

Application for accreditation of PhD program in Applied micro- and nano systems at Vestfold University College

Report from the expert committee



The report on the application for PhD examination accreditation in *Anvendte mikro- og nanosystemer* at Vestfold University College is hereby delivered by the appointed expert committee to NOKUT.

The report is based on the application submitted by Vestfold University College on 01.02.2009, requested supplements to this application submitted on 30.10.2009, and the committee's visit at Vestfold University College on November 11 and 12, 2009.

Place/date:

Göteborg, Lyngby, Uppsala; 18.12.2009

Stefan Bengtsson, Professor, committee leader

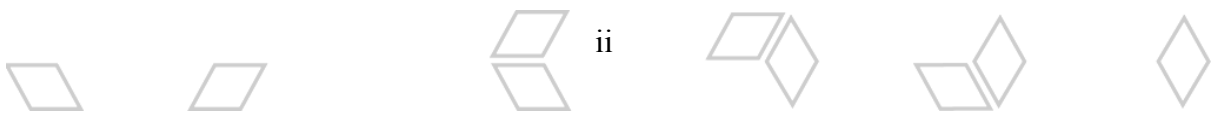
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1 BACKGROUND AND BASIS FOR EVALUATION

1.1 Background

Vestfold University College submitted an application to NOKUT requesting accreditation for a PhD program in Applied Micro- and Nano Systems (Anvendte mikro- og nanosystemer), dated 01.02.2009.

The committee understands that Vestfold University College is applying for accreditation of the proposed PhD program for the first time.

1.2 Members of the committee

Applications for accreditation of PhD programs are evaluated by an expert committee. All members of the expert committee must have competence at professor level.

The committee for this accreditation task was appointed on 13.08.2009 and consists of:

Stefan Bengtsson, Professor

Dept. of Microtechnology and Nanoscience, Chalmers University of Technology, Göteborg, Sweden

Ylva Bäcklund, Professor

VINNOVA, Sweden

Jörg P. Kutter, Professor

Dept. of Micro and Nanotechnology, Technical University of Denmark, Lyngby, Denmark

Stefan Bengtsson has been appointed leader of the committee, and PhD student Farzan A. Ghavanini, Chalmers University of Technology has been appointed secretary of the committee.

The mandate of the expert committee is to evaluate the proposed PhD program in Applied Micro- and Nano Systems (Anvendte mikro- og nanosystemer) at Vestfold University College according to the mandate given in Appendix 5.3 of this report.

1.3 Organization of the report

The report is organized according to the “Standards and criteria for accreditation of doctoral programs and institution-based fellowship programs for artistic development work” (paragraph 2-3 of the Regulations relating to standards and criteria for accreditation of program of study and criteria for accreditation of institutions in Norwegian higher education) issued by NOKUT. The standards and criteria can be found in Appendix 5.1 of this report.



Chapter 2 of the report summarizes the evaluations and conclusions from the expert committee. Chapter 3 describes in detail the evaluation by the committee and presents the results of the evaluation. The evaluation is organized in a point by point style corresponding to the criteria presented in paragraphs 2-3 of the regulations. The criteria listed in paragraphs 2-3 of the regulations can be found in Appendix 5.1. Each section in chapter 3 is divided into three parts: Description, evaluation and conclusion. The descriptive part is mainly extracted from the application submitted by Vestfold University College, complemented by the expert committee's impressions obtained during the visit at Vestfold University College. Chapter 4 summarizes the conclusions from the expert committee. Chapter 5 consists of a number of Appendices.



2 SUMMARY

The current evaluation of the PhD program in Applied Micro- and Nano Systems (Anvendte mikro- og nanosystemer) at Vestfold University College (VUC) is based on the application submitted by VUC on 01.02.2009, requested supplements to this application submitted on 30.10.2009, and the committee's visit at Vestfold University College on November 11 and 12, 2009. Additional comments were submitted by VUC on 03.12.2009 and this report was updated accordingly.

The committee finds that VUC meet all the criteria as stated in paragraphs 2-3 of the regulations and recommend NOKUT to approve the application for a PhD program in Applied Micro- and Nanosystems (Anvendte mikro- og nanosystemer) from VUC. Although VUC is fulfilling all criteria, recommendations for further improvements are summarized in this report.

The committee believes that VUC has systematically worked to build a strong environment in the field of micro- and nanosystems and that this environment now is large enough to take responsibility for a PhD program. The committee is pleased by the fact that the research, to a large extent, is made in collaboration with industry bringing industrial supervisors and experts into the environment.

The committee is also aware of the fact that, based on the statistics (DBH) provided by NOKUT, VUC falls a bit behind comparable environments in Norway in terms of publication records. The committee accepts that this is a result of the traditions in the field where the research activity is very applied and often made in collaboration with industry but strongly recommend the management of VUC to impose a strategy allowing good young associate professors to focus on research and publications, thereby building a stronger and more viable base for the future.

VUC has a broad range of formalised collaborative and cooperative relationships that contribute to the fulfilment of several important goals for the department such as student recruitment, student exchange, and active scientific research at a recognised international level. The committee especially recognises the Institution's engagement in the National Nanotechnology Research School for Microsystems and in the Norwegian Centre of Expertise Micro and Nanotechnology (NCE-MNT), which are of special importance and support for the planned PhD education and the whole research environment. Moreover, the research activities at VUC also encompass a very broad and active international collaboration, which include collaboration with well reputed institutions within the field in Europe, USA, and Asia. It is therefore highly recommended to maintain, intensify and expand the ties to national and international academic partners. This is particularly true if the lab-on-a-chip efforts are to be raised to an internationally competitive level.

The committee, in general, is satisfied with the available technical and administrative infrastructure, such as cleanroom facilities, bio(chemical) laboratory, ICT support, library, etc., but would like to express that the technicians seem not to be involved in the research projects; this is a situation that might be worth reflecting on further since it might serve as an additional motivation or viewed as an extra advantage. Moreover, the committee recommends that the strategy for improving the bio(chemical) laboratory should be clarified and that the leadership should include skilled biotechnicians.

Plans and regulations for the quality assurance of the PhD program are in place; however, the committee recommends VUC to emphasize on a strategy for further professional development and support for supervisors to further enhance the quality of the PhD program.



3 EVALUATION OF THE APPLICATION

3.1 A plan shall be available for the doctoral/fellowship program.

3.1.1 Regulations shall be in place for the doctoral/fellowship program.

Description

The detailed regulations governing the proposed doctoral program in Applied Micro- and Nano Systems (Anvendte mikro- og nanosystemer) at Vestfold University College (VUC) have been approved by the Board of VUC on December 18th, 2008. Appendix 1 of the application describes these regulations in detail. Relevant forms to be used in the doctoral program for application, appointment, follow-up and quality assurance, etc are presented in Appendices 2, 3, 4, 5, 6, 7, 8, and 9 of the application.

The regulations describe the goals, responsibilities, admission, and completion of the doctoral program at VUC. It describes the doctoral program as a graduate school whose purpose is to educate independent researchers at an international level, in interaction with national and international research environments. The Board of VUC has the overall responsibility for the doctoral education at VUC, while the faculties are responsible for specific Ph.D. programs.

The admission of new Ph.D. students is done continuously throughout the year. Admission to the doctoral program is formally decided by the faculties at VUC. The admission regulations require the applicant to have a master's degree, or comparable education that VUC can approve, as a basis for admission. The applicants must have a strong background in the subject from their previous study and shall normally be in the top half of the student population.

A contract is provided to guarantee that the student actively participates and completes the program within the stipulated time. The dissertation must be an independently conducted scientific study of international standard that can be published in the scientific literature of the field. Dissertation requirements are detailed in the regulations. In addition, procedures around supervision and quality assurance are described.

Appendix 1 of the application gives a detailed description of the regulations governing the Ph.D. program in Applied Micro- and Nano Systems within 24 chapters, namely:

- Chap. 1. Scope
- Chap. 2. Objective
- Chap. 3. Responsibility for the doctoral program
- Chap. 4. Doctoral program content
- Chap. 5. Admissions
- Chap. 6. Agreement
- Chap. 7. Doctoral Program

- Chap. 8. Affiliation with a research environment
- Chap. 9. The thesis
- Chap. 10. Supervision
- Chap. 11. Quality assurance and reporting
- Chap. 12. Termination of appointment
- Chap. 13. Examination
- Chap. 14. Appointment of an evaluation committee
- Chap. 15. Submission
- Chap. 16. Committee's work
- Chap. 17. Rework for new rating
- Chap. 18. The committee's recommendation and treatment of the setting
- Chap. 19. Publication of dissertation
- Chap. 20. Trial lecture
- Chap. 21. Defence of dissertation
- Chap. 22. The degree and diploma
- Chap. 23. Appeals
- Chap. 24. Final Provisions

Evaluation by the committee

The committee has the following comments and suggestions to some of the chapters of the regulations governing the Ph.D. program:

Chap. 4: it is not entirely clear what the requirements (ECTS points, hours spent, etc.) are, in particular, for the learning/study part and for the teaching/dissemination part. While some more information is given in chapter 7.4, it could also be specified a bit more here already.

Chap. 5: it is not entirely clear who is the deciding body for admissions. We assume it is the Dean, but that is not clearly stated. It is only stated that the Dean acknowledges the study plan, but not the entire application as such. Also, this section might have to be rephrased if/when the new department structure is implemented at VUC, which might introduce a different distribution of responsibilities.

The committee acknowledges that no specific background is required for admission – this is a good regulation given the highly multi-disciplinary nature of the envisioned research projects, which require students from very different backgrounds to participate.

Chap. 7: some more specific requirements for the learning part are given in this chapter, but it is not clear why there is a range given for the study points to be achieved. If 30 credit points is the minimum requirement, this should be stated as such.

