Assessment Report

Study Programme Group on Engineering

Estonian University of Life Sciences

University of Tartu

Tallinn University of Applied Sciences

5/25/2015

Contents

Introduction

The aim of the assessment panel was the evaluation of the Engineering study programme group in 3 institutions: Estonian University of Life Sciences, University of Tartu, TTK University of Applied Sciences.

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 Johan Driesen (chairman)	Katholieke Universiteit Leuven; Belgium
Prof Sigurdur Brynjolfsson	University of Iceland; Iceland
Prof Sven Anders Flodström	Royal Institute of Technology (KTH); Sweden
Ms Karmen Kütt (student)	Delft University of Technology; The Netherlands
Prof Eero Puolanne	University of Helsinki; Finland
Prof Jan-Eric Ståhl	Lund University; Sweden
Dr Paul Rullmann	Member of the Board of QANU (Quality Assurance Netherlands Universities); The Netherlands
Mr Madis Võõras	Enterprise Estonia, Innovation Division manager; Estonia

After the preparation phase, the work of the assessment panel in Estonia started on Monday, March 2, 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 the three institutions, 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 days meetings were held at the Estonian University of Life Sciences (Tuesday and Wednesday), University of Tartu (Wednesday), followed by the site visit to the TTK University of Life Sciences Thursday and Friday. 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 all three institutions the 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 Saturday, March 7, 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 reports. This work was executed in a cooperative way and the members of the panel intensively discussed their individual views on the relevant topics.

General findings and long-term recommendations

In general the panel is satisfied with the overall condition of the programmes in the institutes visited. The level of the programmes is up to standard, Faculty and staff in general are well qualified and the provisions are sufficient. It is clear that there are programmes or teams that do better or make a more motivated impression than others, but that does not change this overall view.

And of course, there are lots of improvements possible. Very often they have to do with (scarcity of) resources: more equipment, more staff, new laboratories, etc. Most of the teams we met could easily hand over a wish list. Most of those wishes are realistic, and if so, we have given them a place in this report. A modern programme should provide good education, but should also have provisions that are up to standard. But we are well aware of the fact that in a lively and dynamic University or Institute the ambitions and demands will always be bigger than one can afford. Choices have to be made and it is primarily for the University or the Institute to decide how to spend the scarce resources.

With that in mind we have, for the general conclusions, concentrated ourselves on those things that can be improved regardless of those bigger investments - changes that are within the power of the management and of the teams themselves as well.

As staff members, employees, employers, students, alumni, teachers, researchers, managers or directors you have given us the chance to look at the programmes from outside. We are grateful for that. For your openness and enthusiasm. We severely hope that you sometimes permit yourselves to do the same: look at your own programme, your colleagues, your students, your teaching methods, with the eye of a stranger and then think of ways to improve. Possibly you will come up with the same things as we do now.

- **Keep the programme open to the outside world.** We have seen good examples of staff members that visit companies regularly and keep themselves informed. This should be common practice. Subjects like nanotechnology, new materials, cyber physical production,

embedded systems or environmental technology are new important fields that need attention, at least the staff should bring itself in a position to discuss these new developments thoroughly, with the outside world. The same goes for the extra emphasis that is demanded on innovation and entrepreneurship and soft cognitive skills. Those subjects could dramatically increase the attractiveness of the programmes to the students.

- **Collaborate within your own university or institute**. We have seen many opportunities and chances, but often the tunnel vision dominates. Everyone is busy, why all the fuss. But programmes really could improve, when you let yourself be influenced by neighbouring disciplines. Most creative thoughts evolve from the clash of subjects or disciplines that are nearby. Look at it from the perspective of the university instead of from that of your programme.

- **Invest in teaching methods and didactics and incorporate ICT-based learning.** Lots of teachers experiment with new methods and techniques. What lacks is a concerted effort on the level of the programme staff or even higher on departmental level. Good education is crucial. This should be a major concern for all, but it is mostly fixed on an individual basis. Why not make room for a more structured approach on the level of the programme or the department. Question yourselves: what do we expect of a good teacher? Why not organize a discussion on effective learning? Why not invite an inspiring specialist in learning methods from abroad? How do we coach new teachers? Etc. Take digital learning: you do already quite a good job for all those students that live at a distance. Why not use and integrate those experiences into the 'normal' programmes? Estonia is leading in ICT for public administration, so why not embrace this ambition in higher education as well.

- **Develop a Quality Assurance System.** As was already said in the introduction of this report: a 7-years assessment cycle only guided by external surveys is not enough to keep quality standards alive. It is strongly recommended to put up complementary internal quality systems based on learning outcomes. They should be anchored to university level and from there on trickle down to programme level. As it concerns systems that should be part of all Higher Education institutes, it is recommended to develop them in collaboration with EKKA (based on Overarching Learning Outcomes in the National Qualification Framework of Estonia).

- **Double your efforts to stop the drop out.** This is a challenge for nearly all programmes. Drop out is too high and drop out is a waste. There are some obvious reasons like the combination of study and job or the military service, but that doesn't explain it all. We have seen different practices and heard lots of suggestions per programme (see for instance the recommendations on page 34). Most effective practices seem to be the ones that include individual attention; where students experience that they are part of a social system in which they are known and recognized and where the threshold to talk about problems is

low. This should be combined with a discussion and an approach on the level of the institute. Because it is or at least should be a concern for all. We've heard some promising initiatives like the student support centre.

- **Internationalize!** Everyone wants to internationalize, but –apart from a few programmes – nothing happens. Internationalization is very important. It opens the world for Estonian graduates and it opens Estonia to the world. But it is hard work as well. Attracting students, improving your English capabilities, organizing housing facilities and a social live for the foreign students, becoming bilingual in the information you spread around, stimulating European experiences, etc. We suggest you dive into it. Many countries have done so before you.

- **Make internship roles more explicit and improve the quality of internships** to achieve best quality in learning of skills. Internships often appear to be the jumpstart for the first job, so let's treat it like that and coach the students in these first steps on the labour market. The more self-conscious and alert they are, the better their chances.

- **Formalize the way you deal with students, alumni, industry and stakeholders** . Many programme-staff members have an open mind towards stakeholders and students. They use the comments and opinions they gather, but not much is formalized and there is no feedback on feedback. Why not give students full responsibility for the evaluation of the courses in the curriculum in order to achieve the best development. An adult organization should structure this in order to profit from it. This is especially needed when a programme starts to blossom and students suddenly come in abundance.

- **Work out a research strategy for applied (and if applicable scientific) research.** Research and the number of PhDs must increase in order to survive in the long run as academic institutes that can promote Estonian industrial development within the technical and scientific areas. This is a long-term goal; it takes a long time to accomplish. For the short term a research strategy is needed on the level of the programmes, but also on the level of the department. There are in the Review team's opinion too many sub critical environments now, making it hard to form a true and integrated Knowledge triangle. And although it was an overall positive experience to observe the high standard of premises and available laboratory equipment, the possibilities of innovative use of new equipment were still rather unexplored.

- **Professionalize the approach towards the EU.** When it comes to research strategy the question of money is quickly raised. The institutes should really put more effort in professionalizing their approach towards European funds. Europe is a bureaucracy and the competition for funding is tense. That begs for a concerted approach. Don't try to figure it out on your own; collaborate, work together, exchange experiences.

- **Collaborate.** The overarching recommendation is: work together. The thing that struck us as a panel is the overall ambition of the Estonian institutes and companies to blossom and flourish in Europe and as part of Europe. This powerful ambition invites everyone to collaborate and work together for the common good. So, do not loose yourselves in trifle details, in struggles about competences or status differences or in a tunnelled vision; go for the main road together.

1. Assessment report of SPG at Estonian University of Life Sciences

Study programme group	*Engineering, Manufacturing and Technology*
Higher education institution	Estonian University of Life Sciences
Study programmes	Biosystem Engineering (Prof HE)
	Technotronics (Prof HE)
	Engineering (Bachelor)
	Foodstuff Technology (Bachelor)
	Energy Application Engineering (Master)
	Ergonomics (Master)
	Meat and Dairy Technology (Master)
	Production Engineering (Master)

1.1. Introduction and general findings at study programme group level

Comments

- The physical and teaching framework have been developed. Their quality is comparable or better than most other universities. The progress is expected to continue.
- The collaboration with the universities (TUT and UT) is valuable and should be further improved. It is important for EMU and for Estonia to have high quality engineering education in order to keep pace with new technology developments and challenges. Common education programmes and curricula that react to changes in the outside world are necessary.
- Estonian University law allows the professional curricula to be taught at the Universities. So it is possible to have a tertiary professional education College and an Institute within the same organization. However, this should be done carefully and well thought through. Otherwise one risks losing an educational culture that is well anchored in industry. Many other European countries encounter similar problems and it is not obvious that everything gets better by becoming more academic.
- Curricula are planned at the programme level. There seems to be not much coordination between programmes. This is a weakness and there should exist a process for programme renewal, both disciplinary and thematically.
- Ergonomics master programme clearly showed the increase in employability when soft skills are included in the curriculum.

