The Research Council of Norway

Evaluation of Mathematics, ICT and Technology 2023-2024

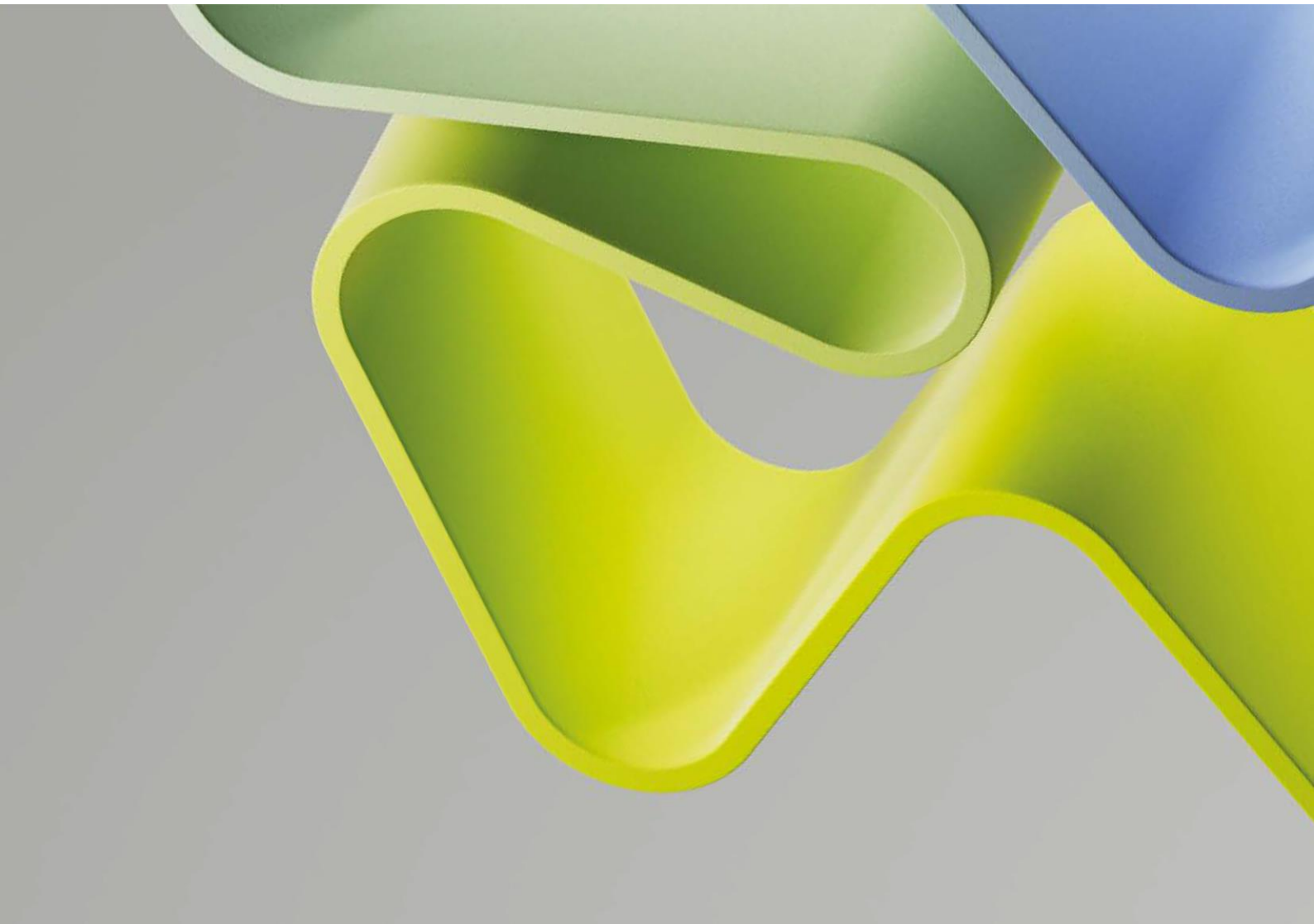
Evaluation Report for Administrative Unit

Administrative Unit: **Department of Computer Science (IFI)**

Institution: **UiT The Arctic University of Norway**

Evaluation Committee Higher Education Institutions 1

December 2024



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Statement from Evaluation Committee Higher Education Institutions 1

The members of this Evaluation Committee have evaluated the following administrative units at the higher education institutions within Mathematics, ICT and Technology 2023-2024 and has submitted a report for each administrative units:

- Department of Informatics, University of Bergen (UiB)
- Department of Mathematics, University of Bergen (UiB)
- Department of Informatics, University of Oslo (UiO)
- Department of Mathematics, University of Oslo (UiO)
- Department of Computer Science (IFI), UiT The Arctic University of Norway
- Department for Mathematics and Statistics (IMS), UiT The Arctic University of Norway
- Department of Mathematical Sciences (IMF), Norwegian University of Science and Technology (NTNU)
- Department of Computer Science (IDI), Norwegian University of Science and Technology (NTNU)
- Department of Mathematics and Physics (IMF), University of Stavanger (UiS)
- Faculty of Engineering and Science (TekReal), University of Agder (UiA)
- Department of Electrical Engineering and Computer Science (IDE), University of Stavanger (UiS)

The conclusions and recommendations in this report are based on information from the administrative units (self-assessment), digital meetings with representatives from the administrative units, bibliometric analysis and personnel statistics from the Nordic Institute for Studies of Innovation, Research, and Education (NIFU) and Statistics Norway (SSB), and selected data from the National survey for academic staff in Norwegian higher education and the National student survey (NOKUT). The digital interviews took place in the autumn 2024.

