Forskningsrådet

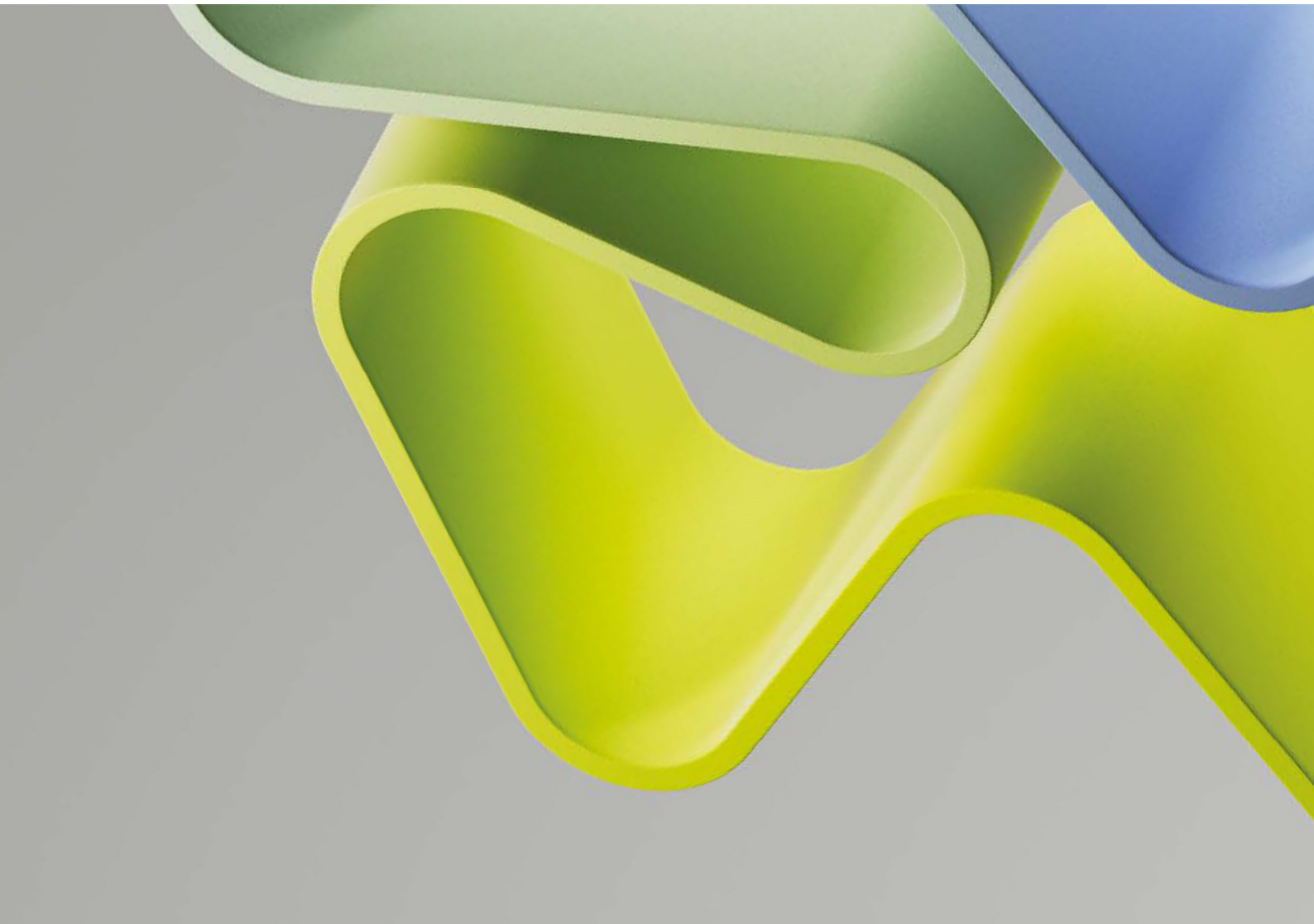
Evaluation of Natural Sciences 2022-2024