Strengths

- The Estonian University of Life Sciences (EMU) is known for its quality, its hands-on mentality, its good balance between practice and theory, its strong ties with agriculture, forestry and with the respective industry and companies as well as with the Government. It is an open organization that is easy to communicate with.
- The close links with industry are clearly visible in the equipment they support for practical training.
- The Graduates have excellent chances to find a job that matches their competence.
- In general the workload of students seems to be appropriate although it needs to be measured, since the students feel that the credits are not reflecting the workload on course level.
- The laboratories and facilities are in a very good condition, well managed and well equipped. The EU funding has been well used.
- The average age level of the staff is dropping, due to the hiring of young motivated and high educated (MSc and PhD) lecturers.
- There are adequate student support services, to the satisfaction of the students.
- There are some lecturers who really seem to be into problem-based learning and in the use of alternative teaching methods.
- Students commend the good atmosphere of the faculty. They are pleased with their programme and education.

Areas for Improvement

- Among the threats are,
    - a low number of students applying, due to the demographical changes in Estonia,
    - low retention, that is high dropout rates,
    - a lack of and a conservative (non-innovative) use of human resources,
    - increased national and European competition concerning research money and students.
- Retention is a general problem at EMU. It varies in degree between the programmes. The reason is the same as at any university; programmes need to attract students with the right qualities and drive. Food technology seems to fare better than the other programmes. It was also stated in the self-evaluation, that more focus should be paid to student counselling. The main problems causing students to drop out are loss of interest and motivation, not managing to balance school and work. Particular obstacles for the first year students in the professional higher education programme are their mathematics and physics studies. Their high school education has not given enough priority to mathematics. The loss of interest also seems to be connected to the programme not meeting the expectations of the students. For instance in Biosystems Engineering students did not know there would be so many agriculture topics in the programme. This could be a matter of accurately communicating an informing potential students. However, sometimes it happens that a sector succeeds in developing an education programme that is perfect from a conservative

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professional view but not attracting and motivating any students. This is a management question on the Rectors level.

- There are few incoming exchange students. EMU should consider its ambitions on this point and take actions accordingly. Many addressed this as a problem, but not many visible actions have been taken yet.

- EMU faces an important problem in the Engineering College: there are not enough students, due to demographical decline and other reasons as the lack of interest in engineering/agriculture studies.

- The military service currently disrupts the studies of 4-year professional higher education students, if they did not serve before starting at university.

- Involvement of teachers in research projects and the involvement of industry in programme renewal would improve education and would open the minds to knowledge development and to new competences that students need in their future jobs.

- It could be made easier for students to share their life between work and study through modern on-line teaching technology. Online education and mobile learning platforms should be introduced.

Recommendations

- A strong focus is recommended on improving the scientific level of the academic staff, not only by recruiting but also by development programmes for the current teachers. In doing so, also the contacts with the society and with business life in particular are of importance, like it is clearly stated in the Self-evaluation report.

- It is recommended that – with regards to these programmes - the Institute rethinks its branding of the programmes and of the different tracks and that it develops a more internationally aligned profile.

- There should be more courses, modules and programmes in English. This is necessary to attract more international students. No English means no European or global students. An internationalization strategy needs to be developed.

- The study programmes are essentially technical (although less for Ergonomics). Soft skills like innovation, entrepreneurship, value judging and leadership should be taught more and better;

- It is recommended to formalize the participation of the students, employers, alumni and staff in programme development; e.g. stating their role in curriculum discussions and feedback.

- The students should also be more involved in the evaluation process of the courses; they are now more treated as an informant/customer than as a companion.
  A clear message about the efforts expected from students to successfully accomplish their study should be communicated to applicants. An online preparatory mathematics course should be launched.

- In the communication about the studies, the future job profiles should have more focus in order to put agriculture, forestry, environment and food industry and catering in the correct perspective.
- A strategy on how to handle part-time or distance learning students should be formulated. Individual study plans should be compulsory and followed up.
- A clear strategy on how to respond to the decreased student numbers due the demographics and dwindling interest in traditional engineering should be formed,
  - a better branding of the programmes (using social media),
  - a plan to increase the number of international students (English proficiency for staff),
  - an increased collaboration with other Institutes to minimize overlap and increase synergies between different educational programmes,
  - a review of programme learning outcomes concerning content and skills.
- The use of the newly added labs should be given priority and be coupled to the revised programme learning outcomes.

1.2. Strengths and Areas for Improvement of Study Programmes by assessment areas

1.2.1. Biosystem Engineering (ProfHE); Technotronics (ProfHE); Engineering (BA)

Strengths
- The faculty seriously pays attention to the dropout problem by noticing the signs, giving individual attention and working with students outside of the timetable.
- Students feel that their feedback influences course design and execution.

Recommendations
- The overlaps of topics in physics and electric measurements should be avoided.
- The course workload should be measured. The students feel that the credits (ECTS) they get do not reflect the actual work.
- The high achieving students consider the programme(s) to be not challenging enough. An increased flexibility should be introduced through e.g. more electives and the possibility of parallel tracks. This would also address the problem of the curriculum being too traditional.

Study programme and study programme development

Comments
- A cross-departmental Teaching Methodology Committee is in place.

- The Biosystems Engineering curriculum is new in this form, but has a strong agricultural background. It has a strong foundation in natural and engineering sciences, but as a four year programme it is rather diversified, covering very many areas of different disciplines. This poses a challenge on the resources needed to get experts for all those areas. The name of the Biosystems Engineering curriculum is modern and nice, but does not exactly describe the contents of the curriculum.
- Estonia is known to be very strong in computer science and applications. Therefore it is only natural that the Technotronics curriculum has been established. The way of organizing the curriculum in a collaboration with several teaching establishments is a wise decision.
- In general the panel met teachers that are dedicated to their job and that have lively discussions on pedagogic aspects.

Strengths
- For students with a professional higher education degree it is easy to continue their study on master level.
- Buildings and laboratories are newly refurbished.
- The university and the Institute have good links with industry.
- There is a pedagogic discussion and debate among teachers.
- There is a good balance between theoretical and practical modules/courses in the educational programmes.
- Students are generally satisfied with their studies.

Areas for improvement
- A strategy needs to be developed for internationalization. Student and faculty exchange, outwards and inwards, could be encouraged.
- Constant updating and at the same time redesigning the curricula could have more emphasis, keeping the overarching idea of the programmes in mind. There are many learning outcomes to be touched upon, which otherwise could result in a fragmented curriculum.

Recommendations
- Change the name of the Biosystems Engineering to one that better reflects its content (e.g. one that still has 'engineering' in it).
- Include modern manufacturing methods in the programmes.
- Try to avoid the overlap of topics (e.g. in Technotronics in physics, electrotechnics and electric measurements).
- In general: see the continuous updating of the programme as a collective effort.
- Introduce the Biosystems Engineering programme better to the stakeholders, i.e. potential students, industry and potential employers.

Resources

Strengths
- Good facilities; buildings laboratories and equipment. EMU has been successful in obtaining EU funding and support from Estonian companies.
- The facilities are well equipped and maintained. EU funding has been important for this rather dramatic modernization. A change that has been catalyzing an overall positive development.

Recommendations
- EMU needs to attract more research funding. To become successful EMU needs to recruit key academics and increase collaboration with other Estonian and European universities.
- EMU needs to put more effort in getting Erasmus Mundus and Erasmus Exchange funding.
- Scholarships (be it provided governmental or by the university) are needed.
- EMU should put effort in applying for Horizon 2020 funding in cooperation with industry, especially SME-s.

Teaching and learning

Comments
- Although there is no formalized debate on (new) teaching methods and didactics, part of the faculty takes part – on a voluntary basis – in an open teaching platform.
- Teaching in English exists within subjects of modelling and informatics.
- In Electrical Engineering students get individual feedback on their achievements, with good results.
- The quality of teaching is good. However, it is needed to develop this quality through an internal quality system, where students, alumni and labour market companies have a saying.
- Workload for students seems to be appropriate. Teaching groups are reasonably sized.

Strengths
- Teachers use a variety of teaching methods and practices such as lectures, projects, skills training and internships and students take part in research and problem-based learning.
- There is a variety of feedback, formal and informal (social media, internet and via employers from internships). Once a year a programme evaluation seminar takes place with the students.
- Open motivating projects and activities are linked to the curriculum as the student society robotics projects and the design network of homes.

Areas for improvement
- There seems to be a lack of visibility of the University level executive management. No one referred to the EMU mission during the discussions. More alignment would improve the coherence of the organization as a whole, University and Institute.
- Technotronics lacks courses in programming.
- The alumni ask for more modules improving students' innovation and entrepreneurial skills, as some of them will be managing their own enterprises.

Recommendations
- The curricula are rather diverse and scattered; they touch upon many subjects without – at the same time - giving the students a coherent image of the discipline/profession. It is recommended to revise them in order to bring more focus to the programme.
- Connected to this: the number of ECTS devoted to compulsory courses is very high. The structure seems to fit faculty demands more than students'. It is recommended to make curricula more flexible and give room to individual choices of the students.
- It is recommended to develop a more coherent role for the programmes in addressing the Estonian future labour market.

