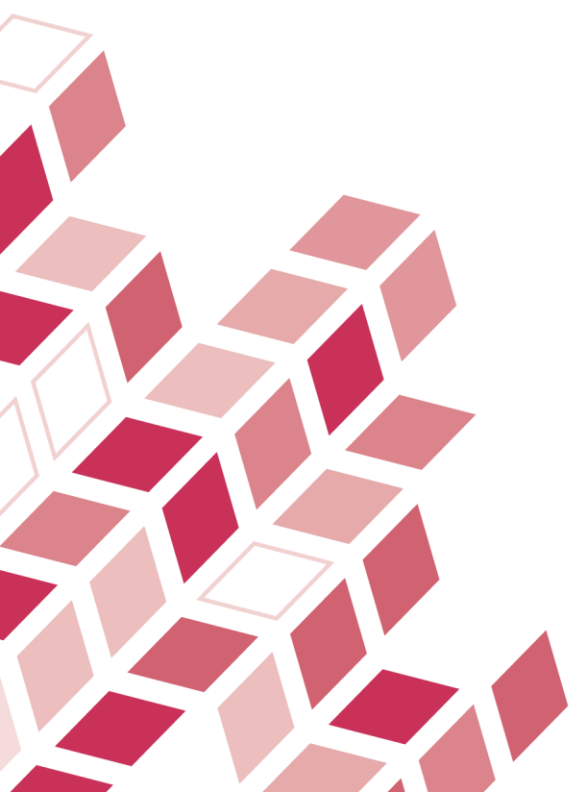# PhD in Computer Science

Ph.d.-studium ved Høgskolen i Gjøvik

Juni 2012

Institusjon:	Høgskolen i Gjøvik
Studietilbud:	Computer Science
Grad/Studiepoeng:	Ph.d.-studium, 180 studiepoeng
Dato for vedtak:	12.06.2012
Sakkyndige:	Professor Knut Conradsen (leder), Danmarks Tekniske Universitet
	Professor Frode Eika Sandnes, Høgskolen i Oslo og Akershus
	Professor David Sands, Chalmers
	Ph.d.-stipendiat Jacob Schack Vestergaard, Danmarks Tekniske Universitet
Saksnummer:	11/366

Forord

NOKUTs tilsyn med norsk høyere utdanning omfatter evaluering av institusjonenes interne system for kvalitetssikring av studier, akkreditering av nye, og tilsyn med etablerte studier. Universiteter og høyskoler har ulike fullmakter til å opprette studietilbud. Dersom en institusjon ønsker å opprette et studietilbud utenfor sitt fullmaktsområde, må den søke NOKUT om dette.

Herved fremlegges rapport vedrørende søknad om akkreditering av ph.d. i Computer Science ved Høgskolen i Gjøvik. Vurderingen som er nedfelt i tilsynsrapporten, er igangsatt på bakgrunn av søknad fra Høgskolen i Gjøvik. Denne rapporten viser den omfattende vurderingen som er gjort for å sikre utdanningskvaliteten i det planlagte studiet.

NOKUTs konklusjon er at det omsøkte ph.d.-studiet i Computer Science ved Høgskolen i Gjøvik tilfredsstiller kravene i Forskrift om tilsyn med utdanningskvaliteten i høyere utdanning. Studiet blir dermed akkreditert.

Vedtaket er ikke tidsbegrenset. NOKUT vil imidlertid følge opp studietilbudet gjennom et oppfølgende tilsyn etter 3 år.

Oslo, 12. juni 2012

Terje Mørland
direktør

Alle NOKUTs vurderinger er offentlige og denne samt tilsvarende tilsynsrapporter vil være elektronisk tilgjengelige på nettsidene våre: www.nokut.no/NOKUTs-publikasjoner

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Innhold

1 Informasjon om søkerinstitusjonen

Høgskolen i Gjøvik ble etablert i 1994 som en følge av den nasjonale omorganiseringa av høyere utdanning. De tidligere profesjonshøgskolene Gjøvik ingeniørhøgskole og Sykepleierhøgskolen i Oppland ble slått sammen til en høgskole.

Høgskolen i Gjøvik har i overkant av 2700 studenter og 290 tilsette og er lokalisert på Kallerud på Gjøvik.

Siden opprettelsen av NOKUT har høyskolen fått følgende studier akkreditert (*i kronologisk rekkefølge etter årstall*):

- Mastergradsstudium i Sustainable Manufacturing, 2012
- Mastergradsstudium i Gerontologi, 2010.
- Ph.d.-studium i Information Security, 2008.
- Mastergradsstudium i Klinisk sykepleie, 2007.
- Mastergradsstudium i Brukersentrert mediedesign, 2005.
- Mastergradsstudium i Applied computer science, 2005.
- Mastergradsstudium i Teknologi (sivilingeniør) – medieteknikk, 2005
- Mastergradsstudium i Helsefremmende arbeid og omsorg i lokalsamfunnet, 2005.
- Mastergradsstudium i Informasjonssikkerhet, 2004.

Som akkreditert høgskole, har ikke Høgskolen i Gjøvik selvakkrediteringsfullmakt for studier i verken andre eller tredje syklus. Høgskolen har akkrediteringsfullmakt for studier i andre syklus for områder hvor høgskolen har akkreditert ph.d.-studium. Høyskolens interne system for kvalitetssikring ble godkjent i 2009.

Høgskolen i Gjøvik søkte til fristen 15. september 2011 om akkreditering av ph.d.-studiet i Computer Science.

Høgskolens omtale av studiet og begrunnelse for søknaden

Søknaden er utarbeidet med bakgrunn i at Høgskolen i Gjøvik allerede har akkreditert et ph.d.-studium i Informasjonssikkerhet (2008). Høgskolen ønsker nå å gi et bredere tilbud til sine phd-studenter og søker om akkreditering av phd-studium i Computer Science. Programmet er i følge søknaden tiltenkt "anchored in the mainstream of what is internationally considered Computer Science in terms of breadth and scope.". Det opprinnelige programmet har hatt fokus på informasjonssikkerhet og det nye programmets profil er og skal utbygges med større fokus på i tillegg bl.a.: biometrics, digital forensics, Colour science and imaging, artificial intellegence. Programmet har med denne profilen et godt grunnlag for interdisiplinære forbindelser mellom forskjellige områder innen Computer Science.

Høgskolen har en studieportefølje og et fagmiljø som dekker et bredere område enn informasjonssikkerhet. Informatikk er et bredt fagområde, og vil kunne dekke deler av aktivitetene på avdeling for helse, omsorg og sykepleie og Avdeling for teknologi, økonomi og ledelse. Høgskolen mener et bredere studium vil styrke doktorgradsutdanningen og også styrke planene om fremtidig samarbeid med andre læresteder. Det vil også gi større fleksibilitet og gi bedre forhandlingskort ved inngåelse av avtaler med utenlandske læresteder om samarbeid.

Studiet er utviklet ved avdeling for informatikk og medieteknikk ved høgskolen.

2   Beskrivelse av saksgang

NOKUT gjør en innledende vurdering for å avklare om grunnleggende forutsetninger for akkreditering er tilfredsstillende imøtekommet slik disse gjengis i NOKUTs tilsynsforskrift [1], samt de formelle kravene til søknaden slik dette fremkommer i våre søkerhåndbøker. For søknader som går videre, oppnevner NOKUT en sakkyndig komite til å foreta faglig vurdering av søknaden. Komitemedlemmene må erklære seg habile og utfører oppdraget i samsvar med mandat for sakkyndig vurdering vedtatt av NOKUTs styre, og opp imot krav til utdanningskvalitet slik disse er fastsatt i tilsynsforskriften.

