The Research Council of Norway

Evaluation of Mathematics, ICT and Technology 2023-2024

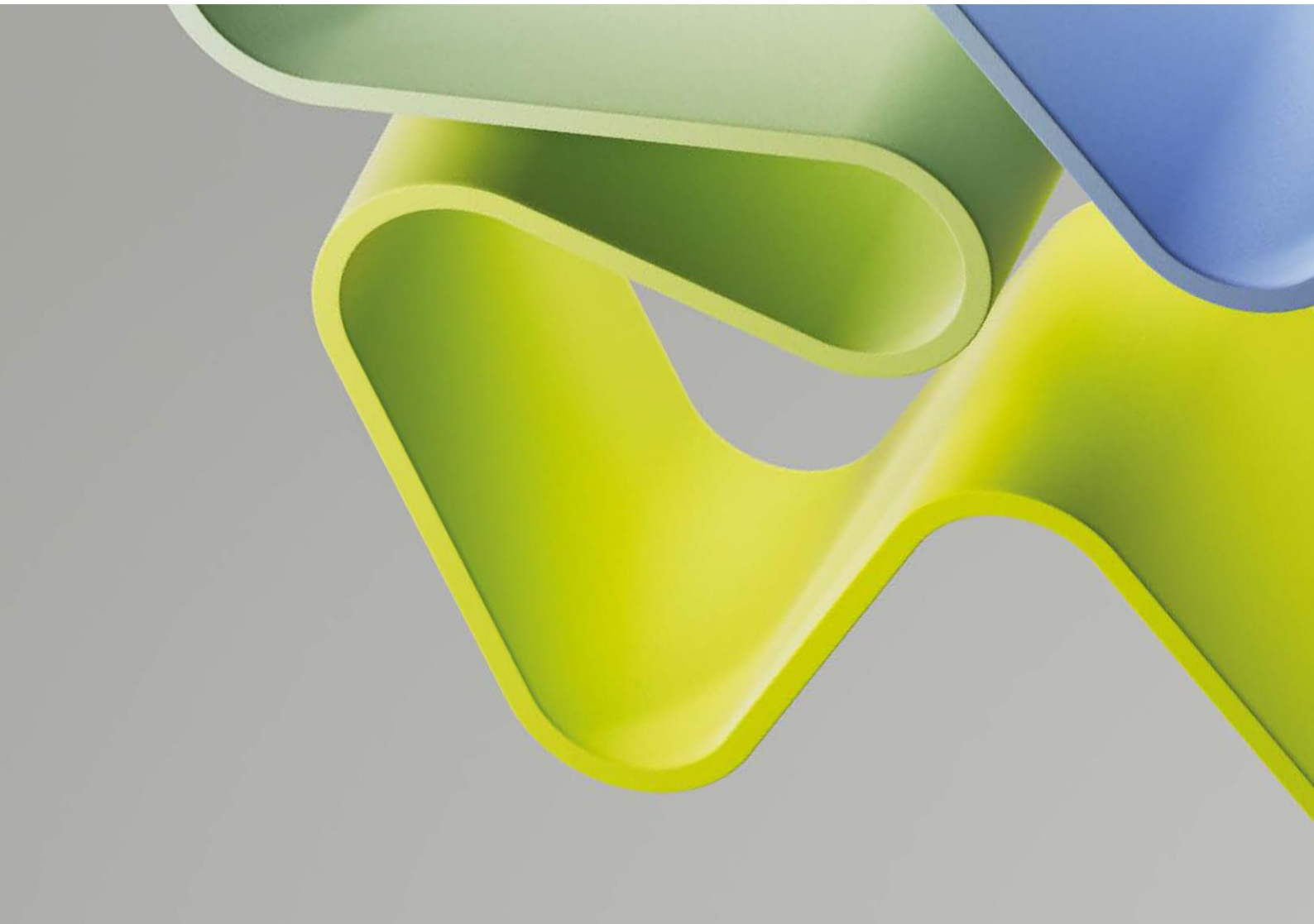
Evaluation Report for Administrative Unit

Administrative Unit: **Department of Informatics**

Institution: **University of Oslo (UiO)**

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),

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Professor Plamen Angelov,
Lancaster University

Description of the Administrative Unit

The Department of Informatics is organized into 17 research groups with four thematic sections, established in 2020, to enhance research and teaching collaboration. The sections include software design and development, distributed systems and security, machine learning and physical systems, and digitalization and information systems. Additionally, the unit hosted three semi-autonomous research centres at the time of evaluation.

The Department Board, elected by staff and students for four-year terms, serves as the unit's main decision-making body. Also the Head of Department and Deputy Head are directly elected by staff and students for four-year terms. The Head of Department appoints various managers and advisory councils in consultation with stakeholders, while the management operates through a three-tier system to establish effective routines and build trust within the newly created section structure.