Chap. 8: The committee acknowledges the regulations put in place with respect to delay of publication to secure intellectual property rights – this is an important point in particular for

VUC because of the close contact and collaborations with industry. However, it could be further considered to include a recommendation that the student should strive to achieve, for example, three peer-reviewed international publications during the study period.

Chap 14: the committee recommends that the item 14-2 be slightly rephrased to allow for members with either a PhD degree or equivalent qualifications (as was used in chapter 10-2)

Chap 20: the committee acknowledges the intention with the trial lecture. However, it is unclear whether it requires the members of the PhD evaluation committee to travel two times to VUC (once for the trial presentation and once for the defence) – this should be clarified.

Overall, the committee strongly suggests that an English version of these guidelines be provided to the prospective students.

Conclusion

The proposal meets this evaluation criterion. The applicant is asked to consider the suggestions and recommendations given above.

3.1.2 The doctoral/fellowship program shall have a representative name.

Description

The proposed name of the Ph.D. program is Anvendte mikro- of nanosystemer (Applied Micro- and Nano Systems).

Evaluation by the committee

The committee acknowledges that the name of the program might imply a very narrow and limiting area of scientific activities to non-experts. However, this is in fact a highly multidisciplinary field spanning over many activities, and thus provides ample possibilities as well as challenges.

Conclusion

The proposal meets this evaluation criterion.

3.1.3 The plan shall demonstrate that the doctoral/fellowship program possesses an adequate academic/artistic level, breadth and depth and coherence within its field.

Description

The scientific field of the proposed Ph.D. program Applied Micro- and Nano Systems is a multidisciplinary area bringing together and taking advantage of different electrical, mechanical, optical, chemical, and biological phenomena. The multidisciplinary nature of the

field sets it in contact with disciplines such as physics, electronics, mechanics, chemistry, and biology. The activity at VUC is focused on design, manufacturing, packaging, characterisation and testing of micro- and nanosystems for different applications. The activity is strongly directed to the systems level, driven by needs in Norwegian industry.

At VUC the research in micro- and nanosystems is aimed at applications in the existing industrial cluster within microsystem technology in Norway. However, these activities have recently developed, and increased international research cooperation is taking place. As a consequence, several specialized research groups at IMST have been established covering the following core subjects (described in more details in 3.1.5):

- Micro-Opto-Electric-Mechanical System - Micro-optics (MOEMS)
- Ultrasound Transducers (ULT)
- Micro and Nano-Sensors for Measurement of Pressure and Motion (SEN)
- Micro Energy Sources - Energy and Environmental Nanotechnology (MEK)
- Passive Radio Frequency Components, Surface Acoustic Wave and Bulk Acoustic waves (RFK)
- Medical / Biological Micro-Electro-Mechanical Systems, Micro System medical applications (BIO)
- Micro- and Nano Technology Building Methods - Integration and Packaging of Micro- and Nano Systems (PT).

Evaluation by the committee

The committee is aware of the fact that this is a critical point (and probably always will be) since the field of Applied Micro and Nano Systems is indeed so broad that it is almost impossible to cover its entirety within a single PhD program. Also, attempting to achieve this would probably dilute the efforts. We believe that any PhD program in this field will thus represent a subset of activities (core subjects) chosen by the program coordinators according to some internal criteria. It is the committee's impression that at VUC the selection of core subjects was performed with the expertise of the already hired academic staff in mind, with an emphasis on design, fabrication, packaging and characterization to provide coherence. Additionally, the needs of the main collaborating industrial partners as well as the strategic decision to include the emerging field of bioMEMS and lab-on-a-chip technologies were taken into consideration. Other selection criteria could have been applied as well, however, the committee is convinced that the final selection is adequate and of great relevance with regards to the context.

Conclusion

The proposal meets this evaluation criterion. The committee advises the applicant to consolidate already existing core subjects before introducing any further core subjects to ensure sufficient academic depth. Moreover, it remains as a challenge for VUC to provide adequate depth in the chosen core subjects by securing appropriate staff, teaching facilities

and laboratory infrastructure. In this context, the committee strongly recommends VUC to increase their efforts in establishing and improving the support for bioMEMS activities.

3.1.4 The plan shall set out how the doctoral/fellowship program is linked with subject areas/artistic subject areas with adequate breadth and clear delineation from other subject areas/artistic subject areas

Description

The activities within the field of micro- and nanosystems have to different degrees academic overlap with subjects as electronics, physics, chemistry, materials science, semiconductor technology, computer science, and signal processing. Within the Ph.D. program in Applied Micro- and Nano Systems at VUC it will be relevant to include activities in the subject areas mentioned above, while keeping the focus on research and innovation taking advantage of micro- and nanosystems for different applications. A good example of this approach is the amazing development that has taken place internationally over the last years in applying micro- and nanosystems for medicine and biotechnology (lab-on-a-chip, micro- fluidic systems, bio-tagging, etc.).

Consequently, it is natural that the Ph.D. program maintains and develops strong ties to fields closely related to micro- and nano systems, such as:

Biotechnology: micro fluidics, optical detection methods, biocompatible packaging technology.

Electronics: processing methods for semiconductor technology, high frequency technology, component design, system design, integration and packaging methods.

Material science: functional materials, thin films, polymers, surface treatment, metallurgy.

Physics: electromagnetism, thermal physics, materials science, acoustics and optics.

Chemistry: processing of materials, self-organization, lab-on-chip, gas sensors.

Mechanics: Elastic properties and strength calculation of materials on micro- and nano scale, energy harvesting, actuator and sensor design.

Evaluation by the committee

The multidisciplinary aspect of the field of Applied Micro and Nano Systems makes it necessary to seek input, collaboration, and co-supervision from a number of related subject areas. This is adequately laid out in the application. However, it is the committee's impression that not all the mentioned related subject areas are sufficiently strong at VUC to provide adequate support and sparring.

Conclusion

The proposal basically meets this evaluation criterion. However, the committee highly recommends VUC to maintain, intensify and expand the ties to other Norwegian universities

as well as European and other international academic partners. This is particularly true if the lab-on-a-chip efforts are to be raised to an internationally competitive level.

3.1.5 The plan shall demonstrate how the doctoral/fellowship program is embedded in one or more core subject areas that are identifiable in an international context

Description

The PhD program in Applied Micro- and Nano Systems is embedded in the following core subject areas:

Micro-Opto-Electric-Mecanical System - Micro-optics (MOEMS)

The research covering activities in the development and integration of micro-electro-optical components based on different technologies and materials such as silicon, polymer and glass. Research on the development of MOEMS hybrid technology has been based on micro actuators and "polymer thin films". Other areas of MOEMS are un-cooled infrared detectors and infrared light sources for gas sensors. Closely related subjects are optics, materials science and microelectronics.

Ultrasound Transducers (ULT)

The research is focused on new miniaturized ultrasound transducers aiming at application for instance for monitoring of the heart function. Central to this research is the development of Capacitive Micromachined Ultrasonic Transducer (CMUT) technology and Piezoelectric Micromachined Ultrasound Transducers (PMUT). Closely related subjects are materials science and signals processing.

Micro and Nano-Sensors for Measurement of Pressure and Motion (SEN)

The activity contains a series of research activities within development of micro sensors, such as micro accelerometers for measuring heart motion, micro sensor for diabetes, micro mechanical piezoresistive pressure sensors, microphones, and micro gyros. Closely related subjects are mechanical engineering, material science and measurement techniques.

Micro Energy Sources - Energy and Environmental Nanotechnology (MEK)

Within micro energy sources, research has been focused on electromechanically converting the energy from vibrations to electrical energy. Micro energy systems are realized using MEMS process technology. Closely related fields are mechanical engineering, materials science and electronics/microelectronics.

Passive Radio Frequency Components, Surface Acoustic Wave and Bulk Acoustic waves (RFK)

The activity covers research on MEMS resonators and switches for RF applications, various technologies for RF MEMS, including capacitive RF MEMS switches. Closely related

subjects are high frequency electronics, materials science, microelectronics and signal processing.

Medical / Biological Micro-Electro-Mechanical Systems, Micro System medical applications (BIO)

The activities on micro systems for medical applications include lab-on-Chip for diagnosis of disease, sampling and sample preparation, dispensing of medicines and biotechnology fluids, and research on stem cells. Research is both on the methods of construction of such systems and on selected biotechnological processes that can be studied using such miniaturized systems. The area allows for an entirely new class of miniaturized biomedical instruments. Closely related subjects are biology/medicine, materials science, microelectronics, and measurement technology.

Micro- and Nano Technology Building Methods - Integration and Packaging of Micro- and Nano Systems (PT)

The research activities in the integration and packaging of micro system cover "flip-chip" technologies, 3D building practise for heterogeneous micro systems, bio-compatible packages, and assembly and packaging issues for Wafer Level Packaging. Fabrication and characterization of structures on micro- and nano belong to the research tasks of this group. Closely related subjects are materials science, mechanical engineering and production technology.

Evaluation by the committee

The seven proposed core subject areas are clearly identifiable in an international context. All of the mentioned subject areas have dedicated international conferences, symposia, and journals or are at least a significant subset of a larger conference or a broader subject journal. Some of the subject areas are more established and, hence, more mature than others, which are emerging and in a strong growth phase. The committee advises the applicant to aim at consolidating the selected core subjects, for instance by merging closely related subjects to broader areas. Moreover, it remains as a challenge for VUC to provide adequate depth in the chosen core subjects by securing appropriate staff, teaching facilities and laboratory infrastructure.

Conclusion

The proposal meets this evaluation criterion.

3.1.6 The plan shall describe the doctoral/fellowship program's academic/artistic objectives and what the program qualifies the student for. The plan shall also describe the necessary background for admission to the program.

