

ESTONIAN QUALITY AGENCY FOR HIGHER AND VOCATIONAL EDUCATION

# Assessment Report

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Study Programme Group on Engineering

**Tallinn University of Technology**



**1/20/2016**

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## Introduction

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

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

The following persons formed the assessment panel:

Prof Jan-Eric Ståhl (chairman)	Lund University, Sweden.
Prof Job van Amerongen	University of Twente, The Netherlands.
Mr Hermann Blum (student)	ETH Zürich. Switzerland
Prof Sigurdur Brynjolfsson	University of Iceland, Iceland.
Prof Panicos Kyriacou	City University London, UK.
Prof Janusz Uriasz	Maritime University of Szczecin, Poland.
Mr Madis Võõras	Enterprise Estonia, Innovation Division manager, Estonia.

After the preparation phase, the work of the assessment panel in Estonia started on Monday, November 9, 2015 with an introduction to the Higher Education System as well as the assessment procedure by EKKA, the Estonian Quality assurance organization for higher education. The members of the panel agreed the overall questions and areas to discuss with each group at TUT, which were part of the assessment process. The distribution of tasks between the members of the assessment panel was then organised and the concrete schedule of the site visits agreed.

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

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

On Friday, November 13, the panel held an all-day meeting, during which both the structure of the final report was agreed and findings of panel meetings were compiled in a first draft of the assessment report. This work was executed in a cooperative way and the members of the panel intensively discussed their individual views on the relevant topics.

## 1. Assessment report of SPG at Tallinn University of Technology

STUDY PROGRAMME	TUT UNIT	LEVEL
Integrated Engineering	Mechanical Engineering Faculty	Bachelor
Mechatronics	Mechanical Engineering Faculty	Bachelor
Thermal Power Engineering	Mechanical Engineering Faculty	Bachelor
Product Development and Production Engineering	Mechanical Engineering Faculty	Bachelor
Fishing and Fish Processing Technology	Maritime Academy of TUT	Prof HE
Refrigerating Technology	Maritime Academy of TUT	Prof HE
Operation and Management of Marine Diesel Powerplants	Maritime Academy of TUT	Prof HE
Marine Engineering	Kuressaare College of TUT	Prof HE
Mechatronics	Mechanical Engineering Faculty	Master
Thermal Power Engineering	Mechanical Engineering Faculty	Master
Product Development and Production Engineering	Mechanical Engineering Faculty	Master
Industrial Engineering and Management	Mechanical Engineering Faculty	Master
Design and Engineering	Mechanical Engineering Faculty/Estonian Academy of Arts (joint programme)	Master
Biomedical Engineering and Medical Physics	Faculty of Science	Master
Health Care Technology	Faculty of Science	Master
Environmental Engineering and Management	Faculty of Civil Engineering	Master

### 1.1. Introduction and general findings at study programme group level

The comments and recommendations reported below are based on a self-evaluation of its study programme that TUT has carried out, on oral information obtained in interviews of different parties concerned with the quality of the study program, and on observations made in connection with visits to laboratories, classrooms and other educational facilities, such as libraries and innovation centres (MEKTORY). The self-evaluation was carried out during working hours under certain time pressure, which can well have resulted in various questions of interest not having been taken up adequately and in certain information of importance not having reached the assessment panel. That can have led to the assessment panel's having made evaluations and given recommendations regarding measures to supposedly consider that had already been assessed or dealt with.

Tallinn University of Technology (TUT) conducts education and research within a wide variety of academic areas at a quality level comparable to that found in the majority of comparable European universities. TUT is well resourced with state of the art facilities and equipment providing the necessary infrastructure for both teaching and research. The study environment and study atmosphere students are provided with are also excellent. The relation between the students and the teachers is clearly positive and dynamic enabling an interactive atmosphere where students and teaching staff work together towards a more successful way of delivering the curriculum.

The relations between the students and the teachers are clearly positive, the teachers being very much available to students for discussion of matters concerned with how teaching is conducted, the courses provided, their content, and details of how they are held.

It was found that both the management of TUT and the personnel as a whole plan for the future and are open to change, and that they are highly energetic in their efforts to develop the university and to keep abreast of developments within society. A very positive policy and basic approach of those in charge of the university is seen in the fact that, after having made very thoroughgoing material investments, they are now strongly focused on the university's personnel and its further development. A new strategic plan for the period on to 2020 is in the process of being formulated. If the overall spirit shown thus far comes to characterize this strategic planning, it can be expected to contribute very much to positive developments at TUT.

It is important that plans of this sort are firmly anchored at all levels within the university, in part through the university's personnel becoming strongly involved and taking on a very strong role in the work to be carried out. It is also important that results associated with such developments be communicated regularly to those with strong interests in such matters. The basis for the strategic plan that is being developed achieving real operative meaning can be seen as lying in a satisfactory balance between a "bottom up" and a "top down" process being achieved, a balance that promotes the genuine involvement of personnel at all levels within the organization, regarding both its continued development and its day-by-day activities.

In the interviews that were conducted – of those in a steering position, of the personnel, and of the students – it was found that teaching was not being given the same level of priority and emphasis as research was. It was felt that teaching should be given as high a level of priority as research and be placed completely on a par with it. Providing a very high quality of education, one that at the same time is closely linked with research, was seen as being highly important from a societal standpoint and as creating the basis for attracting to the university highly qualified personnel, at the same time as both industry and society at large are provided in this way with university graduates who can contribute very much to positive developments in society. It was regarded as important that principles be clearly established within TUT for achieving an appropriate balance between the activities of teachers as a whole within the areas of education, research, administration, and involvement with matters of industrial and of societal development, a balance that should be strongly individual in character and vary over time, both on a short- and long-term basis, its reflecting the teacher's individual qualifications and development. A goal of TUT's new strategic plan was seen to be that of teachers quite generally carrying on both teaching and research, the research conducted supporting both the development of courses and the teachers' own personal development.

It was regarded as highly advantageous, so as to facilitate and strengthen the development of younger colleagues in particular who have only fairly recently obtained a doctoral degree, that a mentor programme be established, experienced teachers and researchers as a whole also being able to provide support for their younger and less experienced colleagues. A mentor programme at TUT was seen as best having formalized and documented activities that represent a part both of the general programme for personnel development and of the new strategic planning that is underway. A positive overall development in such respects during the last few years was noted, one viewed as probably having contributed to the degree of internationalization increasing. It was observed that, despite such positive changes having been achieved, the average age of the teachers involved in certain educational programs or areas of study is undesirably high. It was recommended that the problem this represents be taken seriously, and that appropriate measures be taken so as to also ensure continuity in the educational programs in question. It was recommended, in addition, that a strong international network including both teachers and researchers be established, one providing both increased mobility for those it encompasses, in terms of where they can carry on their work geographically, and increased participation in international research projects, all of which can also enrich the teaching program.

It was pointed out that TUT has worked very constructively in recent years for increasing the degree of internationalization of the education provided, such as having a greater number of Masters programs that are conducted in English, and that this has led to an increase in the foreign student body. In countries like Sweden and the Netherlands this has increased the numbers of foreign students. It is considered highly important that these internationalization efforts continue, and that they continue to expand as well. Many goals are seen as being involved here, such as those linked with demographic developments that call for increased recruitment of students from other countries and an increase in the size of student groups, so as to be able to maintain and increase the economic efficiency of the education provided. As costs for salaries and teaching and the research space needed increase, the lower limits of the size of course groups, and the like, can be expected to be raised in order to be able to keep within the budget limits that are imposed. Such developments can be regarded as unavoidable from both a European and a global perspective, plans being needed in accordance with this for further increase in the degree of internationalization, for a greater number of courses being given in English, for exchange-student arrangements being expanded, and for continued and increased cooperation within research and developmental projects, those that are relevant for education at an elementary level included. It is regarded as particularly important, where resources are limited, that the research conducted encompass many different areas, a matter which can also contribute to a variety of different courses and educational programs.

It is noted that TUT offers a very broad range of educational programs at the Bachelor level, and that achieving as adequate an overview as possible of these different programs and how they relate to one another should be sought. There are seen to be both advantages and disadvantages in having a large number of different Bachelor programs, having many programs resulting, for example, in a more adequate coverage of the wide variety of different industrial areas that exist, which of course is positive, at the same time as it results in student groups at the Masters level being more heterogeneous and smaller in size, which has negative economic effects. The assessment panel suggests that an investigation be conducted to examine the consequences that a return to larger but fewer groups within the overall Bachelor programme would have. The importance of assessing the consequences of

different alternative Bachelor programs in terms such as those of the needs of industry, the prospects of recruiting students to them, the personnel resources available at TUT, the effects these would have on Masters Programs, and the economic effects that different alternatives of the courses and programs offered would have. It is argued that in connection with this an overview should also be sought of the structure both of the present Masters programs and of those conceived of for the future.

It is recommended that a formalized approach to cooperation between TUT, industry and other interest groups be strengthened and be established at two organizational levels – at the organizationally highest level and at the level of teachers and researchers – with the aim of achieving advantages at all levels, in terms of research, cooperation between individual courses and educational programs, coordination of studies and work programs, practical work experience students can gain, work within different projects, and work on final research reports at the undergraduate level. It has been found to be highly advantageous to anchor cooperation between the university and industry at a high level organizationally, even if most of the cooperation takes place at an operative level. It was noted that already at present close cooperation takes place between various industrial organizations within the region and those who plan educational programs and courses. TUT conducts educational programs today at both a bachelor and a Masters level that can be seen as being better coordinated with the needs of industry at a local and regional level than what appears to be the case at an international level generally.

