

Assessment Report

Study Programme Group on Engineering

Tallinn University of Technology



1/28/2016

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1. Introduction

The aim of the assessment panel was the evaluation of the Engineering study programme group in Tallinn University of Technology (TUT).

The panel was asked to assess the conformity of the study programmes belonging to the study programme group and the instruction provided on the basis thereof to legislation and to national and international standards and/or recommendations, including the assessment of the level of the corresponding theoretical and practical instruction, the research and pedagogical qualification of the teaching staff and research staff, and the sufficiency of resources for the provision of instruction.

The following persons formed the assessment panel:

Prof Markus Mueller (Chair)	University of Edinburgh; UK
Prof Klaus Hellgardt	Imperial College London; UK
Prof Olle Holst	Lund University; Sweden
Ms Asnate Kažoka (student)	Riga Technical University; Latvia
Prof Jorma Hölsä	University of Turku; Finland
Prof Peter Palensky	TU Delft; the Netherlands
Prof Marketta Sipi	University of Helsinki; Finland

After the preparation phase, the work of the assessment panel in Estonia started on Monday, November 23, 2015 with an introduction to the Higher Education System as well as the assessment procedure by EKKA, the Estonian Quality assurance organization for higher education. The members of the panel agreed the overall questions and areas to discuss with each group at TUT, which were part of the assessment process. The distribution of tasks between the members of the assessment panel was then organised and the concrete schedule of the site visits agreed.

During the following 3 days meetings were held at TUT. In all cases, the schedule for discussion on site for each of the various study programmes only allowed for short time slots to be available for panel members to exchange information, discuss conclusions and implications for further questions.

In TUT discussions with the persons responsible for the study programmes, the staff, the students and the representatives from the employment market (employees, employers and alumni) were very open and interesting and allowed for an exchange of ideas.

On Friday, November 27, the panel held an all-day meeting, during which both the structure of the final report was agreed and findings of panel meetings were compiled in a first draft of the assessment report. This work was executed in a cooperative way and the members of the panel intensively discussed their individual views on the relevant topics.

2. . Assessment report of SPG at Tallinn University of Technology

STUDY PROGRAMME	TUT UNIT	LEVEL
Electrical Power Engineering	Faculty of Power Engineering	Bachelor
Electrical Engineering	Faculty of Power Engineering	Bachelor
Chemical and Environmental Technology	Faculty of Chemical and Materials Technology	Bachelor
Technology of Wood and Textile	Faculty of Chemical and Materials Technology	Bachelor
Food Engineering and Product Development	Faculty of Chemical and Materials Technology	Bachelor
Power Engineering	Virumaa College of TUT	Prof HE
Fuel Technology	Virumaa College of TUT	Prof HE
Machine-building Engineering	Virumaa College of TUT	Prof HE
Industrial Automation	Virumaa College of TUT	Prof HE
Electrical Power Engineering	Faculty of Power Engineering	Master
Electrical Drives and Power Electronics	Faculty of Power Engineering	Master
Distributed Energy	Faculty of Power Engineering/Estonian University of Life Sciences (joint programme)	Master
Fuel Chemistry and Technology	Virumaa College of TUT	Master
Chemical and Environmental Technology	Faculty of Chemical and Materials Technology	Master
Food Engineering and Product Development	Faculty of Chemical and Materials Technology	Master
Materials and Processes for Sustainable Energetics	Faculty of Chemical and Materials Technology/University of Tartu (joint programme)	Master
Technology of Wood and Plastic	Faculty of Chemical and Materials Technology	Master

2.1. Introduction and general findings at study programme group level

In general the panel is satisfied with the programmes reviewed in Tallinn University of Technology and its Virumaa College. Very open discussions were held with staff at all levels, researchers, students, alumni and employers. It is clear that the faculty and staff are dedicated towards their particular programmes, and are appropriately qualified to deliver these programmes. Students, alumni and employers supported this view. TUT face challenges in terms of resources, financial and human, and staff openly discussed these issues with the panel. The report highlights issues at a local programme level, but also issues that require addressing at a senior management level.

The self-evaluation document was very helpful in informing discussions with the institution. Some quantitative data was included in the self-evaluation report, but additional quantitative data came out of the discussions with representatives of TUT. This additional data is reported in the review and is reproduced to the best of our knowledge. If there are inaccuracies in this additional data, the panel request that the data are corrected.

Before providing general comments on the Programmes, the panel would like to make some general comments and recommendations:

- Academic Staff Policy:
 - Staff Reviews: At present teaching and research staff are reviewed every 5 years, with the emphasis on research. It is very difficult for staff to plan career development on a 5 year cycle. The panel recommend an annual review process in which staff are set targets for both teaching and research. By adopting an annual review process line managers can make promotion cases on an annual basis, and feedback to staff the requirements to achieve promotion. The staff will be more motivated and incentivised to perform in both teaching and research. The panel encourage TUT to support early career researchers in their career development.
 - Staff Recruitment: There is an issue with age profile in some programs, and as an example in Power Engineering there are no staff between the ages of 40 & 60. The Faculty needs to develop a recruitment policy to take into account staff retrials. This is linked with Staff Reviews, and in particular the career development of staff researchers. TUT has some excellent early career researchers, providing a pool for promotion to academic staff.
- Quality Assurance System: the panel recommend a more frequent internal quality assurance strategy to complement the international external assessment undertaken over a 7-year cycle. The internal assessment could involve members from other faculties, members from other Estonian universities and representatives from the employers. In this context we note that a new self-evaluation module has been developed as part of the internal/external quality assurance system which will be deployed every three years.
- Drop-out rate: This is a challenge for all programmes. It may be difficult to address because of issues beyond the institutions' control, eg. complicated national funding mechanisms for student admissions; admission requirements; and student financial difficulties. In discussions with staff and students it did appear that there were two phases of drop outs: early on in the first year due to motivation, wrong expectation and lack of mathematical knowledge; and during the final year of the Bachelors due to financial reasons with students being offered full-time jobs. The panel think that these two issues could be addressed by reviewing the content of the engineering courses in years 1 & 2, to make them more engineering relevant. In particular engineering examples could be included in maths courses to demonstrate the importance of maths teaching at an early stage in the programme. To address the latter dropout issue, discussions should be held with employers to allow students to complete the programmes – it is in both the students and employers interests.
- Internationalisation: TUT has made good progress in attracting more international students. Bringing more international students, researchers and academics provides exposure for the innovative research going on in TUT and adds to the undergraduate experience in teaching and learning. Feedback from the students made it clear that they liked lectures from international staff. The Oil Shale Competence Centre at Virumaa College provides the college with a unique research facility to attract international visitors. In addition to attracting more international students, the panel would encourage greater mobility of Estonian students. Students whom the panel met and whom had spent time abroad, talked very positively of the experience, and it is recommended that more students should take advantage of this.
- Student Feedback: it is accepted by all in discussions that the online student feedback mechanism is not working. Having looked at it, there are too many questions, and the students are more focussed

on examinations at the time of the questionnaire. A similar online approach has also been trialled in the UK, and according to the UK panel members it did not work. Student feedback is very important and when acted upon by staff provides the students with a feeling of ownership and engagement, which will motivate them further.

- Relationship with alumni and employers: the panel members particularly enjoyed the meetings with alumni and employers at both TUT main campus and Virumaa College. It is clear the alumni were grateful for the support provided by staff, and appreciated the programme of study. Alumni offered their own support in return as a means of attracting students, providing mentoring to students, guest lectures and teaching support in labs, and offering case studies for recruitment. There is a very good relationship between employers and programme leaders, with regular contact. All employers were very supportive of the programmes and the staff delivering them. It was felt, however, that more formal links should be made between senior representatives of both industry and the university. With such formal relationships a more effective engagement strategy could be developed to the benefit of both parties.
- EU funding – both TUT and its Virumaa College have benefited from EU funding, which has helped in the development of some excellent research facilities. Continued engagement with EU is necessary to sustain and expand the level of research activity. Engaging with the EU is time consuming, and hence the panel recommends a dedicated team to support academic staff in getting involved in EU Horizon 2020 projects.

2.2. Main campus of Tallinn University of Technology

Observations and comments

- TUT offers a relaxed and pleasant study environment with much student support. TUT has experienced a rapid internationalisation with currently some 1500 international student enrolled (15%).
- There is a threat that more and more Estonian students go abroad (10-15%). Identified actions are planned to reduce drastically (by 50%) the number of BA programmes and to streamline these, with new programmes being available from 2017. This appears to be quite extreme and such plans cannot be found in the documentation provided. It is concerning that such radical moves can be initiated top-down, without much consultation with faculty and programme leaders.
- There appears to be very little interaction with leading international institutions. TUT seems to take a more regional approach – it is not clear why this should be the case.
- Links to the most important strategies and documents relating to learning and teaching were available in the self-evaluation's A part 1. However, specific strategies regarding staff development, promotion, welfare etc. were not clearly expressed.
- The teaching organisation appears to be effective and strong within a faculty, but it was not clear how effective the organisation was across faculties where there is teaching in languages and science.
- It is clear that there have been some very good developments in the programmes in aligning with ECTS rules, and introducing new degree programmes. No doubt this has been challenging and the staff should be commended on the changes made.
- The student drop-out rate is high, with a large number dropping out in the first year due to weaknesses in maths and physics, and a large number dropping out towards the end of the course due to financial problems. In the latter case students take up full-time jobs with industry, and then do not have time to complete studies.