The members of the Evaluation Committee are in collective agreement with the assessments, conclusions and recommendations presented in this report. None of the committee members has declared any conflict of interest.

The Evaluation Committee consisted of the following members:

Professor Rebecka Jörnsten (Chair),

Univ. Gothenborg/Chalmers

Professor Matthias Schütt,
Leibniz Universität Hannover

Professor Jan Hesthaven,
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Professor Mads Nielsen,
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Professor Tiziana Margaria,
University of Limerick

Dr. Joanna Staneva,
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Professor Björn Engquist,
University of Texas at Austin

Professor Plamen Angelov,
Lancaster University

Description of the Administrative Unit

The Department of Computer Science is structured into three research sections, each led by a formally appointed leader who is part of the extended management team. Every section contains 2-3 research groups, each led by a professor. The department's research focus includes systems research, AI, and health-related technologies, ensuring its contributions are relevant to both local and global needs.

Most academic staff have allocated 50% of their positions to research-related activities while encouraged to collaborate across various disciplines. As of January 2024, the department consists of 29 academic staff and 49 researchers. The unit has 12 professors, with 3 female associate professors, and 2 female professors, reflecting a significant increase in diversity since 2015, when the unit had only one female professor. While the gender representation has improved, the overall diversity among researchers, including PhD candidates and PostDocs, remains a focus for further enhancement.

The research is organised in the following research groups:

- Health Data Lab (HDL)
- Open Distributed Systems (ODS)
- Cyber-Physical and IoT Systems (CPS)
- Arctic Green Computing Group (AGC)
- Cyber Security Group (CSG)
- Computational Analytics and Intelligence (CAI)
- Health Informatics and -Technology (HIT)

The department aligns its work with the university and faculty strategies, focusing on interdisciplinary research, innovation, and cross-sector collaboration. Since 2022, the department has operated under UiT's unified strategy, contributing to the "Developing the High North" initiative and supporting commercial ideas through its digital innovation lab. Looking ahead, the department aims to expand its applied research in different domains, including the health and medical domains, incorporating advanced analytics, machine learning, and AI, while establishing new initiatives across its locations. Systems research, including large-scale systems, high-performance computing, distributed systems, cyber security, information access, cyber-physical and IoT systems, mobile applications and infrastructure, and system support for AI, will still be the core research focus at the department and the basis for our contributions into applied research.

The department emphasizes collaboration to enhance research quality. By fostering interdisciplinary partnerships with national and international research groups, the unit aims to tackle complex societal challenges effectively. Collaborations take the form of various research partnerships. This includes the development of collaborative projects and the writing of applications to secure funding for joint research initiatives. Collaborative research activities typically occur within common research projects, and these partnerships often lead to joint publications and dissemination efforts. Additionally, collaboration extends to the co-supervision of PhD candidates, as well as research-based innovation and education activities. Mobility with a research collaboration purpose is also considered an important aspect of the collaborative efforts. External funding is crucial for achieving its research objectives, and collaborative efforts significantly increase the potential for securing these resources.

Overall Assessment

The Computer Science Department at UiT, IFI, is a relatively small, but vibrant Department with seven research groups forming three sections. The department experienced a significant growth especially since 2015 and more than doubled in size.

The strong aspects of the IFI include the long-standing track record in health oriented computer science research, participation in large national infrastructure initiatives in this area and societal impact through Master and PhD students training and developing the Northern region. The Department has a strong regional focus with Arctic Research, Sustainability and e-Health, but is also with ambitions to develop and grow in direction of Green Computing, Security and Machine Learning.

A very strong positive aspect is the significant growth of the attracted external funding, especially from European grants which is partially linked with the growth of the staff number.

Furthermore, on a positive side is the dynamic of increase of the total number of researchers and the size of IFI as well as the number of publications and diversity in terms of including a large proportion of non-Norwegian researchers. It is also very positive and commendable that almost 80% of the publications by IFI in 2022 are Open Access. In addition, IFI has a high proportion of publications with international co-authors, including top-rated ones.

Potential for improvement is in several directions. Probably, the most obvious one is the number of PhD students which is currently around 1 to 1 with the academic staff number indicating a potential for doubling or even tripling. Another quite obvious area for improvement is the gender balance, especially in regards to the number of full and associate professors (currently around 16% females are reported for these permanent positions). Although, the number of female professors and associate professors increased over the last years its % is still quite low (especially full professors).