Description

The aim of the PhD program in Applied Micro- and Nano Systems is to train scientists who are able to perform independent research of high international standard within the field. The candidate must be able to tackle new and challenging scientific problems after graduation within both academic research and advanced product development in industry.

To be admitted as a PhD candidate, the applicant must document his/her competence at the master's level in science, technology, or equivalent. After completing the Ph.D. program in Applied Micro and Nano Systems, the candidate should be able to lead research activities, industrial as well as academic, on a high professional level.

Evaluation by the committee

The application and the guidelines describe sufficiently what the aim of the program is and what the students are expected to learn and receive training in. The admission criteria are laid out in sufficient detail, while keeping in mind that the students need to be recruited from a variety of backgrounds.

Conclusion

The proposal meets the evaluation criterion.

3.1.7 The plan shall describe compulsory and elective components.

Description

The duration of the PhD program is three years. The course part will be equal to the minimum of 30 credits, out of which 5 credit points must be dedicated to the compulsory course of Research Ethics (Science, Ethics and Society).

Elective courses in the PhD program are:

- Optics for Micro- and Nano technologies - OPT600P
- MEMS energy harvesting devices – ENE600P
- Acoustic and ultrasound transducer technologies – AUT600P
- Microfluidic: Mechanism and Applications in Microsystems – FLU600P
- Mechanical sensors and actuators based upon micro- and nanotechnologies – SEN600P
- High frequency devices and RF-MESM – RFM600P
- Interconnection, packaging, and heterogeneous integration of micro- and nano systems – PAC600P

- BioMEMS – Bio600P

Evaluation by the committee

All the courses, both elective and compulsory, are adequately described. The committee notes that teaching in some of the courses is given by part-time staff, i.e., professors with part-time appointments. Particularly in the developing areas, such as bioMEMS, it is crucial to have a strong dedicated person tying the teaching efforts with the ongoing research activities in order to give the subject the necessary weight.

Conclusion

The proposal meets the evaluation criterion but the committee recommends that no more additional courses are offered unless other courses are discontinued or merged. Moreover, it should be avoided to offer too many different courses while the number of expected or anticipated students in the program is limited.

3.1.8 The plan shall demonstrate that the work performed by the PhD student is put in a broader academic context.

Description

The PhD program in Applied Micro- and Nano Systems constitutes a specific discipline embedded in a much broader area. The subject is multidisciplinary with strong components of physics, chemistry, material science/engineering and electronics/ICT. The broader defined nanotechnology contains both bottom-up processes, where structures are built from atoms and molecules, as well as top-down processes, where the desired structures are defined by manufacturing processes based on patterning and etching/modification techniques. The proposed Ph.D. program at VUC intends to focus on projects where the use of micro- and nanotechnology may give rise to industrial products with brand-new and improved properties. The Ph.D. program emphasizes the design, modelling and the realization of micro- and nano systems, as well as the experimental studies with relevance to research in this area. The program is not focused on bottom-up processes, but rather to the application of micro- and nanotechnology for micro- and nanosystems as key components in integrated systems.

By combining the PhD program focused on applied micro and nano systems with the organization of new research projects and committed cooperation in national and international network it is ensured that the candidate will achieve a necessary academic breadth. This is further detailed in the following ways:

- The ongoing Ph.D. studies and research at VUC are largely conducted in cooperation with industry, with clear goals for new applications of micro and nano systems technology. A thesis is usually part of a larger research project with interdisciplinary challenges and the candidate is working in a research group. The companies of the

National Center of Expertise (NCE) in micro- and nanotechnology help to ensure this focus.

- The Department of Micro Systems and Technology (IMST) at VUC has built up a good tradition of leading and holding seminars in micro and nano systems technology. Weekly seminars with invited lecturers from the research networks and the industry are well established as explained in Appendix 32 of the application. This provides Ph.D. students a unique opportunity to gain insight into closely related areas. These seminars will also form the framework around the annual Ph.D. seminars hold by the candidates. In total three seminars per Ph.D. candidate will be organized, where the final one will include an evaluation of the candidate's research work and thus qualitatively be important in ensuring the implementation of the PhD training.
- VUC has established a good relationship with the University of Oslo, SINTEF, and NTNU which give access to courses, laboratories, equipment, and expertise in complementary wide areas. The collaboration includes the coordinated activity of a National Research School in nanotechnology for micro-systems as explained in Appendix 30 and 31 of the application.
- VUC has also established several international contacts within the research area of micro and nano systems. These contacts include established agreements with centers and institutes in China and United States. By means of this network, Ph.D. candidates have the opportunity to spend part of their studies at one of these internationally recognized institutions.

Evaluation by the committee

It is crucial to allow the students to experience their work in a larger perspective. At VUC, this has been recognised and several initiatives are implemented to ensure this. Participation in national networks and industrial collaborations are certainly key elements and are emphasised at VUC. There also exist a number of contacts, both in Europe and worldwide. The committee welcomes the initiatives of a regular colloquium series and the necessity for the student to present their own work in midterm evaluations and workshops before a larger audience with external guests.

Conclusion

The committee recommends that, while the PhD program allows for the possibility of a single supervisor from VUC, the possibility for co-supervisors from other universities and/or industrial partners should be maintained and nurtured. The applicant is advised to increase its participation in formal collaborations and exchange programs on the European level and at the same time intensify and expand the current collaborations. The committee concludes that, overall, the criterion is met.

3.2 The institution shall maintain a stable body of academic staff assigned to the doctoral/fellowship program

3.2.1 The size of the academic staff shall be adapted to the teaching, academic supervision and the research/the artistic development work.

Description

The strategic investment of VUC in Microsystems Technology was launched in 2002. Today, the Department of Micro Systems and Technology (IMST) at VUC represents the country's largest academic environment in microsystems technology as well as one of the nation's largest research environments in micro and nano systems. IMST has now built up a competent group on an international level within peak areas of fabrication methods for micro and nano systems.

The academic community at IMST has systematically been built and includes today nearly 50 people. This includes researchers as well as lab engineers and professors. However, not all employees at IMST will be linked to the PhD program. The PhD program in Applied Micro- and Nano Systems will be run by the efforts of 5 fulltime professors (Henrik Jakobsen, Lars Hoff, Per Ohlckers, Stein Ivar Hansen, Xuyan Chen), 7 fulltime associate professors (Einar Halvorsen, Kaiyang Wang, Knut Aasmundtveit, Muhammad Akram, Nils Hoivik, Tao Dong, Ulrik Hanke), and 3 part-time (20%) professors II (Arthur van Rhenen, Frank Karlsen, Yngvar Berg).

Evaluation by the committee

VUC has systematically worked to build a strong environment in the field of micro- and nanosystems. Today, the environment includes around 50 persons, which is considered by the committee, to be a large enough environment to take responsibility for a PhD program. Furthermore, the fact that the research to a large extent is made in collaboration with industry, brings industrial supervisors and experts into the environment.

Conclusion

The committee is pleased with the size of the environment at VUC and concludes that there are a number of sufficiently strong academic staff members in the environment. The committee concludes that the criterion about whether the academic staff is adapted to teaching, academic supervision and the research within the PhD program in Applied micro- and nanosystems is met.

3.2.2 The academic staff shall engage in active research/artistic development work with proper academic breadth at a high international level.

Description

The expertise of the core group of the faculty members (5 full professors, 7 associate professors and three part-time professors II) is quite evenly distributed over the seven core areas with the exception of the *Micro- and Nano Sensors for measurement of Pressure and Motion (SEN)* core area which constitutes a larger environment. The composition of interests in the core group will evolve over time, when new faculty is appointed and when the content of the PhD program gradually change. Upon request, VUC provided the committee with full publication lists for the last four years as well as the h-indices for the 15 members of staff linked to the proposed PhD programme. The number of publications (peer reviewed and non peer reviewed, both journal papers and conference contributions) of the faculty members during the last four years ranges from 2 to 64. For all members of staff, conference presentations dominate over journal publications in the publication lists. Six of the researchers also list patents and patent applications, with a maximum of 9 for a single member of staff. A similar variation as in the number of publications can be observed in the h-index¹ of the staff to be responsible for the PhD programme, with h-indices ranging from 2 to 17. All members of staff, except one, report an h-index below 10. As pointed out in the material from VUC, the h-indices may be affected by the fact that many of the staff members predominantly publish their results at conferences that may not be indexed by the search engines ISI web and Scopus used to generate the data. Hence, the presented h-indices should be considered to be the minimum value.

According to official publication data from DBH for 2008, provided by NOKUT, the staff of the entire engineering education unit (53,6 full-time person-years) of VUC produced 14,7 publication points, corresponding to 0,3 publication point/person-year, The publications were to 89,2% published in level 1 journals with the remaining 10,8% in level 2 journals.

Evaluation by the committee

It is clear that some of the researchers possess sufficiently high international academic level. However, the academic merits in the group of staff are varying considerably and hence the total outcome is not particularly strong, given the size of the environment. This is confirmed by the publication statistics (DBH) provided by NOKUT, showing that on average VUC falls a bit behind comparable environments in Norway in terms of publication records, such as publications per employee. As pointed out by VUC in the submitted complementary material as well as during the visit, the tradition of publishing results mainly on conferences might have affected publication records such as the h-index negatively. The committee understands and appreciates that a large part of the research is made in collaboration with industry and

¹ The **h-index** is an [index](#) that attempts to measure both the scientific productivity and the apparent scientific impact of a scientist. A scientist has *h-index* of h if h of [his/her] Np papers have at least h citations each, and the other (Np – h) papers have at most h citations each.

thereby is quite applied and, therefore, the dissemination sometimes is better suited for conferences than for journal publications. It is clear from scrutinizing the provided publication lists that several members of the staff do publish regularly at well-known international conferences in the field, such as those of the IEEE. Based on the fact that a few professors and professors II and some successful young associate professors have good publication records, the committee evaluates the level as above the requirements described in NOKUT's regulations.