Den faglige vurderingen inkluderer et institusjonsbesøk hvor følgende grupper intervjues; høgskolens ledelse, masterstudenter, ph.d-studenter/stipendiater, faglig ledelse, fagmiljøet, administrativ ledelse og eventuelt avtakere/arbeidsgivere. Det gjøres også en besiktigelse av infrastruktur. På bakgrunn av både den skriftlige dokumentasjonen og informasjon fremkommet under intervjuene skal de sakkyndige konkludere med et tydelig ja eller nei på om utdanningskvaliteten samsvarer med kravene i tilsynsforskriften. De sakkyndige blir også bedt om å gi råd om videre utvikling av studiet. Alle kriteriene må være tilfredsstillende imøtekommet for at NOKUT skal vedta akkreditering.

Dersom et eller flere av kriteriene underkjennes av de sakkyndige, sendes den faglige vurderingen til søkerinstitusjonen som får tre uker til å kommentere denne. NOKUT avgjør deretter om institusjonens kommentarer skal sendes de sakkyndige for tilleggsvurdering. De sakkyndige får to uker på å avgi tilleggsvurdering. NOKUTs styre fatter deretter vedtak.

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[1] http://www.lovdata.no/cgi-wift/ldles?doc=/sf/sf/sf-20110127-0297.html

3 Innledende vurdering

Tilsynsforskriften § 4-1 Grunnleggende forutsetninger for akkreditering

1. Følgende krav i lov om universiteter og høyskoler skal vurderes for akkreditering:

    a. Reglement og styringsordning
    b. Klagenemnd
    c. Læringsmiljøutvalg
    d. Utdanningsplan
    e. Vitnemål og Diploma Supplement
    f. Kvalitetssikringssystem

NOKUTs vurdering:

Høgskolen i Gjøvik tilbyr akkrediterte studier. Det forutsettes derfor at krav i lov om universiteter og høyskoler er tilfredsstillende ivaretatt. Diploma Supplement er vurdert som tilfredsstillende. NOKUT har vurdert at søknaden er fremstilt slik at den er tilfredsstillende for sakkyndig vurdering.

4 Expert assessment

Summary

On 1st September 2011 Gjøvik University College (GUC) issued an application to NOKUT for accreditation of a PhD programme in computer science. As a part of the accreditation procedure NOKUT relies on an assessment by independent experts, and by January 2012 NOKUT had appointed the present committee. This report describes the findings of the committee regarding GUC's application. The observations of the committee are only briefly summarized here; full details are to be found in the report. The overall conclusion and recommendations are, however, given in extenso.

The conclusion is based on observations with respect to 1) the *basic conditions for accreditation*, to 2) the *study plan*, to 3) *staff composition and qualifications*, and to 4) the *support functions and the infra-structure*. There is a strong interdependence between the different items, which has been taken into account when reaching the general conclusion. Furthermore, some requirements may be assessed in a fairly objective way; others involve balancing different aspects of the matter considered. A few of those more 'subjective' observations are emphasized below.

A crucial *basic condition* for running a PhD programme is having a sufficiently robust PhD student body. The committee finds that it in several ways – convincing track record for existing programme, staff dedication, stakeholder interviews, and labour market assessments - is made probable that GUC has the capacity and the recruitment potential to establish a PhD student body of the required 15 students or more and to maintain such a body in the foreseeable future.

The scope and relevance of the *study plan* with respect to providing the candidates with competencies that are in demand in private and public industry were strongly enhanced by stakeholder interviews.

A sine qua non for a PhD programme is that it is rooted in a strong research environment, which boils down to a question on *staff composition and qualifications.* At GUC there is ample evidence of high quality international research activity at sufficient thematic breadth. This is visible in the range of international publications with some good citation impact across most of the faculty and not limited to just the top handful of researchers, and in the extensive industrial and academic collaborations that have led to joint publications across a broad variety of thematic areas of computer science. The committee finds that it is appropriate for GUC to *not* specifically target level II publications at the expense of their core conferences and journals, especially during the build-up phase of the programme.

The committee finds the s*upport functions and infrastructure* adequate for supporting the study.

In conclusion, the committee finds that the quality of GUC's application for a PhD programme in computer science complies with the expected level according to the requirements in the Regulation on NOKUT's Supervision. **Therefore the committee recommends that the PhD programme in Computer Science at Gjøvik University College is accredited by NOKUT.**

In reaching this conclusion it has obviously played a role that the application under consideration is an extension of an already running PhD programme that - despite its young age - is remarkably successful. This - combined with the strong dedication of the staff and the unanimous support of the stakeholders - has **added credibility to the application and to assessments offered by staff and PhD students** at GUC during the site visit.

It is also important to have in mind that a new programme at - or doctoral candidates from - an institution without a longer track record in offering doctorates may face some scepticism and find 'market' penetration cumbersome. In order to strengthen the programme and at the same time give it a head start, the committee finds it advisable to avoid possible ambiguities and/or lack of specifications in the written material and the proposed operations. ***Therefore - in order to clarify or streamline these possible ambiguities and/or lack of specifications - the committee has some recommendations that should be seen as suggestions, not indispensable conditions.***

Thus, the committee **strongly recommends** that:
- I.   GUC requires an external majority in the PhD evaluation committee.
- II.   GUC is more specific about an innovation and commercialisation strategy in connection with the PhD-education.
- III. GUC is more precise, exhaustive, and uniform with respect to course descriptions generally and with respect to prerequisites and evaluations specifically.
- IV.   Core courses in computer science are at a PhD-level. Students lacking basic knowledge in computer science should take the necessary supporting courses in addition to the core curriculum in the PhD programme.

Furthermore GUC **is advised to**
- V.   Require that a unanimous recommendation from the PhD evaluation committee must be followed unless official regulations are violated.

VI.   Extend its recruitment base by putting larger emphasis on Industrial PhDs and on graduates from GUC's own master's programs, also by considering the interaction between master's and PhD levels programmes.

VII.   Align the description of the learning outcomes with the official translation: Norwegian Qualifications Framework, Levels and Learning Outcome Description, approved by the Ministry of Education and Research 1. February 2012 (well after the application was submitted)

VIII.   Reduce the number of courses and update the teaching materials regularly.

IX.   Rephrase learning outcomes at course level in skills, knowledge, and general competencies. Some of those descriptions are less complete in the current version.

X.   Identify the publication venues which the faculty themselves believe to have the highest international impact, and strive to publish at these important and influential venues, possibly at the expense of producing few publications in total.

Finally the committee

XI.   Supports the intention of GUC to use an internal teacher in the role of an external examiner across all courses.

1.1 Basic conditions for accreditation

1.1.1 Demands expressed in the Universities and Colleges Act

1.1.1 a) Regulations and Management Scheme

The demands expressed in the Universities and Colleges Act, have been evaluated by NOKUT in the preliminary assessment. However, the committee has some further remarks on the internal PhD regulations.

The regulations for the PhD programme have been approved by the board of GUC and are included in the application. The regulations resemble those in use by other universities in Norway. The regulations are accompanied by the guidelines and the contract for PhD-students which may be found in the appendices to the application.

The committee finds that the regulations adequately describe the conditions for operating a PhD programme. However the committee has a few recommendations to the regulations that the university college should consider.

In *§9 Appointment of Evaluation Committee* it is stated that at least one of the committee members must have no affiliation to Gjøvik University College. In order to ensure a high international level over time, the committee strongly recommends that the paragraph is changed so that that there must be an external majority in the committee.

Secondly, it is stated in Section 10.5 that the head of the faculty may approve a recommendation when it unanimously concludes that the candidate is allowed to present (defend) the thesis. It is difficult to see on what grounds the head of the faculty should overrule such a unanimous recommendation from the evaluation committee provided that the committee has taken all legal requirements into accounts. Therefore the committee recommends a rephrasing: The head of the faculty must approve …etc., unless (state what kinds of negligence could justify a rejection).

The wording in *§12 Conferral of Degree and Diploma* should be clarified.

1.1.1 e) Diploma and Diploma Supplement

GUC describes a Diploma and Diploma Supplement that presents relevant information with a clear structure. The information is gathered from FS (Felles Studentsystem) that GUC uses for maintaining all their student records.