The department has over 400 members of staff, with approximately 50 technical and administrative staff across its centres and administration. There are 41 professors (17% women), 36 associate professors (33% women), and over 100 doctoral research fellows (42% women). The department is committed to diversity, equality, and inclusion.

The research is organised in the following research groups:

- Design of Information Systems (DESIGN)
- Digital Innovation (DIN)
- Entrepreneurship (ENT)
- Information Systems (IS)
- Regenerative Technologies (RT)*
- Network and Distributed Systems (ND)
- Digital Security (SEC)
- Digital Signal Processing and Image Analysis (DSB)
- Language Technology Group (LTG)*
- Nanoelectronics (NANO)
- Robotics and Intelligent Systems (ROBIN)
- Scientific Computing and Machine Learning (SCML)
- Analytical Solutions and Reasoning (ASR)
- Computing Education (ITU)
- Reliable Systems (PSY)
- Programming Technology (PT)
- Software Engineering (SE)

*not covered in EVALMIT evaluation

In 2022, the department developed a Strategic Plan for 2023–2026, positioning itself as a leading research-intensive informatics department in the Nordic region. The plan focuses on sustainability and digital transformation, aligning research and education with societal needs, including a strong emphasis on Green Informatics for environmental sustainability. The department prioritizes high-quality, research-based education and fosters collaboration with industry. Strategic goals also include improving diversity and gender balance, while expanding research capacity through new faculty appointments and resource allocations.

The department actively engages in national and international collaborations, adhering to broader university strategies. The unit partners with top global universities, research institutions, and a range of industries, including IT, health, energy, defence, and agriculture. Collaborations are built on mutual interests, often involving joint projects across basic and applied research. The department prioritizes long-term partnerships, formalizing many through agreements. It has expanded international partnerships, particularly through Horizon Europe and collaborations in South America, Africa, and Asia, while also emphasizing interdisciplinary, cross-sector cooperation to enhance research quality and address societal challenges.

Overall Assessment

The department is the largest on this area in Norway. It covers a very diverse range of topics, from microelectronics to social sciences, and has a high number of internal units. Its location in the capital facilitates its access to general infrastructure as well as short distances to attend national events and funding agencies.

The strategy of the AU is to strengthen the strong performers and support the emerging ones. The breadth is perceived as a strength. There is clear appreciation of excellence and there is a general tendency to identify new topics and areas of potential impact and apply their methods and capacity to address them. Examples are ML and security. While several individual units are excellent at the international level and very well known in their domains, other are less prominent (see individual reports).

The organisation seems very well aligned to achieve its goals, and seems to have an appropriate management structure.

New hires are done strategically, as replacements or as positions in new areas. The Department covers 45% of the teaching in the faculty, which is over proportionally high. Despite this the teaching load seems a bit lighter than in other institutions, leaving a reasonable portion of time available for research and other engagements, it has been rapidly growing. The teaching distribution is managed in each unit, taking into consideration the commitments to management and large projects/centres.

The AU has an excellent track record of prestigious competitive grants, with national research centres and EU ERC grants and Horizon program collaborative projects.

The AU has an excellent track record for engaging in collaborations, cross disciplinary efforts within the institution and nationally, and it has substantial national and international collaborations with a large proportion of internationally co-authored papers. In several domains the relevant publication venues are either new and thus not yet ranked, or not ranked as these communities are niche, so the adopted strategy is to strike a balancing act considering tradeoff between the ranking and achieving communication to and notoriety in relevant communities.

The share of women and the diversity have improved, but they are still low at the higher career levels. It is a current goal to attract more female staff and PhD students.

While the number of full-time researchers in the AU has grown significantly, the effort to supervise PhD students has grown even more. This is a problem if one wishes to foster even more growth, as in such case even supervision teams will not be a help if everyone is already very busy.

Over 30% of all publications are at level 2 (high level), which is the preferred target, but over 30% are at conferences, which are not adequately captured by the current bibliometric system. This is a sectoral problem as it is well known that these statistics do not adequately reflect the effective value and relevance of the publications.

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.

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

Recommendations

1. Continue the support of clearly excellent units and research groups.

2. Concentrate effort to increase the quality of the relatively less excellent groups. If this does not succeed, in the mid-term potentially reconsider their role and position in the overall unit, potentially leading to reorganizations.

3. Refine the mid to long term strategy, specifically addressing which areas of the economy and society should be in the focus for applications and technology transfer, encouraging several units to address them and form visible centres of competence.

4. Reconsider the impact of very high student to professor ratio, in the classroom as well as at PhD level, providing increased support to those with high loads.

5. Increase support towards excellent grants application in order to keep the level up, specifically supporting younger members of staff to gradually achieve this level of excellence.

6. Continue the strong national and international collaborations, increasing the ratio of leadership roles vs. participant roles.