Conclusion

A number of staff members have shown good records regarding publications, in particular at international conferences. The committee accepts that this is a result of the traditions in the field combined with the fact that the research activity at VUC is very applied and often made in collaboration with industry. The committee concludes that the size and activity of the current academic staff meets the criterion of proper academic breath at a high international level. However, the committee also strongly recommend the management of VUC to impose a strategy allowing good young associate professors to focus on research and publications, thereby building a stronger and more viable base for the future. Furthermore, the committee recommends the management of VUC to support their researchers in negotiations with industry regarding IPR, for instance by providing a standard agreement template that has been conceptually agreed with industry.

3.2.3 The institution shall retain employees in main positions (hovedstilling) with qualifications within what are regarded as core subject areas for the doctoral/fellowship program.

Description

There are currently 5 professors, 7 associate professors, and 3 professors type II in the core group around the PhD program. The following table gives an overview of the faculty members in main positions in the 7 core areas:

MOEMS	Professor Chen, Professor Jakobsen, Professor Hansen, and associate professor Akram have an active role in this field. Professor Chen and associate professor Akram have both participated in several projects in optics and micro-systems and lead several research projects at IMST.
Ultrasound	Professor Hoff and professor II Berg participate in activities within the ultrasound core area. In particular, Professor Hoff has worked with several major research projects on the use of acoustics and ultrasonic sensors for medical applications. He also has been the head of the Strategic College Project for Microsystems for Cardiac Monitoring.

Pressure and motion sensors	Professor Øhlckers has extensive experience in micromechanics and sensor technology in Norway. He has been active in the education of micro- and nanotechnology within several international projects. Professor Jakobsen has many years of experience as a researcher within this area and has also had the main responsibility for development of the MEMS technology in SensoNor which forms the basis for the participation in the EU projects of STIMESI and Micro-BUILDER.
Energy Sources	Associate Professors Halvorsen and Dong lead the active projects in energy harvesting. Both are very active in the field with several journal articles and many students (master and Ph.D.) associated with research projects.
BioMEMS	Professor Chen, professor II Karlsen, and associate professor Dong participate in the BioMEMS research field. Karlsen has extensive experience as a project manager from the lab-on-chip projects.
RF MEMS	Professor Chen, associate professors Hanke and Høivik have all background in RF MEMS technology. They have participated in several research projects related to RF MEMS and published both at conferences and in journal articles.
Packaging Technology	Associate professors Aasmundtveit, Høivik and Wang all participate in several packaging projects. The projects vary from 3D building methods for ultrasonic transducers, bolometers, and optical systems. Professor Jakobsen has many years of experience in the development of technology for the film techniques, assembly, and packaging in both chip level and wafer level.

Evaluation by the committee

All staff members listed in the application, without doubt, have backgrounds and current activities of relevance to a PhD program in Applied micro- and nanosystems. The choice of core subjects seems to be based on the backgrounds of available staff, rather than being a unique or ideal mix of core subjects for the proposed program. However, the core subjects are all relevant to the proposed PhD program and all staff members are indeed active in important subfields of micro- and nanosystems.

Conclusion

The committee concludes that all of the employees holding main positions have backgrounds and qualifications of relevance for the proposed PhD program. The criterion that all employees in main positions should have qualifications within what are regarded as core subject areas for the doctoral/fellowship program, is thereby met. The mix of academic and industrial backgrounds is appreciated as it ensures bringing both issues of excellence and relevance to the planned education. The committee recommends that VUC impose a strategy to bring the research activities together in a fewer broad research areas with critical mass.

3.2.4 At least 50% of the academic staff assigned to the doctoral/fellowship program shall hold full professorships; the remainder shall be associate professors (førsteamanuensis).

Description

The five full-time professors and three part-time professors II constitute 55.2% of the academic staff assigned to the Ph.D. program. The total person-years dedicated to the program is 9.4 out of which 5.3 (see the following table) are contributed by the full professors.

NAME	POSITION	EMPLOYMENT	MAN-YEAR DEDICATED TO THE PROGRAM		
			EDUCATION	R&D	OTHER
HENRIK JAKOBSEN	PROFESSOR	FULL-TIME	0.2	0.6	0.2 (IMST DEPT. HEAD)
LARS HOFF	PROFESSOR	FULL-TIME	0.25	0.75	
PER ØHLCKERS	PROFESSOR	FULL-TIME	0.2	0.8	
STEIN IVAR HANSEN	PROFESSOR	FULL-TIME	0.1	0.4	0.2 (HEAD OF NCE-MNT)
XUYAN CHEN	PROFESSOR	FULL-TIME	0.2	0.8	
ARTHUR VAN RHENEN	PROFESSOR II	20%	0.2	0	
FRANK KARLSEN	PROFESSOR II	20%	0.1	0.1	
YNGVAR BERG	PROFESSOR II	20%	0.1	0.1	
TOTAL = 5.3			1.35	3.55	0.4

Evaluation by the committee

Of the 15 members of staff listed in the proposal to be active on part time for the PhD program, 8 are holding positions as full professor or professor II. According to the NOKUT regulations the analysis should be made on person-years and not by counting heads. Based on the information given by VUC, this brings the balance to the right side of the 50% limit. Looking into the CVs and publication lists of the professors, it is apparent that several of the professors have relatively limited publication records in recent years, which of course brings

doubt on the capacity as academic supervisors. Instead, they have strong backgrounds from research institutes and industry. There are several strong young associate professors linked to the program that probably will have the opportunity of becoming promoted to full professors within a few years. The latter is also important due to upcoming retirements.

During the site visit, the issue was brought up whether the presented figures for person-years to be active in the PhD program, would lead to a complete depletion of professors at the master's level. Apparently, based on the answers given, this is already the situation today, with the full professors focusing on the around 20 PhD students at VUC.

Conclusion

The committee wishes to emphasize that the academic merits of the staff is not particularly strong, in total. The planned person-years for the PhD students fulfils the 50% requirement of the NOKUT regulation, but taking upcoming retirements into account, the situation is balancing at the border of acceptance. The committee concludes that the requirement that 50% of the person-years planned for the PhD program is fulfilled, but strongly recommends that the management imposes a strategy making it possible for well merited associate professor to continue to focus on research and publications to ensure the possibility to merit themselves for full professorships. Such a strategy would, within a number of years, create a good margin to the requirement that 50% of the person-years assigned to the PhD program should be covered by full professors. In summary, the criterion is met, but proactive actions are needed for the future.

3.3 Academic activities at the institution shall serve to support the doctoral/fellowship program.

Description

The academic activities within Microsystems Technology at VUC have been built up to be the country's largest academic environment in the area and one of the country's largest environments within micro- and nanosystems. The majority of the academic staff has many years of experience in research and development within the field of applied micro- and nano systems. Activities at VUC can be described as relatively broad and multidisciplinary applied research aimed at innovation in areas such as ICT, health, energy, and environment which are in line with the focus of the Ph.D. program. The academic activities at VUC cover the areas such as application of nanotechnology, functional materials integration, and applications of micro-system in a wide range of applications. Today the academic activities at VUC include:

- Micro System Technology integrated within the Bachelor degree studies.
- Master of Science program and education within the micro-system technology.
- An established research with, at the time of application, 17 doctoral candidates within national and international projects such as Micro Systems for cardiac monitoring, 3D packaging methods, Nanosensor technology for in-vivo glucose monitoring, Micro

energy sources for harvesting from vibrations, HICFODS, STIMESI (EU FP6), Micro Builder (EU FP6).

- Weekly academic lectures and international seminars with invited speakers.
- Project management and coordination of activities within the industrial cluster project "Norwegian Center of Expertise - Micro-and Nanotechnology".
- In addition, surrounding activities such as those directed to maritime engineering, ICT, nursery and energy as well as regional innovation clusters support the proposed PhD program.
- Research projects within social sciences within Innovation system and Entrepreneurship also support the proposed PhD program.

Evaluation by the committee

The committee finds the academic activities within Microsystems Technology at VUC to be very satisfactory. There has been a strong and conscious drive within the faculty to establish a comprehensive and complete study from bottom to top, including already established BSc and MSc program in Microsystems Technology. With regard to the scientific and administrative staff as well as the scientific strategy, the college seems well prepared for the PhD education in Microsystems Technology. Other research programmes and environments at VUC also seem to support the proposed PhD programme well. Current ongoing PhD students have been supported in a good way and have produced academic results to an adequate level. Especially, the weekly academic seminars that are carried out at the institution and the engagement in the National Nanotechnology Research School for Microsystems are well appreciated by the committee.

Conclusion

The committee concludes that the criterion is met, but emphasises the publication in well reputed journals and conferences to reach even higher international standards.

3.4 The institution shall be actively engaged in national and international cooperation and in networks of relevance to the doctoral/fellowship program.

Description

VUC is part of the National Nanotechnology Research School for Microsystems. The research school involves three educational institutes, NTNU, UiO, and VUC together with SINTEF Microsystem and Nanotechnology, and the national competence centre for Microtechnology (NCE-MNT). This school brings together academic research efforts with broad international contacts and extensive research activities of high quality, certified by publications in prestigious journals, invited lectures / seminars nationally and internationally, and extensive external financing.