The need of the system employed for the assessment of courses by those who take part in them being improved, in view in particular of the comparatively response rates (lower than 20 %) of those asked to participate in course assessments, is emphasized. It was found that students regard the ÖIS system presently being used for course feedback purposes as not being very useful, but that they appreciate the opportunity to provide course feedback that Student Quality Groups that have been established represent, meetings of this type being held after each semester. According to students, the low response rates can also be explained by the fact that students tend to take direct contact with their teachers to discuss matters pertaining to the courses they take and ways in which they can be improved. It is suggested that the central course assessment system be changed so that it can provide support and documentation through formal meetings being held between students, teachers and programme administrators in which specific courses and how they are conducted are discussed. It is considered important that some form of central system be maintained enabling long-term follow-ups both of courses and of educational programs to be carried out so as to be able to describe and verify changes that have occurred and the developments that have led to these changes.

What can be seen as perhaps the biggest problem to be overcome within TUT is that of the disturbingly high dropout frequencies of students in their abandoning a programme of studies they had been engaged in. The reasons for this were found to be many and complex. It was felt that TUT should aim at improving the statistical basis for the conclusions that can be drawn regarding such dropouts, for example through following students in terms of their being members of cohort groups, doing so for as many years as necessary, rather than simply presenting the numbers of graduates and dropouts there are per year. It was argued, in addition, that TUT should endeavour through depth-interviews to clarify just why the students in question dropped out of their studies and what would have been needed to avoid this. It was noted that on the basis of the results of such investigations it should be

possible to further develop a plan of action aimed at drastically reducing the number of study dropouts that occur and at providing adequate incentives to all those who have a basic interest in such matters to contribute actively to finding genuine solutions to the problems involved. In this context, however, it is important to point out that TUT have taken several positive initiatives to reduce students drop-out rates. These efforts have not yet produced the expected results.

A set of conditions that appears to be unique for TUT and for other institutions of higher learning in Estonia is that the proportion of students who work parallel with their studies is extremely high, which indeed can be thought to affect the dropout rates of students and the numbers of students who complete their exams. TUT has adjusted to these circumstances and offers students the possibility of conducting their studies in the evenings rather than during the day, as well as what is termed “block studies”. It was noted that students there were found to have a very positive attitude toward this system, and also that the foreign students tend to regard the possibility of evening studies in very positive terms. What was felt to be one cause of dropout was that some of the students who abandoned their studies had a very limited conception of what the programme of education they have chosen would lead to or had very unclear expectations regarding their programme of education generally. It was recommended that TUT strengthen and improve the activities directed at high schools which are the primary incubators for recruiting new students. In particular, it was considered that improvements should be made in the information students are provided with concerning different occupational roles and the work tasks they would be involved with after completing their education.

Main strengths:

- TUT conducts education and research at a quality level comparable to that found in the majority of comparable European universities.
- TUT is well resourced with state of the art facilities and equipment providing the necessary infrastructure for both teaching and research.
- The relations between the students and the teachers are clearly positive.
- It was found that both the management of TUT and the personnel as a whole plan for the future and are open to change.

Main areas for improvement and recommendations:

- Teaching at TUT should be given the same level of priority as research.
- The internationalization work should continue and the number of courses being given in English should in general be increased.
- An investigation should be conducted to examine the consequences that a return to larger but fewer groups within the overall Bachelor programme would have.
- TUT should endeavour through depth-interviews to clarify just why the students in question dropped out of their studies and what would have been needed to avoid this.
- It is recommendable that TUT starts providing professional grant-writing services for teaching and research staff.

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

### 1.2.1. Environmental Engineering and Management (Master)

The master's degree programme of Environmental Engineering and Management was developed within the framework of the BALTECH consortium. There are similar curricula at Riga TU and Kaunas TU that were also implemented within the BALTECH consortium. The aim of the programme is to offer an integrated approach towards strategic environmental issues concerning technology and management for sustainable development of industrial processes. The committee supports in general broad programmes like Environmental Engineering and Management as well as the use of English as main language in the programme. It has proved to attract more foreign students to the programme and is also attractive to the Estonian students.

#### *Study programme and study programme development*

##### Observations and comments:

- There is an ongoing strategic development for TUT. The committee considers a programme like Environmental Engineering and Management to be important for Estonia.
- Students enter the programme with different BS degrees, such as in mechanical, civil and chemical engineering. This is considered to be an asset of the programme for all of its stakeholders, teachers and students, and for industry.
- Industrial stakeholders do not participate in development of the curriculum in a systematic way.
- The degree of participation of students in the University course evaluation programme at the end of a semester is low. The student body has its own evaluation system, one that works well according to the students. The students cooperate closely with the faculty in course modification.
- The demographic situation in Estonia is a serious challenge for the University. The department has responded to it by offering the programme in English, with good results.
- The Faculty has no formal policy regarding gender issues.

##### Strengths:

- The programme attracts a large number of applicants. The majority of the applicants are international. The selection of international students is based upon interviews with the potential students.
- The teaching language in the programme is English, resulting in there being a large number of international students. All of the stakeholders considered that to be an advantage to the programme and one of its main attractions.
- The programme gives the students broad skills in environmentally clean production and in environmental management.

##### Areas for improvement and recommendations:

- The team suggests that the faculty formalize the involvement of industry and of other stakeholders in development of the programme.

## *Resources*

### Observations and comments:

- EU infrastructure funds improved the teaching and research environment at TUT.
- Funding of the research by industry seems to be limited according to the faculty.
- The teachers would like to obtain assistance in international grant writing so as to increase the success rate of applications.

### Strengths:

- The laboratories are well equipped with basic analytical equipment as well as portable equipment for field work.

### Areas for Improvement and recommendations:

- Increase the support of faculty in international grant writing.
- Increase the collaboration with industry.

## *Teaching and learning*

### Observations and comments:

- The students are satisfied with the curriculum, the content and how the load is distributed over the different semesters.
- A well-balanced programme over the years.

### Strengths:

- Working in groups is common in the program.
- An international student population is an asset to the program.

### Areas for Improvement and recommendations:

- Offer language courses in Estonian for the foreign student population. It would be easier for students to find future jobs in Estonia if they had basic skills in the Estonian language.

## *Teaching staff*

### Observations and comments:

- There appears to be a good balance between teaching and research load for the faculty.
- There is a good balance between industrially related applied research projects and more theoretical projects.
- There is no language support for the teachers and some students showed concern regarding the language capability of some of the teachers. This was not considered an important issue for the student population generally, however.
- There is an opportunity for the faculty to go abroad for some time, e.g. through use of the Erasmus program.
- The teachers can go abroad on sabbatical leave, yet not many international visiting scholars are coming to TUT.
- Develop and implement a systematic approach to study programme development based on feedback from industry.

Strengths:

- The students felt it was easy to contact their supervisors, as well as other teachers, and issues tended to be resolved quickly.
- The quality and competence of the faculty is high.

Areas for Improvement and recommendations:

- Invite international guest speakers so as to increase international exposure.

*Students*

Observations and comments:

- The programme exceeded the students' expectations.
- There is a possibility for the students to go abroad for some time, e.g. through use of the Erasmus program.
- Only 4 Estonian students applied for the programme last year, as compared with about 80 international students. That could change in the next few years due to plans to charge international students tuition.

Strengths:

- Graduates are well received by industry and are in high demand.
- The students are satisfied with the curriculum, the content and how the load is distributed over the different semesters.

Areas for Improvement and recommendations:

- Increase the visibility of the programme so as to attract more Estonian students.

**1.2.2. Biomedical Engineering and Medical Physics (Master). Health Care Technology (Master)**

The panel would like to commend the University for putting together these subject areas of study, as Biomedical Engineering and Medical Physics (BEMP) and Health Care Technology (HCT), have become areas of both study and research across the globe which are currently growing rapidly. The contribution of technology in healthcare has been immense and hence the absence of such activity within the portfolio of courses available at any university will be an omission. Also, the initiation of such degrees confirms and positively reflects the vision of the institution.

The panel carefully reviewed the material for the BEMP and HCT programmes with a general gnomon the main pillars that identify a good quality academic programme; Knowledge and Understanding, Intellectual Abilities, Practical skills, General transferable skills.

Both Masters programmes are ambitious and intense. The students are exposed to a very large and wide volume of material/courses which can have both positive and negative ramifications.

In their majority all paper work received and reviewed was of high standard and quality, which is a reflection of how the programmes and courses are organised and run. The panel had the opportunity to interact with all the relevant faculty members, the students and the relevant industry in an effort to consolidate their knowledge on the subjects presented. Also, the panel had a detail tour of the facilities used for the delivery of these programmes

(mainly the biomedical engineering and medical physics) in an effort to establish the level of resource available for such activities.

The panel discussed all aspects relating to these programmes and has come forward with some suggestions, observation and recommendations which are aiming in the further improvement and optimisation of the programmes.

These will be detailed below:

### *Study programme and study programme development*

#### Observations and comments:

The BEMP programme is very broad and this might be a risk for a Masters level. Both Biomedical Engineering and Medical Physics are two very distinct areas which could merit their own unique approach in teaching. One of the main concerns, is the cohesion and appropriateness of all the courses offered in this programme of study. The attempt to cover both “topics” might be very challenging for the students with a risk in defocusing and diluting their knowledge.

Also, the absence of common academic background in students can be a further challenge and hence a limitation to teach at a more advance level as expected at a Masters level. Similarly with the HCT programme it seems that there is lack of focus in the learning outcomes and this is due to the delivery of a wide spectrum of courses which might not be directly related to the type of graduates the programme wishes to produce. Also, the title of the Masters programme does not clearly identify the main educational aims which are Health Care Technology. This specialization approach within one Masters which is called Occupational Hygiene needs reconsideration by the management team.

As a final comment on the HCT, without criticising the necessity of such a programme in the healthcare industry, I would like to urge the management team to review if this Masters is something they wish to continue as from our observations the main strength, confidence, competence, staff, resources are focused towards BEMP. Does this Masters fit with the department? As a “rule of thumb” a department should only run UG and PG programmes in areas where they can demonstrate strength and critical mass in research.