7. Continue the positive development towards increased gender balance.

8. Improve the communication effort for excellent research, people and outcomes, including also the next tier of individuals and achievements/initiatives, and not only the stars.

1. Strategy, Resources, and Organisation of Research

IFI is one of nine departments at the UiO Faculty of Mathematics and Natural Sciences (the MN Faculty), with a staff of more than 400 and close to 2,500 students. It is the largest such unit in Norway and the one with the strongest international rankings. In recent years accounting for close to 45% of teaching activity at the Faculty, and for around 30% of externally financed R&D. It has been significantly shaped by the 2 Turing Award and ACM medal winners among its professors.

Since 2020, the department is organized in four thematic sections: 1) software design and development, 2) distributed systems and security, 3) machine learning and physical systems, and 4) digitalization and information systems. These groupings reflect strategic prioritizations during the evaluation period. As several activities are now at that section level, in terms of the report and evaluation, it would have been likely more useful to evaluate those units instead of the individual departments: the new, coarser granularity has a more logic cohesion than the fragmented perspective of the many departments.

A strong objective is sustainability: “Green Informatics” is the theme pervading policies and influencing decisions, like investment: 26 new permanent positions since 2017 and several other resources have been allocated along these priorities and several strategic and action plans at the IFI, faculty and U. Oslo level policies (linked in the self report). This alignment enforces cohesion and coherence of decisions and measures by design. The organization is clearly mature also in under administrative and managerial points of view.

1.1 Research Strategy

The research strategy has been designed in a combination of bottom up and top-down fashion, to accommodate all the insights, this way also taking best account of dependencies. IFI has a comprehensive and forward-looking mission statement, indicating that it has

cognition and ambition at 360 degrees. However, the self-report makes clear that the research takes place in the context of a nearly doubled pressure for teaching (per FTE).

In this context it is of particular importance to consider strategic hiring and how to leverage collaborations in order to share burdens (e.g. across units) and foster synergies, including the synergy between research (their mission statement calls the Department "*a leading research- intensive informatics department")* and a "broad" education that covers the entire width of the discipline.

The recent reorganization in four thematic sections seems to be successful in focusing research. They stem from a recent strategic prioritization effort and the identification of four core values that seem to inform many decisions.

In particular sustainability and equality, diversity and inclusion seem to be very timely and help shape the evolution of the research environment, thematically like through the Green Informatics initiative as well as in the resource allocation.

The research strategy fosters high quality and productivity in research. In fact, there are mechanisms at various levels that recognize and support excellence, both in terms of individual education, mentorship and support and also in terms of resource distribution.

The very good infrastructure and the location in the capital should pave the way to attracting excellent staff, but there seem to be limitations there that play a role on the market.

While so far the strategic goals related to institutional strategies and scientific priorities are met, if the teaching load further increases and the basic funding further decreases, there will need to be a strategic recalibration in order to realign the ambition with the resources.

Recommendations to the administative unit

- Monitor the development of funding streams and policies, in order to recognize early new trends and new risks.
- Continue to aspire to high quality and international visibility and excellence
- Evaluate the effect of the Sections on the overall strategy and the communication and collaboration within the Department.
- Consider increasing support for strategic topics or initiatives, including at the individual level.
- Increase communication ambition about achievements and people.

1.2 Organisation of Research

Since the last evaluation the introduction of Sections has helped organize the decision making and the management structures in a more cohesive way. The *Green Informatics* initiative is understood broadly and taken into consideration in the allocation of internal resources, like seed or equipment funds and doctoral fellowships. The sustainability point of view also informs the support of new faculty members as well as the need to strengthen successful groups, e.g. in connection with large grants. This seems a very positive and constructive approach as it both fosters engagement and rewards success.

The research informed education offers also to MSc students the opportunity to engage in relevant projects, including also "long" MSc thesis of 60 ECTS that are unusual. PhD student education and young researcher supports and mentoring seem pervasive in the concerns of the unit, as we heard also in the interview.

The research organization includes also 3 "semi-autonomous centres", which seem successful, societally relevant and impactful. As these are externally funded and thus not

permanent, it is important to consider what is going to be their long-term role, and how they fit in the new section structure (aligned, transversal, etc.).

The described management structure and responsibilities seem adequate, also in terms of representation. There are also coordination mechanisms that help keep alignment between the different lines of action.

There has been a change of about 1/3 of the staff in the evaluation period, which is high. Many mechanisms for support of entrants are described, spanning funding of 1 PhD student, mentorship, education, language courses if needed, and communication.
The PhD program was evaluated in 2022 with good results.

Teaching allocation happens in the groups, in a group consensus form, that also accommodates individual needs if necessary. Mobility and internationalization are encouraged and in part financially supported.