VUC participates in the Norwegian Centre of Expertise Micro and Nanotechnology (NCE-MNT) which consists of more than 20 industrial companies surrounded by a network of innovation actors, public authorities, and financial investors. Among these industrial enterprises are Infineon Technologies SensoNor AS, OSI Optoelectronics AS, Ignis Photonix AS, Memscap AS, Norspace AS, Norchip AS, GE Vingmed Ultrasound AS, Kongsberg Maritime AS, Jotron AS, Techno Display AS, Micro-elements AS, Techni AS, OSWO AS, and EMG Noratron AS. Moreover, Horten municipality and Vestfold County Council attend the network as public actors. The unique core for the NCE-MNT is the commercialization of new ideas within the micro- and nanotechnology field.

The micro- and nanosystems activity at VUC has built close cooperation with major research activities in Trondheim (NTNU and SINTEF) and Oslo (UiO, SINTEF). The collaboration includes the following institutions and research areas:

- University of Oslo: Department of Computer Science, Department of Physics, Chemistry / Nano Science.
- SINTEF Group: SINTEF ICT and MiNaLab, SINTEF Materials Technology.
- UNIK.
- FFI: Underwater Technology and IR.
- NTNU: ICT, Centre for medical ultrasound technique, Nanotechnology.

The college has also a close relationship with the adjacent and complementary businesses of NTNU, UiO and SINTEF. One example is the collaboration around joint equipment proposals by VUC, NTNU, UiO and SINTEF for upgrading of the cleanroom facilities. VUC has also close contact and interaction with other research and educational environment within the Oslo Fjord Alliance. The Alliance consists of the University for the Environment and Life Sciences as well as of the university colleges in Vestfold, Buskerud, and Østfold.

VUC has established contacts with a wide range of universities in Europe through its participation in the EU projects Micro BUILDER and STIMESI. International cooperation with other academic institutions includes:

- In the Nordic countries:
 - Chalmers University of Technology, Microtechnology and Nanoscience
 - KTH, Micro System Technology
 - DTU, Nanotech
 - HUT
- In Europe
 - Projects in a wide range of research groups at universities and institutions, including the University of Southampton, Manchester University, Imperial College, Herriot-Watt, University of Glasgow, Delft University, KU-Leuven, IMTEK, University of Turin, and University of Neuchatel.

- In USA
 - There are good contacts with a number of leading research groups, but there is a particular emphasis on the cooperation with the Berkeley Sensor and Actuator Center (BSAC) at the University of California, Berkeley, MEMS research at Stanford University, and technology entrepreneurship education at Boston University. VUC has established a cooperation agreement with BSAC for the next three years (2009-2011), which ensures Ph.D. student's access to both courses and labs at the Berkeley research center.
- In Asia
 - There are ongoing contacts with several universities in China, Singapore, Taiwan, South Korea, Vietnam and Japan. Of particular importance for the doctoral education, is the cooperation with Sah MEMS Center of Xiamen University in China.

The Department of Micro Systems and Technology (IMST) at VUC has an important and active role in the Norwegian charter within IMAP (International Microelectronics and Packaging Society). VUC was in cooperation with SINTEF responsible for organizing the 2009 annual conference.. This conference attracts most of the players in Norway within the micro and nano systems and packaging technology, and works as a rallying point both for the academic and the industrial players in the Nordic region.

VUC is also active in inviting scientists from the rest of the world to come and give lectures and short-courses. In the past year, several international IEEE Fellows and EDS Distinguished Lecturers have held talks in micro and nano systems technology at VUC. A list of these lectures is available in Appendix 32 of the proposal.

Evaluation by the committee

The Department of Micro Systems and Technology (IMST) at VUC has a broad range of formalised collaborative and cooperative relationships that contribute to the fulfilment of several important goals for the department; student recruitment, student exchange, active scientific research at a recognised international level and tight relationship to industry and local/regional administration to support applied research and knowledge transfer. The committee especially recognises the department's engagement in the National Nanotechnology Research School for Microsystems and in the Norwegian Centre of Expertise Micro and Nanotechnology (NCE-MNT), which are of special importance and support for the planned PhD education and the whole research environment. Moreover, the research activities at the department also encompass a very broad and active international collaboration, which include collaboration with well reputed institutions within the field in Europe, USA, and Asia. It was the committee's impression during the site visit that especially the formal agreement with Berkeley Sensor and Actuator Center (BSAC) at the University of California, Berkeley worked well.

Conclusion

The committee concludes that the criterion is met.

3.5 Infrastructure shall be adapted to the organization and tuition and related to the doctoral/fellowship program's objectives.

3.5.1 Research fellows shall be provided with requisite and appropriate working conditions, e.g. office space/production premises, equipment, machinery and equipment.

Description

Vestfold University College is now mainly located in Bakkenteigen between Tønsberg and Horten in Horten municipality. The college has already 18 000 m² premises and will receive an increase of 16 000 m² when the teacher education moves from Eik to Bakkenteigen in summer of 2010. The college will, after the expansion, have premises with offices, auditoriums and laboratories adapted for its educational tasks.

Moreover, a new research facility is being planned at VUC. The new Research, Innovation and Commercialization Center will be a central part of the VUC campus. A commercial property company, with two owners, Horten Industripark and SIVA, will be the owners of the new infrastructure. The area to be constructed in the first phase will measure 9400 m². Depending on the number of tenants, the construction will start with a plan to complete by 2011. The first phase will include new areas for state-of-the-art cleanroom facilities, bio laboratory and SEM laboratories, offices, common areas, and meeting rooms for IMST as well as the Maritime Thrust and simulator lab. In addition to VUC, the space will be rented out to local companies and commercial interests.

Cleanroom laboratory

There is a 200 m² cleanroom at VUC for fabrication and characterization of micro-system devices. The scientific equipments established in the cleanroom include lithography, dry and wet etching, wafer bonding tools as well as tools for characterisation.

Bio Laboratory

The Bio laboratory has the basic equipment needed for cultivation and observation of stem cells in vitro, as well as new fluorescence microscopes. The lab has Ph.D. and master students as regular users. The lab is, in addition, used for the laboratory exercises in the course BioMEMS at Masters Level (BIM2MET).

SEM Laboratory

The VUC SEM laboratory is equipped with a Scanning Electron Microscope and includes the following equipments:

- Phillips / FEI XL30, including EDX from EDAX / Point Electronics.



- Optical material-Microscope Zeiss Neophot 32.
- Stereo Microscope Zeiss Discovery V12.
- A simple gold sputter
- Carbon Evaporator (for adding electrically conductive surface to SEM samples).
- Equipment for mechanical grinding and polishing of specimens (especially used to make cross-section of samples for microscopic examination).

National Research School --Common infrastructure

The national research school in nanotechnology for microsystems has a comprehensive laboratory infrastructure with sophisticated and expensive scientific equipment. Central to this infrastructure is the NTNU NanoLab, UiO / SINTEF MiNaLab, and VUC cleanroom for fabrication, integration and packaging of microsystems.

Evaluation by the committee

Vestfold University College offers very good facilities for the PhD students, including offices and laboratories. The college has today 18 000 m² which will increase with additional 16 000 m² during the summer of 2010. The college will, after the expansion, have premises with offices, auditoriums, library and laboratories well adapted for its educational and research tasks. Further, there are long term plans for even more expansion in the area as a Science Park and Innovation centre is planned in the vicinity of the VUC campus which will even further enhance the opportunity for collaboration between surrounding regional industries and organisations. Today, a relatively small cleanroom laboratory, which seems to be well organised and structured, and a bio(chemical) laboratory have been established. The cleanroom laboratory has a mixture of new and older, donated equipments; this is often the case in the micro/nano systems field. The established cleanroom is adequately equipped in accordance with both the research needs of the core areas of Micro Systems as well as the training needs associated with MSc and PhD education. In addition to this cleanroom there is a close collaboration and agreement with NTNU, UiO and SINTEF regarding access to cleanroom facilities at the different institutions which is highly appreciated by the committee. The four organisations have also submitted a joint proposal to the Norwegian Research Council for upgrading of their cleanroom facilities, which is currently under assessment.

Conclusion

The committee concludes that the criterion is met. Even though the bio(chemical) laboratory has the basic equipment adequate for the planned PhD program, the committee recommends that the strategy for improving the bio(chemical) laboratory should be clarified and that the leadership should include skilled biotechnicians.

3.5.2 Library services shall be readily accessible and commensurate with the academic content and level of the doctoral/fellowship program.

Description

The college library offers students and employees access to books and periodicals, access to electronic resources, ordering and loans of requested publications, and training and supervision in advanced information search services. The library has a collection of 60000 books, 430 current periodicals and access to 7000 electronic journals in full text. Science Direct, Academic Search Premier, ISI Web of Science, Ovid, SpringerLink, IOP electronic journals, ProQuest, and IEEE Explore are among the available databases. Articles and other relevant magazines are borrowed or purchased on demand if the library itself does not have access.

There are nine librarians, eight with education on Bachelor level and one on Master's level. Two librarians are dedicated to work with services to PhD students. In addition, there is an office professional position and five student assistants associated with the library. The library offers courses in reference management, and registering the colleges' research results in ForsDok.

A new library / learning centre with a total area of 2400 m² will be ready for use in 2010. There will be forty reading rooms in two reading halls, four computer rooms, seven group rooms, and five mini-group rooms. In total, 365 desks will be available in the new library, most of them being prepared for computer use.

Evaluation by the committee

The present library and its services are readily accessible by the PhD students and the plans for the new library are even more promising in this respect. There will be a vast number of available rooms for reading and group activities serving both undergraduate and PhD students. The library at Vestfold University College is able to provide the literature needed for the planned PhD research and education, including books and access to online databases for retrieving scientific articles such as IEEE Explore.

Conclusion

It was the committee's impression during the site visit that the library staff was very service minded and seemed to care much about the needs of the PhD students. Taking this into account plus the fact that the library is able to provide the necessary literature for the PhD program, the committee concludes that this criterion is met.