It is also highly recommended that the management team of the department engages in discussions with the university in the creation of an undergraduate (UG) degree in Biomedical Engineering. This will be a very timely discussion, as UG Biomedical Engineering is one of the fastest growing disciplines in similar departments/Institutions in many countries. Also, such an UG programme will create the “right” students to enrol on the Master(s) programmes.

#### Strengths:

- Both programmes are recent and respond to industrial/hospital/healthcare demands.
- There is a clear ambition, enthusiasm and strength within the academic team, despite small, that is running this course.
- The curriculum is broad which exposes the student to a variety of subject areas within the two Masters.
- There is a close collaboration between the academic team and the employers (mainly hospitals and some SMEs) which strengthens further the programmes.

- There is a good balance between theoretical and experimental work across the majority of courses which is necessary in the satisfactory absorption of all learning outcomes.

Areas for Improvement and recommendations:

- The management team needs to be concerned on the recruitment of students, as currently is small. The management team needs to put forward a plan or a dissemination strategy in an effort to educate people (students, teachers, government, etc.) about these relatively new areas of study, compared to the more traditional engineering degrees.
- The introduction of compulsory work placement of students in healthcare areas such as hospital or research labs needs to be considered. We are aware that a number of students already work in such areas, however it will be more attractive if it becomes part of the curriculum, where students will be exposed to the profession and the appropriate working environment.
- The team needs to put forward a plan or a strategy of how they will minimise or eliminate drop out from students. It is not good enough just to identify some of the main reasons of why students drop out (i.e. no motivation!). Once they have an action plan then they need to run a pilot and see how this action plan helped in reducing the drop outs. At the moment there was not clear evidence that actually the management team is systematically trying to reduce drop outs.
- There is a need of reviewing the delivery of the curriculum across all semesters for each programme. This is necessary as not all the students have the same entry qualifications and hence it might be challenging to build the right platform before students engage in more major courses in the subject areas.
- There is a need to review the balance between medical physics and biomedical engineering, as at the moment it feels that there is more engineering than medical physics.
- There is a need to clarify the learning outcomes of each Masters as at the moment they come across as generic and vague.
- There is an urgent need to review holistically the HCT Masters as the title and courses delivered do not give it a clear identity. The management team needs to decide what kind of students they want to graduate from this Masters and then restructure the curriculum and perhaps rename the Masters programme. The risk for not doing so is the negative effect to the students as they can be left in some degree of confusion of what they are studying.

*Resources*

Observations and comments:

- The panel had the opportunity to visit all facilities contributing in the delivery of these two programmes (mainly BEMP). Overall the resources available are of good quality and standard and are very relevant to the areas of study with exception the HCT Masters which in a way it was more “played down during this evaluation” compared to BEMP. It is assumed this was the case because the main strength of the department is mainly in engineering and hence there is more confidence, competence and resource in this area.

- The experimental areas and equipment used for the various practical sessions are of high quality and very suitable for the learning outcomes of the BEMP Masters. Some of the experimental areas are rather small in space and resource and not sure how they can accommodate large classes of students.
- It was observed that some students work within research labs, however it was not clear if all students are exposed to such environment.
- The resources that were observed were predominantly biased towards bioinstrumentation and physiological measurement. It was only presumed that the students are exposed to some Medical Physics experimental work in the hospital, however this remains to be confirmed/reported.
- Library and IT facilities are of high standard and most suitable for the delivery of the two Masters. MEKTORY is a fantastic resource and almost a unique asset to the university. It is a great incubator where students can engage in entrepreneur activities.

#### Strengths:

- In addition to the above comments which are mainly positive, the Labs are well equipped with all relevant devices and equipment enabling the students to engage in experimental work.
- Students can be exposed and conduct work within research labs alongside PhD and postdoc researches which is a great experience.
- Equipment available span across the majority if not all of areas of study of the BEMP Masters (apart from medical physics).
- Students are exposed to "hands on" work which is highly commendable.

#### Areas for Improvement and recommendations:

- One of the main recommendations is to engage the students in design beyond their routine practical and projects they do in the various courses.
- There is room in expending computational and modelling resources relating to the subject of study.
- Collaborate with other departments in engineering in order to expose the students in facilities relating to mechanics and materials allied to BEMP.
- For the HCT students it seems that there is an emphasis in bioinformatics/health informatics, however there were no visible resources to support such activity.
- Generally the resources available to support HCT where not make clear to the panel.

### *Teaching and learning*

#### Observations and comments:

The panel met with faculty that support various courses in both programmes. Overall the main observation was that the majority of staff where very engaged and enthusiastic with the programme. It was good to see that the programme has a strong identity which was reflected both from the discussion we had with staff and students.

The main challenge of these programmes is the fact that their remit is too wide and hence this makes it difficult to decide what courses to teach in an effort to create core learning outcomes, and to also cover general knowledge in the field. This is something that the team needs to revisit in their discussions where the curriculum is reviewed.

Internationally Biomedical Engineering and Medical Physics departments or programmes take a stand in what they want to teach and what graduates they wish to produce in full acknowledgement that it will be impossible to cover all the subjects (biomechanics, bioinstrumentation, biomaterials, medical physics, tissue engineering, etc.). Such discussions need to take place within the management team. Sometimes less is more!

The same comment applies for the HCT Programme. Hence, the management team needs to have these discussions in order to have programmes that have a strong core and identity and reflect the core strengths of the department.

Currently there is no balance between engineering and medical physics supporting the programme and this is a clear indication of where the programme (BEMP) needs to focus and create a core.

#### Strengths:

- The majority of staff are very motivated and enthusiastic for this area of teaching and research.
- The majority of the teaching is undertaken by staff that have a good track record in the field and are research active. This is very positive as it is highly desirable in university curriculums to see that teaching is underpinned by research.
- The majority of courses covered have an experimental component, especially in the more senior courses.
- Students are exposed to a variety of topics in the field (this can also be a weakness).
- Projects are conducted within research facilities which is of great benefit to the students.

#### Areas for Improvement and recommendations:

- The learning outcomes of both programmes need to be clarified. There are some similar comments at the beginning of the report for these programmes.
- There are concerns on the level of teaching of some of the courses at this level (Masters), as the material covered are relatively basic (as you will expect to find in an undergraduate programme).
- The contribution and relevance of the courses on the subject of study is debatable and perhaps needs to be reviewed. Every course delivered within the programme needs to be scrutinised and justified of how it fits in the programme.
- The HCT programme needs a holistic review in respect to identity, and curriculum.
- Introduce visiting lecture/seminars from the industry, healthcare sector and professional bodies. Students are always interested to hear from people from outside the academic circles.
- Introduce seminars in professional development and employability pathways.
- Engage students in entrepreneurship activities by taking full advantage of MEKTORY.
- Engage students in pursuing projects in collaboration with clinical experts from the collaborative hospitals.

#### *Teaching staff*

##### Observations and comments:

The panel positively comments all staff in the department as they have shown to be a dynamic and coherent department (despite perhaps the small size). They showed clear enthusiasm for the subjects they teach and the programmes and their positive approach has

been clearly transferred to the student body. They are ambitious in their teaching and research and they have a clear vision where they wish to be in depth of time.

Strengths:

- It seems that the programmes are supported with a good and strong number of qualified staff.
- There was a clear positive atmosphere amongst staff that support these programmes (mainly Biomedical).
- It was positively received that research staff are also involved in the delivery of the curriculum.
- There is a good blend between academic and healthcare experts contributing in the delivery of the curriculum.
- There was clear evidence that staff are involved and interact with students at all levels (within the classroom, in laboratories and project work, etc.).
- There was evidence that the majority of staff are constantly engaged with the profession both in teaching and research.

Areas for Improvement and recommendations:

- There is some concern on the balance between staff supporting biomedical engineering and medical physics.
- There was not a very clear indication on the staff that support HCT and what was the level of engagement of staff within the department that contributes to this programme.
- It is highly recommended that all research staff involved in teaching should undergo some training in order to strengthen their educational skills (you can be a good researcher but not necessarily a good educator).
- It will be of benefit to more junior members of staff if they have a mentoring system where more senior staff will mentor them on all aspects of the profession.
- As an observation, but with not a criticism on the quality of the teaching by the staff, it seems that most of the staff have a much higher volume of conference publications than peer reviewed journals.
- Some staff expressed concerned that there are not clear guidelines of what are the expectations in relation with their contribution in teaching, research or administration within the Institution.
- Some of the research that is conducted, despite being of high standard, is rather esoteric and hence it is highly advisable to encourage staff to engage in more collaborative research with other departments, faculties and universities nationally and internationally.
- Staff will welcome more bottom up compared to bottom down approaches by the University.

*Students*

Observations and comments:

The panel had a good discussion with students from both programmes including alumni.

The feedback was overall positive which confirmed the dynamic of the department and the enthusiasm of the academic team.

Students have stressed that there is not enough information about these programmes and the level of exposure to such pathways of study during their UG studies or high School studies is almost non-existence.

Students expressed some concerns that the learning outcomes are not very clear and focus from the beginning.

Similarly the professional pathways and employment of graduates from such programs are not very clear especially for employment outside hospitals.

There was an overall concern that some of the introductory courses in year one can be structured in such a way to accommodate the different background of students, plus make them directly relevant to the subject of study.

#### Strengths:

- Students commented positively in the interaction they have with staff during their studies. Staff are always available to support them during the formal contact hours or outside the classroom.
- Students felt that the combination of both biomedical engineering and medical physics can be a positive thing as this will contribute positively towards their exposure towards both subjects and hence perhaps maximize their success in employment in either sector.
- The interaction with hospitals and companies (mainly for the HCT) during their studies is very positive.