Recommendations to the administative unit

- Increase the incentives for internal collaboration within the Sections and across units. Next to common initiatives, this also brings better information and communication, assuring that more opportunities are discovered and acted upon.
- Consider risks due to individuals moving, policies changing, other disruptions, and how they would affect the unit. While this is a general issue, the direct and indirect effects on research can be very large and sudden.

1.3 Research Funding

The research funding has been reported and described in detail. It is a strong unit, with significant income from national and international sources as well as a significant component of income from and collaboration with industry.

Not all groups are equally strong here (see the individual reports). One consideration explaining the differences might be the recent joining of many new hires, that are in the process of setting up groups and collaboration networks. Some comments in this repsect would have been useful. Also, comments on the performance of the Sections and the effects (if any) they introduced wrt. research funding would have shed more clarity on their effect as aggregation and catalyst agents.

Growth of base funding was related also to the strong increase of student numbers, but the general changes of policies, budget reductions etc have led to a higher commitment to teach vs. support that is 10% below the 2018 level. The consequences of frozen hirigns, reduction of PhDs/Postdoc hirings from the base funding and slashed supports for additional funding to fellows are worrying if the situation will continue this way.

Prestigious research grants were acquired, including coordination of large RCN consortial projects, SFI centres, ICT lighthouse projects, coordinations and particiaptions in the EU framework, plus other local and national research initiatives.

There is support for research proposals as well as project management after success.

Recommendations to the administrative unit:

- Continue and increase the ambitions and uspport for excellence initiatives (research centres, ERC, large projects) as they give a medium to long term perspective and thus stablity.

- See how to capitalize on the SFI research centres in order to create more permanent groups and structures, and a culture of excellence and internationalizaton on certain topics
- Leverage more the structure of the Sections (which are so far relatively low key in the self-report) for collaboration and strategy but also operationally, e.g. for technical and administrative supports.
- Reconsider the impact of the changed policy for basic funding.

1.4 Research Infrastructures

The infrastructure is excellent. Many groups make use of aspects of the Sigma2 National Infrastructures (research data, HPC and more), of the LUMI system, which is part of the EuroHPC ecosystem, the Norwegian Research and Education Cloud (NREC), eX3, CLARINO, other platforms UiO maintains (e.g. for education), and many more where UiO hosts nodes and provides shared equipment.

Additionally, the UiO science and innovation park, incubator centre, and “startup laboratory” are next door and a central location and role in the emerging Oslo Science City initiative ease access to the largest national pool of resources and collaborations. Individual units have listed facilities they have, equipment they have acquired and maintain, as well as access to national and international pieces of infrastructure.

UiO has been an early adopter of FAIR and CARE principles. The Library offers support and education, as also the IT support team.

Recommendations to the administrative unit

- Use the deep involvement with such infrastructures and the provider role as a unique trait to attract excellent staff.
- Include this aspect in the communication and dissemination strategy
- Try to leverage collaboration around such facilities.

1.5 National and international collaboration

IFI fulfils the ambition of playing a central national role as it has collaborations with relevant research units at all the other universities in Norway. The national collaborations with institutions outside of the university sector in Table 4 are impressive: SINTEF, Simula, research computing entities, regional health authorities, security authorities, and many companies e.g. in the energy sector.

Internationally, they start with the WHO, many international top universities for research but also joint PhDs, e.g. with the UC San Diego, and standardization organisations.
The collaborations span nearly every area of research activity and impact, providing a wealth of connections not only for single groups but also at the Department level and beyond.

Described policies are in place to support exchanges and visits, including covering costs for incoming visitors. The collaborations that take place in the research and educational realms are supported by the respective units and support teams. The collaboration with industry and for technology transfer are supported by various units and also happen in nearby technology transfer and innovation centres.

Additionally, the researchers are very active in the research community in terms of journal editorships, conference hosting, participation in the life of the respective communities through leadership roles in professional associations, COST actions, and other committees, this way increasing the visibility of UiO and also shaping the future of such communities.

Recommendations to the administative unit

- Continue the ongoing work, that is very successful.
- Increase the systematic inclusion of younger researchers
- Try to leverage the connections and collaborations for new initatives and projects

1.6 Research staff

The unit recruited 23 positions in the considered period, which is a high turnover for the unit about 30% of the core staff. This was an opportunity for a generation change and for strategic hiring, as well as for reducing the gender imbalance that is endemic in the sector. The recruits seem to have been successful, but 2 positions were locked due to the changes in the basic funding model.

In terms of topics, a few groups are rather new and are building up. Given the large number of groups, with some diversity in their aims and level of visibility/productivity, it would be useful to reconsider the current structure, especially if there are more retirements ahead that may offer the opportunity to introduce changes.

There was improvement in gender equality and EDI in general.

There are about 50 staff members in supporting roles on Centre or project contracts and 42 in the unit, not included in Table 2. It is not commented to which extent this a good level of support and to which extent it is (sub)optimal.