3.5.3 Research fellows shall be provided with access to ICT services of adequate scope and quality.

Description

The central IT services at VUC provide services and support to all staff and students. A number of computer rooms are available as well as equipments facilitating the use of private laptops in the campus area. The central IT Services has 11 permanent staff and 3 student assistants. The PhD-students are provided with the software needed for carrying out their research projects like, for instance, simulation and modelling of micro structures.

Services such as printing, copying, and audio-visual equipment are offered on the campuses. Remote Access to the college resources is provided through VPN.

Evaluation by the committee

The ICT network and services of the Vestfold University College contains all necessary elements for an efficient academic work.

Conclusion

The committee concludes that the criterion is met.

3.5.4 Technical and administrative support services shall be satisfactory.

Description

PhD students will receive administrative and technical support from VUC support facilities such as Study Section, IT - operations, international offices and buildings operations.

The student administration organizes the implementation of the exams and issuance of certificates as well as registration of grades in the database system. VUC uses ClassFronter as e-learning platform. Academic services also help students if they want to take courses at other institutions and the international office will help with arrangements for students to take courses abroad. A new administrative position as an advisor for the PhD-students has just recently been appointed.

VUC is preparing to fulfil the increased administrative tasks, should the college receive accreditation for education at PhD level.

Evaluation by the committee

The situation regarding the administrative support from the University College, the faculty, and the department for the PhD students and the planned program is indeed satisfactory. The committee received the impression, from the visit, that the institution is well prepared for the new administration processes along with the new responsibilities that will follow from an

accreditation. The laboratory staff and technicians are well educated and have adequate experience from working in cleanroom environment, and yet, show an understanding for the special situation of having untrained undergraduate students as well as PhD students, working in the lab.

Conclusion

The committee concludes that the criterion is met, but wishes to express that the technicians seem not to be involved in the research projects; this is a situation that might be worth reflecting on further since it might serve as an additional motivation or viewed as an extra advantage.

3.6 The institution shall state how the doctoral/fellowship program is quality assured within the institution's quality assurance system.

Description

The quality system at Vestfold University College is prepared on the basis of § 1.6 in the Universities and University Colleges Act. The quality system at Vestfold University College was approved by the Board of NOKUT in May 2007.

Specific forms and procedures have been developed for the Ph.D. program in Applied Micro- and Nano Systems that will ensure the quality of the study and assessment of the scientific work. These are described as follows:

1. Responsibility for the Ph.D. program at VUC

The Board of VUC has the overall responsibility for education at the Ph.D. level. The faculties have the professional responsibility of their Ph.D. programs and for the practical completion of studies. The college director is responsible for the quality of Ph.D. programs at VUC and is responsible for recording and archiving of all documents governing the relationship between the student, VUC, and other partner institutions.

2. Registration and archiving

All documents that regulate the relationship between the student, VUC and other partner institutions shall be recorded and archived. All changes to the agreement and plans shall be recorded and archived.

3. Follow-up and reporting

The students' performance should be followed up so that they can complete their studies in the agreed period. There will be regular contacts between students and academic administration to ensure that the students receive the necessary follow-ups. Progress forms must be completed by both the student and the supervisors twice a year and the forms will be reviewed by the faculty Dean to assess whether special resources / actions are required. A

half-time follow up of the progress of the student is made by assistance of an external expert, which also reviews the effort of the supervisors. The outcome of this review helps in the planning for the second half of the studies.

4. Supervision

Students will have regular contacts with their supervisors. All potential supervisors will take part in a mandatory supervisor seminar. Fixed times for supervision meetings between the students, principal supervisor and co-supervisor are set. Several supervisors work in a team around each PhD student, normally there are three supervisors in a team.

5. Public evaluation

During the course of study, the student holds an open seminar in order to provide other students and researchers at VUC and other institutions with an assessment of how the work is carried out up to that point.

6. Evaluation of thesis and approval of degree

The study concludes with a trial lecture and the defense of the dissertation. The evaluation committee includes two external experts - the first and the second opponent.

Evaluation by the committee

The quality system established for the PhD program in Applied Micro- and Nano Systems is detailed and comprehensive and includes admission procedure, entry qualifications, supervision, follow up reporting, archiving, coursework requirements and assessment, public evaluation and examination of the dissertation. This will ensure a well prepared project plan and a tight follow-up of the students throughout their study.

It is much appreciated by the committee that the acceptance to the PhD program is formalised with an agreement between the student, the supervisors group and the Dean, and in case there are external partners, like industry, there will be additional agreements, including those regulating IPR.

All PhD students are supervised by a team of three supervisors where the main supervisor is a senior academic member of the core Micro/Nano Systems research staff. Such supervisory teams may provide an assurance of a continued supervision responsibility when one or two supervisors terminate their supervision task.

A half-time follow up of the student progress is made by assistance of an external expert, which also reviews the effort of the supervisors. The study concludes with a trial lecture and the defence of dissertation in accordance with the rules of the Norwegian Council for Higher Education's Regulations.

Of the 30 stipulated mandatory credit points in the PhD program, five are compulsory (consisting of one course in Science, Ethics, and Society). The course portfolio at the MSc level comprises 9 courses covering the subject areas defined within the PhD program which can be attended also by the PhD students. Each core subject has at least one representative course in the new PhD program. In addition, due to close cooperation with UiO, NTNU, and the Oslo Fjord Alliance, several other courses are available for the PhD students. The courses offered at VUC to cover the PhD program in Applied Micro/Nano Systems should thus be satisfactory.

Conclusions

In total the plans and regulations for the PhD study are comprehensive and detailed and will ensure a well prepared project plan and a tight follow-up of the students throughout their study. The committee appreciates the well described procedures and concludes that the criterion is met. However the committee recommends VUC to establish systematic quality assurance and competence development regarding the role of the supervisor and the recognition of the supervisors as a professional position. The management of VUC is recommended to emphasize on a strategy for further professional development and support for supervisors to further enhance the quality of the PhD-program.

4 CONCLUSIONS

4.1 Does Vestfold University College meet the standards and criteria for accreditation of the Doctoral programme in applied micro- and nano systems at Vestfold University College?

Yes. The committee finds that all criteria for accreditation of the Doctoral Program in Applied micro- and nano systems are met. Hence, the committee recommends NOKUT to approve the application from Vestfold University College for a PhD program in Applied Micro- and Nanosystems (Anvendte mikro- og nanosystemer).

4.2 The Committee's recommendation on areas of further development of the programme

Although the committee has come to the conclusions that VUC meet all criteria in the applicable regulations, the committee suggests to VUC to consider the following recommendations:

The applicant is asked to consider the suggestions and recommendations by the evaluation committee regarding the regulations governing the PhD program given under subsection 3.1.1 of this report.

The committee advises the applicant to consolidate already existing core subjects before introducing any further core subjects to ensure sufficient academic depth. Moreover, it remains as a challenge for VUC to provide adequate depth in the chosen core subjects by securing appropriate staff, teaching facilities and laboratory infrastructure. In this context, the committee strongly recommends VUC to increase their efforts in establishing and improving the support for bioMEMS activities.

There is a need to maintain, intensify and expand the ties to other Norwegian universities as well as European and other international academic partners. This is particularly true if the lab-on-a-chip efforts are to be raised to an internationally competitive level.

VUC is advised to increase its participation in formal collaborations and exchange programs on the European level and at the same time intensify and expand the current collaborations.

The committee recommends that no more additional courses are offered unless other courses are discontinued or merged. Moreover, it should be avoided to offer too many different courses while the number of expected or anticipated students in the program is limited.

The committee strongly recommends the management of VUC to impose a strategy allowing good young associate professors to focus on research and publications, thereby building a stronger and more viable base for the future. Such a strategy would, within a number of years, create a good margin to the requirement that 50% of the person-years assigned to the PhD program should be covered by full professors. Furthermore, the committee recommends the management of VUC to support their researchers in negotiations with industry regarding IPR, for instance by providing a standard agreement template that is conceptually agreed with industry.

The committee would like to stress that VUC imposes a strategy to bring the research activities together in a fewer broad research areas with critical mass.

The committee recommends that the strategy for improving the bio(chemical) laboratory should be clarified and that the laboratory leadership should include skilled biotechnicians.

The committee wishes to express that the technicians seem not to be involved in the research projects; this is a situation that might be worth reflecting on further since it might serve as an additional motivation or viewed as an extra advantage.

Finally, the committee recommends an additional long term view be taken with respect to the education, support, and development of the supervisor role and recognition of the supervisors as a professional position, and emphasize on a strategy for further professional development and support for supervisors to further enhance the quality of the PhD program.

5 APPENDIX

5.1 REGULATIONS RELATING TO STANDARDS AND CRITERIA FOR ACCREDITATION OF PROGRAMME OF STUDY AND CRITERIA FOR ACCREDITATION OF INSTITUTIONS IN NORWEGIAN HIGHER EDUCATION, § 2-3

(Issued by the Norwegian Agency for quality Assurance in Education (NOKUT) 25 January 2006 pursuant to the Regulations concerning accreditation, evaluation and recognition no. 1040 issued 8 September 2005 by the Ministry of Education and research pursuant to the Act relating to Universities and University Colleges)

2-3 Standards and criteria for accreditation of doctoral programmes and institution-based fellowship programmes for artistic development work.

2-3 (1) A plan shall be available for the doctoral/fellowship programme.