Another important aspect to improve is to benefit from the world-wide interest in AI, machine learning and related research and strengthen the research currently covered by CAI, CSG and some of the other groups as described in section 2.1. This concerns attracting more externally funded research funding (one most obvious is ERC, but also other Horizon Europe programmes, Maria Sklodowska Curie Actions, etc. as well as other international funding sources, industry funding, etc.

The Terms of Reference for the administrative unit is attached to the report.

Recommendations

1. The Evaluation Committee recommends to develop a clear IFI strategy aligned with the UiT overarching strategy and the NT-fak strategy.
2. The Evaluation Committee recommends to report more clearly the cause-effect link in the chain Strategy – Environment and Strategy – Reported Results
3. The Evaluation Committee recommends to develop a more cohesive and adequate strategy and plan for development of research group activities, recruitment, careers opportunities, mobility opportunities, internationalisation, etc.
4. The Evaluation Committee recommends to combine the traditional strengths (e.g. in health, Arctic studies, etc.) with the new opportunities which arise world-wide and to react to these pro-actively rather than reactively.
5. The Evaluation Committee recommends to increase the ratio of the externally funded research.

6. The Evaluation Committee recommends to develop a strategy and provide mechanisms and incentives and put more efforts in applying for and getting funding from ERC (Starter, Accelerator and Advanced grants, Synergy grants) as well as Marie Sklodowska Curie Actions such as Training Programmes and attracting and developing talent.
7. The Evaluation Committee recommends to support the claims for leadership in the area of health research with participation in national infrastructures that are closely relevant
8. The Evaluation Committee recommends to participate in other National research infrastructures that are closely relevant t the UiT strategy and the location/position of UiT near the Arctic Ocean and the unique position in regards to the climate
9. The Evaluation Committee recommends to strengthen and make the most out of the opportunities to leverage more significant and useful national collaborations having in mind the specific location and unique features of UiT
10. The Evaluation Committee recommends to align fully the collaborations (both national and international) with the UiT strategy and the unique specific aspects of the UiT
11. The Evaluation Committee recommends to develop a strategy and measures towards a gender balance at all levels.
12. The Evaluation Committee recommends to develop measures and steps and incentives to increase the number of PhD students
13. The Evaluation Committee recommends to increase the proportion of open access publications especially the ones funded by the research council RCN, ERC, Horizon Europe, etc.

1. Strategy, Resources, and Organisation of Research

The administrative unit being assessed is the Department of Computer Science (IFI) of The Arctic University (UiT) of Norway. IFI has experienced a significant growth on the last few years (from about a dozen academic staff in 2015 to more than doubling it (29 soon to be 30) in January 2024. Its research is organised in 7 groups which, in turn, are grouped into 3 research sections.

The strategy of IFI stems from the University strategy which is called "*Developing the High North"* which itself have several editions and updates, but there is some confusion and lack of clarity about the strategy of IFI itself which will be discussed further.

IFI participates in several National Infrastructure areas, e.g. ELEXIR Norway (bioresources), Sigma2 (e-infrastructure) and INFRASTRUKTUR project eX3 (ICT), but it does not participate in National Infrastructure on Medicine and Health, Climate and the environment and Environmentally friendly energy and Maritime technology despite being a leader in the area of Health and having the Arctic research as its main priorities.

The research group leaders are being selected bottom up while the sections leaders are being appointed by the Department and they also carry some administrative duties.

1.1 Research Strategy

There is some confusion and a lack of focus in regards to the strategy of the Department (IFI). The self-assessment document argues that the University (UiT) preferred a single University-wide strategy while the Department (IFI) developed its own strategy in force since 2022. At the University level, at least two strategy documents are mentioned as relevant and have been used, namely,

i) Developing the High North – UiT's strategy towards 2019, and

ii) Developing the High North – UiT's strategy towards 2022.

In addition to that the Faculty (NT-fak) strategy is also being mentioned to have its own strategy. Ideally, the strategy of the bigger entity (UiT) will ”flow down” seamlessly through the Faculty (NT-fak) to the Department (IFI) and if necessary to the section and a group. Yet, the level of detail and specifics will be different and at the Department level the ideal would map or “project” the UiT strategy having in mind the resources, specifics, the topic area of research, interests, capacity, etc. and come up with a clear, sharp and relevant departmental strategy.

Instead, the self-assessment has a paragraph explaining why IFI has NOT had its own strategy since 2022, followed by relatively general and not quite sharp “main strategic goals” described as “interdisciplinarity”, technological research”, and “innovation”. Goals defined in such a way are not specific, not easy to measure and estimate, not time bound and are quite easy to achieve.

On a positive side, it was impressive that one of the impact case studies, reports the success in establishing five start-ups in seven years by students. This demonstrates not only the positive impact on training and retaining new talent, but also the innovation and interdisciplinarity which were pointed as strategic goals following the UiT strategy.