There is a high percentage of adjunct professors, which is good in terms of bringing external experts into the UiO, but it may be a risk if this is necessary as a means for covering the steadily increasing teaching load. A higher teaching load may also impair at some point the ability of researchers to take sabbaticals or mobility periods.

The theoretical distribution of work is standard, but if the teaching load increases the scientific output may end up suffering.

Mobility and sabbaticals not a reported aspect, but in the interviews, it was clear that it starts to be tight and there is the risk of postponements or even of people not applying as they don’t see how to fit it with all the duties.

Recommendations to the administative unit

- Reconsider the high number of groups and their denomination, especially in the context of the newly introduced sections.
- Consider a recruitment plan in light of the medium to long term strategy and also potential risk scenarios.
- Consider the risk of further teaching and supervision increase, in term of pressure on specific individuals/groups and how to find capacity.
- Monitor the longer mobility and sabbaticals, make them part of the standard planning for everyone but in particular for individuals in the first 5 years of their UiO career, at any level.

1.7 Open Science

Open science policies are adequate, and they are taken into consideration. Education on these aspects of students and staff is carried out in collaboration also with the Library and the IT support units.

The policies are implemented in education and also to a large extent in research. E.g. by publishing in open access venues.

Recommendations on how to promote open science

- Continue the good work on ensuring open access to research outputs.

2. Research production, quality and integrity

As a leading research-intensive informatics department, IFI publishes in high-impact channels and with high international visibility in the form of citations. The total and per capita numbers are very good.

A few focus areas have been identified, and the teams have pursued coordinated efforts to publish in those areas, from the projects or other initiatives. As anywhere else, the pandemic had its toll, and new publication venues that were created recently for new topics are not yet included in the official rankings.

Due to the meanwhile very well known fact that in the Computer Science topics the official methods of quality and impact evaluation do not sufficiently consider or weight conferences, and where these are listed, they are often ranked in specific ways that distort the reality of relevance and impact, the effective data are significantly better than what reported.

2.1 Research quality and integrity

Overall research quality is good with some exceptionally productive and visible groups and others that concentrate more on teaching and local activities.

Concerning research integrity, UiO has established a Standard for Research Integrity to clarify which sets of norms for research integrity hold for the university and its employees. Courses are mandatory for PhD students and all the researchers implement the Vancouver Conventions in determining co-authorship.

Research group Language Technology Group (LTG) overall assessment

The level of research is on par with that of other research groups in the area, and could be improved by publishing at more internationally well-recognised areas within Natural Language Processing. The user involvement is outstanding, as the group conducts a substantial amount of research on creating language resources, for which end users are directly involved in the creation process.

Research group Analytical Solutions and Reasoning (ASR) overall assessment

The level of research is slightly below that of similar international research environments. The strategy has been to become an attractive research group, focus on research-based innovation and EU projects, and involve itself in data science initiatives at the university. Moreover, the goals have been to reach international recognition and have more junior researchers. A strategy has been to offer more MSc courses to facilitate recruitment. The benchmarks have been to focus on excellence in research, in industry collaboration, and to contribute to the department's strategy through building applications for healthcare and involve itself in efforts on machine learning and data science. The group is doing well when it comes to industry collaboration but could still improve its research quality and impact. The level of research is slightly below that of similar international research environments.

Research group Scientific Computing and Machine Learning (SCML) overall assessment

The group has a good size to meet current demand in computational biology and bioinformatics. Concerning the organisation of the group, it is not clear to the panel, whether

the group members meet regularly, whether mobility of staff members to other (international) institutes is arranged and how the PhD students are embedded.The number of PhD and MSc degrees is good. The group is involved in an extensive amount of teaching both as coordinator as well as contributing to courses, hence has impact in the curriculum at the University.The panel finds the amount of external funding attracted very good. They have excellent collaborators and via these collaborations they contribute to interdisciplinary research at the University. The number of projects on which they are PI is however limited. The group has almost no funding from industry.The group publish with their collaborators on interdisciplinary topics in high impact journals. Among the listed papers there are a few outstanding papers presenting novel methodology. However, the number of citations to the published papers listed is limited.Via their collaborations the group has societal and economic impact. However, the group does not show any engagement to knowledge transfer to other groups and to reach out to the public

Research group Digital Security (SEC) overall assessment

The group demonstrates notable strengths in various aspects of its operations, particularly its emphasis on high quality education and research in cybersecurity. Although the group functions effectively and demonstrates a strong commitment to education and research, its further growth is necessary to achieve critical mass in such a multifaceted field as cybersecurity. The recruitment strategy can be strengthened with an increased focus on gender balance. The lack of clear benchmarks for research output and educated personnel hinders performance evaluation. The group's focus areas reflect contemporary challenges with high potential for practical impact. The group offers excellent contributions to education at all levels, with as notable achievement the high number of graduated master's students and the solid number of PhDstudents, resulting in a significant contribution to talent development and knowledge dissemination.The research output is very good at an international level but not yet excellent. The contributions to international standardisation are very valuable. While there are many collaborations with various stakeholders, direct collaborations with industry and public sector actors should be strengthened and the international collaboration can be further expanded.The international impact is focused on the standardisation and some EU level collaborations.

