into repetition of basically old research themes and issues, and preventing the creation of new research themes, which means also waste of funding. Sometimes even the need of partial funding from firms is leading to a dominance of very short term objectives of development and even of marketing.

Another problem is sometimes the weak skills of Civil Engineers in scientific research. There are only some fields on which the researchers of Building and Civil Engineering are competitive with other sectors in competition between research areas on funding of Finnish Academy. This weakness is also sometimes limiting the competitiveness of Finnish researchers of Building and Civil Engineering in the research of EU. This is a problem which has to be solved partly in research field, but mainly in longer term with the development of education of Technical Universities. The improved education of technical and natural sciences would serve basic knowledge on scientific methodologies and methods for research. The researchers have to develop these skills into active level on their specialisation field in the post graduate studies and Doctor thesis work.

It is utmost important that also the Graduate Engineers who will work in practice learn during studies to understand methodologies of natural and especially technical sciences. This will help their long life learning and innovative working in balanced development of technology, management and business in co-operation with researchers towards the strategic goals and visions which are described above.

Together with scientific research projects also the relevant laboratories should be helped on or developed to an adequate level.

5.4.2 R&D works in Polytechnics

The R&D of Polytechnic institutes can be defined as development, consulting and testing rather than scientific research. These works are mainly connected to project studies and engineer thesis, and they are important for interaction between students and practice, as well as between Polytechnics and firms.

The laboratories shall be on a reasonable level and equipped for carrying out the R&D activities mentioned above, but the monetary resources do not allow investing in high scientific level.

6

Recommendations for the development of the education programmes and research in Civil Engineering

Based on the analysis of the current state of Building and Civil Engineering, on the very broad and extensive strategies, visions and analysis of Building and Civil Engineering as well as on its own observations derived from the self-evaluation reports of Technical Universities and Polytechnics, the External Evaluation Team on Higher Education in Civil Engineering presents the following summarised recommendations. These recommendations and some ideas and models for implementing them have been presented more extensively in the chapters above.

6.1 Recommendations for the Technical Universities

1 The programmes in Civil Engineering should be further developed in accordance with the general principles of science-based university education. The educational content has to cover the synthesis, analysis, optimisation and management of broad concepts and narrow specialisations, as well as providing a foundation for life long learning. This requires strengthening the scientific base, especially at the level of technical sciences and, also, partly in some fields of natural science. Currently, there is a large and growing need for specialists in structural engineering and road design, because too few students have selected these specialisations in the past. There is also a perceived lack of cohesion between technical, managerial and economic skills.

2 Plans for developing the Degree Programmes should be made in close co-operation with other Departments having a relevance or synergy with Civil Engineering. This should cover Architecture, Building Service Systems Engineering, Production Economics, ICT and Industrial Management, but need not be restricted to these disciplines or Departments. Relevant international contacts as well as contacts within the national industry, administrative organisations, research organisations and other client organisations could be used to support this work

3 In the building sector the education of design and planning should be broadened to include the integration of all aspects of the technical design of buildings, including life cycle design and maintenance, repair and rehabilitation planning, reuse and recycling. Examples of the need for this integration would cover issues such as internal air quality and healthiness of building occupants, energy-efficiency, whole life economy, lifetime performance and environmental and ecological efficiency. ICT will be an essential tool in all these processes.

4 Education should be extended to understanding manufacturing processes and the management of factory-based as well as site-based production. Improved knowledge of building materials and components could be developed through the above-proposed strengthened base education in technical sciences. Education related to technical issues should be supported by education in scientific principles and methods of human, organisational and economic management.

5 Basic research should be strengthened in most fields by using and applying methodologies based upon natural and technical sciences. The extent of basic research supported at the European level, as well as that funded by the Academy of Finland has to be improved. Success in funding would lead to further activity and the reasonable expectation of follow-on funding.