#### Areas for Improvement and recommendations:

- Students identified that some of the courses or the style of teaching is "boring". This has been expressed in their feedback however they felt that changes have not taken place. The programme management team needs to review systematically such courses and provide an action plan of how to mitigate such negative feedback.
- Some students enter the courses with weak background in Physics and Mathematics. This could contribute to drop outs plus student dissatisfaction for the programmes. If the programme team wishes to recruit students from a wide background then they will need to build up the skills/knowledge of the students to a common level before they engage in major courses.
- Students will welcome more practical exposure especially in medical technologies from the beginning of the programme.
- Students would like to have a choice to some electives in their areas of interest in the second year.
- The HCT students expressed an interest for more IT related courses, especially since the area that the programme is currently focussing is in health informatics/eHealth.
- Students will benefit with some courses/seminars in management and/or entrepreneurship.

### **1.2.3. Integrated Engineering (Bachelor). Mechatronics (Bachelor). Mechatronics (Master)**

In general the committee gained a positive impression of these study programmes. The committee supports the idea of having a broad programme such as Integrated Engineering. Also, the use of English as the language for teaching in the BSc Integrated Engineering and

the MSc Mechatronics is supported. This will attract more foreign students, and is needed because of the demographic situation in Estonia, keeping more students in Estonia who would otherwise have gone abroad, and it will contribute to an international atmosphere. Before the Integrated Engineering programme started, a positive international orientation in similar programmes at other universities was found.

Strengths:

- There is a well-designed and informative website (ÕIS) that provides information on all the programmes and courses that are provided.
- Communication between the teaching staff, the students and employers takes place very readily. Problems of all sorts can easily be discussed.
- E-learning is in the frontline of TUT.
- There is close collaboration with companies.
- A high percentage of international students due to English BSc and MSc degrees.
- There are good procedures for recognising work and experience done elsewhere (APEL).
- Evaluation criteria are generally well defined (for the courses mentioned).

*Study programme and study programme development*

Observations and comments:

The committee supports the idea of using English as the language for teaching in the BSc Integrated Engineering and the MSc Mechatronics. Yet this requires that students and staff master English well enough to be able to communicate effectively. The quality of the English in the report does not convince the committee that this is the case for the teaching staff. Students who complained about bad English of the staff confirmed this.

The number of dropouts is a serious problem. From the data provided it is impossible to determine just how a cohort of students, starting in a certain year, performs. It is recommended that one collect and present the data in such a way that it readily becomes clear how many students drop out or graduate in the various years after the start of the study. One should know how many students of the cohort drop out/graduate after 3, 4, 5, 6, years.

A general complaint of most study programmes is that students have to work for economic reasons, which results in insufficient time for studies and in students dropping out. Students and employers differed in their perspective. Students told the committee that most of them work in jobs directly related to their studies and both students and employers were very positive about what students learned in their jobs. Some of the students indicated that they learned more from their job than at the university. The committee supports the idea of having the MSc courses starting at 16:00, this enabling students to work before that. The employers were happy to facilitate this by offering flexible working hours. Also the availability of e-learning versions of the courses is beneficial in this respect. The committee agrees with the students that working during their BSc studies is less desirable, certainly during the first year.

Both programmes consider it to be necessary to increase considerably the marketing aimed at making engineering more popular. This should also lead to attracting better students. Students often have wrong expectations regarding the study programme and this is a reason for many dropouts in the first year of the BSc. According to the students 50 % of the students have no idea of the contents of the study programme.

The Mechatronics study has a BSc and MSc programme. Only the combination of BSc and MSc seems to be a complete Mechatronics programme. Students as well as employers confirmed that they only saw the combination of the two as a complete programme. On the other hand, the report mentions that “Students are too much engaged with industrial placements” and do not continue their studies after the BSc. The committee recommends that the opinion of the employers be made clear to students who consider stopping after obtaining the BSc.

More specific comments on the contents of the programme:

- In general the programmes look good and have a good choice of courses.
- The programmes consist of many small courses. The committee suggests opening a discussion of whether it is not better to have courses of more ECs instead.

In the Integrated Engineering programme, modelling of physical systems and a model-based approach to practical problems is sometimes mentioned. However, there is no specific course in modelling. Also a course on automatic control engineering is lacking. Such courses should certainly be present in such a broad programme.

In the BSc Mechatronics programme there is not enough control engineering, whereas this is one of the crucial topics for Mechatronics. A compulsory course in control engineering is only offered in the MSc programme. In the bachelor programme it is only covered in a robot practicum.

The teaching staff defined mechatronics as a combination of mechanical, electronic and IT components. The idea that mechatronics is “a systems approach to the synergistic and optimal design of a mechanical system and that it’s embedded in a control system, leading to innovative solutions, which would not have been possible in one of the domains” is not directly visible in the curriculum. The committee recommends making this philosophy explicit by means of courses on multi-domain modelling and automatic control engineering.

It did not become clear to the committee for which possible MSc programmes the Integrated Engineering Bachelor prepares one. Options should be clear for the students from the beginning. The committee also recommends opening a structured possibility of having a number of electives from other BSc programmes to prepare for the related Master.

The difference between the BSc programmes Integrated Engineering and Mechatronics should be made clear. Comparing the admission numbers for Integrated Engineering and Mechatronics in the spreadsheet suggests that the new programme Integrated Engineering has attracted many students who otherwise would have selected Mechatronics. Both are BSc programmes of a multidisciplinary character. When the student numbers are decreasing one could consider having several courses held jointly for Industrial Engineering and Mechatronics. But this would require that the mechatronic students should follow these courses in English.

The combination of Mechatronics with Automation and Robotics is a logical one indeed.

Strengths:

- In general the programmes look good and have a good choice of courses.
- Use of English language on the BSc Integrated Engineering and the MSc Mechatronics.

### Areas for Improvement and recommendations:

- It is recommended that one collect and present the dropout data in such a way that it easily becomes clear how many students drop out or graduate in the various years after the start of the study. One should follow a cohort of students.
- The committee supports the idea of having the MSc courses starting at 16:00, enabling students to work before that.
- Improve the marketing.
- Add courses on modelling and control to the Integrated Engineering programme
- Make the mechatronic philosophy (an integrated approach to a mechanical system and its embedded control system) clear in courses on multi-domain physical modelling and automatic control engineering.

### *Resources*

#### Observations and comments:

- The university is deservedly proud of its library and of MEKTORY. The committee was impressed indeed by these facilities. Students of the Mechatronics programme are involved in the nano-satellite project in MEKTORY.
- Students are positive regarding the library, e-learning and Matlab/CadCam computer facilities.
- Facilities, in general, made a good impression on the committee.
- The report complains about a lack of Estonian specialist literature. This should not be a problem for a programme taught in English. Even for the bachelor, if internationalisation is taken seriously, the committee recommends having more study material in English, even if the lectures themselves could be in Estonian.
- The total number of students is decreasing in general. It also seems that Integrated Engineering cannibalises other studies, especially Mechatronics (23 students less, at the moment that Integrated Engineering starts). But this may be a coincidence.

#### Strengths:

- The library and MEKTORY are fantastic facilities.
- Good facilities in general.
- The English BSc IE and English MSc Mechatronics are increasingly popular among foreign students. There were 325 applicants to IE from abroad last year.

#### Areas for Improvement and recommendations:

- Go for more English study material.
- Think about how to deal with a smaller number of students in the future. Consider merging programmes or sharing courses.

### *Teaching and learning*

#### Observations and comments:

- There are a low number of student projects in which real R&D is involved. This is not good for an academic programme in Mechatronics.
- The selection procedure admits good international students.
- Many thesis projects are done together with industry.
- In general there seems to be a good interaction with industry, the employers involved also being satisfied with the programme.

- Employers and alumni consider only a completed MSc in Mechatronics to be good enough for industry.

#### Strengths:

- The APEL procedure for recognising work and experience from elsewhere seems to work well.
- The selection procedure admits good international students.
- Many thesis projects are done together with industry.
- In general, good interaction with employers.

#### Areas for Improvement and recommendations:

- The report mentions that there is not enough support for the practical training placement of international students. Yet the representatives of the employers indicated that at least the fact that foreign students do not speak Estonian is not a problem. The university should assume responsibility for properly supporting international students in finding a practical training job.
- Integrated Engineering Students expect to obtain closer acquaintance with research in the different faculties than they obtain at present.
- Increase the number of student projects in which real R&D is involved.

### *Teaching staff*

#### Observations and comments:

- All core staff members have a PhD. The staff is well qualified.
- The staff is involved in several projects together with the industry.
- The workload is high. Attracting more and younger staff members is a problem because the salaries at the university cannot compete with those in industry.
- It is not clear whether there is sufficient coordination at the programme level. The fact that the teaching staff apparently did not see the self-assessment report is a serious problem and a missed opportunity. The assessment of the study programme is an ideal occasion for a critical reflection on all aspects of the programme and should not be a point of concern simply for the programme coordinator. Hopefully the report of the committee will be distributed amongst the staff and lead to critical reflections concerning the study programme in a broad sense.
- The staff is confident about developments in both Integrated Engineering and Mechatronics.
- BSc Integrated Engineering and MSc Mechatronics are taught in English. This is a desirable development, one that the committee supports. However, this requires that the teaching staff be proficient in English, as the report mentions: "As IE study programme is taught in English only, the lecturers and professors are selected according to their academic and language skills". Unfortunately the quality of the English in the self-study of especially Integrated Engineering and Mechatronics was rather poor. Also students complain about the mastery of English of the teachers.
- The proficiency in English of the students appeared to be excellent.
- There are only 'recommendations' for developing teaching skills. The courses for improving didactic skills are now voluntary. The development of didactic qualities should be more strongly enforced and staff members should obtain a basic formal qualification for teaching.

- Only one of the teachers present in the meeting with the committee had attended an international conference last year. No one went abroad for a sabbatical, therefore, international influence is small.

#### Strengths:

- All core staff members have a PhD. The staff is well qualified.
- The staff is involved in several projects together with industry.
- The staff is confident about developments in both Integrated Engineering and Mechatronics.
- The BSc Integrated Engineering and the MSc Mechatronics programs are taught in English and attract many international students.