Research group Networks and Distributed Systems (ND) overall assessment

Overall, the research topics and corresponding research results are of very good to excellent quality, with strong impact publications in top, high-impact international journals. The strategy on research topics that have impact in society is sound. Traditional and emerging research topics in energy informatics and networked systems are addressed. Some crossdisciplinary research is performed. The research areas have sufficient breadth for the research group size. Several activities with societal impact such as patents, standards, and open-source software were successful. IFI is an institute with strong internationalcompetitiveness but does not fully exploit their strengths in getting significant EU funding.

Research group Digital Signal Processing and Image Analysis (DSB) overall assessment

The group's main strength is the quality of their work, especially their applied research which seems to include close and highly successful collaboration with stakeholders. In some instances, their research has led to patents and even a spin-off company, which illustrates a successful path from research idea to potential product.The group does well with respect to its benchmark of being nationally leading. In an international context, their work is published

in respectable venues, and some of their applied work is published in the very top journals. They do not, however, seem to play an active role in international collaboration or research leadership.

Research group Design of information systems (DESIGN) overall assessment

The DIS group is entering a process of generational transition. It has a strong historic background in PD and a very good international network in this area of research and a relevant research strategy in terms of contributing to making PD relevant today. The group contributes to significant and high-quality teaching and educational development; however,the group is facing challenges in terms of having the resources to also attract external funding and produce high quality publications.

Research group Robotics and Intelligent Systems (ROBIN) overall assessment

The strength of the group is to perform high-impact basic research while developing systems to meet societal challenges, particularly in health. They have set up a lot of collaborations inside and outside the department, with hospitals, and with leading international research groups. The Rhythm, Time and Motion (RITMO) centre of excellence is an excellent opportunity for collaborative research. Other strengths are teaching and outreach. Weaker points are external funding other than RCN (e.g. EU, industry) and industrial collaboration. Their organisational environment is very strong for supporting the production of excellent research. The research group produces work with a scientific quality that is recognised internationally. The group has played a very considerable role in the research process from the formulation of overarching research goals and aims via research activities to the preparation of publications. The group's societal contribution is very considerable given what is expected from groups in the same research field. Detailed information on the role of economic or societal partners and technology transfer is however missing in the selfassessment report. The group has established an interdisciplinary competence to integrate artificial intelligence, machine learning and robotics, with both technical and non-technical components. They are one of the few groups with such interdisciplinary competence, both in Norway and worldwide. This creates opportunities for them to play a leading role in research.

Research group Software Engineering (SE) overall assessment

The group has a healthy level of basic funding, supplemented by funding from industry, with some funding from other national and international sources. There are six funded projects, half concerned with technical debt and half with agile methods. Members of the group have served as program chair of a wide range of conferences and workshops, and served as guest editors of six special issues of journals. The overall level of research is internationally excellent.

Research group Programming Technology (PT) overall assessment

The group has mainly basic funding, supplemented by a small amount of international funding. There are two projects, one focused on CapillaryNet and one on maritime applications. CapillaryNet has achieved an impressive result, reducing the time to analyse a video of capillary flow from hours to seconds. The maritime work focuses on decentralisedreliable systems and setting new standards. The group has collaborations with Uppsala University, Trinity College Dublin, and Bell Labs, and notably has collaborated with the last on nine granted patents and nine more applied for. The self-assessment says little about the role they play in serving on programme committees, hosting conferences and workshops, or editing guest issues.

Research group Information Systems (IS) overall assessment

Overall, IS at the UiO exhibits several strengths that position it highly in the field of Information Systems and ICT4D. The group has a clear focus on health informatics and ICT4D, largely organised around the Health Information System Programme (HISP) (initiated in 1997) that supports the implementation of the District Health Information System v.2 (DHIS2), a global open-source project coordinated by the HISP Centre at the UiO. IS has established, cultivated and promoted the scaling of the global HISP community of researchers and practitioners around DHIS2. This together with its impressive track record in attracting external funding, underscores IS's commitment to addressing pressing global challenges. Furthermore, the strong publication record, coupled with a strategic approach that prioritises accessibility and impact, highlights the group's dedication to knowledge dissemination.The IS group fosters a strong relationship between research and education, with a notable emphasis on training Ph.D. students from the global south, thus contributing to capacity building and knowledge transfer on a global scale. Additionally, the group's interdisciplinary approach enhances the depth and breadth of its research endeavours, fostering innovation and collaboration across diverse domains.However, challenges remain in consolidating a renewed research group, which may require concerted efforts to address issues related to personnel changes and ensure continuity in research activities.Overall, the IS group demonstrates a high level of performance across various evaluation criteria and makes a significant contribution to the advancement of knowledge in an international context. Its strong emphasis on societal impact, coupled with a global perspective and collaborative ethos, positions it favourably for continued success in achieving its goals and maintaining its leadership position in the field.In conclusion, the Information Systems Research Group demonstrates strong organisational capabilities, a cohesive strategy, and a commitment to excellence in research, education, and collaboration. Through its concerted efforts, the group contributes significantly to advancing informatics/information systems research and achieving institutional objectives.