Teaching staff

Comments
- Internship teachers visit the student during the training, which is useful.
- The course in robotics shows a successful mix of students from EMU and TUT.
- There are too few PhD students. A joint discussion between TU and EMU concerning the "biosystems area" as a future research area for technical, biological and medicine and social science research should be initiated.
- Online courses like MOOCs and blended formats need to be developed. There are many opportunities to collaborate in this area. It should become a part of the faculty's normal work and be supported by a local common intellectual and technical infrastructure
- Teachers definitely search for ways to prevent dropping out. But there is no easy solution. They discuss together the first signs; they give individual attention, sometimes work with students outside of the timetable, etc.

Strengths
- Teachers are enthusiastic and proud. Their motivation is excellent. There is a good mix of young and old. The older teach the younger ones what they have to teach; the younger teach the older ones how they can do that the best.
- The balance between teaching and research is becoming better. Ambition is 40 % of time on teaching, 40 % on research and 20% on educational development.

- An increasing number of teachers have a PhD. It is the ambition that in 2020 every teacher has a PhD.
- Professional development modules within education exist e.g. in teaching in engineering.

Recommendations
- It is recommended to formalize the criteria for a good teacher (basic qualifications level) and to connect this to a teacher-training programme.
- It is recommended to work out a research strategy, in order to use the growing scientific attitude of the staff for further development of the programme content.

Students

Strengths
- Students are satisfied and well informed, they like the *hands-on* approach. They feel well guided and well supported.
- Students feel their feedback influences the course design and teaching, though they are not involved directly in the programme development.
- There are possibilities for students to go abroad and study.

Areas for improvement
- In the planning of the studies the needs of working students are not taken into consideration.

Recommendations
- The programmes could use more flexibility in order to better anticipate the growing wish of students to choose their own learning path and to combine work and study efficiently.

1.2.2. Energy Application Engineering (MA); Ergonomics (MA); Production Engineering (MA)

Comments
- One way to make education more effective is to cooperate with other universities; this discussion has already begun.
- Teaching an increased number of courses in English as well as strengthening the collaboration with other universities can attract an increased number of students. That will contribute to an increased training efficiency. Reportedly, the university has already initiated steps in this direction.

- It is very helpful that the Rector has a special budget for strengthening programmes and courses with specific problems, e.g. because they need additional support measures or additional lectures (mathematics).
- The Ergonomics programme uses the help of alumni for the development work on the programme.

Strengths

- The laboratories are well organized, equipped and suited for the programmes' needs.

Areas for improvement

- The Ergonomics programme could improve from cooperation with companies/industry.
- The laboratory equipment needs to be improved in the agriculture area.
- The programmes could use more flexibility in order to better anticipate the growing wish of students to choose their own learning path (e.g. there is a demand for Psychology in Ergonomics)
- Programmes could improve due to a more global approach; an increased number of international collaborations will have a major positive impact on the development of the programmes.
- The Institute needs to clarify and exemplify professional roles and labour market relations related to each programme.
- An increased efficiency in the study programmes can be obtained by strengthening the collaboration and integration between the existing study programmes. The programme management should strive for having at least 20 students present during lectures and exercises, which provide a financial frame for smaller groups during the laboratory sessions.
- A balancing effort needs to be done between gaining efficiency by decreased adjustment of the basic courses and at the same time saving the essential requirements of each programme. When new courses are created, e.g. those that are linked to the study programme groups, efficiency aspects should be taken into account.
- The evaluation committee believes that it is good to continuously compare own programmes with other international programmes, but it is even more important to adjust your own programmes according to the national needs and their conditions and opportunities. A way to better adapt the programmes to the national needs is to invite alumni to help with the development efforts. The Ergonomics programme has positive experience with this. It has come far in involving alumni in the development efforts.

Recommendations

- It is recommended that the Ergonomics programme improve the cooperation with the companies/industry. One can think of different actions to strengthen the contacts between the university and the industry/society, e.g. a newsletter 5-10 times per year from a relevant group of departments (programmes).

- The university needs to clarify and exemplify professional work tasks related to each programme.
- It is recommended to put more emphasis on the development of lifelong learning and timeshared studies.

Study programme and study programme development

Comments
- The content and structure of the programmes do follow an international "standard" for engineering programmes.
- The possibility for students to form their own profiles is limited with the exception of the Ergonomics master programme.
- Learning outcomes are adequate in numbers and are written in active tense. The learning outcomes for soft skills should be revised and implemented better.
- The structure of the study programmes is well thought through and gives students good guidance. The subject-based examination of is of high value.

Strengths
- The study programme is solid and reliable. Feedback from industry is adequate.

Areas for improvement:
- The importance of ICT in the study programmes seems underestimated or at least difficult to see. CAD/CAM is not sufficient for working with energy application, ergonomics and production engineering.

Recommendations
- Soft skills and ICT skills should be introduced in an integrated fashion into the study programme.
- Electives should be given more room.
- Student involvement in programme development should increase.

Resources

Strengths
- There are well-developed premises and well-equipped laboratories. The staff in the laboratories is competent and motivated.
- There is clear evidence that laboratories can provide and are providing contract research for industry needs

Areas for improvement

- Funding for R&D. Research money in Estonia is very limited, yet essential for the further development of research as well as higher education. It is essential to professionalize the process of project writing and applying for European research grants, on the level of the University as well as in collaboration with (inter) national partners. This is a highly competitive field and should not be approached individually.

Recommendations

- Put effort in applying for Horizon 2020 funding in cooperation with industry, especially with SME-s and international partners.

Teaching and learning

Comments

Teaching methodology is considered in a serious way. The earlier work on learning outcomes and quality had high priority. Individual teachers do develop themselves. There is ambition to cope with the retention problem. Today we have the possibility to blend on-line and campus learning in new ways. A major leap could be considered towards more individual/student centred learning that keeps up the student motivation. For example, the mathematics, physics and basic technology subjects could be complemented with on-line modules. Student failure is very seldom due to lacking ability but instead to lacking motivation due to internal and external circumstances.

Strengths

- The directors and teachers are aware of the importance of teaching methodology and of delivering a high level of quality.

Areas for improvement

- Coupling educational methodology to the motivation and retention problems.

Recommendations

- A strategy and a work-plan are needed to renew teaching methods, implement digital learning and create more flexibility. The analysis and the ideas are there, but they need to come together in order to address the educational challenges in a structured way.

Teaching staff

Strengths

- The faculty has become rejuvenated and younger. Faculty management does a good job.

Areas for improvement
- The faculty could be more involved in educational development and research. Non-local faculty recruitment could increase.

Recommendations
- Keep the high priority on creating a good faculty. Increase the use of guest lecturers.
- Keep, additionally, a strong focus on the improvement of the scientific level and the teaching qualifications of the academic staff, not only by recruiting but also by development programmes for the current teachers. In doing so, also take the opportunity to involve stakeholders from society and business life.

Students

Comments
- The number of students in exercises is reasonable (12-15). The number of students in the lectures is quite large.
- The overall picture for EMU for the study programme group shows an increasing enrolment but not an increasing number of graduates.
- There is some integration between the different courses.
- Many students (30 to 40 %) have a job next to their master study.
- Students have been involved in solving problems for the industry.
- Students frequently are offered payment for their internships and often continue their career there (which stipulates the importance of the choice for an internship; it should be adequate)
- Employers consider the graduates from the professional bachelor programmes as being fit for the labour market. For academic bachelors however a master degree seems to be the prerequisite.

Strenghts
- Students are motivated and capable.
- Due to the fact that there are only few students in each master programme, students get a preferred treatment.
- Students are attractive on the labour market although the global jobless percentage is 12 % or higher.
- Dropout rates are low; the proportion of students graduating in time is large.
- Students also study at other Estonian or European universities as a part of their programme.
- Alumni and their employers are satisfied with the professional preparation and social competencies.

Recommendations

- Students are not very familiar with the master thesis requirements. This should be more clearly stated.
- As the internship often is a first step towards a new job, it is recommended to put more emphasis on the process of applying, presenting oneself, making choices, negotiate. A special group are the EU/international students. They ask for more help and guidance on internships.

1.2.3. Foodstuff Technology (BA); Meat and Dairy Technology (MA)

Comments

- Foodstuff Technology is a renovated programme, based on the combination of specific national needs and foreign benchmarks. The programme has been designed as a technology-oriented programme. Why it is called 'Foodstuff Technology' is not clear (it seems not clear to the department either, as they use Foodstuff Technology and Food Technology interchangeably).
- The section has gone through a period of transition, with personnel changes, with low funding for research and with insecurity about the renovation of the premises. This seems to have had effect on the motivation of the personnel to make the required scientific progress.
- The Food Technology programme has a very high admission rate (10:1), and the quality of the programme has increased lately. The dropout has been low.
- The funding for the programme is based on the number of students. There has not been separate funding for PhD research, so doctoral students have a high teaching load.
- A need for new initiative and more scientific research and publications will be required. There is also a great need for increased collaboration within the university, between the universities in Estonia and internationally.
- The faculty is in favour of (inter)nationalization and exchange of experience. Still it has not happened yet at a large extent. However, there is a strong conviction that the initiative should come from the staff and students themselves. Maybe new steps will be taken, now that decisions seem to be made on the renovation of the premises (the Food Technology House).
- Yet there still seems to be uncertainty about future developments of food science in the university.