6 The continuous and direct interaction of students with the business life could be strengthened, especially in the Department of Civil Engineering in Helsinki Technical University, through the use of more experts from business life in subjects that are dealing with professional practice. Connections with research in other institutions (i.e., Universities and VTT) could be improved through the exchange of lecturers and researchers in selected areas, i.e., where there is undoubted expertise that is lacking in the Department.

7 Existing co-operation with industry in areas of applied research is encouraging and should be continued and developed further. Special attention should be paid to applying the methodologies and results of science-based research to the field of applied research, where this has the potential to modernise and extend the latter's effectiveness.

8 Internationalisation in education and research could and should be improved. In practice, this is likely to mean the exchange of academic staff and students and an increase in collaborative international research, especially in the context of the EC's Sixth Framework Programme. Special attention should be paid to increasing international contact with the most important export countries for the Finnish Building and Civil Engineering business, namely Germany, Sweden, the UK, Russia, Poland and the Baltic countries. In some fields other countries might also be important. Beside technical knowledge, these contacts should be used to raise awareness and knowledge of foreign markets, as well as national and business cultures,

and languages. Success in export terms is more likely to be effective in the language of the target country. This means that students should be competent in English and at least one other foreign language.

9 New teaching methods should be increasingly implemented, especially the use of more integrated exercises, seminars. The use of more ICT tools, the Internet and software covering the natural sciences, technical sciences and professional methods is recommended. Funding should be directed to supporting the development or purchase of software, so that the Universities can make use of centrally updated software and ICT tools. Seminars and team-based activities should be encouraged, since these can have benefits in learning related to skills in leadership, communication and social interaction. The standard of pedagogical skills varies within the institutions and more should be done to ensure that all academic staff engaged in teaching duties are up-to-date in this respect.

10 The reintroduction of Civil Engineering education in Oulu University should be properly considered. The education could be limited into areas where the national and regional need is highest, that is, structural design of special structures, integrated technical design and maintenance, repair and rehabilitation planning and the management of buildings and other facilities. This education could be strongly supported by existing educational provision in the natural sciences, technical sciences, environmental engineering and architecture of Oulu University. Co-operation with the neighbouring University in Luleå could be established. Also local co-operation between Oulu University, Oulu Polytechnic and Oulu VTT could be developed in order to build a strong regional centre of excellence.

11 The funding of higher education and basic research for the Building and Civil Engineering sector should be increased to a level that is commensurate with the needs outlined above: the present provision is inadequate.

6.2 Recommendations for Polytechnics

1 Polytechnics have, as their primary goal, the education of practically oriented Engineers in design, site management, maintenance, repair and rehabilitation and business management. The rapid changes that have taken place and which will continue in the Building and Civil Engineering need to be supported by the continual development of Degree Programmes in Civil Engineering. Most Polytechnics have robust strategies and visions for their future development.

2 One particular area of specific educational need (and, therefore, curriculum development) is leadership and the management of site works. This requires a deep understanding of the entire supply chain for building and construction and the production processes that form an integral part of it.

A practical understanding of manufacturing processes and methods of factories, especially in relation to precast concrete and timber products, should be instilled in the students so that there will be a sufficient number of Engineers to deal with the specific challenges in these sub-sectors. Institutions should consider, in co-operation with contracting firms, means and actions for motivating and promoting the specialisation of students in site and production management, and for developing the attractiveness of site management as a lifelong career.

3 Most Engineers are working locally, but doubtless many will work internationally, or be subject to strong foreign influences, at some point in their careers. This points to a need for active international staff and student exchanges. All Engineers must be capable of following and understanding new developments of standards. European standardisation is a case in point, where the development of norms, standards and guidelines could have profound implications for Finnish industry.

4 Engineers must also be able to participate in the application and implementation of innovation processes in practice, and in bringing about a multidisciplinary approach to project-based work. All Engineers should have strong and practical technical skills, but should also be competent leaders and communicators, and be acutely aware of other social skills.