Strengths

- The employment rate of graduate students from TUT is extremely high. Overall the employers are very happy with the students graduating from TUT. There are good communication links between the employers, students and staff due to proximity of industry with TUT.
- It is good to see the inclusion of an entrepreneurial skills course, also manifested in the excellent facilities of the Mektory.
- It is good to see expertise and common activities collected in centres of excellence and competence to increase the critical mass of academics working in these common activities.
- It is appropriate to find that students are credited for their contributions in posters, presentations and papers.
- Good study conditions, but not in all labs; the panel supports TUT's aim to invest in teaching labs over the next 3-5 years.
- Support system is good.
- The panel support the rapid development in internationalisation, from 100 international students 10 years ago to 1500 today in TUT.
- The staff are dedicated and have the appropriate qualifications to deliver the courses and learning outcomes.
- All staff are treated equally regardless of gender.
- The university is actively addressing the age profile of staff.
- The students are well prepared in going from Bachelors to Masters.
- In order to increase recruitment into engineering TUT staff & students are going into schools to work with pupils as early as 11-12 years old. In addition courses are provided for school teachers to stimulate interest in engineering. The panel wholly supports this approach and commend the staff and students for their dedication.
- There is a plan to attract more international staff and staff from industry over next 5 years, which the panel supports.
- People are considered the most important resource in TUT.

Areas for Improvement and recommendations

- Only 20% of students respond to the official online feedback system so it is the panel's opinion that this student feedback may not necessarily be representative of the whole student population. Action is needed to improve the student response rate.
- A more detailed evaluation of the feedback forms suggests that these need to be completely overhauled as they are far too long and onerous. The forms need to be developed in consultation with students, leading to fewer questions, but collecting more salient points more quickly. It appears that this is being addressed by the university, and the panel supports this.
In order to address dropout rates further, pre (working with high schools) and post admission activities need to be increased, – additional monitoring systems during studies might also help. A system for monitoring students' academic progress in order to evaluate the relationship between their level entering the university and progression during their study is in preparation.
- There is a need for the development of higher international visibility of staff and staff profiles through increased academic impact (e.g. number of publications). International collaborations should be sought, output needs to be increased.
- There is no clear approach to IP in terms of protection and exploitation. Whilst the Mektory exists as an excellent vehicle to house spin-off companies and student/pupil activities, there are few instruments in place to protect IP and develop successful companies.

- In future assessments, statistics that incorporate/benchmark against international performances (universities) would be useful to allow for an objective international comparison.
- Improve the constructive alignment both between the courses and the programmes to ensure that the learning outcomes map onto teaching, practical skills and examinations.
- The panel recommend making engineering programmes more flexible to introduce more engineering subjects in years 1 & 2, which the panel believe will motivate students more.
- The panel recommends that the structure of years 1 & 2 with respect to Maths teaching is reviewed, such that more engineering examples need to be included to show why maths is so important in engineering.
- In order to increase the number of international students, the panel recommends that more courses are taught in English.
- Currently Estonian students are not very mobile, only 3% go abroad for study. The panel supports TUT's aim to increase this number to 10% by 2020.
- The panel recommends that a strategy is developed for more collaboration with top international universities, and create more joint programmes. At present there is only one in Architecture.
- Staff are reviewed every 5 years, but the review focusses on research and not teaching. Therefore staff are not motivated by development opportunities in teaching. The panel recommend an annual review process, including both research and teaching, which will provide staff more opportunity for career development.
- The panel recommends exploring the option of industrial teachers in the form of Adjunct positions. It is clear from individual programme discussions that employers make a valuable contribution to some teaching programmes, and such Adjunct positions would recognise this contribution, and increase the links with industry.

Strengths and Areas for Improvement of Study Programmes by assessment areas (TUT)

2.2.1. Electrical Power Engineering (Bachelor and Master)

Study programme and study programme development

Observations and comments

- There is an emphasis in the course on harmonisation with professional standards, and links with industry ensure this happens.
- Attracting students is proving challenging as young people are not interested in electrical power. There is more interest in softer subjects, such as economics, law, and social science. Stronger links with industry and including more IT in teaching may be a solution.

Student Feedback

- All agree that on-line system is not working, as students are more focussed on exams at the time of the feedback request. Having looked at the feedback questionnaire, it is too long and not surprising that students do not complete. The same problem occurs in UK institutions – online feedback does not work.
- Student reporting system works better, and staff are very appreciative of this, but still only at the end of the year.

Strengths

- Good links with industry – employees come into TUT to give lectures; site visits; internships. In fact all employers that members of the panel met were graduates of TUT. Cooperation agreements exist with most industrial partners, with the focus on research. The panel would like to encourage more dialogue and cooperation on teaching.
- Employers state very good education, providing knowledge of a wide range of topics covering power systems.
- Employers like the internship programme and think that students' working during MA is good, it motivates the students, and companies are flexible to allow attendance at lectures.
- Employers have invested in lab equipment. Encourage staff to engage more widely with industry to get investment for teaching labs.

Areas for Improvement and recommendations

- Better marketing is recommended and using students and alumni as ambassadors into schools. In discussions with staff, students, alumni and employers they are working together to try to make this happen, but it was not clear on how coordinated the approach was. Industry is starting to provide scholarships, which may help attract more students, as students have to fund their own living expenses, which many do by taking on a job.
- Feedback – recommend going towards specific course feedback in lectures, with a small number of questions. Get lecturing staff and students to cooperate to agree the best format and questions for the feedback questionnaire. In this way the students have ownership. At the same time the panel would maintain the annual report from the students, which is valued by the staff.
- Formalise the consultation with employers to ensure that the programme develops in such a way to meet the needs of the labour market in Estonia.

- The teaching of industrial standards should be included where possible as this is very useful for students when working in industry.

Resources

Observations and comments

- The laboratory resources are adequate for carrying out the study programme.
- SMART Grid lab was particularly impressive, with energy storage capability, medium voltage capability and electrical vehicle charging point.
- There is good cooperation with industry – practice of obtaining new equipment with the help of different companies and students using laboratory equipment in enterprises;
- There are laboratories equipped with expensive equipment that is not available for students for independent research.

Strengths

- Very good lab facilities for Electrical Power Engineering covering traditional electrical generation and the more recent interest in SMART Grids.
- Some of the equipment had been donated by industry, showing excellent links with employers and use of up-to-date equipment.
- Laboratories have enough space to accommodate the student groups (enough work places, enough equipment);
- The TUT library has excellent facilities and extensive access for both printed literature and databases/ electronic resources.
- There is a possibility to use the extensive resources available Mektory.

Areas for Improvement and recommendations

- Most of the equipment has been obtained through research projects and huge investments will be needed to keep the equipment up to date and maintain it when the project funding ends. TUT needs to agree on a strategy for doing this and seek investment for further actions;
- Introduce more practical/laboratory work in the curricula.

Teaching and learning

Observations and comments

- Distance Learning – currently there are low numbers of students (10 per year) and teaching is in the evenings and at weekends. This places an increased load on the staff. Students do not get the benefit of full labs because of lack of time – only 1 hour is spent compared to the 4 hours of full-time students.
- Teaching courses in English does exist, but it is not widespread. Employers would like more instruction in English as most of the professional documentation including standards is in English. They would also like to see more practical exposure, more of an issue at Bachelors level.
- Students get feedback on all pieces of work, and the process for project thesis is well organised and managed.

- Quality of teaching is good, but there is very little uptake of professional development and training within, due to time constraints.

Student drop-out –

- Main tranche of dropout is in first year, apparently due to lack of motivation and wrong expectations.
- Many students cannot cope with the Maths and Physics courses because they are not prepared well enough at school.
- The focus on general courses in the first two years may not provide enough motivation for the students – they would like to see more engineering courses; some have been included and the faculty is thinking of including more.
- Students have to work to fund their studies. Most Masters students work in the industry, and get offered full-time jobs, which could explain drop outs at this level. However, in discussions with students and employers, the former can see the benefit of working whilst studying in terms of exposure to real life engineering, and the employers were prepared to be flexible to allow students to attend lectures during the day. Not all employers may be so flexible, so the Distance Learning option is available to students, but this places a heavy load on the staff – working in evenings and weekends.

Strengths

- Excellent textbooks – the students really appreciated these.
- Employers are consulted in the teaching programme but at an informal level.

Areas for Improvement and recommendations

- Employers would like more instruction in English as much of the professional documentation including standards is in English. They would also like to see more practical exposure, more of an issue at Bachelors level.
- Review the maths teaching in the first year, and try to introduce engineering examples to demonstrate the need for a good grounding in maths.
- With regards to Distance Learning the panel recommends a review of the format in which this is delivered in consultation with the employers. It may be more efficient to give individual courses in blocks i.e. 1-2 weeks, in which the employees are released from their work, or students are allowed to work part-time and employers be flexible so students can attend courses, as is the case of some employers the panel met.

Teaching staff

Observations and comments

- There is a generation gap in the 40-60 year range, which is a serious challenge for management. There appears to be no strategy for recruiting staff over a longer time period of say 5 years. At present, senior and junior research staff funded by research projects are being used to fill the gaps in teaching. This approach places additional pressure on researchers, who now have less time to deliver the research. The head seems to be continuously fire-fighting with regard to this, and the Faculty is receiving no direction from senior university management. The university needs to address

this as a matter of urgency, as electrical power is a strategically important subject of national importance to the energy security of the country.