Strengths

- The Programmes are well known for their quality, their hands-on mentality, their good balance between practice and theory, their strong ties with industry, companies and government. They form an easy to contact organization.
- Graduates have a good chance to find a job on their aspired level
- The programmes attract enough students (selection 1 to 10)
- The curriculum is well thought through. All learning outcomes are covered. Important elements relevant to food industry are given good attention, including foundations of natural sciences as well as more applied foundations of general technology studies (i.e. engineering type studies).
- The newly developed curriculum has led to a consistent and attractive programme. Yet the curriculum is also rather fragmented and divided in lots of small subjects of a few ECTS.
- There is a good balance between theory and practice.
- The department has a good relationship with the industry, both in curriculum development and in practical training of students and common research projects.

Areas of Improvement

- There are concerns as well: insufficient resources, a more competitive climate (for research money e.g.). The programmes await a decision on the level of the University Board to build a Food Technology House. This will lead to better lab-facilities, which the organization desperately hopes for. It seems that the decision is made, but the staff hesitates to believe it yet. Clarity is needed.

Recommendations

- It is recommended that the organization prepare a strategy on the level of the university for a long-term planning of necessary teaching staff for each unit. Estimated retirements can be foreseen years before they are actual. This is very crucial for the continuation of the scientific research and teaching.
- More emphasis and initiatives are needed on internationalization of students and staff (including English proficiency of staff).
- It is recommended to actively collaborate in the university and with other universities, national (Tartu, Tallinn) and international (the Nordic circle).
- A thorough analysis of the expected changes on the labour market for the coming decades should be done. If this leads to a lowering of admissions in the future, due to an expected saturation of the markets, the resources should then be used for improving the curriculum and teaching, not for a cut-down of the resources.
- Meat and Dairy Technology: a similar survey as above (Food Technology) and even more importantly will be required for meat and dairy industry, because the given numbers of

students may, on the long run, lead to labour market saturation, which may have a negative impact on admission rates and quality of applicants.

Study programme and study programme development

Comments
- It is not clear how the credits are calculated for the course workloads. The numbers of credits sometimes seem to be rather generous, but naturally that cannot be evaluated without really scrutinising the courses in detail.
- In general it wasn't clear at first sight, to what extent there is overlap between BA courses and MS courses.
- The split between the BSc-programmes on Animal Sciences and Food Technology a few years ago proves to be a good step. It has led to a consistent and attractive programme on Food Technology. Yet the curriculum is also rather fragmented and divided in lots of small subjects of a few ECTS. It is unclear who takes care of the integration of all these small parts and who is responsible for renewing and updating of the programme and who is leading the discussion (there is a methodology committee, but its role in this discussion is not clear).

Strengths
- Practical aspects are well represented in the curriculum. There is practical training, there are pilot studies and the teachers have close contacts with their respective areas of food companies. A great share of individual work is based on practical training. The theoretical teaching leading to thesis work looks very good.
- Important elements relevant to food industry are very well covered, including foundations of natural sciences as well as more applied foundations of general technology studies.
The Meat and Dairy Technology programme is relevant to the Estonian Meat and Dairy industry. The programme is exceptional in that it covers both meat and dairy. That seems to be a rational concept in a country that is not very large. The introduction of a new line of vegetable products is attractive. Besides that, the other two areas have their historical roots as well as their programmes strongly embedded in the Veterinary Institution.
The plans for the further development of the Food Technology curriculum are promising.

Recommendations
- Consider to change the English name 'Foodstuff Technology' into 'Food Technology, as this name internationally covers food materials, processes and unit operations as well as economic effects of industrial food production and processing.
- With the further elaboration of the new curriculum on Food Technology special attention is needed to keep sufficient difference between Food Technology BA and Meat and Dairy MS.

Resources

<u>Strengths</u>
- There are some good facilities (micro-dairy).
- The textbooks written and under preparation are most useful, much used by the students as well as by the industry of the fields of the responsibility of the department.

<u>Recommendations</u>
- All efforts are needed to attract EU-money for the Food Technology House, now that the decision to build seems to have been taken by the board. There are some good facilities (micro-dairy), but it is not enough. A Technological laboratory with easy access to analytical, sensory and microbiological equipment will be urgently needed.
- Particularly interesting and useful, clearly from an academic point of view, are the experimental dairy and other areas (meat and plant material technology). They deserve similar laboratory equipment as well, in addition to the pilot plant level equipment.
- It is recommended that the collaboration with other universities/polytechnics in Estonia and elsewhere should really be made, so that each student will be able to utilize that opportunity, to further increase the quality and resource efficiency.
- Put effort in getting more research money
- Put effort in getting more Erasmus Exchange funding
- Put effort in getting more scholarships.

Teaching and learning

<u>Comments</u>
- The teaching methods have developed much during the last two decades. The teachers have written several textbooks that are used in teaching, and an interesting new one under preparation is 'Food Technology' (about 600 pages). Also there is an impressive list of electronic teaching materials, like videos about different industrial processes.

<u>Strengths</u>
- Teachers use a variety of methodologies and teaching practices (lectures, practical training, students taking part in research, projects).
- There is a variety of feedback, formal and informal (social media, internet, employers from internships).

<u>Recommendations</u>
- It is recommended that the staff take teaching methodology as a subject for the team as a whole. It is now too much approached from the individual perspective of the one teacher/lecturer. A more structured and formal approach is needed to make progress and

to renew teaching and learning on the level of the department as a whole (e.g. including the use of ICT, blended and online learning).

Teaching staff

Strengths
- Competent staff, and there will be more teachers having a PhD in the future.
- Good mix of young and old.
- Growing balance between education and research.

Recommendations
- It is recommended to formalize the criteria for a good teacher (basic qualifications level) and connect this to a teacher training programme.
- It is recommended to work out an (applied) research strategy, in order to use the staff's improved scientific competence for further development of the programme content.

Students

Strengths
- The programme meets the expectations of students.
- The programme is popular among potential students and can be selective with incoming students, since the competition per student place is high.
- Dropouts have decreased and are significantly lower than the university average. The department is putting emphasis on an individual approach and flexible timetables.
- Some students are involved in research activities in the university and there seems to be an understanding, that if a student has interest, then there is a way to be involved.
- The students have access to labs for their theses work and research. Everybody seems to do at least some sort of lab work during his or her studies.
- Feedback is asked from students and they are involved in the programme development, though there are no formal procedures to involve students in programme development.
- Graduates have a good chance to find a job on their aspired level.
- Students feel that their feedback has an influence on the programme.

Areas for improvement
The programme could use more flexibility in order to cope with the demand of students to choose their own learning path. Some want a more theoretical approach, some do want more practical training, some need more flexibility to combine the study with the parallel job they have.

Recommendations

- Although the programme has a high competition for student places, many students do not know exactly what they can expect from the programme. So it is recommended to add an introduction course to the programme, to inform the students from the start what they can expect, how broad the field is they have entered, what choices they can make later on, what they can become once graduated and what is expected from them.
- Formalize and structure the influence of students on course and programme development.
- Formalize and structure the relations with alumni and employers. They are nearby and content with what they get. The organization is still small and everyone knows everyone. That is the time to formalize the relationships a bit more in order to profit of them when the numbers grow.

2. Assessment report of SPG at University of Tartu

Study programme group	*Engineering, Manufacturing and Technology*
Higher education institution	University of Tartu
Study programmes	Applied Measurement Science (Master)

2.1. Introduction and general findings

This is a truly science based, applied science/technology master programme. The teaching staff has a very good research background. The programme has an innovative use of internships to foster both student's knowledge and skills development. Learning outcomes are used in the right way to define curriculum and course/modules content and methods of teaching.

Comments
- The admission requirements are fairly liberal when it comes to chemistry/physics background from earlier bachelor studies.
- It is a small programme and as such the student feedback is often direct and personal.
- Scaling up, due to the Erasmus Mundus programme, the first year studies will demand a new strategy to handle the original AMS and the Erasmus Mundus programmes in parallel.
- Applied Measurement Science is a very broad description and does not correspond to the contents of the programme. The name Analytic Measurement Science seems to be a better name for the actual programme.
- Definitions are used in an excessively wide sense, e.g. metrology (in chemistry) – the scope needs to be defined better.
- Dropouts are no problem in the master programme.

Strengths
- Teaching staff.
- Quality of Internships.
- Laboratories and other infrastructure resources.
- The good teacher-student communication.
- The levelling activities that are implemented for students to make sure that they start on the same level. The levelling adviser helps other teachers to implement special actions for individual students. During the first semester the introduction courses help the students also to reach the level of the other students in the group. Mixed types of grading systems are used.
- Students are stimulated to choose a master thesis that has a strong connection with research; the subject should also have a potential for scientific publication.

<u>Areas for improvement</u>

Student recruitment! The regional/national/Nordic recruitment should be increased. There is a market for English based studies for this type of master programmes. However, bear in mind that increased international recruitment and the quality of students probably will demand more scholarships.