Conclusion
The committee finds that the PhD regulations and the Diploma and Diploma Supplement adequately describe the conditions for operating a PhD programme.

GUC is strongly advised to:

1. Require an external majority in the evaluation committee.

and furthermore the committee recommends that institution:
2. Require that a unanimous recommendation from the evaluation committee must be followed unless official regulations are violated.

1.1.2 Demands expressed in national curriculum frameworks and in relevant Regulations issued by the Ministry of Education and Research must be met

Assessment

With respect to *staffing numbers*, the minimum requirement according to the ministry's regulations is 8 man-years, of which 6 shall be fulltime positions and at least 4 man-years are given by professors. It follows from the application that the staff numbers committed to the programme encompasses 7 professors and 7 associate professors. Of those, 12 have a full time, permanent contract and two a part time, permanent contract. The time committed to the present programme is planned to be 4.8 FTE at a professorial level and 4.3 FTE at the level of associate professor. Thus, irrespective of whether one does a head count or looks at the FTE committed to the programme, 50% or more of the allocated staff are professors. [1]

Questions regarding staff size and qualifications are further addressed in Section 1.3

The committee would like to point out to NOKUT that it might be beneficial for a PhD programme to be able to include more junior or less experienced staff at the level of associated professor without having to increase the number of professors involved beyond 4 FTE.

With respect to the *PhD student body*, the ministerial regulations require that the institutions can document a *capacity and recruitment potential* to establish a PhD programme with at least 15 PhD-students in the programme during a 5 year period. Furthermore the institution must also make it probable that it over a *longer period* can sustain a PhD group of students with at least 15 members

GUC has emphasized that presently 21 PhD students are supervised at GUC, 13 under the faculty's own programme in information security, and 8 supervised at GUC but formally affiliated with other institutions, notably the Computer Science department at the University of Oslo. To this should be added that since submission of the application, 4 PhD candidates have graduated, 2 from the information security programme of GUC and 2 affiliated with other institutions. Under a computer science programme, all of the above students would have been enrolled at GUC, and thus the requirement of a PhD student body of at least 15 would be fulfilled from the start. What is more, GUC is aiming for over 30 PhD students. Finally it should be mentioned that only 10% of the existing PhD students are recruited internally (from GUC's own master's programme). So here there is also a potential for growth.

On the subject of recruitment, it should be emphasized that GUC has had many applicants for the PhD positions announced. On the average there has been close to 25 applicants per announced PhD position

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[1] After the application deadline GUC provided supplementary information regarding additional, recent recruitments by IMT at GUC. This means an increase in the number of professors by two, which allows for affiliating more junior staff and thus increase the planned

in the last six months (where 14 positions were announced). The students are recruited nationally and internationally. This indicates that the research environment of GUC is fairly well established internationally, and there seem to be no reasons for believing that this should change for the worse in the coming years. Also one could point out that the international job market for candidates graduated from GUC very likely will increase in the years to come. The national interest in employing candidates from GUC was strongly emphasized at the interview with stakeholders. They also expressed a great interest in enrolling some of their present employees in a PhD programme.

The present body of PhD students is financed from the Ministry of Higher Education and Research (5 stipends), from competitive grants (5), from other external sources (6), self-funded (2), and from GUC (3). This seems to be a fairly robust portfolio, and considering the topic and the activities at GUC, there are no reasons to believe that the external funding cannot continue at least at a similar level in the foreseeable future. Furthermore, the management of GUC confirmed their commitment to the planned PhD programme in Computer Science, and that the University College was prepared to allocate the necessary additional funding to maintain a satisfactory level of activities if necessary.

To the above remarks on recruitment potential and possible sources of financing the committee point out that the suggested programme is well suited for the Norwegian Industrial PhD programme. Initiatives in this direction would therefore be useful, also from the stakeholders' point of view, as a method to improve the robustness of the programme.

Conclusion
With respect to the staffing numbers, the minimal requirements in the ministerial regulations are obviously fulfilled. Furthermore, the committee finds that GUC in several ways has made it probable that the institution has the capacity and the recruitment potential to establish a PhD student body of at least 15 students and to maintain such a body in the foreseeable future.

The institution is recommended to:
1. Extend its recruitment base by putting larger emphasis on Industrial PhDs and on graduates from GUC's own master's programs.

1.1.3 Estimates of student recruitment, as relevant in relation to the establishing of a satisfactory learning environment and stable provision, must be presented.

Assessment
The assessment is done under 1.1.2.

Conclusion
See under 1.1.2

1.1.4 A plan of the students' expected workload must be presented

Assessment
Not applicable

Conclusion

Not applicable

1.1.5 When part(s) of the provision is taught outside the degree awarding institution formally agreed documents must be in place to regulate issues of importance for the students.

Assessment

No part of the planned Ph.D. programme requires the participation of an external institution.

Conclusion

GUC fulfils the requirement.

1.1.6 Overall conclusion for Section 1.1, Basic conditions for accreditation

The basic conditions for accreditation as they are expressed in the Universities and Colleges Act, in the national curriculum frameworks, and in the relevant regulations issued by the Ministry of Education and Research, are clearly met.

More specifically, the committee finds that

1. the PhD regulations and the Diploma and Diploma Supplement adequately describe the conditions for operating a PhD programme.

2. the minimal requirements with respect to staffing numbers in the ministerial regulations are obviously fulfilled

and with respect to having a sufficient student body, the committee furthermore finds that GUC:

3. in several ways has made it probable that the institution has the capacity and the recruitment potential to establish a PhD student body of at least 15 students and to maintain such a body in the foreseeable future.

The committee strongly recommends that GUC:

    I.   Requires an external majority in the PhD evaluation committee.

Furthermore the institution is advised to:

    II.   Require that a unanimous recommendation from the PhD evaluation committee must be followed unless official regulations are violated.

    III.   Extend its recruitment base by putting larger emphasis on Industrial PhDs and on graduates from GUC's own master's programs

1.2 Study Plan

1.2.1 The educational provision must have an adequate title

Assessment

GUC has made a careful and convincing analysis of the field of study following ACM (Association for Computing Machinery) and IEEE (IEEE: Institute of Electrical and Electronics Engineers) curricula in Computer Science and in Information Technology. The key documents quoted are "*Computer Science Curriculum 2008. An Interim Revision of CS 2001. Report from the Interim Review Task Force. Includes Update of the CS 2001 Body of Knowledge plus Commentary*", compiled by a joint task force of the ACM and the IEEE Computer Society, and to a lesser extent the same body's Information Technology (IT) Curriculum 2008. ACM and IEEE Computer Society are considered to be authoritative sources when it comes to establishing the framework for topics in computer science.

GUC is arguing that their research tends to be directed towards the development and evaluation of new algorithms and models, and towards the investigation of fundamental aspects of the research fields with a clear specialization in security, image, and colour technology. Following the ACM/IEEE curricula, CS (computer science) is characterized by emphasizing theory, principles, and innovation whereas IT (information technology) is focussing on application, deployment, and configuration, although there is a considerable overlap between the areas.

Based on considerations along those lines, GUC has concluded that the programme covers well-recognised core areas of computer science, and thus the name of the programme is
- *Philosophiae Doctor in Computer Science*

The committee agrees with GUC in the institutions characterization of their activities and can therefore fully support the suggested title.

Conclusion

The committee finds that the title "PhD in Computer Science" is adequate and appropriate for the combined current and planned programme.