5 Most of the human and materials resources of Polytechnics are concentrated upon the educational process. Production and product development, materials testing for local firms and the condition assessment of buildings and Civil Engineering structures are useful activities, which are mainly connected to project works and final thesis works. The role of the laboratories within the Polytechnics is primarily to support education and, secondly, to support the consulting and development services of the Polytechnics. Investment in laboratory equipment should be maintained at a moderate level, taking into account other available laboratory resources in order to avoid overlapping investments. Funding given to up-to-date software that can be used to support learning has to be increased.

6 Co-ordination between the Polytechnics could be increased on several levels, for example in unifying the technical curriculum, in unifying the mark levels between Polytechnics, in developing ICT support for learning and in the production of educational materials generally.

APPENDIX 1:
The education of Civil Engineers and related professions in the UK

The UK system of undergraduate education in the built environment – to set Civil Engineering in its broader context – differs from that in many other countries, including Finland and others in the Nordic region.

Civil Engineering education in the universities in the UK – there are no longer polytechnics – is broadly similar, though there are clearly differences amongst them. One of the more important distinctions to draw between the UK and Finland is that the specialisations found in the former are most likely to be located outside Civil Engineering degree programmes and the departments responsible for them. For example, the disciplines of construction management and building engineering may well be the subject of self-standing undergraduate programmes and be managed in departments other than Civil Engineering. In some universities, construction management and its close cousin, project management, are offered as taught postgraduate (Master of Science) degree programmes only.

In the UK, there is more of a tendency to specialise at the undergraduate (first cycle) level. Further specialisation or, increasingly, conversion courses and programmes at the postgraduate (second cycle) level may also occur. This can mean that graduates enter industry with a somewhat narrower focus than would be found elsewhere. Many educationalists and industrialists have challenged this state of affairs over the years. However, there is little evidence of this position changing.

One of the reasons for enduring the *status quo* is the power of the professional institutions, covering the many disciplines that fragment the construction sector. In order to qualify as a Civil Engineer or Building Engineer, one must be the holder of a Bachelor's degree from a university department and programme that has been recognised or accredited by the respective professional institution. A period of approved practical experience and a test of professional competence is also required before full qualification is possible, which is usually signified by the award of a 'chartered' designation.

The professional institutions emerged in Victorian times and, for a long time, provided the only way for most people to qualify in their chosen profession, including Civil Engineering. Historically, it was the professional institutions that exercised the role of education, training and professional conduct. They set examinations and controlled entry to the professions. Most have long since relinquished their education role, leaving it to the universities to provide the education under their ever-watchful eye. Indeed, the professional institutions guard their position jealously, seeing themselves as the guardians of professional standards, ethics and the voice of their respective discipline.

Accreditation by the professional institutions – in the case of Civil Engineering, the Institution of Civil Engineers – takes into account teaching and research quality. All UK universities are rated for the quality of their teaching and research. University departments that fail to achieve standards that are acceptable to the respective professional institution are likely to see recognition of their degree programmes withdrawn. The implications of this for the future of departments can be dire, since student recruitment is based heavily on the formal recognition that is accorded by the institutions.

UK professional institutions have taken lifelong learning very seriously. They have been instrumental in establishing the requirement for practising Engineers and others to undergo a minimum amount of continuing professional development or CPD as it is generally known. Failure to satisfy the requirements of CPD can mean expulsion from membership of the institution and with that the lost of a recognised chartered qualification. That said, cases of expulsion are not so common, although this position may change in the future as tougher requirements are set for all members.

The Bologna Declaration has received a lukewarm reception from the UK professional institutions, from the universities and government bodies and agencies. This is not surprising as the UK operates in a way that is based largely on the three-year first cycle and then a two-year second cycle. The idea of a Bachelor's degree as a sufficient academic qualification in its own right has long been held by the UK. Even so, there is a move towards second cycle qualification amongst educationalists, though in the construction sector this is more the exception than the rule.

A more valid concern, rather than an objection, raised by the UK is its belief in outcomes (or outputs) as opposed to what is generally termed 'time served'. The UK does not share the same view as other countries over the period of qualification through education. A five-year undergraduate degree programme is quite unacceptable to the UK. In fact, there have been moves in the past to compress the studies for a Bachelor's degree into two years, by teaching all year around. However, there is less enthusiasm today than when the idea was first mooted.