<u>Recommendations</u>

- Form a vision for the area of functional measurement technology of the Applied Measurement science Master programme.
- Reconsider the name of the programme, e.g. "analytic measurement science" would be a better description of the actual content.
- Define the scope better, in the Learning Outcomes and add extras like soft skills, leadership and an entrepreneurial attitude.
- Make a plan for the transition to integrate (more students in the lab?) the EMM and for the period after the EMM (keep the momentum).
- Professionalize the use of MOOCs and online modules by making them an integrated part of education, make a business plan for it.
- Offer a Summer School for all students (not only EMM); or integrate this approach in the programme.
- Consider more collaboration with (international) industry and other application fields such as environmental sciences.
- Keep in touch with alumni systematically and structured. The same goes for the students, make use of the feedback of the students (actions are definitely taken yet, but the alumni and students we met didn't seem to know whether their comments led to changes).
- Use the Erasmus Mundus programme to increase European and international recognition.
- Try to keep the entrepreneurial spirit, meanwhile creating a more systematic way to handle relations with the labour market and alumni.

2.2. Strengths and Areas for Improvement of Study Programmes by Assessment Areas

2.2.1. Applied Measurement Science (MA)

Study programme and study programme development

Comments
- A council decides on the content of the programme together with the programme leader. Although representatives of the alumni are members of this council, the alumni we spoke to saw no or very small influence on the development of the programme.
- Representatives of alumni state that the programme should increase the proportion of practical laboratory work. A more accurate analysis is required to see if this change is possible to implement. The programme management, in consultation with the students, will have to determine if it is possible to increase the students' workload or if the change requires that other items need to be removed and in that case, which items or courses should be removed from the programme.
- The learning outcomes are really used the right way; more than just a description.
- It is a small programme where a few highly ranked, both in research and education, really can create something new. The programme could serve as an example as how to improve the education within science and technology at Tartu University.

Strengths
- Internships are relevant to the programme and the quality of execution and reporting is high. The strong connection with research activities is impressive.
- It is a 100% English taught programme; English language teaching and the mix of students contribute positively to the student development and experience.
- Student's learning methods are rooted in physics, chemistry and biotechnology.
- Levelling activities are implemented for students to make sure that they start on the same level.
- The graduate students are very useful in many areas according to the comments from industrial laboratories.

Areas for improvement
- The strategy for running AMS in parallel with Erasmus Mundus must be clear because the numbers of applying students are going to increase.
- The programme could be better announced to the industry; the programme seems to be insufficiently known currently.

<u>Recommendations</u>

- Currently there are several parallel courses (5-7) that are taught at a rather low intensity. The workload in the end of the semesters could be reduced by combining courses into bigger blocks.
- A job-fair is a good way to make the programme better known; also a newsletter could be a good addition to make the programme better known outside the university.
- Look for better and larger utilization of social media for the promotion of the study programme.
- It is recommended to better define the embedding of the AMS programme in the Chemistry Institute (e.g. exchange courses)

Resources

<u>Comments</u>

- Premises and physical infrastructure are on a very good level.
- Laboratories are well equipped.
- ICT, supporting teaching, is well functioning.
- Reasonable funding seems available for the teaching activities. However, there are not enough grants for scientific research (teaching and research need to be in balance to foster the scientific character of the programme and to stimulate science based teaching; so sufficient provisions and financial resources are needed for both).
- The donations and support from the industry are much desired in order to enable funding scholarships.
- Laboratory equipment and localities are excellent. Web use in teaching/learning is good.

<u>Strengths</u>

- The novelty of the premises and laboratories.
- The entrepreneurial mind-set of the core of the teachers; this is a guarantee for flexibility.

<u>Areas for improvement</u>

- Attracting additional funding for scientific research and contract research.
- The expected scaling up due to the EMM will demand more systematic processes and a distribution of tasks. This needs to be timely anticipated.

<u>Recommendations</u>

- There is a lack of textbooks in some areas. This needs to be addressed.
- It is recommended to give attention to competences that are not sufficiently met in the current programme, like leadership and entrepreneurship. This could be done via additional courses.
- More advanced labs are needed for physical measurement.

- Better equipment is needed for demonstrations in lectures.
- It is recommended to look for cooperation within the European Union framework to collectively apply for the Horizon 2020 programme,
  - for instance for the SME incentive grants;
  - or in a larger international consortia for participation in grant programmes like ERA-net.
- It is recommended to analyse the possibility of utilising the laboratories of the Institute of physics.

Teaching and learning

Comments
- Online teaching is just beginning, although some examples of blended learning and MOOC-online-teaching and learning exist. This needs to be developed further and also needs to be applied to professional (continues) learning.
- The education methods are based on individual adaptation to the students' different educational backgrounds. This is only possible as long as the number of students is less than 15 (individual mentoring).
- There is no regular (yearly) discussion on the personal development of staff members between the employees and their superior.

Strengths
- High Quality. Small scale. Good equipment. Fruitful internships.
- The teachers are very enthusiastic with respect to their work and to the programme.

Areas for improvement
The programme is good, but small. It definitely needs scaling up; more students and more staff. It is a necessary, promising but at the same time vulnerable phase of development that needs thorough attention and anticipation.

Recommendations
- In general: continue with improving activities.
- It is recommended that the team regards teaching methodology and the didactical approaches as a subject for the team as a whole. (e.g. including the use of ICT, blended and online learning).
- Direct information about the programme globally (PR).

Teaching staff

Comments
- The quality of the teaching staff is very high as recognized by students but also by rewards. Many teachers are doing high quality research.
- Needed are more international guest professors and guest teachers from industries.

Strengths
- An excellent European and International network.

Areas for improvement
- Recruitment of new staff for the Erasmus Mundus programme will be necessary. Timely anticipation is needed.

Recommendations
- Organize regular meetings between employee and superior on personnel development.
- Open possibilities for the teaching members to improve themselves collectively.

Students

Comments
- Students well meet the expectations placed on them.
- The workload for students is definitely acceptable; students have some extra time to work aside of the studies and/or it also possible to take an extra course.
- The majority of students selected the programme based on the information overheard from other or former students. To attract a wider population of potential students a more focussed information campaign – if possible together with industry - is needed.
- The knowledge and skills students obtain during their work on the master thesis are very important for their coming professional work.

Strengths
- There is an international student group.

Areas for improvement
- Increasing the number of scholarships.

Recommendations
- Make maximum use of the Erasmus Mundus opportunity. Prepare for the post-Erasmus Mundus era.
- Market the Tartu University brand. Market Tartu.

3. Assessment report of SPG at TTK University of Applied Sciences

Study programme group	*Engineering, Manufacturing and Technology*
Higher education institution	TTK University of Applied Sciences
Study programmes (Prof HE)	Automotive Engineering Electrical Engineering Mechanical Engineering Resource Management in the field of clothing and textiles Technical Design and Technology of Apparel Engineering Materials and Marketing Technoecology

3.1. Introduction and general findings study programme group level

Comments

- The study programmes exemplify the European way of educating engineers for different professions and professional roles, where the science and broader technical subjects make the basis for modules of specific professional knowledge and internships in companies. Product and service work and development are mainly education and experience based. 4 years give ample time both for instructed studies and in house laboratory and external internships.
- The learning outcomes correspond well to the Estonia overarching learning outcomes for engineering educational programmes.
- Automotive engineering and Marketing engineering are cross-sectorial in the sense that behavioural and business subjects play an important role. This makes it clear that the focus is on professional roles and not on sectorial knowledge in general.
- The programmes simply address the labour market in a good way, which can be seen also in the labour market statistics; they clearly show that graduates get jobs.
- The programmes have a sound theoretical basis. A basis that probably is tough for part of the students admitted.
- The graduates are attractive on the labour market and the percentage of jobless is low or even non-existent which of course make the study programmes attractive to students. The relatively high number of applicants confirms this.

- The study programmes' curricula are traditional and so are the labour markets addressed. The Engineering Materials and Marketing programme is more cross-disciplinary between technology and economics/business and also seems to attract female students better.
- Of the set of programmes Automotive Engineering, , Mechanical Engineering and Engineering Materials and Marketing already exist for many years. A series of newer programmes were added over the past years such as Resource Management in the field of Clothing and Textiles and Technoecology. Some programmes, such as Electrical Engineering are still in the start-up period and will deliver the first graduates in 2016.
- The programmes and the included courses are described in student-centric Learning Outcomes.
- There are some initiatives to include new teaching methods.
- An effective e-learning environment is present.
- A system is in place for continued development of most programmes: a meeting between the university and the industry takes place every year where the changes in courses and in programmes are discussed.
- Additional funding has been obtained to improve the equipment and to develop the staff.
- Extra funding is used to attract short-term guest lectures from abroad.
- The existing staff has been temporary complemented with external (part-time) teachers as a way to increase the quality.
- The teachers have the possibility to spend 200-400 hours yearly on research and development; the amount of hours is limited because they do not get any designated resources for this. The bulk of the project work can be related to demands coming from industry.
- The student group is extremely non-homogeneous and has different backgrounds and sometimes may be in need of support to adapt.
- Dropouts are a big problem at the university. There is no easy explanation. It is a complex phenomenon often connected to financial and/or personal problems. Another specific reason that is clear is that the students also work during their studies; this can lead to poor academic performance, which in turn leads to dropping out.

Strengths
- TTK has a good reputation among the employers and is praised for the theoretical knowledge as well as for the practical skills of the students.
- There are many jobs for the graduates and they are appreciated for their knowledge and practical skills. For instance, in Automotive Engineering they are considered as ideal candidates to become master technician and foremen. Some successfully pursue a master degree.
- The staff, students and graduates are in general very pleased with the programme and the related workloads. There is an open culture allowing feedback and communication.