1.2.2 The provision must be described with reference to learning outcomes

1.2.2 a) **Learning outcomes must be expressed in terms of a candidate's intended achievements in knowledge, skills and general competence, as related to the National Qualifications Frameworks.**

Assessment

GUC's description of the learning outcomes that must be achieved upon completion of the study programme is grouped into three categories in accordance with the national qualification framework: Knowledge, Skills, and General Competence. In this description GUC has provided three summarizing tables that give a good overview of the planned activities and expected results

Completion Skills / Curriculum expected learning outcomes			Thesis	Oral Defense	Supervisor relationship	Peer-reviewed publications / conferences	IMT6001 Research Ethics	IMT6221 Research Methodology	Mandatory IMT6XX1 courses	Optional IMT6XX1 courses
Knowledge	K1	Knowledge of the most advanced research in the candidate's specialisation area of Computer Science.	excellent		some	good			some	good
	K2	Strong understanding of academic theory and the preparation of high-quality research.	good		good		good	good		some
	K3	Ability to select appropriate research methods and sampling techniques for the candidate's research field.	excellent		good			some	some	good
	K4	Understanding the current state-of-the-art and applying knowledge to the development of new knowledge, theories and presentation of research in Computer Science.	good		good	excellent				good

Contribution to outcomes from the courses and coverage of relevant learning outcomes: ● some ●● good ⦙excellent

Table 1: Matrix summarizing the contributions from elements of the study programme to knowledge outcomes.

Completion Skills / Curriculum expected learning outcomes			Thesis	Oral Defense	Supervisor relationship	Peer-reviewed publications / conferences	IMT6001 Research Ethics	IMT6221 Research Methodology	Mandatory IMT6XX1 courses	Optional IMT6XX1 courses
Skills	S1	Ability to provide management and planning of research projects in Computer Science in Academic and Industrial environments.	excellent		good			excellent	some	good
	S2	Ability to support and participate in Industrial and Academic research projects at a high international level.	excellent			excellent		good		
	S3	Ability to comprehend complex academic issues and the related ethical considerations.	excellent		good		some	good	some	good
	S4	Ability to understand and challenge the existing knowledge and practise in Computer Science.	excellent			excellent				good

Contribution to outcomes from the courses and coverage of relevant learning outcomes: ● some ●● good ⦙excellent

Table 2: Matrix summarizing the contributions from elements of the study programme to skills outcomes.

Completion Skills / Curriculum expected learning outcomes			Thesis	Oral Defense	Supervisor relationship	Peer-reviewed publications / conferences	IMT6001 Research Ethics	IMT6221 Research Methodology	Mandatory IMT6XX1 courses	Optional IMT6XX1 courses
General competence	G1	Ability to identify new problems arising from recent developments in Computer Science and assess their impact on society.	●●		●●	●●		●●		
	G2	Ability to conduct ethical, scientifically sound research in areas of Computer Science at the boundaries of existing laws and accepted limits.	●●		●●		●●●			
	G3	Ability to manage interdisciplinary projects with diverse groups of individuals to bring results in Computer Science to fruition.	●			●●	●●●	●●		●●
	G4	Ability to organise and participate in research and development through established national and international research frameworks.	●●		●	●●●				
	G5	Ability to argue the merits, limitations, and possibilities of new developments in Computer Science in recognised international forums.	●●●	●●●		●●●		●●		
	G6	Capability of applying latest abstract research within Computer Science to specific real-world problems in creative and innovative ways.	●●		●●	●		●	●	●●

Contribution to outcomes from the courses and coverage of relevant learning outcomes: ● some ●● good ●●● excellent

Table 3: Matrix summarizing the contributions from elements of the study programme to general competencies knowledge outcomes.

The wording of the learning outcomes is somewhat divergent with the phrasing used by the Ministry of Education and Research. The committee assume that it is due to the fact that the English translation of the national qualification framework was published after the accreditation application was submitted. This is particularly evident for the general competences. For the learning outcome related to innovation, GUC writes "capability of applying latest abstract research within Computer Science to specific real-world problems in creative and innovative ways" while the national qualification uses a more active form, namely "can assess the need for, initiate and practice innovation". According to GUCs assessment documented in the learning outcome matrix innovation is only covered with a maximum rating of "good" and not "excellent". Given the nature of computer science as a topic there is no reason why this should not be "excellent" and the interviews revealed active efforts at strengthening innovation at GUC.

The learning objective related to publishing research results, namely "can communicate research and development work through recognized Norwegian and international channels" in the national qualification framework is not explicitly stated. The accreditation application in general, as well as the interviews, revealed a culture in which PhD-students actively publish their work in international channels, and the committee is thus convinced that this important learning objective is satisfied. However, it would be useful to explicitly state this learning outcome.

The learning objective "can manage complex interdisciplinary assignments and projects" in the national qualification project, according to GUCs self-assessment, only achieves a score of "good". Interdisciplinary research is a common characteristic of computer science and GUC should develop the PhD-programme so that the score will be "excellent". The environment and potential for achieving this goal should be good. Similar arguments apply to the learning objective "ability to identify new relevant ethical issues and carry out his/her research with scholarly integrity".

Regarding learning objectives related to knowledge, the accreditation application states that "knowledge of the most advanced research in the candidate's specialisation area of Computer Science" while the national qualification framework specifies that "is in the forefront of knowledge within his/her academic field ...". The word "advanced" is found in the second cycle (masters level) in the national qualification framework where it states "has advanced knowledge within the academic field ...".

The learning outcomes in terms of knowledge, skills, and general competences are only specified at programme level and not at course level. It is therefore hard to assess which knowledge, skills and general knowledge the students are to acquire after having completed the individual courses, as well as how they relate to the overall programme, and how they relate to courses at masters level. However, the interviews revealed that work is underway to introduce learning outcomes specified in terms of knowledge, skills, and general competences at course levels.

Conclusion

The committee finds – based on the written documentation and the additional information provided at the interviews at the site visit - that the learning outcomes are satisfactorily described with respect to skills, knowledge, and general competencies.

The institution is recommended to:
1. Align the description of the learning outcomes with the official translation: Norwegian Qualifications Framework, Levels and learning outcome description, approved by the Ministry of Education and Research 1. February 2012 (well after the application was submitted)
2. Rephrase learning outcomes at course level in skills, knowledge, and general competencies. Some of those descriptions are less complete in the current version.

Furthermore GUC is strongly recommended to:
3. Be more specific about an innovation and commercialisation strategy in connection with the PhD-education.

1.2.2 b) The provision's relevance for working life and/or continued studies must be clearly expressed.

Assessment

The demand for highly qualified computer scientists in Norway is high. The portfolio of courses cover a broad range of topics that are well established internationally in computer science and these are almost per convention considered relevant. Furthermore the topics for the research work leading to the PhD thesis are likewise very relevant for industry and external stakeholders. And it must be

emphasized that the suggested programme is relatively unique covering a niche where candidates are high in demand but also where such comprehensive and focussed programmes are not that common. Therefore the candidates will most likely be able to find 'relevant' employment in private and public industry. Here the committee would also like to draw attention to the relevance of the Norwegian Industrial PhD programme. The interviews with major stakeholders from private and public industry substantiated this line of argument.

Many of the existing PhD students that were interviewed had a clear ambition to continue in academia, and looking at their track records it again seems likely that several of those will be successful in that endeavour.

At this point the committee found it noteworthy that the organization of the PhD programme was done with very little consideration for interaction with the study programmes at master's (and bachelor's) level. To put it figuratively, the different programs at the bachelor's, master's, and PhD levels seem to be organized horizontally rather than vertically. It is, however, a common experience that a programme at say the master's level may benefit tremendously from being considered a recruitment base for a subsequent PhD programme if taught accordingly. This may yield a positive feedback to the PhD programme when recruiting (some) internal master's students for the PhD study. The interviews revealed that there are some minor initiatives in that direction given that the PhD students present project proposals to the master's students.

The committee suggests that GUC investigates the possibilities for organizing the computer science curricula in such a way that interaction between the different levels of study is encouraged.

Conclusion

The committee found it credible that the programme would provide the candidates with competencies that are in demand in private and public industry, and that the programme will qualify for further studies, e.g. by pursuing a research career. The site visit reinforced the points made in the application.

The institution is advised to:
1. Pursue the idea of promoting industrial PhDs, cf. Section 1.1.2.
2. Also consider further strengthening the interaction between the master's and PhD programs.