Staff training & Development

- There is very little participation amongst established staff due to time constraints, but also if student feedback is good there is a perception that training is not required.
- At renewal time the focus is on research and hence there is no motivation to improve teaching techniques. Younger staff do attend such courses, and have found them useful.
- Sabbaticals are possible, mainly for younger research staff, and tend to be linked to research projects. Not possible for teaching staff to go on sabbatical due to lack of resource to cover staff member.
- Researchers are encouraged to work abroad before returning as a staff member in Estonia.
- Rather than a review every 5 years, an annual review would be more useful for career planning.
- There is no staff mentoring ie. staff do not sit in on each other's lectures and feedback on style etc. This is a good informal way of providing feedback to lecturers and will help development.

Strengths

- The staff are all dedicated and provide good support to the students. All are qualified to the right level to deliver the course.
- In discussion with students the following were stated:
 - Dedicated staff who know their field.
 - Small dept and hence easy to get to know staff, and they are approachable
 - Younger staff are dedicated and accept feedback.
 - Project work well supported and students were fully informed of the process.
 - Ability to get involved in research through the thesis project.
 - Students appreciate the course textbooks written by staff – very useful.

Areas for Improvement and recommendations

- There needs to be more long term planning with regards to academic staff recruitment and career progression. It appears that there are too many frequent policy changes at a senior level within TUT, which does not allow any long term planning. Plans are made at study group level, but not implemented because they expect changes to be made. Hence the mode of operation tends to be reactive, resulting in fire-fighting.
- Rather than a review every 5 years, an annual review would be more useful for career planning.
- There is no staff mentoring ie. staff do not sit in on each other's lectures and feedback on style etc – Recommend that this is introduced, as it is a good informal way of providing feedback to lecturers and will help development.
- Staff should be encouraged to attend training courses.
- If courses are to be taught in English, the panel recommends that technical English language training is provided to those staff who feel they would benefit from such training in order to deliver the courses effectively.

Students

Observations and comments

- All highly motivated and confident students.
- Students were inspired at school, but also clear that students that the panel met were very good.
- Reasons for not studying engineering – marketing of engineering at school not very effective; nobody explains what it is.
- Engineering is not perceived as prestigious career by school students – more interested in law, economics due to higher pay.
- Masters/Alumni would like to get more involved in lab demonstrations in the Dept at Bachelors level. They thought this would help motivate BA students and provide some peer mentoring. Great idea and is used in the UK.
- Students felt working whilst studying for a MA was good and enhanced their studies. Companies allow flexible working hours to attend courses

Strengths

- Highly motivated and confident students, who are engaged with the course.

Areas for Improvement and recommendations

- More workspace for students – there are 3 students per PC and not enough lab space, again 3 per bench. Students would like to get more hands on experience in the labs. Recommend increasing number of PCs and lab benches for teaching labs.

2.2.2. Electrical Engineering (Bachelor), Electrical Drives and Power Electronics (Master)

Study programme and study programme development

Observations and comments

- In the first 2 years the program there is very little choice, with students forced to follow a set curriculum.
- Students are involved in several positions of the program development (EQW, feedback culture, committees, boards, etc.)
- Fast developing topics are given priority in the decision process of updating the program.
- It was identified that industrial communication must be part of EE.
- Other faculties are involved in the program development.
- The needs of industry are considered and understood. But it must be questioned if a university's job is to produce trained or educated graduates. Universities of applied sciences do the first, normal universities should more tend to the latter.
- The number of technical courses taught in English is really low for an engineering faculty.
- As the secondary school level is considered too low, an online package (video, interactive, etc.) for incoming students would assist in brushing up their skills in mathematics, physics, etc.
- There should be more cooperation with leading international universities.
- Free software is identified as one way to cut costs, but much more can be gained: it is a way to easily share and communicate results and findings with the scientific community. Universities should strongly support that.
- New state funded chair appointed, which will come with funding for teaching – this is viewed as a good opportunity for Electrical Engineering.

Student drop-out rate

- The staff are well aware of the issues, and are trying to address them.
- Motivation and ability is a cause of the main dropout in the first year – same as other programmes.
- Others drop out because of being offered a job before graduation, as students tend to work at the same time. Need to cooperate with employers to try to stop this happening, as it is the student who will lose out in the long run. Distance Learning has been implemented to solve this problem.
- Attracting good students is difficult as there are no quotas on other more popular courses, so more students go to other faculties.

Student Feedback

- This is generally very good from the students, but again online system does not work.
- The student annual report is much better and valued by the staff – general comment from all staff.
- Faculty/student meetings do take place.

- Some staff find social media – Facebook – more effective as students are more willing to engage with it.

Employers

- Overall the employers are very supportive of the programme and agreed that the level of the graduates is general very good.
- The employers are willing to be flexible to allow student employees to attend lectures, as they understand the benefit of having highly qualified graduate engineers.
- Both companies have cooperation agreements with TUT, meeting twice a year. Issues can be raised openly with staff, and they respond. The employers have a very good relationship with the programme leaders. Harju Elekter employees give lectures at TUT, which is well received by staff and students.

Strengths

- Staff are aware of the drop out issue and are trying to address the problem.
- Very good links with industry, with a number of cooperation agreements in place.
- Good internship and project thesis – well organised and managed. Appreciated by employers.
- Responsive to feedback from employers – employers have a very good relationship with programme leaders.
- There is a new generation of staff coming through in electrical engineering, which is good and seen as positive by all staff.
- It was mentioned that students should get more IT knowledge (databases, coding, industrial communication systems, etc.) even in power-related programs.
- Employers are very happy with internship scheme and the project thesis – projects are industry driven, and supervision process is well managed for the benefit of the students.

Areas for Improvement and recommendations

- Make better use of Mektory – some have used it and the students like it. Ideally it would be best to replicate Mektory – the workshop and lab space in engineering.
- Employers identified a lack of soft skills with the graduates. Things like project management, presentation skills, etc. are desperately needed in industry.
- Increase the number of technical courses taught in English.
- The university should try to provide additional resources to assist in brushing up their skills in mathematics, physics, etc.
- Establish more links with leading international universities to assist with research and teaching.
- Work with employers to encourage more students to take the Masters, as this provides more practical experience and knowledge, essential for a career in industry.
- Recommend exploring joint industry/TUT research and teaching posts, which will solve some of the recruitment issues, but also provide students with a wider learning experience. In discussions with employers, they seemed to be supportive of such posts, but there needs to be a strategy developed by both parties.

Resources

Observations and comments

- Teaching labs could be better equipped. For certain laboratories (e.g. EMC lab) important equipment is missing.
- In order to fill any gaps students have to visit companies to use their equipment – this is no bad thing as it exposes the students to industry, making contacts.
- More practical work (e.g. electric machines) is needed.

Strengths

- Research labs are well equipped, as shown by the tour, but funded through research projects, and equipment is expensive for use by students.
- Opportunity for Master's students to get involved in research projects and hence have access to equipment in research labs.
- Industry standard software is used in computing classes.
- Students found the labs to be good, and there are enough benches for students

Areas for Improvement and recommendations

- More practical work, and updating of the teaching labs.
- Seek investment for teaching labs. In the discussion with the Vice Rector, investment in teaching resources is a priority for the next 3-5 years.
- Only criticism from students was regarding the physics lab – it is a bit out-dated, but this is part of a different faculty.

Teaching and learning

Observations and comments

- Changes in the program curriculum take place too often, as it does not allow the program to become established. There seems to be a disconnect between the University executive and the Programme managers making planning difficult.
- Overall the bachelors students were happy with the course, and a Master's student recommended international study.

Strengths

- All courses are regularly updated to take new advancements and changes into account – not a problem for staff.
- Students receive feedback on all coursework and lab work.

Areas for Improvement and recommendations

- More design and group project work – it is engineering after all and the students want to get hands on experience. At present the teaching labs are not well enough equipped for this.
- Recommend bringing industry into the first year to provide the real life case and hence context of the course.

- Recommend introducing more options in the final year of the bachelor's course. Masters is much more flexible.
- Students support subjects taught in English as it will attract more international students, but more specifically will help them with technical language and terminology. English is the R&D language within industry. Even if cannot do all teaching in English, perhaps introduce 1-2 lectures for each course to define the terminology in English.
- Recommend consulting Masters students who have had experience of international study to learn about their experiences.
- Introduce more soft skills into the Bachelors programme, eg project management, leadership, presentation and communication skills.
- Introduce more multidisciplinary knowledge into the Bachelors programme.
- The programme lacks training in specialist software in power engineering.

Teaching staff

Observations and comments

- The actions proposed in the self-evaluation are “more money”, but do not directly address the described weaknesses.
- Some have taken part in the staff training and development, and found it very useful. It is taken into account in the review process. “Teacher of the year” award by students is highly recommended.
- Staff are given the opportunity to go abroad, but it tends to be younger staff, who seize the opportunity.
- Although the staff profile of those attending the meeting was good, there is an issue with replacing retired staff – this is not happening, and the workload goes onto younger staff. There does not seem to be much opportunity for promotion which does not motivate staff – recommend an annual review process with promotions considered annually, not every 5 years.
- There does not appear to be a 5 year plan with respect to staff appointments and retrials. This does not allow programme managers to plan. Some Professor positions are not filled. There is a new generation of staff coming, but they need to be promoted one day.

Strengths

- Staff are dedicated and highly qualified. They have a very good relationship with the students.
- Staff are aware of the drop out issue and are trying to address the problem.
- Staff have very good links with industry, with a number of cooperation agreements in place.
- Internship and project thesis are well organised and managed by staff.
- Staff are responsive to feedback from employers – employers have a very good relationship with programme leaders.
- There is a new generation of staff coming through in electrical engineering, which is good and seen as positive by all staff.