- There are many up-to-date laboratory facilities linked to the focus areas of the programmes. There is room to make them more complete.
- There are initiatives to introduce problem-based teaching, with links to motivating extra-curricular activities.
- There is an onset for internationalization with incoming and outgoing students, though the international students are often separated from the local ones. The staff has experience in participating in international project and networks.
- There are practices where the different stakeholders, such as companies, students and staff, interact on the curriculum development [but could do more systematically, to achieve a common practice amongst all programmes].
- There are good examples of first initiatives using social media, and there is an attractive website.

Areas for improvement:
- The retention rate needs improvement. It is not acceptable to loose so many students. It is understandable that students that work in parallel with their studies will encounter problems. This can be counteracted in different ways, if you basically know that the students have the necessary educational background and that they are motivated. Perhaps, the admission process picks the "wrong" students or there is a mismatch between the (vocational) high school students' knowledge and the basic demands for the study programmes within mathematics, physics and basic technology courses.
- In general: the dropout problem, especially in the earlier years, needs to be followed-up closely. The reasons for dropout are on the one hand study-related and on the other hand linked to the social situation of the students or external societal obligations such as military service. A thorough analysis should be done.
- Following and coaching of the students can be done much better. A mentoring and professional advice system is needed, reporting directly to the programme management.
- The plan, that in 2015/2016 TTK UAS will hire specialists of academic affairs in faculties, whose main task will be student counselling, is supported by the Panel.
- Luckily there are also plans to start a student support centre in the near future. This could be of help. Some support activities are available already but it is still fragmented.
- To give students extra help, the project on learning modules could be intensified, resulting in a repository of modules on subjects that are hard to learn.
- The learning outcomes of the different courses should not only be focussing on the technical outcomes, but should also describe the acquired soft skills, leadership and entrepreneurship attitudes.
- To further develop the soft skills and at the same time enhance the motivation, problem-solving approaches can be introduced already in the lower years.
- The learning outcomes and programme approaches are mainly oriented towards individual components; the system level is often at the background or lacking.

- More integration of curricula could be pursued (e.g. automotive with electro-, techno-ecology and clothing programmes with materials), also more flexible, individual learning paths could be allowed with possible reorientation (which might help to avoid dropout).
- There is only an informal network for alumni and key companies. There is room for a more structured and formalized approach.
- There are opportunities to improve the use of the lab and teaching offerings towards companies. There is already a systematic Lifelong Learning and service offer strategy at TTK UAS (open university – inservice training); which serves as a good starting point (e.g. one could think of a course for foremen, or the retraining of existing staff due to the demographic changes).
- There is a structural lack of research opportunities, mainly linked to underfinancing.
- There seems to be a limited awareness of European R&D funding possibilities, especially on Horizon 2020.

Recommendations
- Introduce system-level thinking and non-technical learning outcomes such as soft skills, leadership and entrepreneurship in the respective Learning Outcomes.
- Organize discussions between programmes with the goal to achieve more integration, e.g. by introducing more flexibility, such as course packages allowing specialization and joint offerings such as shared (elective) courses. Even project-based collaboration of students across programmes could lead to further development of leadership skills.
- It should be guaranteed that the staff is encouraged to keep up-to-date with the fast technological evolutions and integrates this accordingly in the courses and lab infrastructure.
- Students, alumni and employers participation is possible, committees are functioning (also with the help of the student council). This should be implemented in a more systematic way.
- To decrease dropout the following actions can be considered:
    - To guide the students in the transition from high/vocational, learn the students study planning and put in place a mentoring system;
    - introduce mid-terms ("trial exams"), after which "catching up" is still possible;
    - bring projects/cases in the 1st year to enhance motivation;
    - implement orientation tests at the start of the classes, e.g. for maths;
    - introduce team building to encourage social cohesion from the beginning;
    - plan with students how to integrate military service in the programme from the beginning;
    - further develop the distance learning options and programme flexibility to allow work-study combinations as much as possible.
- Internationalization: make a central information point, with enough possibilities to get in touch with "ambassadors" (people who went on exchange). Alternatively, a short group study trip could be planned. The current excursions are based on the activities of individual

teachers only, and not clearly supported by the university. It is recommended to establish a system of excursions in the programmes, both to Estonia and to abroad. The university should make a quality assurance system for the excursions and allocate funding to organize them.

- There are courses taught in English in different curricula. The threshold to experiment with teaching in English to encourage internationalization "at home" should be as low as possible. This is even asked for by the students as well. This could be joint teaching of a course in English or maybe a semester in some programmes. This would also lead to more efficient use of the staff resources as currently some courses are taught double.

- Look for more visits, and hands-on experiences in the companies.

- Develop a strategy to build a community of alumni and key stakeholders such as companies and governmental bodies and use their feedback in a structured and formalized way.

- Develop a strategy for a joint integrated marketing and communication approach to develop the life-long-learning offer as well as the lab services offer to companies.

- Special attention is needed for external teachers, irrespective of whether they come from other schools from industry or from respective institutions. They need to be given information on what is expected of them in relation to coverage and depth of teaching as well as teaching methods and study materials.

- There is not enough study material available. The teachers should be encouraged to produce such a material for the use of students as well as for stakeholders at the same time.

- Legislative aspects related to the subjects are very important. Special courses are needed, but more so, whenever relevant, regulations and legislative matters should be repeatedly included into the course.

- Try to improve the information given to high schools, especially the vocational schools. They seem to be a source of potential students of which the share may be raised. In general take care that the information and ads describe the profile of the future jobs in a realistic way. Use social media better and in a bigger capacity.

3.2. Strengths and Areas for Improvement of Study Programmes by Assessment Areas

Following remarks at the level of programmes should be considered as addition to those presented in the general part 3.1.

3.2.1. Mechanical Engineering; Electrical Engineering; Engineering Materials and Marketing

Study programme and study programme development

Comments
- It is difficult to find practical training for international students.
- The student admission is 1/3 from high school, 1/3 vocational schools and 1/3 from other higher education institutes.
- The typical R&D activity is in collaboration with companies, making prototypes etc.
- Focus is on applied research - no funding for basic research.
- There are plans to create a simulation environment/laboratory in the near future in collaboration with other institutes.
- The student council is actively involved in curriculum development.
- Erasmus and international relations are well introduced to the students.

Strengths
- Faculty have good contact with industry, they get input from companies and students through internships/thesis.
- Innovative teaching methods are used to some extent and they work out well, e.g. a distance course in materials science and problem based learning.
- Some students go abroad for thesis work ~ 3-4 per year.
- The students are in high demand after graduation and find good jobs.
- Project management is taught in a compulsory course.
- Feedback from students is used effectively – students can influence the courses.

Areas for improvement
- It is possible to strengthen the industry relation by having more visiting lecturers from industry.
- Innovation and entrepreneurship could be given more room by involving real Estonian entrepreneurs.

Recommendations
- Although laboratories are not so much about expensive equipment as well as about new

ideas and projects, there is a need for more laboratories in electronics, e.g. high voltage laboratory and for industrial robots for automation. It is recommended to develop those.

- It is recommended to increase the number of laboratory staff.
- It is recommended to think a bit more freely upon what new professional roles there are in the pipeline.
- Allow more electives for students so they can tailor their education to their needs.

Resources

Comments
- Laboratories are well equipped, thanks to EU funding and good cooperation with companies.
- The development of laboratories is coherent with the development of the study programmes.
- Students from different study programmes can use the laboratories.
- The development of laboratories in electrical engineering is coherent with trends in society and economy (larger utilization of electric cars)

Strengths
- The teaching staff is convinced of the importance of lab practice for students and dedicated to the further development of the labs.
- The university can provide subcontracting and contract research based on the laboratories equipment.
- The laboratory for electrical engineering is well equipped.

Areas for improvement
- Laboratories should be modernized and development should follow the trends in industry.
- Funding for R&D.
- The cooperation with industry in Estonia and internationally.
- In cooperation with companies a better utilization is possible of the EU framework programme Horizon 2020.
- There are very good labs available for specialized subjects, but no easily accessible lab facilities for basic technologies; currently the labs of vocational schools are used for this (e.g. for standard motors, transformers).

Recommendations
- It is recommended to extend and improve labs with following equipment: sheet metal processing equipment, laser cutting equipment, CNC milling (7 axes).
- It is recommended to develop an industrial robots laboratory.
- It is recommended to develop a full-scale high voltage lab.

- Look for European R&D funding opportunities, especially in cooperation with SME-s.
- It is recommended to give the entrepreneurial centre of the TKK the task to follow the work programmes in Horizon 2020 and prepare projects and grant applications.

Teaching and learning

Strengths
- LMS eLearning on the Moodle platform.

Areas for improvement
- More effort could be put into e-Learning.
- Student advice. Students are best told early that their motivation and background could cause a problem. In such cases some should best be advised not to start.

Recommendations
- Organizational and geographical mobility should be increased.
- Intensify the contacts with electricity companies (utilities, grid operators) to collaborate with them, on hands-on training, final works, power system and high-voltage technology subjects and for placements.

Teaching staff

Comments
- The further pedagogical education of teachers seems to function well. It was not easy to understand if it was mainly individual teachers initiative or if it was a TTK policy.