1.2.2 c) Content and design of the provision must be satisfactorily related to the description of learning outcomes.

Assessment

The PhD thesis itself is a core element of a PhD project and in many ways the most tangible outcome of the project. Furthermore, it is generally considered

"a proof of independent research performance and competence of the doctoral candidate. The main quality requirement for any thesis is that it should produce a new insight or knowledge – an innovation in the field, a new scientific method or an application of a known method to a new field. The thesis should present an original piece of research work and place it in the context of the theoretical knowledge and the literature in the field. (*Doctoral Programmes for the European Knowledge Society.* Report on the EUA Doctoral Programmes Project 2004-2005).

Therefore the organization of the PhD project and the work done during the course of study will to a large extent be prescribed by consideration for the thesis, and thus the learning outcomes related to preparing and writing the thesis may to a large extent also be attributed to the other elements in study programme. The - direct and indirect – learning outcomes from the thesis work are summarized by GUC in Tables 1-3 above. The expected result within Knowledge and Skills are noted as "excellent" and within General Competences generally as "good". In continuation of the above, the committee finds the fulfillment of these learning outcomes through thesis work very likely.

There are some further comments on the level of the courses. For instance it is not always clear what the specific assumptions on mathematical background are. The committee finds it important to emphasize that many of the disciplines taught require a rather advanced mathematical background. This should be clear in the course descriptions.

The level of the following courses is hard to determine from the course descriptions due to a lack of learning objectives in terms of knowledge, skills and general competences and also due to no explicit prerequisites: Artificial Intelligence, Serious Games, Mobile Technology, Computer Graphics, Parallel Programming, Selected topics in web-based systems, Selected topics in Database Systems and Algorithm design and analysis.

The scope and coherence of the course portfolio is certainly satisfactory within the given context. The programme is aiming at rather specific areas of application, which is reflected in the course portfolio. At the same time, this course portfolio reflects the research strengths of the academic staff. An institution of the size of GUC cannot offer in depth courses in all areas. Such courses must be taken at other institutions or at national or international summer (or winter) schools or other such as the European Graduate School of Technology where GUC is a partner. The committee noted that there is a very positive attitude in management and amongst staff with respect to support students in participating in such activities. The PhD students interviewed found the administration of granting travel money efficient and the attitude generous. Furthermore the committee noted that each student has a general grant of 75,000 kr. for miscellaneous costs occurring during the course of study.

Thus, the programme design (courses) is well suited for reaching the proposed learning outcomes. But as mentioned in the above there is a lack of homogeneity in the course descriptions. The committee finds that the programme would benefit from improved course descriptions and will therefore recommend that GUC starts working on this.

An interesting blend of different courses from several disciplines in (applied) computer science is being offered, and these fulfil the needs of the niche defined by the security and media technology areas. But of course seen from a general computer science point of view we are talking about a relatively narrow selection of topics. The suggested PhD programme is obviously designed having the needs of the primary stakeholders in mind, and this is naturally also reflected in the course portfolio.

Several courses are not on a PhD-level. That is acceptable in an applied programme like this where many students not familiar with say biometry or forensics need some introductory courses in these areas. Of course the number of such courses that are permitted in a study plan should, as is also the case, be limited, and the appropriate level (master/bachelor) indicated in the course description. However, it should not be permitted to have master's level courses in basic computer science

disciplines. If deemed to be necessary prerequisites for a PhD student with a background in, for example, economics, it is the committee's recommendation that such courses be taken in addition to the credit giving activities.

Some of the literature listed under teaching materials in a majority of the courses appears a bit old to represent the forefront of knowledge. Many of the articles are more than 5 years old. Especially with course names such as "Modern Cryptology" one expects the literature to be recent. Some of the courses have no teaching materials listed. It is important that it is possible to read from the course descriptions how the teaching materials support the learning outcomes.

The course "Risk Analysis II" appears before the course "Risk Analysis I". A naming of these courses with descriptions of the content rather than numbering would help better communicate the content of these courses to prospective students. Moreover, from the name alone it is hard to distinguish the contents of the course "Introduction to information security" compared to the course "Foundations of information security".

In the course "Ethics and Legal Aspects of Scientific Research" GUC could consider addressing topics such as national data protection issues and issues related to data collection involving people (Norwegian Social Science Data Services, NSD), the Vancouver convention, etc.

Conclusion

The committee finds that the programme's content and design is satisfactorily related to the description of learning outcomes. However the committee has some (strong) recommendations that – if followed – are believed to improve the overall quality of the programme.

The strong recommendations to GUC are that:
1. Core courses in computer science are at a PhD-level
2. Students lacking basic knowledge in computer sciences must take the necessary supporting courses in addition to the core curriculum in the PhD programme.
3. GUC should state the prerequisites for each course explicitly.

Furthermore, GUC is recommended to:
4. Reduce the number of courses.
5. Update the teaching materials regularly.

Finally the committee will express its:
6. Support to GUC's plans to use colleagues as supporting examiners in course evaluations

1.2.2 d) Teaching and student work must be suited for the achievement of intended learning outcomes, as expressed in the plan.

Assessment

The teaching at GUC comprises conventional courses, seminars, writing small papers etc. The committee finds that such activities combined are suitable for reaching many of the intended learning outcomes.

Research education is also a form of apprenticeship and therefore the role of the supervisor is extremely important. The site visit revealed that students are satisfied with the availability of the faculty members. The part-time employees have well established working methods for their PhD-students.

Routines for handling conflicts have not been tested (cf the previous assessment report), but it was very natural for the PhD students to suggest the involvement of the department head, should a conflict arise.

Funding for participation in international conferences, workshops, and summer schools is available and participation in such events is strongly encouraged.

The committee find that the course descriptions could be further developed in order to describe more clearly what is expected of the students, especially activities that are not part of the formal evaluation. Moreover, the descriptions should be made consistent across the various courses as the level of details and forms vary.

Conclusion

The committee finds – based on the written material and on the clarifications made at the interviews at the site visit - that the teaching and student work is suited for the achievement of intended learning outcomes as expressed in the plan.

The institution is advised to:
1. Improve course descriptions.

and the committee strongly recommends that
2. GUC specifies the course prerequisites.

1.2.2 e) Exams and other means of evaluation must be suited for the assessment of the students' attainment of intended learning outcomes, as expressed in the plan.

Assessment

The course descriptions specify that varied forms of evaluations are used including project, essays/reports, oral examination and written examinations. These seem well suited for assessing whether the intended learning outcomes are satisfied. However, the descriptions of the forms of evaluations in the various courses are not consistent and lack detail. The assessment committee is assuming that these forms of evaluations follow international norms and conventions. For the benefit of the students the course descriptions should clearly specify what forms of assessment the students can expect from the course.

From the descriptions it is not clear what is meant by a project – is it meant to be a piece of work done and the resulting artefact submitted, or is it a report submitted documenting the project? And, if is a written report, how is it different from a term paper and a final report? One solution is to have a general section in the study plan that explains the different forms of assessment used.

The course descriptions would benefit from listing other details such as the extent of the reports, for example minimum or maximum numbers of words, if these are to be submitted as group work, or written independently. Moreover, how long are the oral exams and the written exams?

Examinations aids could also benefit from being more specific. In several subjects the students are allowed to take dictionaries. What kind of dictionaries are these? English-English or English-other-language? Are electronic dictionaries allowed? Moreover, other subjects allow calculators, including "simple calculators" (in Foundations of Information Security), "calculator" (Selected topics in cryptology), "approved scientific calculator" (Colour Science). It is not obvious what the differences between these aids are. It would benefit the students if a consistent and unambiguous specification of calculators were used.

The course descriptions contain the section "Form(s) of assessment" which for most courses is empty and "Form(s) of Assessment (additional text)". There is probably some internal reason for this setup, but from an external perspective to include a redundant section appear unnecessary.