Recommendations

1. The Evaluation Committee recommends to develop a clear IFI strategy aligned with the UiT overarching strategy and the NT-fak strategy.
2. The Evaluation Committee recommends to report more clearly the cause-effect link in the chain Strategy – Environment and Strategy – Reported Results.

1.2 Organisation of Research

The research is organised within seven groups, and most academic staff (associate professors and professors) have allocated 50% of their positions to research–related activities.

There is some lack of clarity on:

- how “research-related activities” are being defined
- how these were measured (is it a nominal allocation or is it being measured, and how precisely are these being measured/estimated)

Groups are further combined into sections, and the leaders of each section are members of the management team. This structure seems rigid and hierarchical and opens questions about the evolution. For example, are there opportunities for early career researchers to progress and set up new groups? Considering the dynamism of computer science as a research area, a ten-year review period is quite long: we all have been witnessing many new paradigms appear, both as theoretical concepts – large language models being one of them as well as implementations and as industrial opportunities, ChatGPT being another one.

The research is organised further into groups and projects. These projects can be internal within a particular group or across groups and include external partners. The unit has several partners from international universities. Staff are also involved in two master programmes, and students can act as teaching assistants, which is a commendable

involvement of students that creates opportunities for development and close ties with the researchers.

Some research groups report much more cohesive and impactful results, notably the two groups around Health (Health Informatics and Technology and the Health Data Lab). Despite the great opportunities that are currently offered by the world-wide technology development, the results by the Computational Analytics and Intelligence group have to be seen more as a potential for future development.

Recommendations

1. The Evaluation Committee recommends to develop a more cohesive and adequate strategy and plan for development of research group activities, recruitment, careers opportunities, mobility opportunities, internationalisation, etc.
2. The Evaluation Committee recommends to combine the traditional strengths (e.g. in health, Arctic studies, etc.) with the new opportunities which arise world-wide and to react to these pro-actively rather than reactively.

1.3 Research Funding

The research funding comes mostly from state sources (45.8M NOK in 2022) with external funding being less than 40% of that (16.9M NOK in 2022).

It is commendable that approximately half of that amount (7.8M NOK in 2022) comes from industry: this indicates impact and applicability of the research.

Another significant proportion (7M NOK in 2022) comes from RCN. Also positive is that the total external funding doubled since 2018. 37% of the research budget comes from internal funding sources which means that the proportion and role of the external funding is rather small, with the funding from RCN being even a smaller proportion.

Recommendations

1. The Evaluation Committee recommends to increase the ratio of the externally funded research.
2. The Evaluation Committee recommends to develop a strategy and put more efforts in applying for and getting funding from ERC (Starter, Consolidator and Advanced grants, Synergy grants) as well as Marie Sklodowska Curie Actions such as Training Programmes to attract and develop talent.

1.4 Research Infrastructures

Some research groups such as the Health data Lab took part during 2011-2019 in the ELIXIR Norway national infrastructure project for biological information.

Two other groups (AGC, Arctic Green Computing) and CPS (Cyber-Physical Systems) participate in ex3 national infrastructure (an experimental heterogeneous cluster) and the AGC group also participates in the Sigma2 national infrastructure (e-infrastructure for computational science in Norway).

However, it seems there is no participation in the national infrastructures on the following topics:

- Climate and environment
- Environmentally friendly energy
- Medicine and health

- Maritime technology

which would have been logical to expect having in mind the claimed leading role of the UiT nationally in the area of health and the strategies and the location/position of the UiT in the Arctic and close to the Arctic Ocean.

Recommendations

1. The Evaluation Committee recommends to support the claims for leadership in the area of health research with participation in national infrastructures that are closely relevant
2. The Evaluation Committee recommends to participate in other National research infrastructures that are closely relevant to the UiT strategy and the location/position of UiT near the Arctic Ocean and the unique position in regard to the climate.

1.5 National and international collaboration

It is commendable that the UiT has strong international collaborators such as CERN, EMBL, ESRF, IARC, ESA. Two groups (see the previous sub-section) took part in international infrastructure projects, which is commendable.

The balance of collaborations (both national and international) is somewhat skewed towards two out of the seven research groups, namely the Health Data Lab and the Arctic Green Computing, leaving the other five research groups exposed with practically no indications of collaborations (Cyber Security group, Open Distributed Systems, Computational Analytics and Intelligence and to some extent the Cyber-Physical Systems research group).

Recommendations

1. The Evaluation Committee recommends to take lessons learned for building collaborations from the Health Data Lab and the Arctic Green Computing groups and expand the international networks of the other research groups.

1.6 Research staff

IFI experienced a significant growth in the last years (from about a dozen staff members until 2015 to 29 or 30 in 2024). Less than 16% of these are, however, female. The current level of PhD students is quite low (about 1 per academic staff). There is a clear potential to double or even triple this number. The structure of positions is also not quite optimal, with full professors being almost half of the headcount and all other levels (two types of Associate Professors, Assistant and Adjunct Professors) summing up to about an equal number.