In any comparison between the UK and Finland one must remember that there is a huge difference in populations and the number of universities. This provides great variety and choice, but it also means hidden dangers, not least from the level playing field that was created 10 years ago when the former polytechnics were turned into universities. For most of the polytechnics, that had a more vocational orientation, this has meant a transformation in culture to one where research has become substantially more important: some have succeeded, others have not. The binary divide between the perceived more academic educational programmes based in the universities and those they were viewed as more practical or vocational in the polytechnics may have gone. However, the search for the best possible education continues.

Brian Atkin
November 2002

APPENDIX 2:
Statistical characteristics of the institutes

University/Polytechnic	Staff/student-staff ratio	Students/ female	Applications/priority/ students entered
South Carelia Polytechnic	9/18,5	167/26	151/39/39
Häme Polytechnic	14/27,3	382/57	247/-/105
Jyväskylä Polytechnic	2/63,5	127/17	246/61/21
Kajaani Polytechnic	4/18	72/11	91/20/21
Kymenlaakso Polytechnic	5/18,2	91/19	91/43/33
Oulu Polytechnic	24/14,6	351/55	478/199/143
North Karelia Polytechnic	4//27,2	109/17	136/43/33
Pohjois-Savo Polytechnic	21/9,3	196/35	224/69/77
Rovaniemi Polytechnic	8/16,6	133/14	301/135/51
Helsinki Polytechnic	24/16,7	401/73	571/231/123
Satakunta Polytechnic	5/21,4	107/30	171/33/34
Seinäjoki Polytechnic	4/21	84/10	135/45/30
Swedish Polytechnic	1/69	69/3	37/32/11
Sydväst Polytechnic	4/21	84/10	35/13/15
Tampere Polytechnic	14/25,4	356/68	562/167/87
Helsinki University of Technology	39/18,1	706/242	949/129/124
Tampere University of Technology	22/22,5	496/109	477/143/72
Turku Polytechnic	8/29	232/20	494/176/69
Vaasa Polytechnic	11/11,8	130/34	125/40/26

APPENDIX 3: Statistics of the Finnish Construction and Real Estate Cluster

Table 1. Output of the Finnish Construction and Real Estate Cluster in 2001

	Building Services	Building - Industry	Building Product Industry	Real Estate Industry	Civil Engineering
New Construction	2190	3300	3760		
Renovation and Maintenance	1560	710	2910	1020	
Civil Engineering			900		2700
Facility Upkeep				12300	
Exports	1485	400	3015		100
Foreign Subsidiaries	2800	550	4050		
Total (€ Mill.)	8000	5000	14600	13300	2800

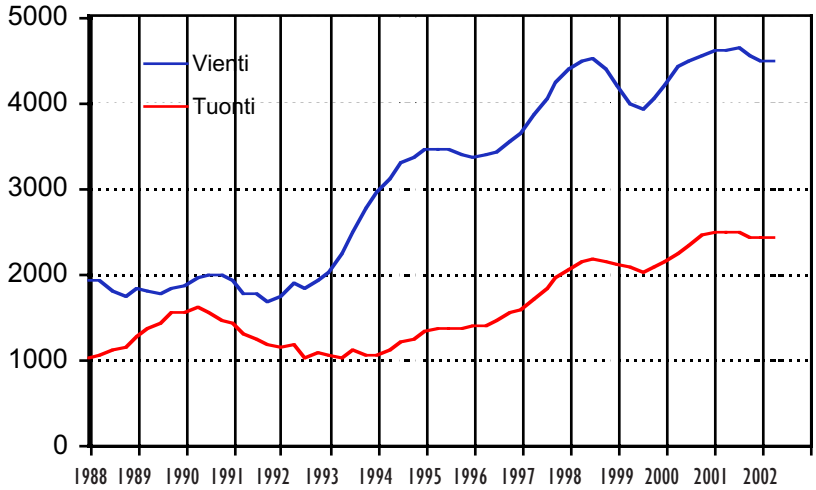
Reference: VTT rakentamisen liiketoiminnat 12/2002

Table 2. Export industry turnover & exports (€ Mill.)