Evaluation report

Department of Physics and Technology

University of Tromsø - Faculty of Science and Technology

January 2024



Contents

Statement from Evaluation Committee II

The members of this Evaluation Committee have evaluated the following administrative units at the higher education institutions within natural sciences in 2022-2023 and submitted a report for each administrative unit:

- Department of Chemistry, Norwegian University of Science and Technology
- Department of Physics, Norwegian University of Science and Technology
- Department of Chemical Engineering, Norwegian University of Science and Technology
- Department of Materials Science and Engineering, Norwegian University of Science and Technology
- Department of Geoscience, University of Tromsø
- Department of Chemistry, University of Tromsø
- Department of Physics and Technology, University of Tromsø
- Department of Energy Resources, University of Stavanger
- UNIS – The University Centre in Svalbard

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

The Evaluation Committee has consisted of the following members:

Professor **Amelie Hagelauer** (chair)

Technical University of Munich, Germany

Dr. **Eric Deville**

IFP Energies Nouvelles, France

Professor **Christian Ruegg**

Federal Institutes of Technology ETH Zurich, Switzerland

Professor **Guido Mul**

University of Twente, The Netherlands

Professor **Sigridur Suman**

University of Iceland, Iceland

Description of the administrative unit

University of Tromsø – UiT
Department of Physics and Technology – IFT

The administrative unit
The unit employs 136.48 FTE research staff out of which 30.8 are associate and full professors, 4.2 are lecturers and teaching assistants, 36 researchers and postdoctoral fellows, 51.3 PhD students, 6.07 administrative personnel and 8.11 technical personnel. Research focus areas include Data analysis, Space physics, Energy, Climate and environmental monitoring, Medical technology and Nanotechnology and optics.

The belonging research groups
IFT consists of six research groups – Space Physics research group, Ultrasound research group, Microwaves and Optics research group, Renewable Energy research group, Earth Observation research group, and Complex Systems Modelling research group.

The administrative unit works in relation to the unit's strategies
Synergies are considered and emphasized when establishing master-level courses, study programmes, new research projects and directions in the longer term. Many research projects include internal collaboration and with other departments at UiT, notably at Health- faculty. The department hosts internal seminars, and an e-mail newsletter regularly informs about funding opportunities and obtained grants. The department annually distributes 2-6 PhD positions, mostly in-kind to competitively funded projects and centres. This is in line with the priority given to external funding. New permanent positions are typically allocated to study-programmes, large research efforts and following UiT strategic decisions.

The unit works in relation to the belonging sector
At department level, each research group and PI has a strong focus on contributing to society, e.g., UN sustainability goals. The department is active in developing the high north through collaboration with local industry, attracting talents and educating a skilled workforce. The department also strives to create jobs through innovation and spin-off companies. Research can, in some cases, provide solutions to problems that are specific for the high north and remote areas.

Where the unit will be in the future
IFT seeks to foster internationally leading research, attract external funding, train and give opportunities to young researchers, and contribute to society through research, innovation and education. IFT makes an annual plan with a bottom-up approach and taking into account the strategy of UiT. The importance of external funding is internalized, with senior staff setting examples for the younger. The role of the department is to facilitate the research and give competitive advantages. Internal collaboration and synergies are important, and the work-life balance must be suitable for individuals in different periods of life.

Overall assessment

The unit consists of six research groups covering a selection of topics and expertise that contribute to the local needs in education, research and to some extent innovation. The location of UiT is a challenge for recruiting students and staff, but also offers opportunities to realise unique projects and collaborations in the Artic that will increase in importance in the coming decades. The Evaluation Committee was impressed by the ambition and motivation of the team.

Given the size of the student body and other limiting factors, UiT-IFT is right to focus its activities on a (small) number of key topics. This focus could even be stronger leveraging unique local opportunities e.g. the ESCAT 3D infrastructure and collaboration with the Polar Institute. On the other hand, for photonics applications currently a cleanroom facility is missing and would need substantial investment to be internationally competitive. For Complex Systems Modelling and Renewable Energy a clear long-term strategy is needed. It is unclear if the motivation for these groups is education and teaching, research or technology transfer.