#### Areas for Improvement and recommendations:

- All members of the teaching staff should feel a responsibility for the curriculum as a whole.
- The level of English of the teaching staff should be improved. The committee suggests that all members of the teaching staff be tested and, in the case of failing the test that is given, should be forced to improve this by taking appropriate language courses. Also, a sabbatical in an English-speaking country would be beneficial. Due to a high workload, taking a sabbatical appears to be difficult.
- Enforce training of the staff in teaching skills by formally requiring certain basic qualifications.
- Attending international conferences and sabbaticals should be placed higher on the priority list.

#### *Students*

##### Observations and comments:

- In general the students made a very good and enthusiastic impression on the committee. They were positive about the programme.
- The English of the students is good.
- The students are happy about how easily they can contact the staff. The response times to emails are short. In general, students can gain contact with the staff very easily.
- The response rate of students to the ÖIS system is too low (20 %), their providing comments only 'rarely'. During the site visit it appeared, however, that Student Quality Groups fill this gap, these leading to feedback meetings of students and staff after each semester, often followed by improvements in the curriculum.
- Students are well aware of the possibilities of the Erasmus programme for student exchange. From the students that the committee met, three of them indicated to (plan to) use Erasmus for gaining international experience.
- Students observed that many dropouts are due to the fact that 50 % of them have no clear idea of what their study programme is really about: "They only look at the titles". The university should take appropriate actions to change this. The committee is happy to see that there are actions taken already at high schools to popularise engineering.
- Working alongside studying is a necessity. The self-study programme considers this to be a problem, its being a partial cause the high dropout rates. The students, in

contrast, were in fact quite positive to working parallel to their studies. Most of them were able to get part-time jobs related to their studies. Some of them indicated that they probably learned more on the job than at the university. It also appeared that the university has more or less accepted the situation by starting the lectures in the MSc programme at 16:00 and by offering e-learning options. The employers indicated that they are positive about this situation and that they were well prepared to offer flexible working hours.

### Strengths

- In general the students made quite an enthusiastic impression on the committee.
- The students are positive about the programme.
- The students were happy with how easily they could contact the staff. The response times to emails were short. In general, contacts between students and the staff could be established easily.
- The English of the students was found to be excellent.

### Areas for Improvement and recommendations

- Because of the demographic situation, the number of students is expected to decrease in the coming years. The committee recommends:
  - Intensifying activities at high schools aimed at making engineering more popular.
  - Taking measures to reduce the number of dropouts.
- The committee recommends that action be taken to reduce the high dropout rates by:
  - Sketching a clear picture to beginning students regarding what the programme they have selected is all about.
  - Showing the challenges and attractiveness of the study programme they have chosen by means of an introductory course. Measures have already been taken in the Mechatronics curriculum to make it more attractive. A course 'Organizing of Studies' has been introduced, as well as a tutoring system.
  - Providing good information about alternative engineering programmes and minimising the barriers to switch to alternative programmes.
  - Finding a way to deal with the necessity for students to earn money, either by providing more grants, providing better study loans or by accepting the reality that delays are inevitable if students work, and adapting the study programme accordingly through offering flexible time schedules and e-learning.
- Courses in mathematics in high school are viewed as not being particularly strong. The committee recommends that if the university has no possibilities of improving what is done in this respect at high schools, the university curriculum should be adapted accordingly.
- Improving student feedback. The committee recommends improving the feedback system based on the procedures of the student's Quality Groups, rather than making it compulsory to fill in the present ÖIS forms.
- The whole feedback procedure should be formalised in the sense that, in line with the observations regarding student feedback that have been made, the Plan - Do - Check - Act cycle be closed.

#### **1.2.4. Product Development and Production Engineering (Bachelor). Product Development and Production Engineering (Master). Design and Engineering (Master). Industrial Engineering and Management (Master)**

From an international perspective, the Bachelor and Masters programs offered can be seen as being very broad and interdisciplinary in character. As a rule, the different Masters programs start with a set of courses during the first term that all of the programs have in common, this being followed by going into depth thereafter regarding matters either of product development or of production and production development. At TUT, priority is given throughout to taking a broad approach to the subject matter as a whole rather than concentrating on details of a sort dealt with primarily in a highly specialized program. The course structure offered can lead to the student's possibly being confronted with certain initial difficulties in later doctoral studies, at the same time as it can provide the advantages of the student's possibly more easily finding employment later at a small firm (SME). The programme of training given can be said to reflect rather well the industrial needs that characterise SME.

The most negative comments one might direct at the programme concern the fact that there are many students who drop out, particularly rather early in the course of the programme they have selected. It should be pointed out, at the same time, that this is by no means unique for studies in Estonia generally. The Evaluation Committee has noted that the students they have interviewed have tended to be very strongly motivated for going on with their studies, at the same time as the teachers report a lack of motivation on the part of various students to be the major cause of the high dropout frequencies. An important question concerns how one can best recruit the type of students who are most appropriate to the different study programs. It is strongly recommended that those in charge of the study programs work together with the head of TUT in efforts to increase the amount and quality of the information that high school students are provided with concerning the different study programs involved, particularly information having to do with the occupational roles students can be expected to have after completion of their education.

The remarks presented below are general in character, unless specified otherwise. For remarks applying to a specific program, the initials of the programme are given following the remark in question, such as IEM, for example (Industrial Engineering and Management).

#### ***Study programme and study programme development***

##### **Observations and comments:**

- The number of international students has increased during the last period of time.
- A well-functioning forum (of the round-table conference type), in which the interested parties participate, can be fruitful to use for discussing further development of the educational programs in question.
- SME represents a major part of the employers potentially available for students who have completed their studies in these areas. They give priority to hiring persons who in their studies have taken courses and taken part in educational programs that give students a broad form of education rather than a more specialized one possessing depth but not breadth, a matter that means those who complete their exams being more generalists than specialists, this being what is most in demand in the regional work market.

- There being a large number of different Bachelor programs leads to student groups at the Master level tending to be very heterogeneous, which is a hindrance to education there, its increasing the dropout level of students.
- Students taking part in a Master-level programme can have a very broad educational background, a matter which can be both an advantage and a disadvantage.

#### Strengths:

- Both the teachers and those in charge of a studies programme adapt how courses are given in a manner enabling students who have a job during the day to carry on their studies parallel to this.
- There is quite a well-functioning contact network between teachers, students and industry, at the same time as there are improvements in it that could be made.
- The study atmosphere of students taking part in the educational programs offered is very positive, and relations between the teachers, the students and those in charge of the programs are very positive as well.

#### Areas for Improvement and recommendations:

- Strengthen activities concerned with spreading information regarding different study programs in a manner that results in larger numbers of students selecting programs of study that are really for them, at the Bachelor level in particular.
- Contribute to efforts for obtaining an appropriate number and appropriate set of different Bachelor programs, aimed both at achieving advantages both in terms of their being a sufficient number of students in each programme and of there being reasonably homogeneous student groups in Master studies following this. A structure of 2+1+2 years of study is a possible arrangement, this involving first 2 years of study together in a general Bachelor program, followed by a year of specialization and then by a 2-year Master program.
- There should be a strong coordination of a study program's different courses throughout.
- Those in charge of a programme should receive greater help than at present from alumni in development of the program.
- Teachers should take active contact more frequently with industry with the goal of improving the educational programme and how it is conducted, and of making matters easier for students who have a job parallel with their studies.
- Those in charge of the different programs should, together with those in charge of TUT, work for making it easier for teacher within the DE and IEM programs to combine research activities with teaching, partly with the aim of increasing their study program's contacts with research.
- The continuation of a high level of internationalization so as to maintain and increase the inflow of foreign students should be seen as essential.
- The centralized course assessment system should be designed in such a way that it can provide a fruitful basis for discussions between teachers and students regarding both courses and study programs.

#### *Resources*

#### Observations and comments:

- Equipment appropriate for educational purposes which is present can in many cases be seen as highly appropriate too for research purposes.
- Cooperation regarding matters of equipment and work space has enabled the undergraduate studies programme to be enhanced by the research resources that are available.
- A fine infrastructure in the form of a well-developed library and a very interesting innovation centre (MEKTORY) is available.

Strengths:

- The various study programs and courses have both equipment and infrastructure that are highly appropriate at their disposal.

Areas for Improvement and recommendations

- Close cooperation between different study areas provides the basis for more adequate use of the resources available in terms both of time and of equipment.
- Still closer cooperation than at present between research and teaching will lead to an increase at all levels both in terms of quality and in use of the resources available.

*Teaching and learning*

Observations and comments:

- The lectures for Master's students are largely held after 4:00 PM or still later, so that students who work during the day will be able to complete their education.
- It is highly positive that student study dropouts have been reduced by the introduction of special entrance examinations for the educational programs involved.
- Distance learning (E-learning) is employed to make it easier for some students who work to go on with their education.
- The education provided is anchored within research in part through its sharing the use of equipment used by researchers as well.

Strengths:

- The undergraduate studies programme employs sensible principles for helping or enabling students to find appropriate themes for their final research papers, this being a mixture of letting them find such topics themselves, being open to the desires of different firms and the like to have various matters investigated, resulting in external research projects of this sort, and the encouragement of research by TUT regarding matters of interest to them.

Areas for Improvement and recommendations:

- One should increase the incentive of the teachers in the different departments to take special courses on teaching at the university level and also make it obligatory for newly employed teachers to take such courses, aimed at developing and improving their teaching abilities.
- One should formalize and structure work aimed at finding areas of research and problem formulations that can form the basis for work on Master theses.
- One should formalize and structure the handling of such matters as those of field trips, visits to firms and other organizations, opportunities to obtain practical work experience, internships of an industrial character, and the like.