Most academics have 50% of their time allocated to research, with some having a smaller percentage. The key question is how this time is being used, and if there are incentives for more successful academics who bring significant external research grants or impactful publications in prestigious outlets regularly. For example, these can be awarded PhD studentships funded internally or offered a reduced teaching load or an accelerated promotion or a sabbatical, etc. The self-assessment does not provide much information about such measures. This is clearly a potential for a better incentive and engagement of the available staff.

Recommendations

- The Evaluation Committee recommends to develop measures and steps and incentives to increase the number of PhD students.
- The Evaluation Committee recommends to develop a strategy and measures towards a gender balance at all levels.

- The Evaluation Committee recommends to try to recruit at more junior levels than full professor in order to better balance the talent pipeline at all levels.

1.7 Open Science

The university has a clear policy on Open Science and guidelines for management of research data. IFI is reporting a remarkable increase of the Open Access publications (from less than 20% until 2016 to over 80% for the period 2019-2022).

In addition, due to the specifics of Computer Science some of the research groups at IFI also produced software tools and machine learning models which were made available through repositories. In addition, open data sets were made available, e.g. HyperKvasir as well as image and video data.

Recommendations

Increase the proportion of open access publications, especially the ones funded by the research council RCN, ERC and Horizon Europe.

2. Research production, quality and integrity

ICT researchers at UiT published 85 papers in 2022 (an average of 70.3 over a 3-year period), which is significantly lower than the 360+ publications reported by some other Norwegian universities. Having in mind the smaller size of IFI, it is understandable, but it is still at the lower end numerically.

The share of 10% of most cited publications is 8.6%, and the mean normalised citation score is 99 over a 3-year period (2019-2022), which is reasonably high but again behind several other Norwegian universities.

The level of international co-publishing is quite high (44.7%), but again not very high in Norway. Furthermore, IFI has 16 publications with top-ranked authors, which is not quite high (although not the lowest in Norway) and offers a potential for increase. The interdisciplinarity score of IFI is quite high.

Researchers at UiT received one of the highest amounts of funding from RCN (following only the significantly larger groups at NTNU and UiO. Moreover, this funding has significantly increased over the last several years.

There has been a clear increase in the number of publications in the last five years, but this is based on a drop during the first five years. The majority of the publications are in IEEE venues, but also in the more regional Linkoping Electronics Conference Proceedings with a smaller number in ACM, Scientific Reports.

Importantly, the mean normalised citation score for the unit has been below 100 for the last couple of years as well as for half of the 10-year period (5 out of 10 years). It is commendable that the proportion of 10% most cited increased compared to the first few years, when it was 0 up to 15.5%, but then it slipped down for the last couple of years.

The most cited paper is in the *Journal of Medical Internet Research.* This strengthens the conclusion that health is the strongest field of research, but there are few papers like this one.

2.1 Research quality and integrity

The seven research groups of the UiT IFI, which are part of the EVALMIT evaluation, differ in size, structure and performance. Some of them are larger and more established with a larger number of permanent staff and thus, comparing them directly is not the best way to analyse. There is no outstanding group in performance, but some are stronger and better performing than others regarding their organisation, societal impact and user involvement. Research groups such as Cyber-Security and Health Informatics stand out with their strong performance and clear focus. Other groups, such as Open Distributed Systems, Arctic Green Computing, and Cyber-Physical Systems, have the potential to improve, but groups like Computational Analytics and Intelligence lack focus. For example, the tremendous developments in the area of deep learning, foundation models, and quantum and neuromorphic computing would normally be part of this group, but there is no visible significant activity in the core of these areas or in another more narrow area of the AI which has huge potential for future development. The group of Cyber-Physical and IoT Systems is somewhat similar in the sense that the focus is not very clear, and the potential outweighs the achievements.

Research group Health Data Lab (HDL) overall assessment

The Health Data Lab (HDL) is a new organisational unit focusing on bioinformatics and machine learning. The group has grown from a PI research group to a unit with six permanent faculty, one researcher and 4 PhD students. The HDL group is highly active in innovation research (startups) and student entrepreneurship.

The teaching load is high for the members of the group and since the research is project-driven through collaboration, the research profile of the unit is not so focused. As a result, the productivity of the unit is a bit lower. The group aims to increase publication rates and apply for external funding as PIs. The group has a large list of specific benchmarks which they are likely to achieve. Internationally the group is hard to compare because of the unique collaborative focus. The general impression is that the group is internationally strong.

The HDL group provides UiT researchers with expertise in bioinformatics and machine learning. The are active collaborators on multiple cross-disciplinary projects.