Areas for Improvement and recommendations

- Recommend an annual review process rather than every 5 years, with equal emphasis on research and teaching. This will motivate the staff more and allow junior staff to see more of a career path.

- Work with the employers to allow staff the opportunity to be seconded into industry, which will enable staff to bring industrial experience into their teaching and research. The employers would be supportive of such a programme.

Students

Observations and comments

- Students are expected to be motivated, but no one speaks of motivating them.
- Self-organization of students leads often to miraculous improvements in motivation and performance: incentivize student clubs (robot soccer, hacking teams, renewable energy, electric mobility, etc.)!
- Drop-out rate – this is due to motivation, difficulty with maths and expectation. Some students thought the first year was good as it acted as a “filter” to remove weak students!
- There are evening/weekend courses for working students.
- Masters students do not see a problem with working and studying at the same time, and the employers are flexible.
- Students think that school maths is not at a high enough level starting the engineering programme, but they understand the programme structure in providing 2 years of general study to bring all students to the same level.
- More industry contact and industry relevant projects, subjects was a request from the students.
- Overall the students like the program, but more group work would be appreciated.

Strengths

- All students whom the panel met were very motivated, and valued the contribution and support of the academic staff. The working environment is stimulating, and the staff are dedicated.
- Students value the opportunity to go abroad, and think it is a very worthwhile experience.

Areas for Improvement and recommendations

Students would like (which the panel support):

- More contact with industry, especially at Bachelors level.
- More internship placement opportunities.
- More labs exposing students to real life applications – ties in with staff comment on wanting better teaching equipment.
- More group work in order to train students in management, group dynamics, etc. would be appreciated.

2.2.3. Distributed Energy (Master)

Study programme and study programme development

Observations and comments

This is a new course, running for only 3 years, with the first cohort graduating this year. It is a joint programme between TUT and the Estonian University of Life Sciences (EULS) with the students obtaining a joint degree. The students spend Semester 2 of the first year at EULS. It is refreshing to see such collaboration between two institutions and across TUT faculties, and in particular the enthusiasm for the programme from the staff, students and employers. It is clear that the staff worked closely together with employers in the design of the course, and have modified it taking into account comments from students and employers.

The demand of such a course stems from the widespread use of district heating systems and the plans for micro generation CHP systems within small communities. Estonia is a world leader in wood chip and associated boiler technology, and hence there is a demand for highly qualified graduates in this area. The use of other micro generation, such as wind and solar are also becoming more widespread. Research into power electronic converters for distributed generation is taking place within TUT.

Threats

- First year students were very well motivated, but also came from a wide range of backgrounds – some from industry who wanted to learn more about the topic to help with their career. The staff are concerned that in future years the students will come directly from Bachelors programs, and hence will not have motivation or be of such a high quality.

EMPLOYERS made the following general observations:

- There is a need for this course in Estonia, and the programme that has been developed is able to equip engineers in this field.
- Currently there are some scholarships available.
- Employers use Mektory – one employer has agreed to build a lab on district heating – students should have access to this.
- Industry is happy to provide staff for occasional lectures, but not much more.
- Employers are convinced that TUT can grow the student cohort from within Estonia – there should be enough demand, but aggressive marketing required.
- Employers are happy to give lectures at recruitment open days to assist with growing the course, but not prepared to become part-time professors due to lack of resource within industry. Also need to target municipalities.
- Industry should be invited for the university "open door days" for networking, maybe give a presentation there, etc.

Strengths

- The management team meet every quarter to discuss quality assurance and the program delivery. Quality assurance is ensured through the regulations and guidelines of each university, but there appears to have been some attempt at harmonisation. EULS and TUT are both involved in the thesis projects and jointly assess the students.
- There is very close cooperation with industry, with whom they meet quarterly also.
- Good feedback for a broad program is a very good sign. It is often not easy to motivate (good) students for something like that since they prefer to specialize.
- There is large freedom of choice for courses, so students can specialize in their favourite direction.

Areas for Improvement and recommendations

- In order to ensure highly motivated students the course should be marketed to industry as a way of career progression, making use of Distance Learning, but preferably working with employers to be flexible with working hours.
- Staff would like to see more effective communication links between senior university staff and execs in the company, to establish cooperation agreements. At present the dialogue is between academics and their counterparts – middle management, but it is CEOs who make the decisions. Invite Vice Rector for Research/Enterprise to a management meeting to present the course and discuss how closer links with industry can be developed.
- Cooperation agreements need to be set up with employers – there do not appear to be such agreements in place at the moment.
- This programme could be attractive to professionals working in this area, who would like to increase their knowledge. The programme could be modified into a number of Continuous Professional Development (CPD) courses to be taken in the evening. This would result in additional revenue.

Resources

Observations and comments

- Some specific lab equipment is missing (e.g. small turbines).

Strengths

- Field trips at EULS are appreciated by the students.

Areas for Improvement and recommendations

- More industry involvement in courses and contribution to lab equipment – in heat engineering, there is a need for lab equipment of a small scale to allow students to learn about boiler technology and how it can be controlled.
- Provide more internship placement opportunities – the employers are happy to take students.
- Recommend talking to employers more and simply asking for lab equipment if it is needed. Our discussions with employers indicated that they would be more than happy to help with equipment, if they knew what was required.

Teaching and learning

Observations and comments

- The students were not so convinced about having international students on the course – they questioned their motivation.
- The students would not like to see all courses taught in English, better to have a mix.
- Employers support teaching in English, which would also lead to internationalisation and would also grow the course.
- External and international staff are involved.
- Projects are interlaced with teaching.
- The students come with very different levels of knowledge, depending on their previous education
- There is a low feedback culture, maybe because of the wrong timing or tedious feedback forms.
- Students appreciate the introductory courses given in the first year, as it enabled all students to be brought up to the same academic level.

Strengths

- Good to have international staff on the course and to learn from their experience. They felt that international lecturers really added value to the programme.
- Wide range of topics covered ensures students graduate with extensive knowledge of the field – appreciated by employers and students.
- Students can choose and tailor the subjects to their needs and interests.

Areas for Improvement and recommendations

- The panel would encourage the continued use of international lecturers in light of students' comments. From the discussion with staff it appears that there will be fewer overseas lecturers on the course.
- Encourage more students to go abroad through ERASMUS.
- Teach more courses in English as a way of attracting international students – this requires very good marketing.
- More computer programming, and perhaps more exposure to industry standard software.
- More hands on experience in courses other than forestry.
- More industry practice and internships needed.

Teaching staff

Observations and comments

- The teaching staff are dedicated and very supportive. There are good communication links between the faculties within TUT and the partner university EULS.
- Administration of the course is very efficient, with staff providing feedback very promptly. The students praised the staff, stating that compared to other universities in Estonia, TUT was excellent for the management and delivery of the programme.

Strengths

- According to the students the major strength of the Masters is the broad overview of topics covered in the programme. The staff are very supportive, providing excellent feedback. The programme admin is effective. Good inter-personal relationships were built up between the staff and students. The students felt that the staff were interested in them. The students were very impressed with the staff and their professionalism in administering and delivering the course.
- Staff have excellent relationships with employers, who were consulted during the establishment of the course, and all parties meet regularly – perhaps need to formalise if not done already.
- Programme staff are receptive to changes demanded by students and employers, and respond accordingly. A number of changes have been made since the start of the programme.

Areas for Improvement and recommendations

- Expand the international aspect of the course, by continuing with external lecturers.
- Introduce more English taught courses to meet industrial requirements.
- Work with senior university management to create more formal relationships with senior executives in the industry, which will help in formulating an engagement strategy with the aim of future investment.

Students

Observations and comments

- All students were from the first cohort, with all but one having graduated. The background was wide ranging and also the age profile was wide. Two students have an economic background with experience in industry, one having run his own company. One student came from the Electrical Power Bachelors at TUT, and the final student had an HR/Marketing background – she enrolled on the course because her new job was in the energy field, but she had no knowledge in this area. The Masters can be seen as a course allowing a change in career or enhancing career development within the energy field.
- For non-engineers it was hard at first, but with hard work and working together the students enjoyed the course. The staff were very supportive, and able to help whenever needed.
- Travelling to Tartu was okay, and they enjoyed this part of course, as for all students it was a completely new topic, but they appreciated the importance of the material taught at EULS. The students particularly enjoyed the forestry field trips, again as it was something that they would never had the opportunity to do.
- The students have an underdeveloped cosmopolitan attitude (e.g., they do not want foreign students) and believe the program should only teach things necessary for Estonia, for Estonians. It sounded that they believe that Estonia is the only country in the world with trees. Some international exchange - in both directions - would not hurt.

Strengths

- Students are very highly motivated.
- Program administration is experienced and very efficient
- Introductory courses to levelize the expertise of incoming students are appreciated.
- Coming from a wide range of backgrounds and age is very good as it enhances the learning experience of all students.

Areas for Improvement and recommendations

- Better marketing in order to attract more students – all students present suggested that they should be used as case studies or ambassadors for the course.
- Students recommended targeting municipalities, who are most likely to be integrating distributed generation into the system. Staff in such organisations need to be informed of distributed generation. Also make more use of social media.
- Students would appreciate more industry cooperation.
- Show success of alumni and use case studies for marketing.

