

SOME FINNISH VISIONS OF ENGINEERING EDUCATION

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Abstract: The Finnish higher education system consists of two sectors: universities and universities of applied sciences. The latter are also called polytechnics. Both sectors have significant engineering education.

The engineering education is not very popular in Finland nowadays. This causes problems in the future.

There are some Finnish Visions:

- A) The National Cooperation Group for Engineering Education was set up in 2007 in order to produce a national strategy for engineering education in Finland. The group has members from the Ministry of Education, universities, unions and labour market. The Group submitted its interim report "Well-being from Technology through Cooperation" in January 2008.
- B) The mission of the Finnish engineering education is to benefit people and the environment through providing knowledge and skills, research and innovations for the society and business life. As part of the National Strategy Project for the Engineering Education it was seen necessary to find out what kind of learning objectives do the challenges associated with sustainable development impose on the Finnish engineering education and how have the units providing engineering education responded to these challenges. Therefore, a research study was conducted at the Finnish Association of Graduate Engineers TEK.
- C) The Ministry of Education and all Finnish universities of applied sciences have a project called ENGIN. The project goals are
 - (1) to increase the attractiveness of engineering studies,
 - (2) to shorten the studying time and
 - (3) to decrease the number of interruptions of the studies.The project contains three groups: the group of structure development, the group of marketing and the group of teaching methods. The project has already organized some seminars and published two books about good learning practices.

Keywords: engineering education, vision, national strategy, sustainable development

1. INTRODUCTION

The engineering education is very significant to the Finnish economy. Engineers solve many problems and overcome challenges of today and tomorrow. But the opinion of the youth about engineering studies is nowadays not very positive. The young people see many problems and troubles in the new technology. The engineering education needs to change and show its important meaning also for the youth. Issues concerning sustainable development in the all education are increasingly relevant now and in the future. Enterprises need the best engineering education, but the focus ought be on quality, not on quantity. The Ministry of Education in Finland has a structure development program which aims at creating a new structure and new degree programmes in the Finnish engineering education.

2. BACKGROUND

The Finnish higher education system has two parallel sectors: universities and universities of applied sciences also called polytechnics or AMK institutions.

2.1. University education

Universities concentrate on academic and scientific research and education. Polytechnics are more oriented towards working life and they base their functions on the high demands of working life. The education and training provided by the polytechnics respond to labour market needs. Their task is also to conduct R&D which supports education and promotes regional development.

Finland has 20 universities. They enjoy the principles of academic freedom and autonomy, and hence, universities are very independent in their decision-making. All universities are state-run, the government providing some 70% of their budgets.

The total university enrolment is currently over 176 000 students.

All universities carry out research and confer doctorates. Each university has also a centre for continuing education.

Student intake, number of students and qualifications in universities, years 2003-2007

Year	Student intake	Share of females	Number of students	Share of females	Qualifications	Share of females
2003	20 782	55.8	169 846	53.5	18 197	61.3
2004	21 072	56.7	173 974	53.4	18 293	61.7
2005	20 858	56.6	176 061	53.7	19 176	61.8
2006	20 150	56.5	176 555	53.8	19 410	61.6
2007	19 648	57.4	176 304	54.0	22 310	63,0

Source: Statistics Finland

Table 1.

2.2. University of applied sciences education

The Finnish polytechnics system was built during the 1990's to create a non-university sector of higher education. It was founded on the institutions, which previously provided post-secondary vocational education and which have been developed to form a nationwide network of regional institutions of higher education, i.e. polytechnics.

Polytechnic education emphasises close contacts with business, industry and services, especially at the regional level. The degrees are designed to meet the changing requirements and development needs of the world of work, having a pronounced occupational emphasis, and qualifying graduates for various expert duties.

There are 25 polytechnics operating under the Ministry of Education. Most polytechnics are multi-field institutions and operate in several units.

Currently there are over 133 000 students registered at universities of applied sciences in Finland. Universities of applied sciences undertake some research and development with an applied and practical emphasis.

Student intake, number of students and qualifications in universities of applied sciences, years 2003-2007

Year	Student intake	Share of females	Number of students	Share of females	Qualifications	Share of females
2003	36 701	55.1	129 875	53.3	20 588	62.0
2004	36 483	56.3	131 919	53.7	20 821	62.4
2005	36 911	56.5	132 783	54.2	21 397	62.8
2006	36 276	55.7	132 560	54.3	21 006	63.6
2007	36 634	55.5	133 284	54.5	20 969	63.5

Source: Statistics Finland

Table 2.

2.3. Engineering education in Finland

Finland has 7 universities and 21 universities of applied sciences providing engineering education.

The total number of engineering students was 74,007 in 2009, 35,621 of which were university students and 38,386 were polytechnics students. The total number of graduated engineers in the same year was 9,000 (4,079 from universities and 4921 from polytechnics). (Statistics of the Ministry of Education)

Globally about one million engineers graduate every year, while the corresponding figure in Finland is about 9,000. This means that Finland cannot compete quantitatively.