Strengths
- The motivational package of the teachers is adequate.
- The staff in the laboratories is young, competent and motivated.

Areas for improvement
- More guests both academic and industrial and both students and faculty should be invited. 4 years is a long time and students must feel that they study at a university that is alive and not just an educational institution. Guests and mobility play an important role here.

Recommendations
- See general recommendations under §3.1. For instance about encouraging the staff to keep up-to-date with the fast technological evolutions, integrating these accordingly in the courses and lab infrastructure and on using (new) teaching methodologies and didactics.

- It is recommended that renewal on both fields (new content and new methodologies) be approached in a structured and organized way for and with the team as a whole.

Students

Comments

- See general comments about the study programme group: the students are satisfied, feel involved, are inclined towards internationalization, can participate and consider the workload to be manageable. However, knowledge gaps, flaws in motivation at the start of the programme and social conditions pose a risk for high dropout numbers.
- Electrical Engineering is a newly started programme; there are no final year students yet.
- Graduates get jobs.
- Mobility should increase.

Strengths

- Students are connected to new technological evolutions and research in the field.
- There are valued interactions with other programmes.
- Internationalization was present from the start of the programmes.
- ME is one of the larger programmes in terms of numbers of students, but the lab groups are kept small enough to allow hands-on learning.
- Industrial and labour market networks work well. Still this can be developed even more.

Areas for improvement:

- The retention rate must improve.

Recommendations

- See the general recommendations in §3.1.
- Students and alumni should get organized to be able to have clearer opinions on the programmes and to become the stakeholders they should be.

3.2.2. Technoecology

Comments

- The focus of the programme is in the waste management area. Technical aspects of waste that are considered are dominantly water and energy (organic materials).
- The programme addresses a very relevant subject: waste management and ecological technologies. The programme realizes good quality, with a good balance between practice and theory and between technology and environment, it touches upon a broad variety of subjects.

- The programme does not cover the complete area of waste handling; there is some lack of knowledge in the recycling technology.
- On the university level an interview template for developing the programme together with the industry is used. The development of the programme often parallels the development of the teachers.
- The curriculum council has a meeting once a year, together with all stakeholders, to discuss the further development of the programme, get suggestions for changes, etc.
- According to the discussions with the teachers, the programme is well known and established in the Estonian Society and in the waste handling industry.
- The general opinion of students is that there is no gap or overlap between the courses and that the programme is consistent with respect to the structure.
- In order to be more attractive on the labour market it is favourable for students to continue with a master degree.
- The network between university, industry and the other parts of the society seems to work well.

Study programme and study programme development

Strengths
- The curriculum is well thought through and all learning outcomes have been addressed. Important elements are well covered except for the part of recycling technology.
- The University has good relationship with industry.

Areas for improvement
- An additional course is needed in thermodynamics and mathematics, to prepare students for the diploma thesis especially in the area of energy. This improvement is going to be implemented next year.
- Introduction of more material technology into the programme should improve the understanding of the recycling process related to products and materials.
- Deeper international cooperation and deeper knowledge about the international laws in the area of waste management are needed.
  A better introduction is needed in the first semester to inform about the importance of the technical disciplines. Also a better connection is needed between the technology oriented courses and the biology-oriented courses.
- It clearly can be established that the internship is very important for the first job after exam; therefore more attention should be paid to the planning and the selection process for an internship.

Recommendations

- The programme should have at least one course or part of a course that deals with recycling technologies such as shearing and crushing processes, material identification, screening and sorting.
- It is recommended that the organization devises a strategy for:
    - Internationalization (including English proficiency for staff, and attention for European legislation and environmental policies).
    - Collaboration within its own university and with other universities, both nationally (Tartu, Tallinn) and internationally (the Nordic circle).
    - Further formalizing the relationship with the industry.

Resources

Recommendations

- The internationalization of the programme should be increased. This presupposes resources for international study-trips.
- Better laboratory equipment in biology and waste technology is very much welcomed. Both the teachers and the students support this. More lab training should improve the education.

Teaching and learning

Comments

- There is a good working climate between students and teachers. The students have a very clear view of their professional role after graduation and of the expectations of employers. The graduate students meet the employers' expectations.

Strengths

- Teachers use a variety of methodologies and teaching practices.
- For students a variety of ways to give feedback is appreciated, formal and informal.
- There is quite extensive e-learning support.

Recommendations

- In general: see recommendations in §3.1.
- It is recommended to work out an (applied) research strategy

Teaching staff

Comments

- According to the teachers, there is necessary time for personal development.

- Yearly discussions take place between employees and their superiors where workload and individual development are addressed.
- Every 5th year teachers are tested for a new accreditation therefore continues improvement is needed with regards to the specific discipline and the didactic skills.

Strengths
- Teachers are skilled and enthusiastic; the age-level is below faculty-average.

Areas for improvement
- University or faculty should take action to increase the employee's incitement to learn more of the English language.

Recommendations
- There are basics of the skills of university teachers described in an instruction by educational scholars from Tartu and Tallinn University, it is used in assessing the teachers and planning their professional trainings. It is recommended, however,to further formalize the criteria for a good teacher (basic qualifications level) and connect these to a teacher-training programme.

Students

Comments
- The students have chosen the programme because of the broad array of subjects that is covered.
- The programme has a dropout rate below the average of the faculty. The major part of the dropouts is related to economic problems. The potential dropouts are handled on individual bases.
- Students find the workload do-able.

Strengths
- Students are satisfied, well informed, they like the hands-on approach. They feel well guided, supported.
- Their feedback plays a role, although there is no official involvement in curriculum development.
- The number of dropouts is low compared to the university average.
- Students are satisfied with the possibility to participate in international projects like the NordPlus.

Recommendations

- It is recommended to form an alumni organization. It can give a voice to the experiences of the first generation of graduates of this young programme and could improve it.
- It is recommended to formalize the influence of students on programme development more.
- The same is applicable to the relations with alumni and employers.
- As the internship is an entrée on the labour market that often leads to the first regular job in this professional field, it is recommended that full attention be paid to the importance of its selection process and the successfully dealing with it.

3.2.3. Automotive Engineering

Study programme and study programme development

Strengths

- The curriculum is well thought through. All learning outcomes are covered. Important elements are getting good attention.
- There is a good balance between theory and practice and the students have good technical skills and are in high demand from industry.
- The programme is a good example of the strength of "learning by doing" when it comes to students motivation.

Areas for improvement

- There is a need to add more courses on new technologies such as hybrid and electric cars.

Recommendations

- It is recommended that the organization thinks of a strategy for:
    - internationalization (including English proficiency for staff, and attention for European legislation and environmental policies)
    - collaboration in its own university and with other universities, nationally (Tartu, Tallinn) and internationally (the Nordic circle).
- The relation with the industry is good but needs to be formalized further.

Resources

Comments

- Laboratories are well equipped, thanks to EU funding and good cooperation with companies.

- The development of laboratories is coherent with the development of the study programmes.
- Laboratories can be used by students of different study programmes.
- Resources for scientific research are lacking.
- The teaching staff is dedicated to further development of the labs.

Strengths

- The University can provide subcontracting and contract research based on the laboratories equipment.

Areas for improvement

- Labs development can be done better and could follow the trends in industry with less delay of time.
- The utilization of the EU framework programme H2020 can be done better; possibilities in cooperation with companies need to be explored.

Recommendations

- It is recommended to improve labs with the following equipment: diesel engine stand, electric cars lab.
- It is recommended to intensify and enlarge the cooperation with regional car dealers, with the purpose to equip laboratories in exchange for educational services for the car sellers and service companies.
- Give the entrepreneurial centre of the TKK the task to follow the work programmes in Horizon 2020 and to prepare projects and grant applications in cooperation with SMEs.

Teaching and learning

Areas for improvement

- See general recommendations in §3.1.

Recommendations

- See general recommendations in §3.1.
  For instance about retention and dropping out, internationalization, English taught courses, research strategy.

Teaching staff

Areas for improvement
- See general recommendations in §3.1.

Recommendations
- See general recommendations under §3.1. For instance about encouraging the staff to keep up-to-date with the fast technological evolutions and to integrate this accordingly in the courses and lab infrastructure.
- See also the recommendation on (new) teaching methodologies and didactics.
- It is recommended that renewal on both fields (new content and new methodologies) be approached in a structured and organized way for and with the team as a whole.

Students

Comments
- See general comments about the study programme group: the students are satisfied, feel involved and are inclined towards internationalization, can participate and consider the workload to be manageable. However, knowledge gaps and motivation in the start of the programme, and social conditions pose a risk for high dropout numbers.
- Automotive Engineering is one of the larger programmes in terms of numbers of students, but the lab groups are kept small enough to allow hands-on learning.

Strengths
- In place is a good integration strategy for students with vocational schools or gymnasium backgrounds, allowing them to develop teamwork and leadership skills in hands-on sessions.
- Students appreciate the opportunity to take part in projects such as Formula-student.

Areas for improvement
- See general recommendations in §3.1.

Recommendations
- See general recommendations in §3.1.

3.2.4. Technical Design and Technology of Apparel; Resource Management in the field of Clothing and Textiles

The Faculty looks very positively at the future because the trend shows that there is a demand for clothing manufactured in Europe and this demand is continually increasing. The education is unique in Estonia and comparison with other programmes needs to be done with universities abroad, e.g. Finland, Sweden and Germany.