Finally, there should be a general section where it is specified what happens if a student is submitting coursework too late or if a part of a course evaluation is not approved. Will the student have a chance to redo a part of a course or will they have to redo the entire course? If there is some flexibility involved, what is the acceptable limit for returning assignments after deadline?

Conclusion

The committee find that the exams and other means of evaluation, that are in use at GUC, are suited for the assessment of the students' attainment of intended learning outcomes as expressed in the plan.

The institution is strongly advised to:
1. Be more precise, exhaustive, and uniform with respect to course descriptions generally and with respect to evaluation specifically.

Furthermore the committee
2. supports the intention of GUC to use an internal teacher in the role of an external examiner across all courses.

1.2.3 The provision must have satisfactory links to research and academic and/or artistic development work, adapted to its level, volume and other characteristics.

Assessment

The training for obtaining a PhD degree is obviously a research-focused activity. The major elements in a PhD programme are therefore found in a research section, and they nominally require two and a half years of full-time participation. This activity is conventionally measured by the scope and quality of the research output generated. GUC quotes the General Rapporteur's Report from the Bologna Seminar: Doctoral Programmes for the European Knowledge Society (February 2005), where ten principles for PhD studies were identified. The first of those was:

- The core component of doctoral training is the advancement of knowledge through original research. At the same time it is recognized that doctoral training must increasingly meet the needs of an employment market that is wider than academia.

The committee find that this philosophy – not surprisingly - permeates the entire application, and thus the proposed programme clearly has satisfactory links to the research areas/groups at GUC.

Conclusion

The PhD programme has satisfactory links to research and academic and/or artistic development work, adapted to its level, volume and other characteristics.

1.2.4 The provision must be attached to student exchange and internationalisation arrangements adapted to its level, volume and other characteristics.

Assessment

There is a proven track record of student exchange and internationalisation. GUC has its own international environment, and there are comprehensive plans for joint PhD programs at the right level. Furthermore, Colour Lab and NISlab have very good partners from university and from industry, nationally and internationally. There are – through long term joint appointments - very close links to the Fraunhofer Institute for Computer Graphics, to the Technical University of Darmstadt, and to Royal Holloway, University of London. Furthermore the faculty has good networks through international cooperation, e.g. in European projects. (This issue is also addressed from a pure research point of view in section 1.3.4.)
Considering the absolute size of GUC, student exchange and internationalisation is definitely one of the stronger points of the application.

The PhD-study also accommodates internationalisation at home as all the PhD-courses are given in English and several of the key academic staff are recruited from abroad and do not speak Norwegian.

Conclusion

The committee finds that the institution and suggested PhD programme has systems for student exchange and internationalisation arrangements adapted to its level, volume, and other characteristics.

1.2.5 Overall conclusion for Section 1.2, Study Plan

The quality of the study plan complies with the expected level required in the Regulation on NOKUT's supervision.

More specifically, the committee finds that:
1) The title "PhD in Computer Science" is adequate and appropriate for the combined current and planned programme.
2) (With respect to programme description)
   a. The learning outcomes are satisfactorily described with respect to skills, knowledge, and general competencies.

b. The programme will most probably provide the candidates with competencies that are in demand in private and public industry, and that the programme will qualify for further studies.

c. The teaching and student work is suited for the achievement of intended learning outcomes as expressed in the plan.

d. The exams and other means of evaluation, that are in use at GUC, are well suited for the assessment of the students' attainment of intended learning outcomes as expressed in the plan.

3) The proposed programme has satisfactory links to research and academic and/or artistic development work, adapted to its level, volume and other characteristics.

4) The institution and proposed PhD programme has systems for student exchange and internationalisation arrangements adapted to its level, volume and other characteristics.

Furthermore the committee strongly recommends that:

I. GUC should be more specific about an innovation and commercialisation strategy in connection with the PhD-education.

II. Core courses in computer science are at a PhD-level.

III. Students lacking basic knowledge in computer sciences must take the necessary supporting courses in addition to the core curriculum in the PhD programme.

IV. GUC should be more precise, exhaustive, and uniform with respect to course descriptions generally and with respect to prerequisites and evaluation specifically.

The institution is advised to:

V. Align the description of the learning outcomes with the official translation: Norwegian Qualifications Framework, Levels and Learning Outcome Description, approved by the Ministry of Education and Research 1. February 2012 (well after the application was submitted)

VI. Rephrase learning outcomes at course level in skills, knowledge, and general competencies. Some of those descriptions are less complete in the current version.

VII. Pursue the idea of promoting industrial PhDs, cf. Section 1.1.2.

VIII. Also consider the interaction between master's and PhD levels programs.

IX. Specify the prerequisites and other details for the courses

X. Improve course descriptions

Furthermore the committee

XI. Supports the intention of GUC to use an internal teacher in the role of an external examiner across all courses.

1.3 Discipline community/-ies attached to the provision

1.3.1 The composition, size and collective competence of the relevant discipline community/-ies must be adapted to the provision as the plan describes it and adequate for the conduct of relevant research and development work.

Assessment

According to the application, the core faculty at GUC comprises members from seven nationalities and with complementary educational, research, and industry backgrounds. Most of the core faculty members have received higher education or have conducted research in at least one foreign country. The core faculty is involved in national and international research projects, and is very research active. Two key staff members are part time (50%) employees, splitting their time between GUC and Fraunhofer-IGD/Fachhochschule Darmstadt and Royal Holloway-University of London respectively. One Professor spends longer periods of time at GUC, e.g. in terms where he is lecturing, whereas the other Professor aims at a weekly presence for a few days every week. Both are available on a daily basis to their students via mail or Skype. The PhD students participating in the interviews all declared that the contact to the part time employees was very satisfactory.

This strong basis of previous experience creates an environment that supports collaboration with both academic institutions and industry, both in Norway and internationally. Furthermore, the diverse expertise of the academic staff enables it to provide doctoral candidates with informed advice on steps beyond the PhD completion, in industry, academia, and public service.

The activities at the Faculty of Computer Science and Media Technology (IMT) are divided into two academic units, the Norwegian Information Security Laboratory (NISlab) and the Media Technology Laboratory. NISlab has an academic staff corresponding to around 15 FTE and MTL around 25 FTE. A considerable part of these FTE is adjunct positions. The academic staff are also affiliated to focussed research laboratories, the most notable being the Norwegian Color Laboratory. Other labs are the Testimon Forensic Laboratory and the Norwegian Biometrics Laboratory. The noteworthy activities in Artificial Intelligence are not organised in a formal laboratory. These focussed research activities comprise between 5 and 10 senior faculty members from both main academic units. A considerable part of GUC's external research collaboration is executed through the focused laboratories.

The committee wants to emphasize that the faculty comprise persons with very varied competencies, and that they have organized themselves in coherent working groups defined by specific areas of application (security, biometry, forensics, colour technology). The committee experience a very engaged staff, with pioneering spirit and certainly having a common vision on where GUC could/should make a difference in the supply of Norwegian third cycle education. This creates an interesting educational environment well suited for a targeted PhD-programme in (applied) computer science. At the different interviews various groups were asked where they would like to expand if possible. It was striking that both management and faculty members independently expressed the strengthening of neighbouring disciplines in order to secure a long term continuous update of the programme. There were no unrealistic visions on broadening the programme to cover areas where

there is no expertise today! The committee strongly supports this line of consolidating rather than expanding at the cost of depleting what today is a stronghold.

The PhD programme is according to the application planned to include 14 persons contributing with 9.1 man years to the programme. 2.7 of those faculty members are affiliated with NISlab, 5 with MTL, and two have joint NISlab/MTL affiliations. In Section 1.1.3 some recent extensions of the scientific staff at GUC are commented on.

Conclusion

The composition, size and collective competence of the discipline community is adapted to the programme as described in the plan, and deemed adequate for the conduct of relevant research and development work.

1.3.2 At least 50 per cent of the academic FTEs allotted to the provision must be members of the institution's own academic staff. Of these, professors (full or associate) must be represented among those who teach the core elements of the provision.