The operation at UiT-IFT is small, bottom-up, and effective. The management structure is typical for the academic setting.

The quality of the impact cases that were provided to the reviewers was somewhat below the average of other units in terms of quantity (only two impact cases) and quality of information. Stronger examples for impact were however mentioned at various places in the documents.

The Evaluation Committee considered the points raised by the unit in their Terms-of-Reference document and have commented on those throughout the report where applicable.

Recommendations

The Evaluation Committee recommends areas of improvement and focus for future development: if UiT-IFT aligns its activities with local opportunities, infrastructure, and industry, it can create unique, internationally competitive education and research programmes. If it fails to do so, it will be very difficult to create and maintain world-leading activities because of the difficulties recruiting enough students and staff. Specifically, the Evaluation Committee highlights the following:

- A closer and strategic collaboration with the local Polar Institute could be an opportunity that was not mentioned in documents or during the review as one of the strategic priorities of the unit. It should be considered
- The Complex Systems Modelling group is well connected but lacks critical mass and strategic partnerships. It could contribute to broader programme in scientific computing and data science including AI
- The project for a local cleanroom must be realised with priority should the activity in nanofabrication continue
- Renewable energy is a broad topic and should be address in an interdisciplinary centre to respect local needs and create impact
- The unit’s growth could focus on three key areas or hubs and one interdisciplinary centre and aim for world-leading and unique research, education, and technology transfer programmes in these topics.

1. Strategy, resources, and organisation of research

Because in the terms of reference several questions are referring specifically to research strategy, the Evaluation Committee comments on three aspects here:

First, the structure with six research groups, six topics and three hubs allows UiT-IFT to address several needs such as efficient science management, attractive teaching programmes, and serving various external stakeholders. Given the size of the unit and its special boundary conditions strengthening and organising the operation primarily in three hubs “earth observation and space technology”, “machine learning and data science”, and “photonics and microscopy” could be an efficient way forward. The topic of “renewable energy” is very broad and potentially very applied and could be run centrally as an interdisciplinary centre of several units by the university.

Second, the partnership with the Polar Institute is apparently long standing but doesn’t seem to be a strategic priority. This is a missed opportunity. Such collaboration should appear more prominently and various levels such as the hiring plan, future infrastructures (data and experiment), international partnerships.

Third, combining the two previous points the Evaluation Committee recommends to define a long-term strategy concerning education (Bachelor, Master, and PhD level) to attract the best talents to Tromsø and possibly to the Artic region including Svalbard.

1.1 Research Strategy

The administrative unit takes a "bottom-up" approach, where UiT-IFT aligns with the goals and strategy of UiT. The goals are revisited on an annual basis. Six research groups (five are reviewed here) in UiT-IFT decide themselves their research focus and how to align with the UiT strategy. The groups have synergies and a separate structure for teaching programmes, and use of facilities as well as some collaborations within the unit and with other administrative units.

1.2 Organisation of research

The administrative unit is organized with a Head of Department (HoD), a deputy HoD responsible for teaching, and the head of administration. Research group leaders are appointed and participate in the extended leadership team. The unit participates in seven study programmes with separate leaders and boards. This organization serves well, and all the faculty members are potentially participating in the research or teaching leadership. It is well organized for their size and activities.

The administrative unit identified recruiting students as a major weakness related to location, and as a potential challenge in the future because a reduced number of students entering higher education programmes in Norway (due to demographics).

The six research groups are: (1) earth observation, (2) machine learning (AI) that is not reviewed here, (3) CSM (CoSMos), (4) renewable energy, (5) space physics, and (6) UMO. Specific recommendations are available at the beginning of this Chapter and individual comments are available in Chapter 2.1.

Group (1) struggles to maintain continuity in graduating PhD students, and although well respected internally and having the organizational support to do so, could do better with publications and external visibility according to the expert panel. This group has extensive collaborations and obviously great potential for interdisciplinary and -sectorial collaborations and impact.

Group (3) only has thrww faculty members, is highly rated, and has both high teaching load and large number of PhD students. It is an excellent group, but with fewer than the expected five members to form a group and with research interests that were considered diverted.