Research group Reliable Systems (PSY) overall assessment

The group's strategic focus is well-aligned with the IFI and UiO strategy and is a shaper in national (the Foundation for Industrial and Technical Research (SINTEF)) and international research and education activities. The group is unique in having a strong strategic focus on EU funding, comprising projects and also the first MSCA network with IFI as beneficiary. The strategic goal in 2014-17 of being awarded an SFI centre was achieved with Sirius. Similarly, activities in Security have led to research outcomes and to the early establishment of the SECURITY research program. With a yearly research income initially matching and now about twice the amount of its basic funding, this group is very successful in securing external funding.The research is highly interdisciplinary, spanning engineering, energy, health and biology, with a new centre where digital twins are used to study pandemics and sustainability. It is very international, with project collaboration with many top institutions and groups in Europe and beyond. The group maintains several open-source tools and projects, some of which like OTTR and ABS are used in industry. The ten highlighted projects cover diverse topics and domains, they are all of top quality and with leadership or significant contribution by PSY. There are numerous publications, many in top rated venues. The group is very active in the academic community: coordinating EU and national projects, hosting and chairing events and with an impressive number of program committee roles in a variety of excellent and very good conferences. The ten highlighted publication are of high calibre and by different group members, showing that the entire team is high performing. PSY is striving to achieve gender balance, and this has been achieved for PhD graduates, and with the recruitment of a female associate professor.The social contributions span significant

education engagement and innovation, open-sourcetools and projects, contributions to standards and to technology transfer, as well as media interviews and articles. The reorganisation into competence-based Laboratories and the increased visibility to the large population of BSc students are excellent responses to challenges in organisation and recruitment.

Research group Nanoelectronics research group (NANO) overall assessment

The group contribution is recognised in research within biomedical, Internet of Things (IoT), medical monitoring applications fields. The main contributions are:
• Novel solutions for impulse radio resulting in successful commercialisation of CMOS UWB radar sensors in high-volume products. This research also includes biomedical applications and system / antenna design. There are many ongoing collaborations with relevant companies (mainly NOVELDA), which is a success story.
• Low-power, low-voltage digital system design exploring novel fault-tolerant design principles targeting energy-harvesting IoT applications.
• Biomedical instrumentation for glucose monitoring including neuromorphic silicon system design.
• Novel solutions for sensor interfacing exploring frequency coding. One of the lowest power analogue-to-digital converters available has been reported. NANO research contributions have been recognised through two best paper awards, one technology innovation award (IEEE ISSCC-2018) and the University of Oslo InnovationAward in 2022. Two of the professors are also listed in the Stanford Elsevier list of the 2% most cited scientists globally. Part of the group strategy is a strong international engagement and exposure in the IEEE Circuits and Systems (CAS) society, where several staff members serve in central positions. The group has been and is involved in several research projects funded by EU and the Research Council of Norway (RCN) and is actively participating in several new proposals including an SFI (Sentre for forskningsdrevet innovasjon). Scientific quality is documented bythe group publication list, including several high-quality channels.The NANO group has strong relations with the Norwegian semiconductor and technology industry, which are formalised through several industry funded projects. The collaborationshave led to commercialisation of several ideas. Although the research quality is high, it is limited due to low involvement in international projects, very limited permanent faculty staff. Further, there is no clear hiring strategy within the department. If this continues to be the case, the group's performance will decline. The EU Chip Act will create new opportunities to exploit the high level of microelectronics activity and long history of chip design in Norway, so the group is strongly recommended to invest on hiring new permanent staff to raise both the quantity and the quality of the group.

Research group Digital Innovation (DIN) overall assessment

The research activity of the DIN group in terms of projects and publications are at the highest international standard. There is a strong organisational structure in place and it is clear that the quality of research activity is spread across the group rather than being reliant on just one or two staff. The Expert Panel struggled to find many suggestions for improvement, and even these (increasing funding and funding diversity and development of junior staff) the Expert Panel feel is already happening in some form and are only suggestions that the group may wish to adopt. Regarding user involvement, the Expert Panel scored this as a four rather than a five only because that involvement wasn't very clearly explained. The Expert Panel feel given the applied and collaborative nature of the projects that user involvement is also very strong.