Firm	Turnover 2001	Export 2001
Kone Group	2816	2675
Finnforrest Group	1428	1214
Outokumpu Copper Products Oy	492	472
Addtek International (current Consolis Group)	531	450
Paroc Group Oy Ab	281	188
Rannila Group	169	101
Sanitec Oy	995	94
Uponor Oyj	1192	91
Koskitukki Group	149	89
PPTH Norden Oy	117	59
Optiroc Oy Ab	149	54
SaintGobain Isover Oy	111	43
Tulikivi Oyj	59	32
KWH Pipe Group	411	30
PRTForest Oy	98	22
Oras Oy	115	14
Parma Betonila Oy	162	13
Normek Group	45	12
Alavuden Puunjalostustehdas Oy	32	10

Reference: VTT rakentamisen liiketoiminnat 12/2002

Figure. Annual foreign trade of building products in Finland, € Mill. (incl. building timber: 75% of timber export. Upper line = export, lower line = import)



Reference: Tullihallitus, RT

Table 3. Finnish companies in foreign ownership in 2001

NCC Finland Oy	Lohja Rudus Oy Ab
Skanska Group	Optiroc Oy Ab
Peab Suomi Oy	SaintGobain Isover Oy
Terramare Oy	Finnsementti Oy
	Novart Oy
ABB Oy Talotekniikka ja kiinteistöpalvelut	Abetoni Oy
Sanitec Oy	Gyproc Oy
	H + H Siporex Oy
LTKonsultit Oy	Winenerberg Oy Ab
Optiplan Oy	Minerit Oy Ab
SCC Viatek Oy	

Reference: VTT rakentamisen liiketoiminnat 12/2002

APPENDIX 4:
Guidelines for the self-assessment

DESCRIPTION: QUANTITATIVE AND QUALITATIVE INFORMATION (max. 20 pages)

1 THE FRAMEWORK

- The organisation of the university/polytechnic and the position of the degree programme within it. Describe briefly the history of the programme
- Mission, aims (broad purposes), objectives and strategies of the university/polytechnic and the degree programme. Describe the internal process by which its mission is defined and converted into strategic and operational plans
- Adoption of the system essentially based on two main cycles. In what way the Bologna-process has been taken into account by your university/polytechnic
- Financial resources of the degree programme

2 DEGREE PROGRAMME/DEPARTMENT STAFF

- Staff profile including the number of staff, educational background, age profile, pedagogical skills etc. Describe the staff profile and evaluate how it fits to your current plans.
- Evaluate what have been the plans for staff development and what are the main targets of the topic in the near future
- What are the incentives in order to motivate staff

3 DEGREE PROGRAMME STUDENTS

- Describe and assess the current profile for graduating students in terms of managerial skills, professional competences, and entry level into corporate employment. How do the above mentioned relate to the target profile in the degree programme
- Describe the main types of students (different types of intake students) served by the degree programme. List and evaluate the main actions taken in the past and planned in the future to improve the match between intake profiles and the mission and degree programme objectives
- The international nature of the student body. International marketing of the degree programme, admissions procedure, international placements, readiness of the degree programme students for mobility

4 TEACHING AND LEARNING

- Study programme, curriculum, aims and content in 2001–2002
- Please attach an appendix on curriculum and course contents in English (attached document)
- Evaluate teaching methods, curriculum contents, student engagement and participation for the improvement of study methods
- Use of learning resources (materials, laboratories, libraries etc.) and latest innovations of teaching (computer aided teaching, virtual learning etc.)
- Describe and evaluate the connections between research and study programme
- How is the internship programme for students built into the curriculum. Evaluate the importance of your internship programme and other links to the working life