## *Teaching staff*

### Observations and comments:

- One should introduce a mentor program, one oriented both to research and to teaching, for younger teachers who have completed their doctorate.
- All doctoral students should likewise be involved in teaching.
- Those teaching within the different programs generally state that they consider the balance between teaching and research to be satisfactory, the relative proportion of teaching they say that they themselves do tending to lie somewhere between 20 % and 80 %. There can be seen to be a lack of research and of teachers involved in research within the DE and IEM programs, however.
- The teachers appear to be clearly conscious of its being the case that an increase in the number of international research projects tends to lead to better teaching.
- It is not uncommon at all for a person to be in part at TUT and in part elsewhere. (DE)

### Strengths:

- The teachers can be said to be very much committed to their work and very much open to self-improvement.

### Areas for Improvement and recommendations:

- Both the teachers and those in charge of TUT should endeavour to increase the number of international research projects being carried out.
- Work for educational activities being given the same level of status as research activities.
- Greater cooperation between the teaching of different courses and between different departments should be aimed at.

## *Students*

### Observations and comments:

- Students tend to a very considerable extent to work at a job parallel to the studies they are engaged in, there being purported to be more than 80 % of the students to whom this applies.
- In most cases, students who have a job alongside their studies have one thoroughly in line with the studies they are engaged in. This is regarded by the students themselves, their teachers and their employers as providing positive synergy effects.
- Students speak of wanting to have a greater amount both of practical and of experimental work in the course of their studies, and of wanting courses to be better in line with the needs of industry.
- Generally speaking, students express a desire for there being a greater number of optional courses available, but in this scene economical aspect should also be taken into consideration.

### Strengths:

- Students are able to clearly influence the development both of the courses they take and of the study programs they are involved in.

- Students tend to be very much engaged in their studies and to very anxious that the courses and study programs available to them be developed further.
- Exchange students tend to state that they are very proud of the education they receive and that they experience it as being very good and as being highly competitive internationally.

Areas for Improvement and recommendations:

- There being a need of increasing the number of students from other countries who come to study there.
- That one should attempt to maintain a balance between the number of native students who study in foreign countries and the number of foreign students who study there.

### **1.2.5. Thermal Power Engineering (Bachelor). Thermal Power Engineering (Master)**

#### ***Study programme and study programme development***

On the basis of the framework given by the university (e.g. ÖIS), the programme and its content are well defined and are transparent to both students and teachers. It was obvious to the committee that the programme is under continuous development, and that broad feedback is being given to those who have a stake in it. The programme lives in particular from the good contacts it has with industry and the open faculty culture it has that encourages feedback from students.

As in other study programmes, and as mentioned in the general comments, the student's own feedback system involving study quality groups and direct contact is clearly working much better than the formal surveys within the framework of ÖIS are. The impression the committee got of the quality culture in the faculty was very positive. Since the open culture enables students to address problems immediately, they see no benefit in filling out forms regarding them at the end of the term.

However, especially for long-term quality assurance and for purposes of comparison, a certain level of formality can be seen as necessary. This includes the feedback not only from students but also from alumni, employers and other stakeholders. Such formal systems are not defined or not working for the Thermal Power programmes. The ÖIS feedback is not attractive to students. Employers and Alumni are somehow in contact with the department, but according to different statements feedback is often given informally and therefore without regularity and transparency. The committee sees room for improvement and recommends to base the definition of formal systems on the existing informal and well working procedures.

The ÖIS feedback there is not attractive to students. Employers and Alumni are somehow in contact with the department, but without regularity and transparency. The committee sees clear space for improvement there and recommends basing the definition of formal systems on the existing informal procedures that work rather well.

The relatively high drop-out rates were of general and serious concern to the committee, their affecting nearly every programme in the programme group.

- The Thermal Power Engineering MSc programme is one of 4 programmes in which the graduates are outnumbered by students who drop out of the programme. In particular, there is a huge difference between MSc students who come from the corresponding BSc programme and those who come from different programmes. Whereas continuing students rarely drop out of the programme, students with different backgrounds can have huge problems in dealing with specific topics of the programme, this appearing to be the cause of most of the MSc drop-outs.
- Unfortunately, there were no signs that the staff is aware of this process or that this is an issue the programme management is currently working on. In particular, there was no evidence that there are stronger measures being taken than in programmes in which the problem is not that dramatic.

From the perspective of the visiting team, there is a strong need for an approach that clarifies the prerequisites for students beginning with the MSc programme, and for a strategy aimed at those students that the programme aims in particular to attract. Currently, students entering the MSc programme and having a different BSc lack a great deal of the background required for the MSc program. Although they may eventually graduate, their employability tends to be low. At the same time, students coming from the BSc Thermal Power Engineering programme mentioned repetitions between BSc and MSc courses.

Room for collaboration regarding this matter exists, especially in connection with the PHE Refrigeration Technology dealt with at the TUT Maritime Academy. Most of the MSc students have a background in either Thermal Power Engineering or that study programme. In the BSc programme, the problem of drop-outs is not as great, but is still a serious issue. Fortunately, the staff is much more active in this area. Drop-out rates do not decrease with the introduction of more specific programme-related courses in the first few semesters, but they may affect the lower semesters nevertheless. The committee points out that there were no data comparing different generations of students and their way of proceeding through the programme, so one cannot determine in which semesters the drop-outs occur. Such statistics are a necessity in order to adequately address the problem of drop-outs effectively and make adequate recommendations for the future.

An issue for the department is the number of students entering the programme generally. The committee was convinced by the advertising message developed for the programme. It was considered to be clear that the management and the staff have invested much work in efforts to attract more students to the programme.

The students expressed a need of greater and more adequate information at the start of their studies, since it is a common problem in the programme group that students are not sufficiently aware of the content of their study programmes in the early semesters. The committee is optimistic that this situation will improve with the introduction of a newly conceived orientation lecture in the first semester and increased marketing of the study programme.

Regarding the future development of the programme, students, employers and alumni all expressed a wish for more technological courses and electrical engineering related courses in the programmes involved.

#### Strengths:

- A well-structured programme with clearly defined learning objectives for lectures, modules and programmes.
- A strong quality culture and an open-door atmosphere.
- High employability.

Areas for Improvement and recommendations:

- Formalize feedback channels.
- An appropriate strategy for students who enter the MSc from outside the programme.
- More measures to address the drop-out problem.

*Resources*

Due to the move to a modern building with a considerable amount of new laboratory facilities, the Department of Thermal Engineering obtained a great deal of new equipment and highly suitable space for both teaching and research. The committee has strong reason to believe that the space that was allocated also supports to a considerable degree many future plans, its thus being an indicator of sustainable resource development.

Course materials are available to students via internet or the modern library mentioned earlier. Since the staff already has experience with the development of their own materials in Estonian, the committee is confident that the indicated change to an increasing use of the English language in teaching will not be a big problem in terms of the material available.

The most limiting factor for resource allocation is that of the sources of funding available. Research projects within Estonia are nearly always funded by industry. There is only one example of EU funding there, that being and in cooperation with industry.

This is a sign of the relevance of the work done by the Department. The faculty is known as being specialized in regard to shale oils and for taking an active part in the international research community, hosting conferences and welcoming visiting professors. On the other hand, this puts the department in a role of research being linked to and dependent upon industrial developments. The staff has shown considerable vision concerning the future of their field, moving to more sustainable energy sources and looking into other areas of thermal engineering. Also, students and employers have shown an interest in broadening of the study programme. For a future-oriented development of the Department, it will be necessary to diversify the sources of funding. There is no general solution to such a problem. However, the committee notes that it may be useful for the Department to increase its international academic cooperation and the mobility of its staff.

Strengths:

- Modern building and facilities, more space for laboratories since the move took place.
- Teaching materials that are available via internet.

Areas for Improvement and recommendations:

- More diverse funding sources.

*Teaching and learning*

Teaching has a high priority to all members of the staff. Since there is no general rule about the proportion of research versus teaching, this varies a lot between different staff

members. Still, the committee recognises the fact in general of teachers having sufficient time to spend on teaching and a general motivation to do so.

Since some of the teachers are not involved in research at all, it is not possible to show links to modern research in all of the courses. In general, students felt that it depended on the teacher her-/himself whether teaching was related to research or not. The committee recommends that all teachers be active in research as well.

The study programmes with their modules, learning outcomes and assessment criteria are well defined.

Students are well informed about their study programme, lectures and assessment methods, as well as the expectations directed at them. They appear very much satisfied with the information they have available, their feedback possibilities and the availability to them of their teachers.

The ERASMUS programme is open to all students and the committee recognises that this is both used and highly appreciated by the students. However, since the Thermal Power Engineering programmes have a relatively strong focus, students have problems finding suitable programmes at other universities. Since the committee could find no example of help regarding this from the department, it recommends that it be provided in the future so as to encourage student mobility.

Another aspect of student mobility concerns the teaching language. All courses in the programme are in Estonian, which makes it difficult to make the programme attractive to incoming visiting students. For the cases that existed, the staff was strongly motivated to find suitable arrangements, but this was relying on personal initiatives both from students and teachers. The committee strongly recommends to implement more English courses into the programme to encourage both student and staff mobility.

#### Strengths:

- Student satisfaction.
- Strong cooperation with industry partners allows students practical experience.

#### Areas for Improvement and recommendations:

- Support and advertisement of student mobility.
- More English courses.

### *Teaching staff*

The Department of Thermal Engineering has 37 staff members. Their ages cover a large interval, with a mean of approximately 50. The majority of the staff is male, all professors included. The committee has no reason to believe or suspect otherwise than that all staff members are adequately qualified.

Younger members who join the Department are usually assigned a senior teacher to support them in developing their teaching skills. However, only a small fraction of the courses the university offers are taught by the new members. Also, language courses are seldom provided them. However, the student feedback as a whole regarding them is very positive.