Study programme and study programme development

Comments
- Both programmes can be considered as one programme with 3 specializations; Technical Design (design and materials), Technology (manufacturing) and Resource Management (logistic and sales). The result of this concept is improved efficiency in education.
- The curriculum of both programmes is well thought through. All learning outcomes are very well arranged on the website. Nevertheless, this is a professional field, which is dynamic and highly technology driven. There are many subjects that students would like to study more in depth or as extra elective (e.g. maintenance of textiles, legislation and regulation, longer internship).
- The programmes can´t meet the needs of the market with respect to the number of graduates. The limitation in the intake of students is related to the laboratory resources.
- Some students didn't realize sufficiently that the programmes have a focus on engineering and not only on design or fashion design.
- Discussions take place with students on an individual basis to prevent them from dropping out.
- Some of the dropouts from these programmes are related to unique causes: the student takes several selected courses and then directly gets employed without any need for a diploma.
- The industry claims that the internship should be prolonged and that more attention should be paid to materials.
- The formal feedback system is in place, but the teachers claim that the direct feedback after each lesson is more important for the continuous development of the curricula.

Strengths
- The programmes are well connected with the industry and its needs.
- Even the teachers have internships (mobility programme) and visit companies to learn and to get an understanding of the industrial developments and the industry's expectations of the graduates.
- There seems to be a very clear niche for these programmes in the Estonian higher education and labour market. There are no other programmes in Estonia that are offering education in the field related to textile technology.

- Students are asked for feedback regularly and frequently there are evaluations amongst the staff. In the yearly evaluations also employers are participating. Nevertheless: students do not always know what has become of their feedback.
- The curriculum of both programmes is well thought through. All learning outcomes are touched (beautifully arranged on the website).
- The curriculum consists of a lot of relatively small subjects. However, the variation of theoretical lessons and practical training (internships, projects) supports the integration of the different subjects in a natural way. What also helps to motivate students is that many of them foster the dream to start a company for themselves.

Areas for improvement

- The Estonian language is an obstacle in increasing the number of international students, for example through Erasmus Mundus.
- The programmes involved should gain in quality with increased coordination between the basic courses and the applied core courses.

Recommendations

- Start to use the English language in education, begin with one semester, a semester suitable for exchange students.
- In order to get the proper students, who do not drop out of education, information about the education programmes should be clarified. It must be clear that the programmes have an engineering focus.
- To increase the number of male students it is recommended to intensify the information directed toward potential students on technical textiles and flexible composites. This can be done through participation in fairs and by the increase of the information on the website and/or in other written formats.
- It is recommended that the rather informal organization around the updating of the programme be formalized, including the reporting back to the students on their feedback. This is to guarantee that the organization keeps up the natural way of working when the programme starts to grow.
- It is recommended to organize more flexibility within the programme in order to make room for new developments and connections.
- The courses in materials technology are recommended to be increased; especially those related to practical testing regarding strength, wear, scratch and ripping resistance, drapability, colour fastness etc.
- We strongly recommend increased cooperation with the Faculty of Architecture and the Faculty of Transportation for the use of the skills and knowledge in textile technology, especially the scanning, nesting and CAD technology. It is a great possibility for the programme to look into the area of renovation, e.g. furniture, additional covers for furniture and car seats.

Resources

Comments
- The faculty has the ambition to further develop the labs, increase the amount of research and conduct research on "publishable level", employ a person with research experience and get resources for study-trips for students (visit fairs and fashion shows, universities abroad, industry and competitions).

Strengths
- Overall provisions for training and practising are in good order and sufficiently available (at least for this total of students)
- The body scanner is a very promising instrument that could be a catalyst for new developments in the programmes and a bridge for collaboration with other partners in the university.

Areas for improvement
- See general recommendations in §3.1.

Recommendations
- See general recommendations in §3.1.

Teaching and learning

Strengths
- Teachers use a variety of methodologies and teaching practices (lectures, practical training, students taking part in research, problem based learning, presentations).
- There is a variety of feedback, formal and informal (social media, internet, employers of internships).
- Teachers know – at least those belonging to the core of the textile team – what their colleagues teach. So they are able to connect study content easily.
- New teachers are welcomed well. They get a mentor, start with easier subjects, get feedback from experienced teachers, get feedback from students and do a self-assessment.

Recommendations
- It is recommended to formalize the procedure on the introduction of new teachers.

Teaching staff

Comments
- All teachers have been involved in research during the last 8-year and the students have also been involved in the work.
- The teachers are pleased with the workload and therefore have time for their own development. The research is mainly consisting of different kind of applied and demand driven projects.

Strengths
- The teachers are highly motivated with respect to their work and to the programme.
- Teachers are enthusiastic and experienced. There is a good mix of young and old teachers.
- Teachers have frequent contacts with other partner institutes abroad, they visit fairs, conferences etc.
- Teachers do some research, mostly in the form of demand driven projects from industry; here certainly is much room for improvement.
- Teachers are involved in professional training for companies. This is a good stimulus for upgrading their knowledge and experience.

Recommendations
- There are basics of the skills of university teachers described in an instruction by educational scholars from Tartu and Tallinn University, it is used in assessing the teachers and planning their professional trainings. It is recommended, however, to further formulate the criteria for a good teacher (basic qualifications level) and to connect this to a teacher-training programme that includes new teaching methodologies and didactics based on digital learning.
- University or faculty should take action to increase the employee's incitement to learn the English language.
- It is recommended to work out a (applied) research strategy, in order to use the growing scientific qualifications of the staff for further development of the programme content.

Students

Strengths
- Students are satisfied, well informed, they like the *hands on* approach. They feel well guided, supported.
- Their feedback plays a role, although they do not seem to get feedback on their feedback and they seem not involved in curriculum development.
- The workload is do-able.

- A number of the graduate students start their own studio or company; several of these students have this dream already when they are admitted to the programme.
- The drop-out rate in the programmes is low; students on the verge of dropping out get individual attention.

Areas for improvement

- The balance between the genders could be improved, as most of the students are female.

Recommendations

- It is recommended to give more information to the students on the applied research being done and to incorporate the results in the classes.
- It is recommended to give students a stronger incentive/direction to go abroad during their studies, either by doing an exchange semester, participating in a visit or a fare or doing an internship. Students' fear of not managing to complete their studies timely should be addressed, taking the experiences of previous students into account.
- It is recommended to formalize the influence of the students more, whether it concerns curriculum discussions, feedback on teaching and teachers or organizational and administrative subjects; i.e. a tighter involvement of students.
- The same recommendation is applicable to the relations with alumni and employers. They are nearby and content with what they get. The organization is still small and everyone knows everyone. That is the time to formally embed the relationships in order to profit from them when the numbers grow.
- As the internship is an entree on the labour market that often leads to the first regular job in this professional field, it is a very important step in the career of the student. It is recommended that full attention is paid to the importance of this selection process and to the way to successfully deal with this.

4. Conclusions

The aim of the assessment panel was the evaluation of the Engineering study programme group in 3 institutions: Estonian University of Life Sciences, University of Tartu, TTK University of Applied Sciences.

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.

In general the panel is satisfied with the overall condition of the programmes in the institutes visited. The level of the programmes is up to standard, faculty and staff in general are well qualified and the provisions are sufficient. It is clear that there are programmes or teams that do better or make a more motivated impression than others, but that does not change this overall view.

And of course, there are lots of improvements possible. Very often they have to do with (scarcity of) resources: more equipment, more staff, new laboratories, etc. Most of those wishes are realistic, and if so, we have given them a place in this report. But we are well aware of the fact that in a lively and dynamic University or Institute the ambitions and demands will always be bigger than one can afford. Choices have to be made and it is primarily for the University or the Institute to decide how to spend the scarce resources. We have with that in mind for the general conclusions concentrated ourselves on those things that can be improved regardless of those bigger investments - changes that are within the power of the management and of the teams themselves as well.

For a more extensive elaboration of the conclusions, see paragraph General findings and long-term recommendations – page 4.

In headlines:

- Keep the programme open to the outside world.
- Collaborate within your own university or institute.
- Invest in teaching methods and didactics and incorporate ICT-based learning.
- Develop a Quality Assurance System.
- Double your efforts to stop the drop out.
- Internationalize!
- Make internship roles more explicit and improve the quality of internships to achieve best quality in learning of skills.

- Formalize the way you deal with students, alumni, industry and stakeholders .
- Work out a research strategy for applied (and if applicable scientific) research.
- Professionalize the approach towards the EU.
- Collaborate.

  This last recommendation can't be emphasized enough. It is important to develop a systematic multi-stakeholder approach on the level of the institute/faculty, with participation from inside and outside: from staff and students and from alumni, industry, labour market, other (Estonian) universities and Government. The panel has seen some good examples of this, but not everywhere and often not as sufficiently thorough and embedded as it could be. Yet, to keep the programmes up to standard, to renew them in an educational perspective and to adapt them to new competences continuously, collaboration, exchange of views, reciprocal influencing and pooling of resources are a prerequisite. This counts even more for classical engineering Institutes where the study programmes often have a long tradition.