In Finland, consequently, the primary focus must be on improving the quality of education, research and development in the field of technology.

The Ministry of Education has a structure development program for the Finnish higher education.

The goals are e.g. less university units, larger campuses, cooperation with degree programmes and also university fusions and alliances.

3. SOME FINNISH VISIONS, IDEAS AND ACTS

Many visions, strategies and acts for developing engineering education already exist. The National Cooperation Group for Engineering Education was assembled in 2007, and the development project of technical and engineering education began the following year. Moreover, many surveys, researches, inquiries and reports are constantly made.

3.1. *The National Cooperation Group*

The National Cooperation Group for Engineering Education was set up in 2007 in order to produce a national strategy for engineering education in Finland. The group has members from the Ministry of Education, universities, unions and labour market. The Group submitted its interim report “Well-being from Technology through Cooperation” in January 2008 and its final report “The National Profile Map” in 2009. The report has some significant visions and objectives for the Finnish engineering education:

“Finland endeavours to create the world’s best innovation environment. A prerequisite for this is that our engineers are the most competent.”

“In order to reach the objective, the key issues are to develop the financing systems of tertiary education, improve teaching, increase internationalization, take into consideration challenges of the sustainable development and structural development of the higher education system.” (Ref.II)

The Cooperation Group has also prepared action plans for the development of the teaching and learning of engineering and how to better face the challenges of sustainable development. The Group defined five most important proposals:

- The number of higher education institutions and establishments of institutions providing engineering education must be reduced.
- The qualitative criteria of the budgetary funding systems of universities and polytechnics must be widely applied in addition to the criteria based on the volume of education and research.
- Universities and polytechnics must collaborate in developing professional societal communication to various target groups as the youth and the political decision makers.
- Finnish engineering education needs to be made a world famous brand: a trailblazer for the requirements of sustainable development and working life collaboration.
- Cooperation both between stakeholders of engineering education and with other actors in the innovation system must be further intensified. (Ref.II)

This profile map is a remarkable tool in writing new strategies for the engineering education and in realizing structural developments.

There was also a project called “Competencies through Learning”, which was implemented as a part of the National Strategy Project for the Finnish Engineering Education. The abstract of the final project report states:

“The purpose of the project was to develop teaching of the engineering education at universities and polytechnics. The intention was to define how education must be developed in order to meet the strategic objective set by the National Cooperation Group for the Finnish Engineering Education: The best engineering education in the world is provided in Finland.”

“The starting point for the project work was an analysis of the anticipated skills and competencies that engineers need in the working-life in future. Learning objectives were defined based on the analysis of skill needs. Consequently, the project ended up with extending discussions to a number of questions and development needs including tertiary education institutions’ operating culture, qualifications, steering of teaching and teaching methods.”

“Excellent problem solving skills are a key strength of the Finnish engineers. These skills are based on in-depth knowledge of technology and good competencies in math and natural sciences. However, in order to meet the skill needs of the labor market in the future, the present engineering education provided by the universities and polytechnics needs to be developed in several ways. Many competencies those are important in working-life, like business expertise, internationalization and sustainable development skills, do not get enough attention in education programs.” (Ref. III)

3.2. Sustainable development and education

According to the National Cooperation Group for the Finnish Engineering Education the mission of the Finnish engineering education is to benefit the people and the environment through providing knowledge and skills, research and innovations for the society and business life.

The youth values life on different ways nowadays than so called baby boom generation: egoism is over, money is not the first thing and ecological visions are important. Issues like sustainable development, healthy environment, climate change, clean water, energy sufficiency, well-being and quality of life are more and more under discussion. Therefore all universities want to answer to these challenges in their new strategies. The sustainable development is integrated in the most degree programmes of engineering education.

The National Strategy Project for the Engineering Education was created in order to find out, what kind of learning objectives sustainable development imposes on the Finnish engineering education. Furthermore, the task of the project was also to find out, how engineering education has responded to these challenges.

Therefore, a research study was conducted at the Finnish Association of Graduate Engineers TEK. Project researcher Annina Takala was responsible for conducting and reporting the study.

The research study consisted of an extensive literature survey and interviews of 66 experts representing all key stakeholders of engineering education. The leading Finnish experts on technology and sustainable development were also represented among the interviewees, the National Cooperation Group and the steering group of this research study.

This research report has many important points:

“Sustainable development is a nationally and internationally accepted political concept, in which the objective is to assure the prerequisites of good life now and in the future, locally, nationally and globally. The essential question is how all activities can be adapted to the ecological carrying capacity.”

“Technology plays a key role in responding to the challenges associated with sustainable development. For example, mitigating climate change and sustainable use of natural resources require new and innovative technology that has energy and material efficiency as its starting point. Engineers act as decision-makers and experts and play a decisive role in advancing sustainable development.”

“The main challenge is to achieve a holistic view on sustainable development that simultaneously takes into account the environmental, social and economic aspects, in addition to the temporal and spatial dimensions. Engineering education needs to prepare students better, than it currently does, for systemic and life cycle thinking. Challenges of sustainable development are interdisciplinary by nature. Cooperation between different professions and disciplines is needed.”