Research group Cyber Security Group (CSG) overall assessment

CSG is unique in the scope of their activities and vision. They do remarkably well with philanthropic funding and donations as they focus on special kind of projects that are of interest to large communities. An example of their community work is Corpore Sano Centre which aims at high-impact interdisciplinary research and innovation at the intersection of computer science, sports science, law, mathematics, psychology, and medicine. They participate in teaching activities and publish papers at well-known conferences and in journals. The group had also many collaborations for startups and spin-offs, which is important for societal contributions.

Research group Open Distributed Systems (ODS) overall assessment

ODS aims to carry out societally relevant research in the area of mobile communications' applications and systems. ODS has several professors and associate professors but a low number of PhD students, while the number of master's students has been good. The mobility of researchers in both directions has been supported. Compared to the available basic funding, external funding is low for basic research, while some constant industry funding on a low level has been acquired. Research output is modest in terms of quality, quantity, and impact. Many international collaboration contacts exist, but the concrete details and scientific

results from those are unclear. Some transdisciplinary projects have been performed and the efforts to create societal impact are visible, e.g., by filing patents.

Research group Cyber-Physical and IoT Systems (CPS) overall assessment

The CPS group has good ambitions and a good national basic research funding level. International contacts (for example with Princeton) have been well established but have a higher potential to be used for internationally funded project activities. The group's relation to arctic and sustainable energy is not clear and could be better defined. Infrastructure for research is available. CPS runs several local research infrastructures. Publication track record can be improved by targeting high-impact publication journals and conferences. Societal impact is good due to societally relevant research, open-source software, and outreach activities. Performed research is system-oriented and has some relations to societally interesting research questions such as climate change. Contributions to master's and PhD student education is good but could be better exploited for high-quality publications and attracting more international basic research funding.

Research group Arctic Green Computing Group (AGC) overall assessment

The AGC group has a balanced composition regarding professors and PhD students. The group participates in international projects and has achieved good results. The research strategy is clearly defined. Funding from national and international sources exists but it is low compared to basic funding. Some publications are of high quality, but this can still be improved. Contributions to teaching are very good. Societal and knowledge transfer activities are limited. The group is well positioned at a national level but not very distinctive at an international level.

Research group Computational Analytics and Intelligence (CAI) overall assessment

The main strength of the research group is that their research is within a popular field which is generally well funded and offers ample opportunity to collaborate with stakeholders within different application domains. The main weakness of the group, however, is that they are not currently doing well in taking advantage of these opportunities. Their level of funding is low, they report problems with recruitment and retainment of staff, and they report on a research environment that does not support high quality research. A positive development is the BioAI team's work on microscopy and nanoscopy in collaboration with another department at UiT, which comes with a marked funding increase. Nevertheless, this covers only part of the group, and relying only on this direction of research would be too high risk, and potentially too applied, to stand alone. The papers listed by the group are of mixed quality, many published in low impact venues that are not well known. They do, however, take an active role in the publications. In short, the group does not satisfy its own benchmarks, and has a low scientific performance compared to other groups in both a national and international context. Working with national and international stakeholders within applied domains, their performance on the social impact dimension is satisfactory.

Research group Health Informatics and -Technology (HIT) overall assessment

• Strength: The group has international recognition and a methodological research focus and strategy. The core of professors is rather small but may support effective and coordinated actions.

• Weakness: The virtual composition of the group is unclear and internal structures are missing. The group lacks diversity and fails to secure sufficient funding, particularly from European sources. Also, the fields of applications are too diverse.

• Overall performance: In the international context, the overall performance of the group is very good.

3. Diversity and equality

The department follows the UiT Equality, Diversity and Inclusion (EDI) action plan 2020-2024. It has zero-tolerance policy to discrimination. IFI has monthly culture discussions which is commendable.

In 2021 IFI had a project specifically dedicated to EDI called Better Balance Informatics funded by the Balance program of the RCN. All this is commendable, yet the gender balance is still distant from parity – only five out of 29 or 30 staff are female according to the self-assessment.

A very large proportion of staff come from outside Norway, which demonstrates that the Department is successfully blending staff with diverse cultural experiences and traditions.

4. Relevance to institutional and sectorial purposes

IFI is research-driven and is using its research to inform and shape the education activities. In this respect it is highly commendable that students, especially at Master and PhD level, are being integrated and involved in research activities and publications. This is a sign of high-quality education and ambition to develop the younger entries. It offers opportunities for development and growth to the students as well as hands-on experience and natural interactions. This attitude and practices also facilitate the societal objective that IFI promotes, namely to contribute to the society and its welfare. It also contributes to value creation and innovation and offers a fresh stream of talent.

IFI has a well-developed and functioning approach to early career support and a system for mentoring, training and career development and monitoring.

The Digital Innovation Lab is the tool recommended to be used for innovation and commercialization. The collaboration with Norinnova AS is also commendable.

5. Relevance to society

IFI is actively involved research projects that are closely related to the three objectives of the Norwegian Research and Education, namely:

i) enhancing competitiveness and innovation capacity;

ii) environmental, social and economic sustainability;

iii) high quality and accessibility.