2.2.4. Chemical and Environmental Technology (Bachelor and Master)

Observations and comments

- The latest main developments of both Study Programmes were done in 2009 (modified slightly in 2013 and 2014).
- The objectives and learning outcomes are assumed to be consistent with Standard of Higher Education and TUT Curriculum Statute.
- The development of the study programme is based on the legislation, development plans, analysis of labour market, and professional standards as well as recommendations of the European Federation of Chemical Engineering.
- The development was coordinated by the Study Programme Committee of the Faculty of Chemical and Materials Technology.
- The introduction of changes to the curricula rather slow but possible and these have been made since 2009 but constant development is still necessary.

Areas for Improvement and recommendations

- More flexibility is needed in both Study Programmes.
- The curriculum structure to be modified to decrease the BSc student drop-out rate (to increase the motivation by including more speciality courses to the beginning of studies).
- The share of programming and process control to be increased.

Resources

Observations and comments

- Teaching and research laboratory equipment not always adequate, especially so with unit processes laboratory. At least a few pilot-plant equipment should be available (related to the research projects with industry, of course).
- Process control facilities are very elementary.

Areas for Improvement and recommendations

- Improve (modernize/update) the teaching (and research) laboratory equipment.

Teaching and learning

Observations and comments

- Teaching in process control (including automation) is not adequate. Use of appropriate software is largely missing.

Strengths

- Teaching combines theory and practise.

- Team work is used.
- Teachers easy to approach.

Areas for Improvement and recommendations

- Improve the maths/physics skills of students by filling the gap between the school and university level (supporting courses).
- Teaching in software based process control must be improved (both quality and quantity).
- Create a meaningful (suggestion based) student feedback system. Making the feedback compulsory is probably not a productive measure.
- Only 10 to 30 % of the students give their feedback. Unfortunately, quite often the students do not explain their score and do not give the recommendations.
- Close the student feedback loop to indicate changes made as a result of feedback.
- Increase the use of English as the teaching language.
- Increase the publishing rate.
- Increase international co-operation (including foreign staff).
- Increase the intake of foreign students.
- The use of guest (part time) lecturers from industry should be encouraged.

Teaching staff

Observations and comments

- Most of the teaching staff is adequately competent. The age structure is also a healthy one. The threats due to the world-wide recession have not been acknowledged, however. This may make the workload on individual staff members even more serious a problem than presently.

Strengths

- Flexible workload distribution between teaching and research partly used.

Areas for Improvement and recommendations

- Increase the participation of teachers to pedagogical support courses/programmes.
- Encourage the use of sabbatical leaves to boost research.

Students

Observations and comments

- Use of even more active (even aggressive) recruiting of (mainly Estonian) students.

Strengths

- MSc students seem very motivated.

Areas for Improvement and recommendations

- Activity in feedback especially in course development to be improved.

- Use of English to be encouraged as a teaching language.
- Opportunities to have parts of studies abroad to be encouraged by financial support and international contacts.
- The representatives from industry/companies expressed the concern that the training (internship) periods (eg three weeks) are not productive and require too much work from the host.
- The soft skills (eg oral presentations, writing reports, dealing with ethical questions) are acquired by the students mainly by the trial and error method. Both systematic feedback from the teacher and professional personnel are not in systematic use. Since these skills are very much required after graduation, more efforts must be paid on developing the system of feedback and teaching.

2.2.5. Technology of Wood and Textile (Bachelor, BA), Technology of Wood and Plastic (Master, MA, TWP), Materials and Processes for Sustainable Energetics (Master, MA, MPSE)

General observations and comments

- Industry needs graduates in all three fields, textile, wood and plastic.
- There is a lack of graduates in the Estonian furniture industry.
- There is a lack of graduates who are specialized in plastic, the need is 5-10 every other year.
- The students in the BA programme are divided into about 50 % wood and 50 % textile.
- There should be also a specialisation line for plastic in the BA programme.
- The graduates should also be able to work in global enterprises, in global environment, more international people are needed.
- It's difficult to get enough students to enrol on the BA programme and the MA (TWP) programme. Annually they take maximum 40 new students (BA), but usually the number is less than 40, which means that number of applicants is less than 40. The reason for that is that materials technology is unpopular. Courses, where number of students is less than 9 are economically not profitable, and thus are not processed. To get enough motivated students active advertising is needed as well as other activities, cooperation with the secondary schools and so on. Also the recruitment of foreign students should be encouraged. Industry is ready to be actively involved.
- After the BA degree it is possible to go to different MA programmes, however most of the students continue in the International TWP programme.
- BA and MA (TWP) are relevant, unique programmes in Estonia. Estonian University of Life Sciences is starting something similar to the BA programme. The MA (TWP) is the only one in Estonia and has good cooperation with industry.
- Student feedback of the programmes is low as reflected in the whole university, feedback from the industry is wanted as much as possible. Close cooperation gives possibility to do this.
- The reason for starting a new international MA programme (TWP) was the lack of students. In 2015 TUT took 30 new students, of which 15 were international. Their background (BA) is in chemical engineering or mechanical engineering. Admission is made according to the application papers and interviews, which are important.
- The International MA programme (MPSE) was initiated in a competition arranged by the Ministry of Education, which wanted to support new programmes in new fields. The Programme is delivered in partnership with the Estonian University of Life Sciences having one semester/year in Tartu. The first intake of students were recruited in 2009, and in 2015 there were 19 new students of which 15 were international. There is no problem to get students, in 2015 there were about 60-70 applicants. The programme is a research based programme, with students having a background (BA) in either Engineering or Natural Sciences. Admission is based on application papers, interviews are not needed. This programme doesn't have much cooperation with the industry, because at the moment there is not much related industry (e.g. wind). Five graduates have been recruited from the programme and the employers seem to be satisfied with their knowledge.

Study programme and study programme development

Observations and comments

- MA programmes are new, (TWP started three years ago, MPSE started in 2009) international, and all the teaching is in English.
- The BA programme has been running for many years, with the latest modifications two years ago.
- The BA is not a degree the industry is interested in because it is too general in content. The MA is the final degree with main specialisation.

Strengths

- All programmes are unique and relevant in Estonia and important for the industry.
- A typical feature of the programmes are the good cooperation with industry.
- The MA programmes are new and international, responding to the requirements and needs of the employers.
- The MA programmes are up to date, with research based teaching and project based courses.
- The MPSE programme attracts a lot of very good applicants.
- Good relationships to the industry and other organisations in the fields, according to their recommendations the teaching programmes can be developed and fixed.
- Dropout rates are low in the BA and MA programmes, which does not reflect the experience in other programmes within TUT.

Areas for Improvement and recommendations

- The structure of BA programme should be reassessed. The programme is quite general and very tight, just 8 ECP free choice studies, which explains why the students usually take more courses than required for the degree. The field of plastic is underrepresented at the moment; the programme focusses more on wood and textile. The need for specialization in plastic or for more plastic courses should be assessed.
- The BA programme is taught entirely in Estonian, which can be a problem for exchange students. A package of courses, which are taught in English, is suggested.
- The new curriculum for MA programmes should be finalized, some courses are still under development and some new courses are still needed.
- It would be good to have more international students on the MA programmes from neighbouring countries, because the industry and the employers are mainly operating in Estonia and in neighbouring area. It's beneficial that the graduates know the circumstances and environment where they are going to work.

Resources

Observations and comments

- There is a lot of research going on with industry.

Strengths

- Most of the laboratories and other facilities seem to be in order and up to date, having been rebuilt two years ago.
- Students recognise the benefit of gaining laboratory skills, and have access to labs at times outside normal lab sessions.

Areas for Improvement and recommendations

- New technologies, ideas, targets for development are arising in the industry all the time and the university should be able to react to them. This requires a close dialogue with the industry and resources in research and teaching staff, laboratories and facilities.
- Cooperation with the Estonian University of Life Sciences should be intensified. The universities have some close fields and they complement each other well. There will always be a lack of resources, which is why cooperation is important, e.g. common resources, common programmes like MPSE.
- Cooperation with international universities should be intensified, which will enhance internationalisation.
- More investment in laboratory equipment for textiles is needed.

Teaching and learning

Observations and comments

- Teaching methods seem to differ from traditional lectures to problem based learning, for example in the BA programme the traditional lectures are general.
- Learning outcomes have been defined as they should be, but in the BA programme they could be difficult to achieve in three years.
- Teaching is only in Estonian in the BA programme.
- In ERASMUS exchange, there are annually only a few students outgoing, more are incoming.
- Books are the main form of teaching material, with many of these books a bit dated, especially in the BA programme.

Strengths

- Teaching methods in the MA programmes seem to be up to date.
- Learning outcomes seem to respond to the requirements of industry.

Areas for Improvement and recommendations

- Use more research articles, more up to date reports and teaching material instead of books.
- Teaching methods in the BA programme should be improved to include more research and problem based teaching and project courses instead of traditional lectures.
- More visits to factories in all the programmes. Besides the theory the students should know the practise.

Teaching staff

Observations and comments

- The age structure of the teachers is not in balance, many of the teachers will soon retire.
- The workload of teaching staff is high. Researchers are teaching nearly as much as teachers, which will affect their research output.

Strengths

- Competent teaching staff.
- All academics are teaching.
- New professorship to the MPSE programme is planned, who will continue the design of the programme and research and teaching of the programme.
- New Fulbright teacher is coming especially in the field of plastic.