“The findings of the present research indicate that the Finnish engineering education already enhances sustainable development. However, sustainability is not an approach consciously chosen. The way in which sustainability is carried out is, for example, in the form of isolated courses and research projects. A complete picture of the overall situation is missing. In order to follow the mission of the Finnish engineering education, knowledge and skills related to sustainable development need to be included among the key learning objectives in all degree programmes of engineering.” (Ref. IV)

All these examples tell that we have to change and develop the engineering education. The world has changed and is changing, and especially young people’s goals and values are different from those of previous generations. The future forces to come up with new ideas for education.

3.3. Engineering Associations’ National Climate Plan for Finland

In the international project titled Future Climate – Engineering Solutions being implemented by various engineering organisations, the associations of each participant country have drawn up the profession’s proposal for their country’s national climate programme, wherein national structures are analysed and technology-based means for cutting emissions and for slowing down climate change are presented. Because the problem is a global one, also global methods are needed to solve it, but in this assessment the focus is on national solutions.

These recommendations were presented in Copenhagen in December 2009 to the UN Climate Change Convention.

Finland’s contribution was drawn up in collaboration by the Finnish Association of Graduate Engineers TEK and the Union of Professional Engineers in Finland UIL. Education, e.g. engineering education, plays a major role in Finnish report:

“Education is in a key position in order that skilled people are available to develop technology also in the future. Expertise in sustainable development must be included in all education and training programmes in the field of technology, and this must be linked to core know-how. At the core of expertise in sustainable development there are the following: material and energy flow and energy efficiency, the ability and readiness to apply critical thinking, and system and lifespan thinking. In order that the objectives might be reached, it is necessary to clarify the foremost issues related to sustainable development and do so field-specifically and include them in educational programmes. Investments must be made in the quality of education and in the development of educational methods and learning environments.” (Ref.V)

The same thoughts are in new engineering education visions and strategies.

4. THE DEVELOPMENT PROJECT OF TECHNICAL AND ENGINEERING EDUCATION

The Ministry of Education and all Finnish universities of applied sciences have established a project titled INSSI (ENGIN in English documentation). This is a development project of technical and engineering education in universities of applied sciences and is going on until the end of March 2011.

4.1. INSSI project (engineering project) 14th May 2008 – 31st March 2011

This INSSI project has three main aims:

- a) To increase to attractiveness of engineering studies so that number of applicants will rise at least 10 %
- b) To shorten the studying time in universities
- c) To decrease the number of interruptions of the studies.

The project contains three groups:

- a) The group of structure development
- b) The group of marketing
- c) The group of teaching and learning methods.

The project has already organized some seminars and published two books about good learning practices.

The group of structure development has planned new structures for studies (common basic skills after which development skills will follow) and has suggested that in the future the number of the names of engineering degree programmes will reduce but maybe some new degree programmes need to be created.

The group of marketing has made some television ads and created the website in order to increase the interest in engineering education amongst the youth. The website “insinooriksi.fi” (“to become an engineer”) has e.g. good hero stories of young engineers, an engineering quiz and an engineering engine with which young people can find the best study programme for themselves.

The group of teaching methods has collected the best practices in engineering educations from all the Finnish universities of applied sciences. These practices (more than 70) are published in two books and many of them were presented during INSSI Forum on 17th – 18th March in Hämeenlinna. INSSI Forum collected more than 350 Finnish engineering teachers to discuss and to learn from each other.

4.2. The SME Inquiry

The Confederation of Finnish Industries EK explored the small and medium-sized enterprises leaders’ opinions about polytechnic engineering education in the autumn 2009. Small and medium-sized enterprises (SMEs) form the vast majority of companies in Finland.

The inquiry was based on the intermediate results of the INSSI project and it was conducted in the form of web questionnaire. EK received response from 400 SME owner-managers and executives. The results of the inquiry were published in January 2010.

The results of the inquiry clearly demonstrate that there is a growing demand for technical and engineering skills in the ongoing structural change of the economy.

A common request of the respondents was to include methods of ”learning by doing” abundantly in the education. According to them, a special skill of the polytechnics must be an exploring, developing and forward-looking dimension of this ”learning by doing”.

The inquiry proves that engineering education needs differentiation to meet the various demands. SME leaders strongly support reforms that are under way in universities of applied sciences.

These reforms include:

- Making the network of universities of applied sciences more effective through the so-called criteria of well-functioning campus,
- Bringing curricula closer to practice and problem-solving,
- Reforming learning environments and working methods,
- Linking internships and learning more closely together, and
- Increasing partnerships with enterprises

(Ref. 1)

The INSSI project has a challenging task to merge enterprises' wishes with youth's style of living and learning, and the common economic situation.

5. CONCLUSION

The engineering education is meaningful and important for the firms and enterprises, for the economy and for the future. Changes in engineering education and new contents are obligatory. New Finnish visions and strategies are coming to all universities and degree programmes. They act as guidelines also for teachers and students – towards our future!

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