Group (4) lacks focus for their future as a research group. They are a young group that has not set roots yet. Renewable energy is a very broad topic and should be address in a centre involving several units of UiT to make a specific impact and attractive offering in and around Tromsø.

Group (5) is one of the largest research groups in Norway in this field, and it is active in their individual research topics. The expert panel considered them lacking cohesiveness and significant EU funding despite them making recognized contribution advancing the state of the art in their field. They make good use of their organizational infrastructure and facilities. The group has a large number of researchers with three senior members, and five more recent faculty members.

Group (6) has 6-7 faculty members, also several students and high marks from the expert panel for scientific quality. A cleanroom facility is missing and is limiting the potential for educating students locally.

The groups vary in size and attractiveness in a national and global context. Focussing on e.g. 3 major themes and possibly some interdisciplinary centres could help the unit to define and maintain a stronger position in the academic sector in Norway.

1.3 Research funding

Research funding is not a major concern of the unit. It has a healthy level with again a central role of RCN. The unit has been successful winning and attracting ERC Starting Grants. Industrial income is from long-term collaborations with (local) commercial satellite operators and the energy sector.

The challenges are very similar for all units reviewed by this Evaluation Committee. But UiT-IFT seems in addition to struggle with the lack of investment/capital funds to realise the cleanroom facility whereas operational and equipment funding is already in place. This is rather unusual and could be resolved with a one-off investment of order 2 MEUR by UiT, a donation or some other source.

1.4 Use of infrastructures

The unit hosts EISCAT 3D. This is an important infrastructure for Norway and part of a larger international collaboration. Already the predecessor EISCAT was operated there.

The unit uses and depends on NORFAB in Trondheim. The PIs are not satisfied with access because of travel required to use the facilities and the related limitations for student training and projects. If the activity of the UMO group should continue, a local cleanroom needs to be realised urgently.

UiT-IFT operates Sigma2 as local computing facility with mixed success. Some international partnerships and projects in modelling and HPC could help.

The unit uses the local node of a national (electron) microscopy platform.

Access and use of the infrastructure at the nearby Polar Institute are not described.

1.5 National and international collaboration

The level and type of local, national, and international collaboration fit well the potential and needs of the unit and its "bottom-up" strategy. The collaborations include obvious partners for the respective activities such as the local satellite company KSAT, the local hospital UNN, the applied

research institute NORCE, and the European Space Agency ESA. These collaborations are mainly at project and single PI level and not strategic partnerships of the unit.

Addressing some of the challenges of the unit (recruiting, critical mass), a focus on fewer research themes and with some global, strategic partners could be an interesting way forward.

1.6 Research staff

The personnel composition is balanced between senior roles and young talent. It is above 20% female at the faculty level, and about 30% at the graduate student and early career level. The admin staff is about 2/3 female. The number of graduate students is 1-2 per faculty member. However, some groups have higher numbers (grant success also leads to more internal funding). The overall staff composition suggests that renewal over time will improve the observed gender balance.

The unit uses various tools to welcome new personnel and offers courses for ECR training. It is not mentioned how they support new faculty members that are starting their teaching or research.

Mobility is available to all levels based on available funding (e.g. for sabbaticals of senior academics and for research stays of PhD students via RCN grants). It is stated that this funding has been reduced significantly. It appears that it is easier to obtain a mobility grant to come to UiT-IFT than to visit elsewhere.

2. Research production, quality and integrity

The self-assessment defines six research topics and describes how the research groups contribute to these topics. Group (2) or machine learning and AI is evaluated elsewhere, but their potential for interdisciplinary and intersectorial impact is highlighted again here. All the groups participate in data analysis while the Space Physics has its own application. Energy application has synergy from groups (1) and (4). Groups (1), (3), (4) and (6) contribute to climate and environmental monitoring. The UMO group contributes to health applications, as well as to nanotechnology and materials.

The productivity in the listed topics aligns with the productivity of the research groups contributing and includes publications as well as patents and licenses. Based on the individual research group assessments the productivity in energy could be improved because groups (1) and (4) are the two groups contributing to this topic and both were assessed as being able to improve productivity. Nano, health, and space physics are all productive and contributing to the state-of-the-art in their discipline.