Areas for Improvement and recommendations

- More guest lecturers from outside the university to bring more practical experience and new aspects to the studies and to lighten the workload of existing staff.
- A plan to recruit new professors, researches and teachers is needed because of the age structure and high workload of the teaching staff. International researchers and teachers are needed especially for the MA programmes.
- Teaching staff should be encouraged to take courses in pedagogy.

Students

Observations and comments

- For some students living in Tallinn, it is a problem to go to Tartu, which explains why they do not want to apply for the MPSE programme. However, some students like to study in two places because it's good to get to know two universities.
- Nearly all the students are in employment whilst studying for a degree.
- The BA programme was changed last year and according to the students it is much better now, when wood/textile/plastic is taught already during the first years of the programme.
- Students have a lot of presentations and writings they got feedback from the teachers.
- The student feedback of courses is low, but the students give feedback face to face to the teachers in all programmes.
- In the BA programme plastic is not included in the name of the programme, which is why it can be a surprise for some students that they also have to study plastic.

Strengths

- Good supervision is available for students.
- Teachers support and help the students in their studies.
- There is flexibility in the studies.
- According to the students the new MA programme (TWP) has been improved through internationalisation and better teaching. The good mix of international and local students provides a good atmosphere.
- Cooperation with industry is important, not only in projects, but also to allow students to obtain more practical experience.

Areas for Improvement and recommendations

- The BA programme is tight. However the students can take free choice courses as much as they will, but this means, that it could be difficult to have the degree in three years.

- When the staff make changes to the schedule or other things, the students should be informed with plenty of advance notice.
- Skills concerning how to “manage people”, so-called social skills, are important in working life, but they are not taught.
- More cooperation with international companies, which are currently only dealing with Estonian industry. There is an opportunity for TUT to increase its links with international companies.
- Lectures should be more interactive and there should be more lecturers from industry.

2.2.6. Food Engineering and Product Development (Bachelor and Master)

Observations and comments

- The employers are generally happy with the students from TUT. The students have a broad and technical background filling the needs of the companies. They do have some possibilities to influence the programmes.
- The employers are happy with the solid ground that students are standing on; they will provide details.
- The employers see a need for more equipment for the student to practise on
- There are contacts between companies and the staff. However, these can be improved. An advisory board can be formed.
- The opportunity for both BSc and MSc-students to fine tune their education by optional courses is good.
- The panel observed that more students are admitted into the BSc-level than those that can continue to MSc-level and at the same time students with other background can enter at the MSc level. This causes an imbalance in terms of that student with only a BSc are graduating. The possibility for those students to find a job was unclear.
- The students graduating from the MSc-program do not have difficulties finding a position. This gives a clear indication that the employers are satisfied with the educational programmes.

Strengths

- Possibilities for exchange (incoming as well as outgoing).
- Continuous and active development of the programmes.

Areas for Improvement and recommendations

- Constructive alignment can be used in developing both courses and the programmes.
- Learning outcomes for the courses as well as the programmes may be structured in more detail. I.e. as learning outcomes in terms of *knowledge and understanding, skills and abilities, judgements and approaches*.
- Moving course related to the general topic of the programme to an early stage of the education. Some students did not find it motivating starting with math and so forth and this may lead to drop-outs. The course in Gene technology in the beginning was appreciated.

Resources

Observations and comments

- New library with study facilities for the student, course literature available. e-resources
- Newly renovated building

Strengths

- Well-equipped laboratories
- General facilities are good

Areas for Improvement and recommendations

- Pilot-scale equipment for training purpose is needed(suggestion from employers)

- Financial resources for continual update of laboratory facilities are needed.

Teaching and learning

Observations and comments

- The programme is well organized.
- The use of math is unclear though compulsory, may lead to dropouts due to lack of motivation. It is recommended that content of math is revised and that it is made sure that the relevant maths is used in the Food Engineering and Product Development courses following the math courses so that the students understand the importance of having a good grasp of maths. It should also be considered to include numerical methods as those are important for modelling purposes. See also below.
- Soft skills (computer skill, academic writing, presentation techniques, ethics, general safety issues) are dealt with but it is slightly unclear to what extent and how progression is guaranteed (See also below.)
- It is observed that computer programming is not a part of the programmes. Computer modelling is an important tool for an engineer.
- It is unclear what practical skills (e.g. general, instrumental, pilot-scale, aseptic techniques (microbiology)) the students are expected to have and how this is examined.
- The scientific process from “hypothesis to results” , i.e., formulating a hypothesis, planning of experiments (statistical methods), laboratory work (doing the experiments), evaluating the results, documentation of the results and finally the communication of the results (written reports and oral presentations) and the progression of these skills should be stressed more in the curricula.

Strengths

- Motivated and popular teachers
- New methods are introduced

Areas for Improvement and recommendations

- The progression of soft and practical skills should be organized in a structured way (learning outcomes –activities –examination). This probably calls for cooperation between courses

Teaching staff

Observations and comments

- The staff of the programme is highly active in research. Research is published in international journals with high reputation (impact factors) as well as in national journals. The researchers are presenting both at international and national conferences. Furthermore there are several active PhD-students. All this acts as a guarantee for the important link between research on one hand and teaching on the other. Unclear how many teachers apart from PhD-students are taking staff training (pedagogical courses).
- Based on the ÖIS the students are satisfied with the staff.

- Work load of the staff seems to be OK, however sometimes the panel were given the impression that some work was done by over qualified person, e.g. preparing for lab-work. Employing technical staff should be considered.

Strengths

- Highly qualified and dedicated staff.
- Recruitment of younger staff to cope with future retirements has been successful.

Areas for Improvement and recommendations

- Staff training in teaching and learning in higher education. In the “Job description for Academic Staff” nothing is mentioned about staff training. Teaching development (is requested) may need that.
- Evaluation system for the courses and the programme can be improved. The panel have learned during the week that this is becoming compulsory to some extent. Motivate the students to take active part in the process, e.g. by closing the loop.

Students

Observations and comments

- High drop-out rates
- It is noted that many students work and study at the same time. This has both pros and cons. As long as they are working in the area of their education this is motivating. If not, it will “only” be an extra work load. It also makes e.g. group meetings between students difficult to organise.
- Problems with prior knowledge has been mentioned by teachers on several occasions.
- Activities for recruiting students are in progress.
- Employers pointed at independence and team work abilities as important
- There is an interest to go abroad and some students actually do so. Credit transfer does not seem to be a problem.
- Prior knowledge from high schools/gymnasium is sometimes poor

Strengths

- Those student that are in the programme are motivated (although some comments were made by BSc-students about motivation related to some of courses in first year)
- Those continuing with the masters programme are well prepared and motivated

Areas for Improvement and recommendations

- Early counselling for potential dropouts
- The reason for high dropout rates are several. One is lack of prior knowledge, i.e. the students admitted into the programmes are not qualified. Admission criteria should be modified.
- The economic situation for the students forces them to work part or full time in parallel to their studies. Possibilities for scholarships and study loans should be considered.

2.3. VIRUMAA College

Observations and Comments

The College has a special role in the region in providing a technical education for local people with the aim of supplying a qualified and knowledgeable workforce to the local industry. The main language spoken in local industry is Russian. The region is the main industrial centre for Estonia, with the focus on oil shale, mining and chemical engineering. Virumaa College provides the only technical education in the region at PHE level and 1 Masters programme, a total of 6 study programmes in this study programme group. The PHE courses are of 4 years duration including a total of 12 months of internships. There are 610 students supported by 101 staff, of which 34 are academic members – 10 PhDs, 2 researchers and 15 visiting staff. The student to academic staff ratio is high (in international context) at around 17 - this evidently leads to a high workload. Of the 610 students, 267 are distance learning, and 30 post-graduates. There is very close cooperation with local industry, who have provided 236 scholarships to students, equivalent to €142,193, a significant investment from industry.

The Director of College is a member of Council of TUT; the Director of Student Affairs is a member of the university study committee, teaching units have direct contacts (e.g. analytical department, thermal engineering department), sometimes laboratories of TUT are used, there are visiting lectures from TUT, staff participate in some joint research projects – thus, overall, there appears to be a good integration of the College into the University.

The College and employers work in partnership to promote engineering within schools in the region, with the aim of attracting more students. All employers met have a cooperation agreement with the College, and meet formally twice a year.

In recent years almost 60% of the funding has come from EU funds, which has been used to update teaching labs and facilities. A tour of these facilities showed up-to-date equipment, and all the necessary equipment to ensure the students are able to meet the learning outcomes of the courses. However, such a high reliance on EU funds is a potential threat as it is expected to decrease, although the College has applications in for EU funding for the Oil Shale Competence Centre.

The Oil Shale Competence centre is a unique R&D centre for investigating oil shale technology. There are a number of labs and incubator space for local companies. The centre has to become self-financing. Its main aims are in offering services, providing education, stimulating entrepreneurship (SMEs) and disseminating knowledge. Students can undertake internships within the Centre. The Oil Shale Competence Centre provides the College with an excellent opportunity to attract more investment and international partners. It carries out applied research with USA, China, Jordan, Mongolia, Morocco and other countries and will be continuing to seek support from the EU. From the meeting the panel feel that it is not exploited enough by the College, and would even recommend changing the name to International Centre of Excellence in Oil Shale Technology.

As well as the Oil Shale Competence Centre there are a number of other opportunities associated with the teaching programmes:

- There is a growing demand from employers for engineering with more specialist knowledge.
- Engineers are interested in retraining to gain more knowledge of new technology.
- There is very good support from the local industry.