Regarding the balance between teaching and research, there are no clear expectations concerning this on the part of the Department or the University. Thus, there is also no

orientation for incoming new staff members in this respect, except that every researcher is required to do some teaching. Accordingly, teaching has a high priority for members of the staff generally. The committee recommends, as pointed out earlier in the report, that expectations regarding the balance attained be discussed on a university level and that a greater awareness of this topic be generated.

The staff has many contacts internationally. Members attend conferences and some of them have had visiting appointments at other universities during their career. Unfortunately, these links do not encourage genuine staff mobility to any extent. There is to be one incoming visiting professor during the coming year, but the committee found no examples of staff members who had plans for, or considered the possibility of, having a sabbatical in some other country.

#### Strengths:

- A highly motivated staff.
- Offers of courses for the teaching staff concerning teaching skills, languages and teaching technologies.

#### Areas for Improvement and recommendations:

- Having a clear policy concerning the balance between research and teaching.
- Staff mobility.

### *Students*

The students in both programmes are highly motivated and in general are also satisfied with their study situation. They are very capable, but as discussed earlier there are large differences in their chances of graduating, depending in part upon the type of BSc or MSc degree they are aiming at.

Students have many options available for studying abroad, but as mentioned above it may well be difficult to find suitable courses at other universities. Also, since MSc students are usually working as well, they can be faced with complications in terms of mobility.

The large numbers of students working alongside their studies also leads to longer study times.

In terms of the employment rate, neither of these two matters presents a problem. The employability of graduates is high and employers tend to be very much satisfied with graduates of the MSc programme, which is the usual degree with which a student leaves his or her thermal power engineering studies. Because of this, it is also not difficult for students to find places for attaining practical training and experience, since employers are actively searching for such students.

#### Strengths:

- Assistance during the first year: Courses in Russian, a tutor system, preparatory courses, "Introduction to Thermal Engineering"-lectures.
- Good employability.

#### Areas for Improvement and recommendations:

- Mentoring and supervision should be increased in the 3rd and 4th year.

### **1.2.6. Fishing and Fish Processing Technology (Prof HE). Refrigerating Technology (Prof HE). Operation and Management of Marine Diesel Power Plants (Prof HE) – the Maritime Academy of TUT**

The objective of this section of the report is to present results of the evaluation of three programmes: Fishing and Fish Processing Technology, Refrigerating Technology, the Operation and Management of Marine Diesel Power Plants. The programmes are provided at the professional higher education level by the Estonian Maritime Academy. The Maritime Academy was merged with Tallinn University of Technology (TUT) in 2014. The programmes were adapted to the principles that apply at TUT. Amendments to the curricula, including matters of content, duration and the titles involved, were introduced for 2015/2016.

The evaluation of programmes included the assessment of the different curricula, the verification of self-evaluation reports, and on-site visits. The visiting team held meetings with representatives of the administration (the management of the different programmes), the teaching staff, the students, the alumni and social partners. The evaluation team visited the different facilities of the Academy. The general results arrived at were as follows:

#### ***The study programme and study programme development***

##### Observations and comments:

- Graduates from the programs that were evaluated can apply for the posts available at sea and onshore.
- The Operation and Management of Marine Diesel Power Plants programme fulfils the requirements of the International Convention on Standards for Certification, Training and Watch Keeping, this also being confirmed by an external audit conducted by the Estonian Maritime Administration.
- The contents of the curriculum of the Fishing and Fish Processing Technology programme were discussed with both internal and external stockholders, and with the Ministry of Rural Affairs.
- The different programmes were also discussed with the Nautical School regarding the removal of overlapping parts.

##### Strengths:

- All the programmes are well recognized in Estonia and are needed for Estonian industry. The country also has a long maritime tradition.
- Constant demand from the labour market for graduates of the programme was observed.

##### Areas for Improvement and recommendations:

- The learning outcomes of the programmes that were evaluated should be amended, since the learning outcomes tended too much to be focused on knowledge rather than on ability and skills, which is not fully consistent with the character of the professional programmes involved. This observation was underlined both by the societal partners in question and by the students. Use of new facilities and new equipment that have just been installed in the Academy can help in making changes of this sort.
- Better communication with employers and closer cooperation with them are recommended, since this group could help appreciably in improving the quality of the programmes in question.

- Establishing formal quality systems focused on the quality of the entire education provided would be an asset. Please ensure that quality system focuses on improvement of quality of education, mainly: learning outcomes, programmes, learning methods. System shall involve internal and external stakeholders in quality processes.
- Systems for providing information about different programs, including the contents of the websites involved, should be improved.
- The flow of information between the Maritime Academy and the University management shall be improved (in both directions).

### *Resources*

#### Observations and comments:

- The programmes are delivered on premises owned by the Maritime Academy of TUT. The premises in question are located in three buildings, these representing a single complex located in separate parts of TUT and of the city of Tallinn. The infrastructure involved consists of classrooms for lectures and for practical work, laboratories for practical work, simulators, workshops and a library. Students of the Maritime Academy and of the Nautical School are taught on these premises.
- The premises are sufficient in terms of size to secure delivery of the learning outcomes that are aimed at. The number of the different places and work stations involved is sufficient. A few additional technically relevant pictures and posters could help to brighten the place up. Most of classrooms that were visited had a projector and a PC for visual presentation of the subject matter.
- Possibilities for delivery of the learning outcomes that are intended can be increased appreciably after the summer semester of the academic year of 2015-2016 since the Academy is currently in the process of reconstruction which is going on and the installation of new and more modern equipment in several laboratories. A second-hand ship engine is to be installed in the workshop during the coming weeks. Students will have the possibility of performing disassembling exercises in connection with it. Teachers within the Faculty have reported their own rooms being equipped with IT facilities that are also to be made available to students during after-lesson periods. There are also rooms of this sort that are to be available to part-time staff members.
- Since most of the students work in industry, the practical training that is available is satisfactory. It is not clear, however, whether a known standard of training is to be employed and what types of facilities are to be available in places in which practice is to take place. Students of the Operation and Management of Marine Diesel Power Plants programme and of the Refrigerating Technology programme that are planning for career at sea endeavour to obtain experience and practice at sea. They search themselves for practice places on ships. It is not clear how practice of this sort is monitored by the Academy. Students are obligated, however, to deliver a practice book confirmed by an authorized person and to present to the Academy a report of practice of this kind.

#### Strengths:

- The development of laboratories that is being carried out is consistent with development of the study programmes.

- The Academy is well equipped with a library of its own.
- Its being merged with the Technical University of Tallinn gives the Maritime Academy the opportunity for better utilization of its resources and for increasing its chances of financial support.

#### Areas for Improvement and recommendations:

- The development of laboratories should be in line with the needs of the programmes as a whole. It appears that the development of new laboratories recently has not met the needs of the Refrigeration Technology program.
- Cooperation with employers should be expanded, since the latter can help deliver equipment or provide access to their own facilities for teaching purposes.

### *Teaching and learning*

#### Observations and comments:

- The programmes delivered meet the Standards of Higher Education requirements.
- The learning outcomes of each of the curricula focus mainly on knowledge alone, what is not consistent with what should characterize a professional program.
- The workload of mathematics that is provided is during the early semesters of the study programme can be regarded as sufficient in itself, yet the learning outcomes achieved do not appear to be sufficient. It is suggested to include learning goals of mathematic in learning outcomes of the curriculums.
- The numbers of dropouts that occur in the Operation and Management of Marine Diesel Power Plants and in the Refrigerating Technology programme appear to be rather high.
- The Fishing and Fish Processing Technology programme is a new programme that is being offered.
- Each of the programmes includes additional modules that one is free to elect.
- The most recent amendments to the Admission Requirements resulted in a decrease in the number of admissions.

#### Strengths:

- The learning outcomes of the Operation and Management of Marine Diesel Power Plants programme are linked with the STCW convention and the Estonian professional standards for engineering officers.
- The sequence of subjects in the programs is well organized.

#### Areas for Improvement and recommendations:

- The learning outcomes should be more closely oriented to abilities and skills.
- Although the training of seafarers is regulated by the STCW Convention, there is room for improvement in both teaching and learning through the utilization of modern teaching techniques and the introduction of opportunities for mobility.
- Since the English language is a maritime language, further subjects than those involved thus far should be taken up in the programme in English.
- Since insufficient language proficiency in Estonian is one of the reasons for dropouts, this factor should be taken into account in admissions requirements.

### *Teaching staff*

#### Observations and comments:

- The teaching staff at Tallinn University of Technology is selected on the basis of internal regulations. The academic staff meets the legal requirements. Members of the teaching staff of the Operation and Management of Marine Diesel Power Plants programme have their professional marine experience confirmed by certificates they can provide, this meeting the requirements of the STCW convention. The mobility of the teachers is not apparent, however, and the workload of the teaching staff is high. For these reasons, teachers are unable to readily take extended leaves for upgrading their competence. Teachers are evaluated periodically.
- There are no foreign teachers involved in the teaching process.
- The teaching staff does not possess all of the competence needed to teach courses as required by the STCW convention. These courses should be included among those available to the students. Amendments to STCW convention introduced new requirements in 2010. If there are no members of the teaching staff at the Academy who have completed the relevant course and hold the relevant certificate, the course must be bought in for the students. If it is only a lack of competencies of the teaching staff then University may consider to upgrade them.
- The teaching staff is engaged in the writing of books and of other texts.
- The Maritime Academy of Tallinn University of Technology is undertaking a programme aimed at lowering the average age of the academic staff to 54 years of age by the year 2020. In the 'Operation and Management of Marine Power Plants' program, the very high average age of the teaching staff (72) is a serious threat to the viability of this program. Management shall have this restriction in mind and elaborate plan for staff sustainability.

#### Strengths:

- Most of teachers have a maritime background (professional experience in this area), which has a positive impact on the learning outcomes achieved.
- The teachers' professional knowledge is up-to-date.
- The teachers' competencies are consistent with the teaching areas in which they are involved.
- The teaching staff in the Fishing and Fish Processing Technology programme is young and highly motivated.