Assessment

A NOKUT requirement for third cycle education is that minimum 50% of the FTE allotted to the proposed programme are professors. The committee would like to point out to NOKUT that this limits the opportunity to expand the involved staff with junior or less experienced staff, without having to increase the number of professors accordingly. This might not be a beneficial restriction for a PhD programme.

GUC has documented a total of 9.1 FTE allotted for the programme. Of these, 4.8 FTEs are professors, equivalent to 52.7% of the total. The requirement of minimum 50% FTE professors is thereby met.

Considering the proposed PhD programme and courses, the core competences of the staff involved in the PhD programme are found to be within the fields of information security, colour science, computational forensics, serious games, artificial intelligence and image/video quality and processing. The first few of these are already well established on GUC and strongly represented among the involved professors. The latter topics are closely related and well represented among professors and associated professors. Furthermore they contribute to the consolidation strategy expressed among faculty during the site visit interviews, also mentioned in Section 1.3.1.

Conclusion

GUC meets the requirement of minimum 50% of the FTEs allotted to the proposed programme are professors with a ratio of 4.8 to 9.1 equivalent to 52.7%. The committee finds that the core elements of the proposed PhD programme and PhD courses are well represented among full and associate professors.

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[2] GUC supplied NOKUT with "Update of workload tables for CS core faculty" at the site visit in Gjøvik, stating that the tot. man. years as of march 2012 will increase to 11,25, with an additional of two new professors recruited to GUC.

1.3.3 The discipline community/-ies must be active in research and/or development work.

Assessment

The core staff committed to this PhD programme (14 persons) at GUC has in the period 2008-2011 produced 73.8 "publikasjonspoeng" in all which gives an average of 1.31 publication points per person per year. Almost all publications from the core staff are on level I and only 1% on level II.[3] The Norwegian universities (all of them) on average have had 22 % of their publications on Level-II and an average of 0.91 publication points per person.[4]

An indicator in the Norwegian system for high international quality is the number of publications in so-called *Level II* channels[5]. However the committee find that statistics based on level II publications to be a somewhat limited indicator of research activity in computer science in general. Furthermore, for the two strongest areas of research at GUC, namely *information security* and *colour science,* there are very few appropriate level II journals. We note that it is not unusual that the top subject-specific conferences in computer science are more competitive than journals, have a significantly higher impact in terms of international visibility, and provide a much more timely route to publication.

To gain further insight into the international research activities, the committee requested bibliometric data showing the citation impact of the faculty members associated with the programme. For this the committee requested that the additional data be generated from Harzing *publish-or-perish* tool (www.harzing.com/pop.htm). This presents each author's articles in order of the number of citations as measured using Google Scholar (scholar.google.com). This data showed a satisfactory international impact. The core staff members have documented an h-index[6] ranging from 3-17, with the majority scoring over 10. In a number of cases we noted very high productivity relative to the citation impact.

Further to this bibliometric data, GUC have documented an extensive list of collaborators form Nordic and other European countries, with a balanced mix of industry and academia partners, which have resulted in academic publications of some kind.

The thematic breadth of the faculty was argued in Section 1.3.1. The committee also find that evidence of high international research activity can be found across the breadth of the faculty, and concludes therefore that there is sufficient breadth.

Conclusion

The committee find that there is ample evidence of high quality international research activity at sufficient thematic breadth. This is visible in

- the range of international publications with some good citation impact across most of the faculty and not limited to just the top handful of researchers, and
- the extensive industrial and academic collaborations that have led to joint publications across a broad variety of thematic areas of computer science.

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[3] Source: Numbers reported by GUC in a document sent to NOKUT dated 28-02-2012.
[4] Source: Database for statistikk om høyere utdanning (DBH)
[5] See Database for statistikk om høyere utdanning (DBH), http://dbh.nsd.uib.no/index.action. They also list authorized publication channels for Level II. See:
http://dbh.nsd.uib.no/kanaler/kanalSok.do?tittelSoek=&issn=&nivakode=2&status_klasseid=&fagraad=98&kanaltype=&fagkode=&landgruppekode=&sortering=1&oaid=&search=advanced
[6] The H-index attempts to measure both scientific productivity and the scientific impact of a scientist. The index is based on the set of the scientist most cited papers and the number of citations that they have received in other publications (from Wikipedia)

Beyond this we make the following observations. For the reasons outlined in the assessment above, we believe that is appropriate for GUC to *not* target level II publications at the expense of their core conferences and journals, especially during the build-up phase of the programme. The management appear to have come to similar pragmatic conclusions about publication culture, and the committee find this encouraging. The committee noted that in a number of cases there is a very high production of research articles relative to the citation impact.

The institution is advised to:
1. Identify the publication venues which the faculty themselves believe to have the highest international impact, and strive to publish at these important and influential venues, possibly at the expense of producing few publications in total.

1.3.4 The academic staff should actively participate in national and international cooperation and networks relevant to the study

Assessment

The NISlab maintains close research links with three international partners through joint appointments and has been involved in projects or individual research collaborations resulting in scientific publications with twenty-four institutions or companies from ten countries.

International networks are a primary driver of European Union funding under the framework programs. As a member of the TURBINE project the College has built strong research connections with the nine other partner organisations from six countries. Through participation in BEST GUC is one of 26 members from both Industry and Academia gathered from across Europe.

In the latter half of 2011 NISlab participated in a work group established by INI (Forsvarets informasjonsinfrastruktur) to establish a research laboratory and a M.Sc. programme in Information Management as the principle Academic institution. The design of this programme has been completed and recommendations are currently with INI.

The MTL through the Colorlab maintains links with over twenty universities from eleven countries, three research institutes and many Norwegian companies and other international and multinational companies.

Gjøvik University College is also a partner in a submitted Erasmus Mundus PhD programme in Computer Vision, and an on-going Erasmus Mundus Master programme in Color Imaging which is one potential stream of PhD candidates into the broader PhD in Computer Science programme including imaging and media technology.

Gjøvik University College has been invited to establish a European Graduate School in Computer Science in collaboration with Plymouth University, Cork Institute of Technology and Hochschule Darmstadt.

The PhD candidates also provide additional opportunities for research collaboration. Of the twenty-three students currently being supervised at IMT, nineteen (83%) come from outside of Norway. This creates links to the research institutions where they completed their qualifying degree.

Conclusion

The academic staff maintains close research links with several international research groups, and it likewise has close cooperation with national and international enterprises. GUC participates in several international networks for student exchange. Thus, the composition, size and collective competence of the discipline community is adapted to the programme as described in the plan, and deemed adequate for the conduct of relevant research and development work.

1.3.5 For provision with vocational practice/internship arrangements, the discipline community/-ies and the practice supervisors must have relevant experience from the practice field.

Assessment

Not applicable

Conclusion

Not applicable

1.3.6 Overall conclusion of § 4-3 Discipline community/-ies attached to the provision

The quality complies with the expected level according to the requirements in the Regulation on NOKUT's supervision.

To elaborate on this, the committee has found that:
1. GUC meets the requirement of minimum 50% of the FTEs allotted to the proposed PhD programme are professors with a ratio of 4.8 to 9.1 equivalent to 52.7%.
2. The core elements of the proposed PhD programme and PhD courses are well represented among full and associate professors.
3. There is ample evidence of high quality international research activity at sufficient thematic breadth. This is visible in
   a. the range of international publications with some good citation impact across most of the faculty and not limited to just the top handful of researchers, and
   b. the extensive industrial and academic collaborations that have led to joint publications across a broad variety of thematic areas of computer science.
4. It is appropriate for GUC to *not* specifically target level II publications at the expense of their core conferences and journals, especially during the build-up phase of the programme.
5. It is encouraging that the management appears to have come to similar pragmatic conclusions about publication culture.
6. In a number of cases there is a very high production of research articles relative to the citation impact.

The institution is advised to:
   I. Identify the publication venues which the faculty themselves believe to have the highest international impact, and strive to publish at these important and influential venues, possibly at the expense of producing few publications in total.