It further aligns well with some of the six thematic priorities which are:

a) ocean and coastal areas;

b) health;

c) climate, the environment and energy;

d) enabling and industrial technologies;

e) societal security and civil preparedness; and

f) trust and community.

The closest alignment is with the thematic priorities b) health and c) climate, the environment and energy. This further aligns with the related UN Sustainable Development Goals (SDGs). The examples that support this include the weather forecast research and energy-efficient computing.

5.1 Impact cases

Comments to impact case 1:

Title: Health Research

This impact case study has a very clear focus, scope and is very relevant to both, the UiT overall strategy and the research groups that were involved with expertise and track record. It is very important overall (Globally, for Norway as well as specifically for Tromso as the Northern-most outpost being remote and hard to reach). It plays on the strengths and track record of the research groups involved and IFI. It is strong and compelling and of a world class.

Comments to impact case 2:

Title: Distributed Systems – sustainability

This impact case study makes use of the specific location of UiT in the Arctic Tundra and near the Arctic Ocean as well as from the strengths of the IFI research. This impact case study is highly relevant and very important. It is slightly less clear the strength of the achievements in terms of strong publications and/or the industrial impact and takeover of the results of the research. It can be seen as a work in progress and an area with potential for further development.

Comments to impact case 3:

Title: Student Entrepreneurship

This is a very interesting and, to some extent, unusual impact case study. It covers the support and efforts by IFI who co-founded 5 start-ups with its students over the last 7 years. This is highly commendable and can have impact in multiple directions (development of staff and personnel, development of high tech and science, local impact, social, educational, using these as an example for future generations of students, future links with these start-ups for research projects, proliferation and links with Global companies, etc.).

Extremely relevant (having in mind that UiT is in a challenging geographical location and retention of talent may be challenging), extremely important. Strong as far as it can be judged by the self-assessment and preliminary results. It deserves to be monitored and nurtured having in mind the highly volatile nature of the start-ups in the computer science area.

Comments to impact case 4:

Title: From Distributed Systems research to Educational Programs to Societal Challanges and Back

This impact case study to a great extent overlaps with the Impact Case study 2. It places the emphasis not on the actual research but on the impact on education, yet it lacks clarity and focus. It is less convincing than the other impact case studies and it is not clear why it was

selected as a stand-alone impact case study and did not just supported the impact case study 2.

Methods and limitations

Methods

The evaluation is based on documentary evidence and online interviews with the representatives of Administrative Unit.

The documentary inputs to the evaluation were:

- Evaluation Protocol that guided the process
- Terms of Reference
- Administrative Unit's self-assessment report
- Administrative Unit's impact cases
- Administrative Unit's research groups evaluation reports
- Bibliometric data
- Personnel and funding data
- Data from Norwegian student and teacher surveys (only for HEI's)

After the documentary review, the Committee held a meeting and discussed an initial assessment against the assessment criteria and defined questions for the interview with the Administrative Unit. The Committee shared the interview questions with the Administrative Unit at least two weeks before the interview.

Following the documentary review, the Committee interviewed the Administrative Unit in an hour-long virtual meeting to fact-check the Committee's understanding and refine perceptions. The Administrative Unit presented answers to the Committee's questions and addressed other follow-up questions.

After the online interview, the Committee attended the final meeting to review the initial assessment in light of the interview and make any final adjustments.

A one-page summary of the Administrative Unit was developed based on the information from the self-assessment, the research group's evaluation reports, and the interview. The Administrative Unit had the opportunity to fact-check this summary. The Administrative Unit approved the summary without adjustments.

The Committee judged the information received through documentary inputs and the interview with the Administrative Unit sufficient to complete the evaluation.

List of administrative unit's research groups

Institution	Administrative Unit	Research Groups
The Arctic University of Norway	Department of Computer Science	Health Data Lab
		Cyber-Physical and IoT Systems
		Health Informatics and - Technology
		Cyber Security Group
		Arctic Green Computing Group
		Open Distributed Systems
		Computational Analytics and Intelligence

Terms of Reference (ToR) for the administrative unit

The board of UiT the Arctic University of Norway mandates the evaluation committee appointed by the Research Council of Norway (RCN) to assess Department of Computer Science based on the following Terms of Reference.