2.1 Research quality and integrity

Research group: Complex Systems Modelling

This rather new research group (established in 2019) specialise in education and research on complex systems and non-linear dynamics, including HPC, with applications to controlled fusion, atmospheric physics, meteorology, and climate dynamics. The group includes three permanent academic members with rather diverted research interests. The research strategy is formulated rather vaguely: it is not clear what are the benefits of combining different research topics in the same group. The group have a broad funding portfolio, mainly RCN and TSF, but also MET and participation in an EU project. The support of the host institution includes supercomputer time, the funding of the DYNAMO centre, and 3 faculty posts. The group interact well with international research infrastructures (EuroFusion, MIT, ECMWF), The group play an important role in the host institution both in terms of active involvement in the UG and PG teaching, and inter-departmental research collaboration. The group members are involved in various national and international collaborations, including the leadership in the Space, Plasma and Climate section of the Norwegian Physical Society,

and expert membership in the International Tokamak Physics Activity Scrape-Off Layer and Divertor topical group.

Research group: Earth Observation

The organisational environment at the University Tromsø is adequate for supporting the research of the Earth Observation group. The research and publication quality of the group is recognized internally in terms of originality, significance, and rigor. The group has played a considerable role in the research process including the formulation of overarching research goals, the research activities and the publication's preparation. The EO group at UiT has a very considerable contribution to the economic and societal development in Norway, predominantly locally in the Tromsø region. The societal partners have a considerable involvement in the research process from the problem formulation to the publication and establishment of services.

Research group: Renewable Energy (REG)

The IFT Renewable Energy Group is small and growing (currently male dominated). It is a strategic initiative of the institution to enhance collaboration with the energy sector etc, but still at an early stage of development, despite being originally set up under different name in 2010. It had 2 permanent employees in 2018 and 4 professors by 2021. Previously research was driven by individual research interests and only now is a collaborative strategy being developed. This early stage shows in the lack of coherence of the submission and an underdeveloped strategy. It is not clear from the submission that they know where they are going. They should clearly broaden their expertise as the group grows and make more efforts to hire more women. However, they should also consider the scope of what can be achieved and focus their aims. They clearly have strengths on which they can build. With a clearer strategy this mark would be a 3.

Research group: Space Physics

This is a large and active group. All professors have their own unique research interests, which cover a rather broad and diverse range. There is no apparent or declared cohesive strategy for the research activities of the group, apart from the rather general and inclusive “engagement in high quality research at an international level” and “contribution to the development of space research infrastructure in the North”. Two important focal points of the group are dust (in the mesosphere and in space) and the preparatory scientific work on the EISCAT_3D research infrastructure, which seems to be a major driver of the current and future activities. The group has active collaborations within the University of Tromsø and an extensive network of international research collaborations. The research publications of the group in peer-reviewed journals are internationally excellent in terms of originality, significance and impact. The group’s overall work significantly advances the state of the art in the disciplines they are engaged in. Despite its big size and activity, the group has not achieved any major competitive EU funding.

Research group: Ultrasound, Microwaves, and Optics

The group is well organized and performs research at a high-level, generating knowledge beyond the state of the art. The main part consists of very well-defined optical research projects with high quality research output. The additional “small” research projects focusing on e.g., ultrasound transducers, seem to be a little outside the main focus of the group (optics). Therefore, the group should perhaps consider to mainly focus (only) on their main optical research or to increase the impact of the other research items. This is, however, a very strong group and with some very interesting developments among the faculty members that should serve to establish an unambiguous strong international position for the group. There is the necessary critical mass at all academic levels of the group to

actually make this happen. Also, there is a very sustainable distribution between faculty and the number of postdocs and PhD students.

2.2. Open Science

UiT and IFT are committed to Open Access. A large fraction of publications are OA and such publication is supported by central university services. They also employ a local repository for publications. OA can be costly for high impact journals. It is not clear who covers the costs for the unit with 48 faculty members.