1. Regulations shall be in place for the doctoral/fellowship programme.
2. The doctoral/fellowship programme shall have a representative name.
3. The plan shall demonstrate that the doctoral/fellowship programme possesses an adequate academic/artistic level, breadth and depth and coherence within its field.
4. The plan shall set out how the doctoral/fellowship programme is linked with subject areas/artistic subject areas with adequate breath and clear delineation from other subject areas/artistic subject areas
5. The plan shall demonstrate how the doctoral/fellowship programme is embedded in one or more core subject areas that are identifiable in an international context
6. The plan shall describe the doctoral/fellowship programme's academic/artistic objectives and what the programme qualifies the student for. The plan shall also describe the necessary background for admission to the programme
7. The plan shall describe compulsory and elective components.
8. The plan shall state that the fellow's work/project is incorporated in a wider academic context.

2-3 (2) The institution shall maintain a stable body of academic staff assigned to the doctoral/fellowship programme

1. The size of the academic staff shall be adapted to the teaching, academic supervision and the research/the artistic development work.
2. The academic staff shall engage in active research/artistic development work with proper academic breadth at a high international level.

3. The institution shall retain employees in main positions (hovedstilling) with qualifications within what are regarded as core subject areas for the doctoral/fellowship programme.

4. At least 50% of the academic staff assigned to the doctoral/fellowship programme shall hold full professorships; the remainder shall be associate professors (førsteamanuensis).

2-3 (3) Academic activities at the institution shall serve to support the doctoral/fellowship programme.

2-3 (4) The institution shall be actively engaged in national and international cooperation and in networks of relevance to the doctoral/fellowship programme.

2-3 (5) Infrastructure shall be adapted to the organisation and tuition and related to the doctoral/fellowship programme's objectives.

1. Research fellows shall be provided with requisite and appropriate working conditions, e.g. office space/production premises, equipment, machinery and equipment.

2. Library services shall be readily accessible and commensurate with the academic content and level of the doctoral/fellowship programme.

3. Research fellows shall be provided with access to ICT services of adequate scope and quality.

4. Technical and administrative support services shall be satisfactory.

2-3 (6) The institution shall state how the doctoral/fellowship programme is quality assured within the institution's quality assurance system.

5.2 Program for site visit (identify no names)

Date: 11th and 12th of November 2009

Meeting room: First day: A101A/B Second day: A101A/B.

Time	Interview group
Day 1, 11 th of November	
08.45-09.00	Committee meeting
09.00-09.30	Meeting the management of the institution; Administrative Director, Rector, Pro-Rector
09.30-09.45	Break
09.45-10.15	Meeting the representatives for the master degree students, Master in Microsystems Technology. (Max 6).
10.15-10.30	Break
10.30-11.15	Meeting the PhD-students (max 6).
11.15-11.30	Break
11.30-12.15	Meeting the management at the Faculty of Science and Engineering; the Dean, Pro-Dean, pro-Dean research, the Faculty Director, program coordinator (max 5)
12.15-13.15	Lunch, only the committee.
13.15-14.15	Meeting the scientific staff I (max 6)
14.15-14.30	Break
14.30-15.30	Meeting the Scientific Staff II (max 6)
15.30-15.45	Break
15.45-16.15	Meeting the administrative staff; admissions officers, representatives of the study- and research administration and the library. (max 6)
16.15-16.30	Break
16.30-17.00	Guided Inspection of the infrastructure at the campus; library, working facilities for Phd-students and scientific staff (office premises, etc.)
17.00-17.30	Committee meeting
Day 2, 12 th of November	
09.00-10.00	Guided inspection the technical infrastructure, All three laboratories; Cleanroom, Biolab, and SEMlab.
10.00-10.15	Break
10.15-10.45	Meeting representatives of the supporting technical positions, lab engineers, etc.
10.45-11.00	Break

11.00-12.00	Meeting representatives for external employers, industrial partners, representatives of the local business, etc. (Max 6).
12.00-12.15	Break
12.15-13.00	Meeting the management of the institution; Administrative Director, Rector, Pro-Rector, dean
13.00-14.00	Lunch, only the committee
14.00-16.00	Committee meeting.



5.3 MANDATE FOR THE EXPERT COMMITTEE ON ACCREDITATION OF STUDY PROGRAMMES

Adopted by the Board of the Norwegian Agency for Quality Assurance in Education (NOKUT) on 29 March 2006.

Pursuant to the Act relating to universities and university colleges of 1 April 2005 and the Ministry of Education and Research's regulations concerning accreditation, evaluation and recognition pursuant to the Act relating to universities and university colleges of 8 September 2005, the Expert Committee is assigned a mandate to:

1. Assess whether the PhD program in Applied Micro- and Nano Systems at Vestfold University College meets all the standards and criteria for accreditation of doctoral programs (§2-3, NOKUT's regulations)
2. Give reasons for its assessment and provide an unambiguous conclusion in a written report.
 - The report shall contain assessments for use by the institution in further enhancement of the study program.
 - The report shall be quality-assured before it is issued.
3. Issue a report to NOKUT.

The formal basis for the Committee's assessment is constituted by:

- Regulations relating to standards and criteria for accreditation of study programs and criteria for accreditation of institutions in Norwegian higher education adopted by NOKUT on 25 January 2006.

The Committee's assessment will be based on the following:

- The institution's application and other relevant written materials which NOKUT and/or the Committee deem necessary for assessment purposes.
- The Committee's experiences from visits to the institution.

The assignment is concluded by NOKUT's decision.



Nasjonalt organ for kvalitet i utdanningen
Att. Gerhard Y Amundsen
Postboks 1708
0121 Oslo

Deres referanse:	Deres dato:	Saksnummer:	Vår saksbehandler:	Vår dato:
09/58-12	23.12.2009	2008/815	Tone Gran Tone.Gran@hive.no	15.01.2010

Rapport fra sakkyndig komité - Ph. D.- utdanning i anvendte mikro- og nanosystemer - kommentarer fra Høgskolen i Vestfold

Høgskolen i Vestfold er svært glad for at sakkyndig komité finner at alle kriterier for akkreditering av doktorgradsprogrammet i anvendte mikro- og nanosystemer er oppfylt, og at komiteen derfor anbefaler NOKUT å godkjenne akkrediteringssøknaden fra Høgskolen i Vestfold.

Den sakkyndige komiteen har i sin rapport gitt flere anbefalinger som høgskolen er bedt om å vurdere. Slik vi ser det vil disse anbefalingene styrke høgskolens Ph.D. program i anvendte mikro- og nanosystemer. Høgskolen ønsker derfor å imøtekomme alle anbefalingene. Komiteen har oppsummert anbefalingene i kapittel 4.2. Vi kommenterer disse anbefalingene i 10 punkter som vedlegg til dette brevet.

I sitt møte 18.12.09 har styret ved Høgskolen i Vestfold vedtatt ekstrabevilgning på 2 millioner kroner til strategisk utvikling av Ph.D. program i anvendte mikro- og nanosystemer for 2010. Den sakkyndige komiteen anbefaler meget sterkt at Høgskolen oppretter ordninger som gir unge førsteamanuenser mulighet til å fokusere på forskning og publisering for dermed å kunne bygge et sterkere fagmiljø for fremtiden. De strategiske midlene som er bevilget for 2010 kan brukes både til utvikling av studiet og til kompetansehevingstiltak for personalet. I tillegg har Vestfold fylkeskommune avsatt 10 millioner kroner til et universitetsfond for Høgskolen i Vestfold til bruk i perioden 2009 – 2012. Av disse midlene skal 3,5 millioner benyttes til kompetansehevingstiltak for personalet. Kompetansemidlene er foreløpig ikke fordelt. Rapporten fra sakkyndig komité vil styrke søknaden til disse midlene.

Høgskolens styre vedtok i siste møte før jul at 2 av 3 nye stipendiatstillinger for 2010 skal tillegges dette programmet, med tilhørende bevilgning. Avdeling for realfag og ingeniørutdanning har etter dette 25 aktive Ph.D. stipendiater som er i et doktorgradsløp, en stilling som er under tilsetning og to nye stillinger som skal lyses ut.

Anbefalingen om å utbedre bio(kjemiske) laboratorium vil bli fulgt. Anskaffelse av utstyr og ledelse av laboratoriet med dyktige bio-teknikere vil ha høy prioritet som en integrert del av utviklingen av hele BioMEMS området. Vi vil spesielt nevne den nye BioMEMS labben og

forskningsområdet som er planlagt i tilknytning til nytt ren-rom i FIN-Senteret (Forskning, Innovasjon og Næringsssenter, som planlegges oppført i 2010 med innflytning i 2011). BioMEMS området skal styrkes med en professor i 100 % stilling til å ta ansvar for området fra august 2010 (Professor Frank Karlsen), i tillegg til to nye førsteamanuenser med BioMEMS og bioteknologi bakgrunn.


Innfor fagområdet for Ph.D.programmet i anvendte mikro- og nanosystemer vil høgskolen opprettholde, forsterke og utvide bånd til andre norske universiteter og internasjonale samarbeidspartnere, ikke bare gjennom deltakelse i den nasjonale forskerskolen der HVE deltar sammen med NTNU, UiO og SINTEF, men også til relaterte akademiske forskningsgrupper innenfor områder som halvleder fysikk, optikk, material-vitenskap, medisin, bioteknologi, IKT og ASIC, ultralyd billedannelse og maritim teknologi. Spesielt ønsker vi å etablere gode samarbeidsrelasjoner med akademiske institusjoner med relaterte aktiviteter for BioMEMS området, både i Norge / Norden og internasjonalt.

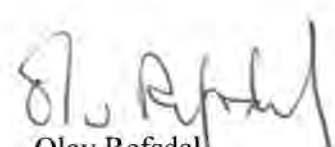
Komiteen peker på stipendiat veilederne som en gruppe som bør vies spesiell oppmerksomhet for å få en god doktorgradsutdanning. Forskerne knyttet til fagområdet mikro- og nanoteknologi har månedlige møter. Dette er en arena der erfaringer kan deles og hvor vi ønsker å sette veilederrollen og alle dens aspekter på dagsordenen. Vi ser at mange norske institusjoner arrangerer årlige workshops for veiledere på doktorgradsnivå. Dette er en idé som også vi ønsker å innføre for å få sterkere fokus på veilederrollen. I tillegg vil våre forskere få erfaringer gjennom samarbeid og partnerskap med mer erfarne akademiske grupper, spesielt forventer vi at den nasjonale forskerskolen vil fungere som et godt nettverk for videre samarbeid på dette området.