#### Areas for Improvement and recommendations:

- Teachers should be encouraged to seek mobility.
- Plans for development of the Academy should focus not only on the age of the teachers but on the quality of their work and on their personal development.
- One area of concern is that of age gaps found in teaching staff.
- Persons representing industry should be more closely involved in the teaching process.

#### *Students*

##### Observations and comments:

- Students are well motivated in regard to their studies.
- Students are well aware of their learning outcomes.
- Students are well aware of the assessment criteria that apply.
- Students are well aware of the career paths that are available.

- Students tend to express a positive view concerning the learning facilities and the new laboratories that are available.
- Students tend to express a positive view of the support they can receive from teachers.
- Students of the Refrigerating Technology programme differ from one another in the number of months of professional practice they have, either 3 months or 9 months, depending upon the career paths they follow (sea or shore). With the rather small number of students there are in the group, this can lead to economic problems for the Academy in running the program.
- Many students fail to take part in mobility programs.
- There are no foreign students in the program.
- Formal communication channels between students, members of the alumni and the Maritime Academy have been established.

Strengths:

- Students receive considerable support from the Maritime Academy.
- The Academy provides a special system for solving problematic situations.
- The clear career path involved and the continual needs of the labour market ensure good employment opportunities.

Areas for Improvement and recommendations:

- The students and the alumni, who both have very much at stake in regard to success of the program, should be consulted in matters concerned with the program, learning outcomes and improvements.
- The involvement of alumni in the studies carried out could be increased, a matter that would help to sustain the teaching staff.
- Students should be encouraged to take part in mobility programmes.

### **1.2.7. Marine Engineering (Prof HE). The Kuressaare College of TUT**

Kuressaare College (KC) of TUT has a unique strategic role in regional policy within Estonia, and on the island of Saaremaa in particular, through its by providing specialists having skills that are relevant to various areas of economic importance in Saaremaa: those of tourism, marine engineering and entrepreneurship.

General observations and comments:

- In addition, KC and the Small Craft Competence Centre (SCC) support matters of technical and emotional culture of shipbuilding, which has a long tradition and a strong heritage on Saaremaa.
- Another important role of KC is to contribute to the professional development of specialists, as well as to lifelong learning activities in the region, to international networking and to the creation of new knowledge.
- The resources of the mother university, TUT – including the competence of the teaching and research personnel, the laboratory resources, and participation in international networks – have been transferred to KC, yet there is potential for still more in this regard.

- The Contemporary Marine Engineering (ME) study programme at KC was developed on the basis of practical experience in KC and the needs of industry, this being consistent with what is true of similar study programs internationally.
- The establishment of SCC by KC in 2011 and the full-scale development of it in 2015 provide KC with unique technical, research and business potential, not only in Estonia but in all three Baltic states – as well as around the Baltic Sea.
- The various positive circumstances pointed out above cannot be regarded as an excuse for the very obvious problems that are connected with KC: the rather small numbers of admissions, the high dropout rates, the insufficient outreach and insufficient promotion of the study programs, and the low degree of utilization of the potential of SCC.
- Although KC has been quite successful in different international projects, greater emphasis on the part of the KC management concerning what KC has to offer is needed in order to achieve a high level of business-related cooperation with companies and entities in all of the states around Baltic Sea (and in Europe generally).
- Research and testing services taking advantage of the potential of SCC, based on use of modern testing and research equipment and facilities (such as a wave pool) should be utilized on a full-scale basis as soon as possible.
- KC should be made more “visible” to potential students presently still in high school. Special road-shows for high-schools, aimed at promoting KC, should be arranged.
- Better and more sophisticated use of multimedia channels (Facebook, twitter, etc.) for attracting motivated students to study ME at KC should be arranged for.
- Industry should be brought closer to academia in the sense of building up a virtual work forum that can serve as an interface between industry and students, providing information for both concerning internship opportunities, seasonal work opportunities, and the like.
- KC has the potential for much more ambitious goals. It could become a marine engineering hub for the Baltic states, for Finland and for the Scandinavian countries generally. The physical prerequisites are almost achieved already. A study programme in English should be introduced in an effort to attract international students. Distance learning for practitioners could also be an option.
- Last but not least, the management of KC should have more ambitious conceptions regarding what should be aimed at and what can be achieved, supported by strong leadership skills.

### *The Study programme and its development*

#### Observations and comments:

- The Marine Engineering study programme (SP) involves close cooperation with the local boat- and shipbuilding industry, kits comprising basically all subjects that are relevant at the level of teaching involved.
- The competence and the resources of TUT and of the Estonian Maritime Academy are being used very effectively for the development of the SP.
- Developments within the SP are taking place and industrial feedback is being provided.

#### Strengths:

- SP is being “tailor-made” in terms of the needs of local industry, a process that can be continued.
- Basically all subjects of relevance are being dealt with, and there is a good balance between general and professional subjects.
- SP utilizes both human and physical resources of the local industry.
- Students who have graduated have good potential for continuing their education at the Master level either at TUT or internationally.

Areas for Improvement and recommendations:

- Theoretical subjects (mathematics, physics, etc.) should be linked more directly (integrated) with professional studies.
- One reason for dropouts is a loss of motivation on the part of certain students during their 1st and 2nd semester due to certain theoretical subjects (such as math and physics) that can possibly be experienced as “boring”. A possibility to consider is that of transferring certain of these theoretical subjects to later stages of the study programme and of certain professional subjects to earlier stages of the study program, study, for example in a manner such that only about 1/3 of the theoretical subjects come during the 1st year.
- Endeavouring to demonstrate to students how studying theoretical subjects can help one to solve practical problems.
- Placing greater emphasis on ship design, on CAD and CAM competence, and on practical work that is computer-based.
- Having a greater number of outdoor activities in SP involving real boats sailing on the real sea.
- Having a greater amount of practical work and teaching of practical skills in SP.
- Organizing an industrial advisory panel that meets 2 times a year to achieve a state-of-the-art overview obtained from real life and to forecast for the future both short- and long-term trends.
- Integrating the study-programme subject “Integrated product development”, as presently taught at TUT, and adapting it to the needs of the shipping industry.
- To the extent that the employment possibilities of the local (Estonian) market are limited, looking for new markets.

*Resources*

Observations and comments:

- The physical infrastructure of KC can be seen as being in very good condition, there mostly being well-equipped laboratories and computer classes having access to modern HW and SW.
- The background resources of TUT are always available.
- The SSC test pool is unique within the Baltic region and possesses very considerable potential for research and for the rendering of services.

Strengths:

- SCC: is in possession of unique equipment and has a highly motivated and skilled staff.
- The e-learning resources.
- The video lecture resources from TUT.

### Areas for Improvement and recommendations

- KC should have a study ship (or boat or yacht) for carrying out practical work on the sea. This would help to make SP more popular and serve to make students more highly motivated.
- The accommodation of students not living on the island but coming for study sessions once in a month should be better arranged and if possible encouraged by KC.
- Cooperation concerning practical work between KC, the Maritime Academy of TUT and the Marine Institute of TUT, concerning practical work carried out at sea, should be considered.

### Areas for Improvement and recommendations:

- The laboratory should be complemented by the purchase of equipment for the measurement of fracture toughness and chock resistance.

### *Teaching and learning*

#### Observations and comments:

- The original block-teaching method, involving one-week studies in place at KC, and 3 weeks of individual studies.
- This method is one well-accepted by students who are working at a full-load level.
- The teaching of shipbuilding and repair engineers should be considered as a direction for the future.
- Students interested in ship design (naval architecture) at the Master and PhD level have the possibility to continue their education at Aalto University and should be given the chance to do so.
- KC should concentrate in the future more on the areas of marine engineering and shipbuilding, supported by the potential different technical subjects taught at TU, such as (integrated) product development, production engineering, electronics and telecommunication, making use of the resources of the Marine Academy and such subjects as those of “electro-technology” and “power-plants of ships”.

#### Strengths:

- The involvement of practitioners from industry.
- Involvement of the academic staff of the Maritime Academy.
- The involvement of guest lecturers from Finland and from other countries.

### Areas for Improvement and recommendations:

- Not accepting “boring” lecturers.
- Taking measures to ensure that no lecture or class is cancelled during any given study week.
- Building up a system for providing accommodations for non-local students who come to KC for a study week.
- In cooperation with industry, building up an acknowledgment system for motivating students to graduate.

### *Teaching staff*

#### Observations and comments:

- Its possessing a good combination of local teaching resources, TUT and foreign teaching resources.

Strengths:

- The involvement of practitioners from industry in the study process.
- Guest lecturers being available.

Areas for Improvement and recommendations:

- Teachers needing to show greater motivation to keep students from dropping out.
- More active participation in research and in cooperative research projects.
- Utilizing the full potential of H2020 and of other European programs for obtaining funds for research.
- TUT providing methodological help in connection with the writing of project proposals.
- Making the curriculum of all courses closely related to the subject involved in efforts to enthuse students to a greater extent.

*Students*

Observations and comments:

- There are students from very different age groups differing in terms of work experience and life experiences.
- Nearly all students are working alongside their studies, their constantly being exposed to a work environment in this way.
- Dropouts are partly related to the work pressures involved, which can interfere with ability to carry out homework.
- Students coming directly from high school often lack sufficient exposure to matters concerned with their future job.

Strengths:

- A good command of English on the part of a great many students.
- Students who have had considerable work experience appear to frequently know quite exactly what they want from KC and to be well motivated to continue their studies.

Areas for Improvement and recommendations:

- Students should believe from the beginning of their studies that the degree they are aiming for is essential to them.
- Making study more attractive by organizing competitions in connection with it – such as that involving robotic boat building.
- Involving high school students in a robotic boat building project.
- Contacting student boat-design and boat-building clubs in Southampton (at the University of Southampton).