Strengths

- The unemployment rate of graduated students is very low, ca. 10% which shows that the graduating students are in high demand.
- There is significant interaction with and support by local/regional industry (14 companies) providing 236 scholarships over the last ten years. Enterprises also offer support in terms of equipment and textbooks.
- The College and staff are involved in many outreach activities which appears to be paying off as students are better informed and motivated – this has yet to be represented by statistics.
- Promotion by former students, particularly for shale course, summer camps (gymnasium pupils). This is already in progress but could be further enhanced.
- Student Counselling is available through workshops and peer-to-peer support.
- Staff mentoring and commitment to the College is also to be commended.

Areas for Improvement and recommendations

- Perhaps more distance learning support can be provided to help working people to qualify for higher degrees, it might be useful to try to integrate vocational school leavers to combat decline in student numbers. Recognition of Prior Learning (RPL) is in place to facilitate this approach.
- Remedial courses could be offered prior to enrolment (e.g. summer school) in order to combat weaknesses in mathematics and physical sciences and prepare students well for the start of studies, thus decreasing drop-out rate.
- Students could be attracted from e.g. Ukraine and Russia, but also from other Estonian regions.
- The Oil Shale Competence Centre is a superb asset that needs to be expanded (internationally) and needs to improve its visibility!
- The workload distribution is approximately 30% research and 70% teaching/admin – this ratio needs to be shifted through additional appointments to also decrease student/staff ratio.
- When asking staff, students and employers what to prioritise if additional funding were to become available, the unanimous response was "additional academic staff" - the panel completely agrees with this notion.
- The average age of teaching staff is high which is of concern. The college needs to make academic life more attractive to younger members. Encourage students to pursue research and then academic life. An option is for the College to look into an alternative recruitment model to provide enough motivation or younger staff to teach. This will require working with employers, to explore joint industry posts and freeing up more time for staff to do research. Salaries also need to be reviewed to attract or keep the best people.

Strengths and Areas for Improvement of Study Programmes by assessment areas (VC)

2.3.1. Power Engineering, Machine-Building Engineering and Industrial Automation (Prof HE)

Study programme and study programme development

Observations and comments

- The panel met the employers, who were mainly represented by HR managers. There was no technical representation. All companies represented have cooperation agreements with the College.
- Employers appreciate their involvement in designing the program, and in the amount of practical work, in particular internships.
- The employers are concerned at the lack of chemical engineers across Estonia as a whole. The College has tailored its courses towards fuel technology, but chemical engineers need to have a broader knowledge base.
- In terms of R&D there is little resource available, but some companies do get involved in the Oil Shale Competence Centre.
- The College has modern campus with state of the art labs.
- There are plans for extending the campus by one additional building but no information was provided and funding is not clear.
- The college specialized on outputting trained personnel for the local industry which is very appreciated there.
- For future development the College want to focus on people, recruit more younger academic staff, which the panel supports.

Main threats for employers:

- Age profile of the teaching staff. This has been raised and the College recognises this.
- The College is not able to attract enough students, as a lot of young people leave the region. There is a major demography issue, even though the region is of economic importance, it is not considered an attractive place to live.
- The threat of the mutual dependency of the local industry and the college is underestimated. It is believed that having also power engineering as subject is diversification enough, which is a bit short sighted.
- Industry is based on production and sales, not research. Production is competitive because of the lower salary level. The future will surely move more towards product design and research, while production might migrate to other countries (as long as it is not fully based on local raw materials). There was no clear strategy for the future. Changes (markets, price development, political decisions, etc.) might hit by surprise.

Main Opportunities for employers

- Internationalisation, and in particular they agree that the Oil Shale Competence Centre offers an opportunity to attract overseas researchers and students.
- Attract international students from Russia and China.
- English is not so much of a concern for the employers except Eastman. Estonian is more of an issue – they would like more teaching in Estonian.

Student drop-out rate

- According to the statistics more students drop out each year than graduate, which is very serious.

- Most drop out in the first year due to difficulty with Maths. The College recognise this, and have taken action to reduce the impact by providing a remedial maths course to help students get up to same level. In fact the aim of the first two years is to ensure all students are at the same level before taking specialist engineering courses. Statistics have been presented showing that the majority of students do pass the remedial maths test, but those who fail tend to fail the final exam later on.
- The College has tried to work with Schools to improve the maths education, but only had support from technical high schools and not Gymnasium type schools. With the former the courses were not compulsory and there was a low uptake from the school pupils due to lack of motivation.
- However, the question must also be asked, do the students actually need to be taught so much maths, as based on the discussion with the students not much of it is actually used in their final jobs. Given that most students intend to work in the companies, a very practical education is required.
- Peer to Peer mentoring works well in providing support to the students in the earlier years.
- Main threat to the College is the reduction in student numbers due to demography. At present the minimum number of students that the College can sustain is 15 per annum and per programme, which given the current intake is not of concern at the moment.

Strengths

- Consultation with national industry, and close cooperation with other faculties and universities.
- Study programme has been developed over a number of years taking into consideration the requirements of industry. This is good for the students as it allows them to be exposed to real life problems and techniques, but it is not clear how new developments in research are included in the course.
- Industrial Automation covers all aspects, a wide range of subjects.
- All employers agreed on the following strengths:
 - Location of the College close to employers is important.
 - Programs are very practical.
 - Good opportunities for internships.
 - Very good links with the College.
 - College staff are receptive to the needs of employers in developing engineers suitable for their work environments.

Some employees teach courses, which the industry is pleased to support as it motivates the students. The companies also encourage staff to upgrade their skills at the College, and Distance Learning Programme is promoted.

Areas for Improvement and recommendations

- College and Employers continue to work with schools to emphasise the importance of improving the level of maths in schools – need to think of ways of incentivising the schools and the pupils.
- The College review with the employers the need for such intense maths in the first two years, as once in the company it is not used widely. In a Prof HE course perhaps the level of Maths is too high.
- The panel recommends introducing examples of how the maths is relevant to their engineering studies, which will also require more basic engineering courses taught in the earlier years. Both this point and the previous point may help to reduce the drop-out rate in the first year.

Resources

Observations and comments

- There has been a lot of investment in labs, both teaching and research. A tour of the labs certainly showed very good facilities.
- Beside the teaching labs also research labs with up-to-date equipment is needed to attract industry contract.
- There is enough lab equipment because there are so few students.

Strengths

- Good links with industry to assist with teaching resources.
- Extensive IT facilities for staff and students.
- Management of resources seems to be very effective, lab space is flexible so that use can easily be changed.
- As far as the students are concerned the labs are well equipped, and they receive lots of hands on experience.
- Industry standard software is available to the students and used in courses.

Areas for Improvement and recommendations

- Invest in research lab equipment in order to attract researchers and industrial contracts.

Teaching and learning

Observations and comments

- Organisational Studies Course is good and helps students be aware of responsibilities, and manage time.
- There are 30 distance learning students and this is growing. Staff have adapted courses and labs to cater for this.
- There are some shortcomings in the teaching of commercial software. It seems to be done at a basic level, with more training required once a student is in industry.
- When asked about soft skills of the students, the employers stated that actually the students did not really need them when they start work, but they can be trained as and when required, if students move into management. Most students start in production like any other new employee, but they move up the ladder more quickly.

Strengths

- Links with TUT, in particular alignment with quality assurance; access to labs; and use of lecturers.
- Internship scheme provides excellent opportunities for students.
- Student feedback is used in an effective way.
- There is the opportunity to go abroad to study through ERASMUS. An alumnus had experience of ERASMUS, and recommended it to all students.
- Changes to the courses are made in discussions with College staff and students. Employers sit on a formal curriculum committee.
- According to employers students are well prepared for work, and the internship programme helps with student awareness. If students require training, the companies provide this.

- All are made aware of the procedures for internships, and there appear to be clear communication links between staff, students and companies.

Areas for Improvement and recommendations

- Need to increase the number of returned student feedback questionnaires - 10-20% is very low.
- Introduce engineering examples in maths to show how maths is applied and why it is important. The students thought this would be useful.
- Addressing the issue of student cheating – consider established software such as Turnitin.
- The panel encourage all staff to get regular training on commercial software.

Teaching staff

Observations and comments

- Members of the panel met staff from all programme disciplines, with some having had industrial experience. One member of staff was actively engaged in supervising doctoral students, and another member of staff worked part-time in the College and in a School.
- Staff spend 70% time on teaching and 30% on research – not clear if true for all staff. The college recognises that staff need to diversify, and there are examples of staff going abroad to France, Russia and Bulgaria. This has resulted in student exchange, but it does not continue once the staff member has returned – need to be more pro-active in maintaining links and promoting exchange with existing partners.
- Staff do feel overloaded and recognise the need to recruit younger members of staff, but it is difficult to motivate younger academics to apply. One issue is salary, as industrial salaries are more attractive, but there is also the challenge of having the time to being able to apply knowledge ie more time to do research.
- Recent PhDs have come back to work part-time as lecturers, but are working in companies or setting up their own companies. It is the expectation that these individuals would not be able to do this if they were 100% in the College as the workload would be too high, and the opportunity to do research is not available.

Strengths

- Good resources for staff in terms of training and encouragement to improve qualifications.
- Staff are active in developing new materials for teaching, in particular e-courses for the growing demand in Distance Learning Students.
- Good that 2 staff gained PhDs last year - this is encouraging and gives an incentive to staff.
- Teacher to Teacher seminars - very good and should continue.
- Mentoring of new young staff.
- It is good to see staff and students working together on projects such as Negavatt. Good for relationship building.
- Internships and project thesis well managed and organised.
- There are good communication links between students and staff.