At erfarne laboratoripersonale og -teknikere bare i beskjeden grad er involvert i forskningsprosjekter er riktig kommentert av komiteen. Vi tror involveringen vil øke når flere praktiske arbeider blir gjort i laboratorier, og når forskergruppene blir bedre organisert. For nåværende og fremtidige forskningsprosjekter vil vi forsøke å innlemme laboratoriepersonell i planlagte forskningsaktiviteter på et tidlig stadium.

Som nevnt innledningsvis er komiteens anbefalinger kommentert samlet i vedlegg til dette brevet. Siden komiteens rapport er skrevet på engelsk, har vi også valgt å skrive våre kommentarer på engelsk.

Med vennlig hilsen
Høgskolen i Vestfold


Petter Aasen
Rektor


Olav Refsdal
Høgskoledirektør

Comments to the Report from the expert committee - Ph.D. program in Applied micro and nano systems at Vestfold University College

In the report from the expert committee several recommendations were presented for us to consider. The opinion from Vestfold University College is that these recommendations will strengthen the Ph.D. program in applied micro- and nano systems. VUC will start a process to meet all the recommendations. The Committee has summarized the recommendations in section 4.2. We comment on these recommendations in 10 points. Please note that the committee's recommendations from Chapter 4.2 are shown in italics at the start of each of the points.

THE COMMITTEE SUGGESTS TO VUC TO CONSIDER THE FOLLOWING RECOMMENDATIONS:

1. The applicant is asked to consider the suggestions and recommendations by the evaluation committee regarding the regulations governing the PhD program given under subsection 3.1.1 of this report.

The committee gives the conclusion that proposal meets this evaluation criterion. However VUC will go through the Regulations and consider the suggestions and recommendations given by the committee. Afterwards the Regulations will be translated into English.

In chap 4 it will be clarified that the programme has a normalized duration of 3 years (180 ECTS credits) full time research education, of which the candidates have their individual theoretical syllabus with a minimum of 30 ECTS credits (equivalent to 6 months of full time study).

At HVE it is always the Dean who is the formal deciding body for all matters at the Faculty. In our regulations we have described the Research body (Forskerutdanningsutvalget) as the deciding body for admissions, but the agreement for admission has to be signed by the Dean (Chap. 6) - this will be clarified in chap 5.

Chap 9 will describe this PhD program and any other PhD programs at VUC in the future. Then the dissertation may be presented either in the form of a monograph or as a collection of articles linked by means of an introduction to the work and a summary of the most important results and conclusions. The summary must clearly define the problems which the Ph.D. study set out to investigate and also draw together the results from the component parts into a coherent conclusion, which places them in a wider context. In order to have the dissertation assessed, the standard of the main parts must be comparable to that found in international scientific papers published within the same general subject area. A responsibility rests upon both the candidate and the supervisor when selecting the research project to take into account the requirement to publish the results. During the course of the dissertation work results should, as a rule, be submitted for publication to international journals and/or presented at international conferences. Naturally there will be a recommendation from our faculty that the student should strive to achieve, as a minimum, three peer-reviewed international publications during the study period.

In Chap 14 the item 14-2 will be slightly rephrased to allow for members with either a PhD degree or equivalent qualifications (as was used in chapter 10-2).

It is the intention that the trial lecture should be held in conjunction with the defence, on the same day, or the day before. Then the members of the PhD evaluation committee have to travel only once to VUC– this will be clarified (chap 20).

2. The committee advises the applicant to consolidate already existing core subjects before introducing any further core subjects to ensure sufficient academic depth. Moreover, it remains as a challenge for VUC to provide adequate depth in the chosen core subjects by securing appropriate staff, teaching facilities and laboratory infrastructure. In this context, the committee strongly recommends VUC to increase their efforts in establishing and improving the support for bioMEMS activities.

The selection of core subject areas within applied micro- and nano systems for the PhD program will be a matter of continuous concern and development due to several reasons. The advice from the committee to consolidate existing areas before introducing new areas will be followed and actions will be taken already in 2010. In particular, the BioMEMS area will be strengthened with a full time professor to take responsibility for the area from August 2010 (Professor Frank Karlsen), in addition to two new academic positions with BioMEMS and biotechnology background.

3. There is a need to maintain, intensify and expand the ties to other Norwegian universities as well as European and other international academic partners. This is particularly true if the lab-on-a-chip efforts are to be raised to an internationally competitive level.

VUC will maintain, intensify and expand ties to other Norwegian universities and international partners, not only through the national graduate school with the partner groups at NTNU, UiO and SINTEF, but also to related academic research groups in areas such as semiconductor physics, optics, material science, medicine, biotechnology, ICT and ASIC, ultrasound imaging and maritime technology as well as to international research groups working in the same area. Special attention will be given to establish good working relations with academic institutions with related activities for the BioMEMS area, both in Norway/Scandinavia and internationally.

4. VUC is advised to increase its participation in formal collaborations and exchange programs on the European level and at the same time intensify and expand the current collaborations.

The strategy of having co-supervisors from other universities or from industry will be an important part of the program. Participation in formal European cooperation projects and other international collaborations will have high priority and research projects by the PhD candidates will be an integral and natural part of the VUC participations in such projects. The academic staff at VUC will continue to build on the existing network for future co-supervisors.

5. The committee recommends that no more additional courses are offered unless other courses are discontinued or merged. Moreover, it should be avoided to offer too many different courses while the number of expected or anticipated students in the program is limited.

VUC will follow the committee's recommendation on not offering any additional courses. Currently, as a member of the National research school, several PhD courses are offered by the partners, and efforts will be put forth to increase and strengthen the academic level of existing PhD courses in collaboration with the research school participants.

6. The committee strongly recommends the management of VUC to impose a strategy allowing good young associate professors to focus on research and publications, thereby building a stronger and more viable base for the future. Such a strategy would, within a number of years, create a good margin to the requirement that 50% of the person-years assigned to the PhD program should be covered by full professors. Furthermore, the committee recommends the management of VUC to support their researchers in negotiations with industry regarding IPR, for instance by providing a standard agreement template that is conceptually agreed with industry.

VUC has already imposed a strategy to allow good young scientists to focus on research and publications to build a stronger academic base for the PhD and the master program. This is part of the yearly time planning process. The management will not only support the researchers by using a standard agreement with industry regarding IPR, but will also take an active role in the negotiations to find good "win-win" relations.

The recommendation by the committee to publish in more well reputed journals and conferences is well in line with the management intentions and requirements from UHR as well as the researchers own plans, and will be followed.

The strong recommendation by the committee to impose a strategy making it possible for well merited associate professors to continue to focus on research and publications to ensure the possibility to merit themselves for full professorships is highly appreciated and well in line with VUC's strategy and long-term plans. Both the management and the experienced professors will be supporting the associate professors in their work to define and finance their own research projects and hours for this purpose will be given high priority in the yearly planning process.

The Board at Vestfold University College provided additional grant of 2 million NOK to the strategic development of the Ph.D. program in applied micro- and nano systems for 2010 (at their meeting 18.12.2009). The grant can be used both for development of the program and to impose a strategy allowing good young associate professors to focus on research and publications and thereby build a stronger base for the future. In addition, the Vestfold County Council allocated 10 million NOK as a university fund for Vestfold University College for use in the period 2009 to 2012. 3.5 million NOK will be dedicated to enhance the competence of the faculty. The funds are not yet distributed. The Report of the expert committee will strengthen the application from the faculty for these funds.

7. The committee would like to stress that VUC imposes a strategy to bring the research activities together in a fewer broad research areas with critical mass.

The recommendation from the committee of imposing a strategy to bring the research activities together in fewer, but broader research areas with critical mass will be followed and in place before the PhD program is being officially started.

8. The committee recommends that the strategy for improving the bio(chemical) laboratory should be clarified and that the laboratory leadership should include skilled biotechnicians.

The recommendation to improve the bio(chemical) laboratory will be followed. Adequate equipment, leadership of laboratory with skilled biotechnicians will have high priority as an integral part of developing the BioMEMS area in whole. In particular, a new dedicated BioMEMS lab and research area is planned adjacent to the new clean-room in the FIN-senter (Forskning, Innovasjon og Næringscenter), to be constructed in 2010.

9. The committee wishes to express that the technicians seem not to be involved in the research projects; this is a situation that might be worth reflecting on further since it might serve as an additional motivation or viewed as an extra advantage.

The limited involvement of experienced laboratory staff and technicians in research projects is correctly commented by the committee. The involvement will increase when more and more practical work will be done in the laboratories and the organization of the research teams are strengthened. Current, and future, research projects will incorporate laboratory staff into the planned research activities at an early stage.

10. Finally, the committee recommends an additional long term view be taken with respect to the education, support, and development of the supervisor role and recognition of the supervisors as a professional position, and emphasize on a strategy for further professional development and support for supervisors to further enhance the quality of the PhD program.

The recommendations by the committee are highly appreciated and to the point. Competence development regarding the role of supervision will be given priority and discussed at the monthly meetings where all researchers are present and where experiences can be shared. A specific workshop on this issue will be organized. The researchers will also seek guidance and use experience through cooperation and partnership programs with more experienced academic groups. In particular, it is expected that the National Research School will provide an excellent framework for further cooperation and co-advising of PhD students with the participating universities.