- In what way the needs of society and industry related to civil engineering has been taken into account in teaching and in planning of courses
- Are there any quality systems taken into account in the planning of teaching of your degree programme

5 ASSESSMENT OF STUDENTS

- The range and use of assessment methods (e.g. written exams with essay questions or applied problems, continuous assessment of coursework, laboratory work, projects, use of learning diaries and portfolios) and marking/grading policy
- The use of students' self-assessment (e.g. examples how students evaluate their own learning and how teachers give feedback to the students)
- Feedback to students and/or curriculum/course design
- Monitoring of student progression. Assessment and improvement of student feedback systems

6 STUDENT SUPPORT AND GUIDANCE

- General guidance (e.g. strategy for support and guidance, written guidance on the programme/course level)
- Academic guidance (e.g. concerning course options, study skills)
- Describe the arrangements for career counselling on campus
- Tutoring and students' welfare support

7 CO-OPERATION AND NETWORKING

- Describe the main networking partners
- Degree programme co-operation with other institutions (national, international)
- Teacher and student mobility/exchange (partner institutions, quantitative figures). Identify major benefits and/or difficulties emerged from the exchange

8 DEGREE PROGRAMME INTERACTION BETWEEN INDUSTRY AND COMMERCE

- Describe the key processes used to manage the degree programmes relationships with the industry. List key relationships with industrial partners (e.g. projects, thesis-work, advisory groups). Evaluate the regional impact of your university/polytechnic
- Evaluate the key changes in the corporate involvement in the affairs of the programme that have occurred in the past 5 years. Identify future proposals for the involvement of industrial partners that will support the mission of the programme
- Recognition of educational requirements in industry, commerce and public life

9 RESULTS OF SELF-EVALUATION

- SWOT-analysis, both personnel and students. Please extend analysis to all above mentioned topic areas.
- Major strengths identified. Relation of strengths to goals
- Major weaknesses identified
- Major new developmental areas identified

10 PRACTICAL ARRANGEMENTS

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

APPENDIX 5:
Participants of the site visits

	Sarja	Stenius	Atkin	Cederwall	Elmroth	Lähteen-mäki	Laukkanen	Isotalo	Vesa	Vuorelma	Vatanen	Talvio
FINHEEC 13.10.	•	•	•		•	•	•	•	•	•	•	•
South Carelia Polytechnic 14.10.	•	•	•		•				•		•	
STADIA 15.10.	•	•	•		•				•		•	
HUT 16.10.	•	•	•		•			•	•		•	
Oulu Polytechnic 17.10.	•		•		•	•	•				•	
Turku Polytechnic 18.10.	•		•		•	•		•				•
Tampere Polytechnic 21.10.	•	•	•	•			•					•
TUT 22.10.	•	•	•	•						•		•
Jyväskylä Polytechnic 23.10.	•	•	•	•						•		•
Pohjois-Savo Polytechnic 24.10.	•	•	•	•				•				•
Swedish Polytechnic 25.10.	•	•	•	•				•				•

APPENDIX 6:
The programme of the day during the site visit

Evaluation of Civil Engineering Education at Universities and Polytechnics 14.10.–25.10.2002

Time	Programme	Persons involved
09:00–9:30	arrival to the Institution	evaluation team members preparatory meeting of the evaluation team
09:30–10:00	initial welcome & introduction of the Institute	dept. representatives (max. 8 people)
10:00–11.15	meeting with the programme students	students (max. 6 people, 1–5th year students)
11:15–12:30	meeting of the programme staff	staff members (max. 8 people, professors, teachers, lectures, assistants)
12:30–13.30	*lunch with students and staff*	
13:30–14:45	time for studying student exercises and thesis work	display of materials, thesis work, project papers, and course book
14:45–15:15	visit to lecture halls, laboratories,	persons in charge of facilities and individual library and introduction of equipment etc. teachers
15:15–16:30	meeting with the representatives of commerce and industry	representatives of industry (max. 6 people)
16:30–17:00	meeting of the evaluation team	evaluation team members
17:00–17:30	feedback	students and staff of the department

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