1.4 Support functions and infrastructure

1.4.1 The institution must have rooms, library services, administrative and technical services, ICT resources and working conditions for their students that are satisfactory and adapted to the provision as described in the study plan and the number of enrolled students.

Assessment

At the site visit the laboratory facilities at GUC was inspected. The committee found that the laboratories were well equipped with industry related hardware and appropriate for conducting research related to the elements of computer science included in the proposed PhD programme.

The interviewed students (M.Sc. and PhD) expressed nothing but satisfaction with regards to the study environment, administrative or library services.

GUC subscribes to several key library resources such as ACM digital library, IEEE eXplore, Springerlink, Lecture notes on computer Science, Elsevier Sciencedirect and others that are all highly relevant for the PhD-study. These resources allow students to download research articles directly, and thus provide students with ease of access to high quality research covering a majority of the research that is published in the field of computer science.

Conclusion

Support functions and infrastructure are adequate for supporting the study.

5 Institusjonens kommentar

PhD in Computer Science: Response to the expert committee's conclusion and recommendations.

Gjøvik University College would like to thank the expert committee for the thorough report relating to our application for accreditation of a PhD programme in Computer Science from 27 April 2012, and are pleased that the committee recommended that the PhD programme in Computer Science at Gjøvik University College is accredited by NOKUT.

Although the committee's report was unanimous and without conditions, it listed recommendations and advice. A number of these were related to descriptions of requirements and learning outcomes at both course and programme level. As the committee notes, formal national guidelines were only released by the Ministry of Education and Research one year after the application was originally produced. Gjøvik University College will be using these guidelines to restructure the presentation of our content as we had also noted the varying opinions on describing learning outcomes, especially for third cycle study while preparing the application.

We do not find any errors or misunderstandings in the committee's report, which is the primary scope of this opportunity to respond. However, in respect for NOKUT's and the committee's thorough work, we have included a brief reply to the committee's recommendations. We very much appreciate the recommendations provided, and we will in the following describe how we will take them into consideration when implementing the new program. The discussion of the committee's recommendations can be found attached to this response. To conclude, we wish to again thank both the committee and NOKUT for their feedback during the application process and especially for the well-structure and smooth-running visit to Gjøvik in March 2012 leading to a recommendation for accreditation of the programme.

Best regards,
Gro Kvanli Dæhlin Prorektor

Inge Ø. Moen (sign.) Høgskoledirektør

HØGSKOLEN I Gjøvik

Attachment:

Reply to the committee's recommendations.

We note that the requested scope of any comments is limited to addressing perceived errors or misunderstandings leading to an unfavorable review. While we do not feel is the case with this evaluation, we feel it is appropriate to briefly address the recommendations of the expert committee, which we found constructive and useful. These issues will be reviewed and influence the final structure of the PhD programme prior to formally offering the programme.

Response to the Strong Recommendations:

I. *GUC requires an external majority in the PhD evaluation committee.*

This measure will provide additional transparency and rigor to the evaluation process. This recommendation will form part of the guidelines for assembling future evaluation committees, as will the advice from point V. relating to recommendation made by this committee.

II. *GUC is more specific about an innovation and commercialization strategy in connection the PhD-education.*

The national directive to include innovation and more commercialization is relatively recent and changes to course programmes take some time to propagate. GUC has begun several initiatives, e.g. the Innovatoriet and innovation courses at several levels of study to nurture a stronger environment for innovation and increase the commercialization of work at GUC. We agree that preparation of a clearer overview of these components and their overall objectives will be beneficial to the stakeholders in the new program, and the recommendation will be followed.

III. *GUC is more precise, exhaustive, and uniform with respect to course descriptions generally and with respect to prerequisites and evaluations specifically.*

It was observed by GUC during the preparation of course descriptions for the application that the format required was ill-defined and open to broad interpretation. However, GUC shares the committee's desire to more clarity and will follow the recommendation. GUC will standardize the PhD programme course descriptions, utilizing the learning outcome descriptions from the Ministry of Education and Research as of February 2012, (also mentioned in comment Vil, VIII and IX).

Core courses in computer science are at a PhD-level. Students lacking basic knowledge in computer science should take the necessary supporting courses in addition to the core curriculum in the PhD programme.

In part due to the delay between the initial writing of the application for NOKUT and the time it went to the committee" some aspects of the course descriptions have not reflected their current taught content. This and the committee's recommendation will be addressed through a review and standardisation to the new national framework already discussed. The regulations define a minimum standard of academic background for admission to the programme, and also specify that additional coursework may be required of a candidate; GUC application, p.34, "The Individual Study Plan may also be augmented beyond 30 ECTS Credit Points where a candidate's background necessitates this for the successful completion of the Research Section. Other requirements may also be levied as part of the Individual Study Plan in cases where a candidate does not meet all formal requirements of admission; however, in these cases this is formally treated as a conditional acceptance, and candidates are considered as only entering the Educational Section of the Ph.D."

Additional comments: In the application some of the courses listed were dependent upon completion of ongoing recruitment. The courses listed support our overall research in a general sense and our growth plans for the near term, with some expertise currently injected through our research collaborations. Incorporating this expertise locally at the PhD level is reliant on a Professor leading the research in that area. Computer Graphics/HPC computing and Parallel Programming are two such domains. Since the application was submitted, we have participated in founding the Norwegian Research School of Technology together with a number of other universities and university colleges with various programs in technology and ICT, and this eases the demand for courses to be presented locally by having topics covered by our partners in the NRST. This permits GUC to reduce courses offered to those aligned most closely to research activities of the Faculty, as per the committee's recommendation.

We agree with the committee's other advice, sincerely appreciate their efforts and will be evaluating how to best implement it into our PhD programme. GUC would like to thank the committee and NOKUT for the clarity and punctuality throughout the accreditation process.

6   Vedtak

Doktorgradsstudiet ph.d. i Computer Science ved Høgskolen i Gjøvik tilfredsstiller kravene til akkreditering slik de er utformet i NOKUTs forskrift om tilsyn med utdanningskvaliteten i høyere utdanning (tilsynsforskriften), kapittel 4 Akkreditering av studier, §§ 4.1 – 4.4, vedtatt av NOKUTs styre 27. januar 2011.

Ph.d.-studium i Computer Science akkrediteres.

7   Dokumentasjon

Det skriftlige grunnlaget for de sakkyndiges vurdering er som følger:

- *Søknad om akkreditering av doktorgradsstudium ved Høgskolen i Gjøvik i Computer Science* datert 01.09.2012, saksnr: 11/366
- med tilhørende vedlegg:
    - Vedlegg 1:   *Communication regading expansion of the PhD programme*
    - Vedlegg 2:   *Vitnemål og Diploma Supplement*
    - Vedlegg 3:   *PhD Regualtions*
    - Vedlegg 4:   *PhD Guidelines*
    - Vedlegg 5:   *PhD Contract*
    - Vedlegg 6:   *GuC Quality System*
    - Vedlegg 7:   *Partners able to contribute to the PhD in Computer Science*
    - Vedlegg 8:   *PhD Course Descriptions*
    - Vedlegg 9:   *Formalised PhD Student Exchange agreements*
    - Vedlegg 10: *CVs of PhD Faculty*
    - Vedlegg 11: List of publications by faculty members 2007-2011
    - Vedlegg 12: *Faculty research Networks*
    - Vedlegg 13: *Faculty Research Network Documentation*
    - Vedlegg 14: *Current and Completed PhD Students*
    - Vedlegg 15: *Nasjonal forskerskole for lærerutdanning. Intensjonsbrev*

- *Supplerende informasjon vedr. Søknad: Ph.D. i Computer Science, i brev av 28-02-2011, jnr 11/366-14*
- *Forskrift om tilsyn med utdanningskvaliteten i høyere utdanning*, datert 27.1.2011, med tilhørende merknader

- *Database for Høyere Utdanning*, http://dbh.nsd.uib.no/