Areas for Improvement and recommendations

- Encourage all staff to complete a teaching qualification as part of their internal development.
- The staff seek more opportunities in industrial cooperation; increasing international links; and more teaching equipment in particular for robotics.

- More research equipment to engage with employers. The Oil Shale Competence Centre is focussed on chemical and fuel technology, but there appears to be little in the way of research facilities for power engineering, industrial automation, and machine building. There are students & staff with the necessary knowledge, but not equipment to apply this knowledge.
- Concerned the average age of teaching staff is high - need to make academic life more attractive to younger members. Encourage students to pursue research and then academic life. The panel recommends that the College needs to look into an alternative recruitment model to provide enough motivation or younger staff to teach. This will require working with employers, to explore joint industry posts and freeing up more time for staff to do research. Salaries also need to be reviewed to attract or keep the best people.
- There are only 3 staff teaching the Industrial Automation programme - this is of some concern in terms of loading.
- There are only 2 staff teaching Power Engineering and Mining, educated to Masters level, and do not appear to research active.
- It seems the current students are happy with staff, or they just do not want to complain, but alumni had more critical comments due to external experience. Recommend College consult alumni more actively and act upon feedback.

Students

Observations and comments

- Members of the panel met a number of 3rd and 4th year students, as well as some alumni and overall the students are very satisfied with the College and the course, but the alumni had more comments due to more experience gained after graduating.
- The students are clearly very employable after completing the course, which should provide the staff some reassurance that they are doing a good job.
- For all the students the motivation of attending the College is to get a job in one of the local companies.
- The students accept that the first two years are very hard and intensive due to the level of maths. Support is provided by staff, and if you work hard you will succeed. Once into the 3rd year, they then only have 3 days a week of courses, so much more manageable.
- When asked what the students and alumni would like to see improved there was no response. The question was thrown back to the Chair by an alumnus, "Can you give some examples of cases where changes have taken place as a result of student feedback" – this implies alumni and hence perhaps the students feel that their voice is not being heard.
- In the 3rd year there are only 3 days of study load per week, which allows students to take a part time job, and also reduces the pressure on the students.

Strengths

- The small cohort ensures that they receive a lot of support and attention from staff, and the course is therefore flexible to meet their needs.
- Students are very employable.

Areas for Improvement and recommendations

- The students were not forthcoming in potential improvements or feedback to staff – it was almost as if they did not believe the feedback was acted upon. This does not align with self-assessment.
- Review engagement of students in feedback and how it is acted upon, in light of comment from an alumnus.

- The alumni feedback is only voluntary. It should be more formally organized.
- More industry cooperation - also internationally - is wanted.
- There is no feedback to the feedback. Students do not know if and how their feedback changes anything, which leads to no motivation to give feedback. More transparency is needed.
- Image campaign needed to keep young people here for study. Program and location is not popular enough.

2.3.2. Fuel Technology (Prof HE), Fuel Chemistry and Technology (Master)

The Fuel Technology study programme of professional higher education was launched at Virumaa College of TUT in 2005. The MA programme in Fuel Chemistry and Technology was launched later 2012 in response to the need for more advanced studies in this particular area.

Study programme and study programme development

Observations and comments

- Final study programme (Master) has only been operational for a few years – it seems thus somewhat too early to draw significant conclusions.
- Whilst the offered courses appear to be superficially comparable to those of TUT (see above) and thus may seem to be competing, it is the different emphasis (Virumaa College – praxis, TUT – theory) that allow these courses to flourish side by side.
- It is clear that these courses are designed to serve the local/regional community and feed into the local industry. Thus most students are local and are later employed in local industries.
- Whilst the Oil Shale Competence Centre (which appears to be financially independent) interacts with local industry and participates in MA programmes it would be highly beneficial if more effort were made to expand this activity – there is enormous potential here (not only in financial terms but also in terms of reputation for Virumaa College).
- Whilst it is clear that the language of instruction is Russian due to this being the predominant language of the regional, it would be beneficial to start exploring the delivery of courses in Estonian and English - the latter particularly in support of the Oil Shale Competence Centre.
- Whilst the Fuel Chemistry and Technology programme appeared not to have been updated since 2012, it became clear during discussions that this was actually a regular activity involving staff, students and industrial representatives.

Strengths

- The Oil Shale Competence Centre is a unique asset!
- There is a long tradition of companies cooperating with College on this programme apart from Eastman, who have only recently joined the industry partnership.
- Companies provide scholarship programmes and short course teaching of specific topics involving experienced staff.
- Companies comment positively on the local availability of highly educated prospective employees.
- Companies comment positively on the practical aspects of the programme which minimised in-house training.
- Companies are represented and have input into the curriculum committee of study programme.
- It is good to find “teamwork and management” as new module.
- Modules can be taken for professional development.
- There is a well organised internship programme, which even allows teachers to gain experience in various plants.

- Recognition of Prior Learning (RPL) is in place – members of the panel were able to talk to a student who took advantage of this. This is a very useful feature that allows cross discipline integration and education.
- The programme is well documented.

Areas for Improvement and recommendations

- There is perhaps too much a focus on Fuels (shale) – companies and students commented on the need for a somewhat broader education in chemical engineering (particularly process engineering), more automatisisation content would be also beneficial.
- International relations should be expanded.
- Oil Shale Competence Centre needs to internationalise further and demonstrate clear leadership (issuing of White papers, international collaboration EU – Horizon2020 and others, exchange visits, incoming international visitors, organisation and hosting of conferences, patents in collaboration with industry, etc.). This is an enormous opportunity!

Resources

Observations and comments

- The laboratories at Virumaa College are all of extremely high standard and comparable to the best seen in the rest of Europe. In particular, the laboratories associated with the Oil Shale Competence Centre were highly impressive displaying the latest equipment for the necessary tasks of characterising not only shale but also to facilitate different conversion processes and analysing the resulting products. However, this excellent facility appeared to be under-utilised. More effort needs to be made to bring this facility to the attention of the international community for joint work and collaboration purposes!

Strengths

- Laboratories are a great strength and support the course well (practice) – this has also been highlighted by the employers interviewed by the panel. Many laboratories have been developed with clear input from different companies.
- There appears to be sufficient space allocated for teaching, modern IT infrastructure.

Areas for Improvement and recommendations

- Discussions with staff and students have revealed that there is a lack of software skills and IT resources relevant to industrial practice. Whilst the panel understand that the core structure of the study programme emphasises practical aspects, it would be nevertheless useful for students to be exposed to mathematical programs such as Matlab or process simulation programs such as ASPNE. There are substantial academic discounts for these and similar programs and this should therefore be within budget.

Teaching and learning

Observations and comments

- Students comment that this is an enjoyable course delivered by competent lectures; many students wish to continue with a PhD.

Strengths

- Experimental facilities, teaching resources, lecturers, course syllabus – all are very practical and professional.
- The ‘best people in the field’ are actual lecturers, e.g. eminent guest lecturers from Russia (St. Petersburg) deliver invited seminars and courses.
- E-learning is available. A large amount of e-material is available to the students.
- There is easy access to ESTER, which allows student to interrogate most libraries in Estonia.
- Internships in local industry prepare students very well for later jobs.

Areas for Improvement and recommendations

- International and local links could be enhanced to import new ideas.
- Particularly the Oil Shale Competence Centre should think of also supporting techno-economic analysis and projects; the Centre could for example produce ‘White Papers’ in its area of expertise in order to increase visibility.

Teaching staff

Observations and comments

- Staff development strategies are in place.
- Whilst, on paper, the average age of academic staff appears to be somewhat high, there is a clear effort in recruiting younger lecturers to the College. Younger members of staff can communicate readily in English and, if this process continues, staff internationalisation and the resulting visibility of Virumaa College will be greatly enhanced.
- Competence centre staff pursue a number of interactions/collaborations with China, USA and other shale rich countries; there is also close interaction/co-operation with companies.
- Staff facilitate travel of students between College and University to build stronger links and share facilities.
- Staff do not appear to be involved in departmental budget plans, however, staff can write special proposals to acquire new equipment etc.

Strengths

- There is active and progressive staff recruitment and development.

Students

Observations and comments

- The panel met a number of students from different parts of the study programme, e.g. student with a background in Finances now doing an MA in Fuel Chemistry and Technology (he was required to do additional courses), who has his own company starting up a pilot plant programme. The panel also met a former student and first ‘product’ from the new MA programme who is now working as environment manager in an oil shale plant. The panel met an Engineer from the Oil Shale Competence Centre, studying shales from countries around the world (Jordan, Morocco, etc.) and talked to ERASMUS students, who went to Bulgaria, helping fellow students find places.

- Although official feedback is low, it appears to work very well through individual contacts.
- It is good to note that there is an interview process for Fuel Chemistry and Technology (evaluation of motivation not just entry marks)
- In future self-assessment reports it might be useful to incorporate employment statistics/destinations. The panel did learn, however, that the employment rate after completion of studies are Virumaa appear to be near 100%.

Strengths

- There are clear efforts re. early engagement of pupils via various outreach activities.
- There are also laudable efforts to decrease the load for part-time students.

Areas for Improvement and recommendations

- Decrease drop-out rates.
- 4th and 3rd year students appear not to be exposed much to professional software.
- In general, there are very few courses in English.
- It is not clear whether an alumni association exists – this should be instigated also in terms of collaboration and donations.