UiT-IFT employs Norwegian standards to ensure access to research data and is aware of related research integrity conditions. These are in line with international standards.

3. Diversity and equality

A plan against discrimination is in place. There are clear responsibilities for handling cases. The plan follows best practice. Specific emphasis on gender balance makes sense for this administrative unit based on the present composition of staff.

4. Relevance to institutional and sectorial purposes

UiT-IFT relies on the PI's of the research groups to fulfil the university's strategy concerning sector-specific objectives. Notably, the research topics listed by the unit map onto several UN sustainable development goals.

Employees have the duty to report innovations to the unit and university administration in writing. The unit has a process in place to follow through on these reports and to file a patent application as deemed fit. The unit can secure limited funding for innovation projects and support these activities. Interestingly, innovation funding has a higher success rate then research funding for more fundamental projects.

The unit has long-standing collaborations with local, national, and international research institutes and local and national companies because of their strong research groups. However, government is not mentioned as stakeholder despite the many topics related to the environment and environmental monitoring.

UiT-IFT provides training opportunity for MS and PhD students in soft skills, support for grant writing and career planning. The scientific training is performed within the research groups. Groups with high productivity presumably are successful in training their students. No information was provided regarding how junior faculty is prepared or mentored for teaching.

5. Relevance to society

As mentioned above all the research groups contributed to the UN sustainable development goals with their research efforts as well as transfer knowledge and technology to industry.

Case 1 combines interests and expertise in UiT-IFT with local real-world needs of life in the Arctic. Case 2 is a more conventional example of technology development and transfer in a spin-off company that leverages the close collaboration and capabilities of groups in UiT-IFT in nanofabrication and results in deep-tech innovation in biomedical research and diagnostics. Submitting only two impact

cases for five research groups and a period of more than ten years seems rather minimal given the potential, expertise, and unique location that the unit has.

Comments to impact case 1

In a collaboration with the Centre for Research-Based Innovation CIRFA and MET Norway PhD students and PIs from the Complex System Modelling (CoSMo) and Earth Observation (EO) groups in UiT-IFT have developed and applied an assimilation algorithm extracting initial conditions from experimental data that enter large-scale computation and forecast models (Barents-2.5) for high-latitude ocean and sea-ice conditions. The forecasts are now in routine operation at MET Norway and have direct impact for shipping in the Arctic around Svalbard, in contingency models for oil spill preparedness and for search-and-rescue assistance.

Comments to impact case 2

On-chip nanoscopy was invented at UiT and successfully applied in a broad range of research projects in histopathology, vascular biology, neuron sciences, fishery sciences, and cell biology. The two resulting patent families are exploited by a spin-off company, developing, and marketing an innovative, new microscopy platform. Initial research and development were supported by EU grants (ERC, PoC, EIC) and later commercialisation by innovation and start-up funding creating jobs in the high-tech industry in Tromsø.

List of administrative unit´s research groups

Institution	Administrative Unit	Research Groups
University of Tromso	Department of Physics and Technology	Space Physics research group
		Ultrasound research group
		Microwaves and Optics research group
		Renewable Energy research group
		Earth Observation research group
		Complex Systems Modelling research group

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 (see appendix 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

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 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 assessment, and the interview. The Administrative Unit had the opportunity to fact-check this summary. The Administrative Unit approved the summary with minor adjustments.

Limitations

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

Appendices (link to website)

1. Description of the evaluation of EVALNAT
2. Invitation to the evaluation including address list
3. Evaluation protocol
4. Self-assessment administrative units
5. Grading scale for research groups

Website: https://www.forskningsradet.no/tall-analyse/evalueringer/fag-tema/naturvitenskap/

Norges forskningsråd
Besøksadresse: Drammensveien 288
Postboks 564
1327 Lysaker

Telefon: 22 03 70 00
Telefaks: 22 03 70 01

post@forskningsradet.no
www.forskningsradet.no

Publikasjonen kan lastes ned fra
www.forskningsradet.no/publikasjoner

Design: [design]
Foto/ill. omslagsside: [fotokreditt]

ISBN 978-82-12-978-82-12-04018-2 (pdf)