Assessment

You are asked to assess the organisation, quality and diversity of research conducted by Department of Computer Science as well as its relevance to institutional and sectoral purposes, and to society at large. You should do so by judging the unit's performance based on the following five assessment criteria (a. to e.). Be sure to take current international trends and developments in science and society into account in your analysis.

a) Strategy, resources and organisation

b) Research production, quality and integrity

c) Diversity and equality

d) Relevance to institutional and sectoral purposes

e) Relevance to society

For a description of these criteria, see Chapter 2 of the mathematics, ICT and technology evaluation protocol. Please provide a written assessment for each of the five criteria. Please also provide recommendations for improvement. We ask you to pay special attention to the following 6 aspects in your assessment:

1. **Interdisciplinary:** The Department of Computer Science (IFI) has been involved in many interdisciplinary research projects and activities in the period reported for in the evaluation. IFI has focused on interdisciplinary activities in response to recent UiT strategies (including the current UiT strategy «*Eallju – Developing the High North*» and previous strategies at UiT) and societal expectations. Also, the field of research typically done at the department can easily be applied in a wide range of disciplines. IFI has been involved in many interdisciplinary projects, including projects funded by strategic funding from UiT (UiT interdisciplinary strategic initiatives, UiT thematic ventures, and UiT Aurora centers), the Norwegian research council and EU. In the period of the evaluation, the number of funded projects has increased significantly, and most of these projects are interdisciplinary. The funding received for fundamental computer science research is limited.

2. **Relevance to a changing society: T**he systems and technology focus of the Department of Computer Science has high relevance for society, and the department has a focus on applying it to complex societal challenges. This is done both through interdisciplinary research and system and technological research that can be applied in a wide range of fields. In many disciplines, our research can contribute to more efficient processes and improve the quality of the research outcome. For example, health diagnosis and follow-up, analysis (including ML- and AI-based analysis) and system support for analysis of a wide range of data, and environmental data collection and analysis.

3. **Innovation**: The department has established an innovation lab focusing on supporting ideas and research that has potential commercialisation, including support to students and their process towards a start-up. We have, for example, supported several student groups towards successful STUD-ENT funding. Innovation has been a priority at UiT, and the previous strategy (*Drivkraft i nord: Strategi for UiT mot 2022*) included the

sentence, «*UiT will be a driving force for increased innovation and business development in the High North*».

4. **System and experimental research**: The Department of Computer Science has focused more than 30 years on system research with an experimental approach (prototyping – building real systems).

5. **Growth**: The Department of Computer Science has grown significantly during the period for the evaluation. The staff and number of students have more than doubled in the period. IFI has also, in recent years, established itself with staff and students at two new locations (Mo i Rana and Bodø) to fulfil the need for technology competence in the Nordland region. In this period, the department has also become a more diverse department.

6. **Eallju**: In the current UiT strategy «*Eallju – Developing the High North*», there are 3 strategic areas of effort that are prioritised at UiT and lay down guidelines for where the resources will go: *The Arctic and the northern regions*, *Major societal challenges*, and *Talent development and diversity*. This strategy has only been in effect for a limited time in the evaluation period, but we find similar goals in the previous strategies. The current focus on these three strategic areas has started to influence us and will be even more visible through the description of plans for the coming years.

In addition, we would like your report to provide a qualitative assessment of Department of Computer Science as a whole in relation to its strategic targets. The committee assesses the strategy that the administrative unit intends to pursue in the years ahead and the extent to which it will be capable of meeting its targets for research and society during this period based on available resources and competence. The committee is also invited to make recommendations concerning these two subjects. 3

Documentation

The necessary documentation will be made available by the mathematics, ICT and technology secretariat at Technopolis Group.

The documents will include the following:

- a report on research personnel and publications within mathematics, ICT and technology commissioned by RCN
- a self-assessment based on a template provided by the mathematics, ICT and technology secretariat
- the strategies of UiT The Arctic University of Norway «*Developing the High North – UiT's strategy towards 2022*» and «*Eallju – Drivkraft i nord: UiTs strategi mot 2030*»

Interviews with representatives from the evaluated units

Interviews with the Department of Computer Science will be organised by the evaluation secretariat. Such interviews can be organised as a site visit, in another specified location in Norway or as a video conference.

Statement on impartiality and confidence

The assessment should be carried out in accordance with the *Regulations on Impartiality and Confidence in the Research Council of Norway*. A statement on the impartiality of the committee members has been recorded by the RCN as a part of the appointment process. The impartiality and confidence of committee and panel members should be confirmed when evaluation data from Department of Computer Science are made available to the committee and the panels, and before any assessments are made based on these data. The RCN should be notified if questions concerning impartiality and confidence are raised by committee members during the evaluation process.

Assessment report We ask you to report your findings in an assessment report drawn up in accordance with a format specified by the mathematics, ICT and technology secretariat. The committee may suggest adjustments to this format at its first meeting. A draft report should be sent to the Department of Computer Science and RCT. The Department of Computer Science should be allowed to check the report for factual inaccuracies; if such inaccuracies are found, they should be reported to the mathematics, ICT and technology secretariat within the deadline given by the secretariat. After the committee has made the amendments judged necessary, a corrected version of the assessment report should be sent to the board of UiT the Arctic University of Norway and the RCN no later than two weeks after all feedback on inaccuracies has been received from Department of Computer Science.

Appendices

1. Description of the evaluation of EVALMIT
2. Invitation letter to the administrative unit including address list
3. Evaluation protocol
4. Template of self-assessment for administrative unit (short-version)

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