Research group Entrepreneurship group (ENT) overall assessment

The group is deeply engaged in education. The basic funding appears to be sufficient, but the level of external research funding secured is very low, meaning that the group is reliant on this based funding to support their research activities. Despite this, the group publishes at a high level. The research group contributes to relevant international conferences, as well as highly ranked journals in relevant domains. Thus, the research output of the group is strong in an international context. The group consists of members that individually have strong merits but seem to be quite diverse and loosely coupled as a research group. The research strategy is general and vague. It does not contain any explicit ideas on how to increase research funding or how to change the balance between teaching and research. This is also manifested in the benchmarks that mainly mention education related KPIs, while research is broadly described. To achieve its goals, the group needs to find ways to lower the teaching burden. They also need to develop a strategy to attract more external funding. Here, the excellent publication records as well as the strong collaboration with industry would be an opportunity. The group's main contribution to society is made through their study programs, therefore there is also potential to strengthen the societal contribution beyond student internships and education.

3. Diversity and equality

The gender proportions have improved over the period, and various initiatives have increased the awareness and sensibility to the EDI topic, but more needs to be done.

A number of gender and EDI policies at the different institutional levels are listed.

Also in the MSc and PhD student cohorts the female particpation and the diversity have increased. The unit should continue to work on EDI.

4. Relevance to institutional and sectorial purposes

The research as well as the education topics are closely related to the currently hot societal challenges (sustainability, health, communications, digitalization, security, AI) as well as to the hot technological challenges.

Several contributions to standardization activities, to policies, to roadmaps, to international upskilling initiatives etc go well beyond the traditional scope of project-based research and course-based education.

The courses include research-informed elements like the innovative 60 ECTS MSc thesis work, over 1 year and often in projects or in cooperation with companies, showing commitment to this mission at the system level, well beyond single individuals.

There are many commercialization activities and technology transfer initiatives and next to them there is a bulk of achievements in several groups (also) in foundational contributions that may bear fruits in the medium to long term. This is essential research and should be appreciated and recognized.

At the PhD and postdoctoral level there are many career-building opportunities, both in the unit and at the UiO level. Specifically in the innovation and entrepreneurship domain there are national and international opportunities and programs as early as for students.
In the UiO Growth house there is induction and support for new promising ideas. Mentoring is provided both in form of supervision and also ad-hoc when needed.

5. Relevance to society

The overall contribution of the unit is very well aligned towards the Norwegian Long-term plan for research and higher education, societal challenges and the SDGs.

The Green Informatics initiative is the top-level system wide initiative on this, but looking at the individual projects, impact cases, and initiatives it is very clear that there is an underlying current of thinking and acting from a “responsible IT” point of view that informs choices, engagement and decisions.

For example, the DHIS2 Health Toolkit is a game changer in a sector of public services building in the Global South that has required years of continuous and relentless engagement and has led to great impact

5.1 Impact cases

Comments to impact case 1: eHealth infrastructures

This is a long term and large scale line of research with translation into practice through the DHIS2 Health Toolkit spanning 30 years: 1994-2023. It includes local cooperations (hospitals), regional actors, governmental agencies nationally and internationally with a trong collaboration with Unicef and the WHO. It concerns on one extreme concrete initiatives e.g. for diabetes, on the other extreme a globally adopted information system that serves as data management and intervention monitoring platform in over 60 countries.

This is not really a single, well defined “case”: it is a large line of research spanning decades and including a variety of aspects at very different scales.
In general there is definitely strong evidence of its relevance to improve the health of indivduals and populations, as well as a clear case for the importance of the IT platforms for this kind of knowledge management, information systems, spawned doctoral and educational programs for various kinds of professionals, and also an ambition to become a hidden standard, being adopted so widely in many countries.
The strategic cooperation with global agencies like UNICEF and WHO is certainly a strong channel for easing adoption and spread.
As the title of the case study is “infrastructure”, it is suprising that the economic aspects are not described: is a company developing and maintaining the toolkit? Or is it done project-driven in a commuity of practice? Is it open source? What are the IT and non-IT employment figures (developers, consultants, trainers) directly connected with this software?

Comments to impact case 2: Knowledge-Driven Transformation of Engineering and Operations in Capital-Intensive Energy Facilities

Tis line of work (since 2016) spans knoweledge management, representation languages and tool building to helo companies (here in the oil and gas isndustry) to manage their sectoral and internal knowledge and share data. There are tools and there is independent uptake by researchers (Australia) and startup companies, that corroborate the level of trust in the quality of the approach and tools.

Knowledge management and knowledge sharing (within ecosystems and with competitors) are known to be a diffcult to tacke due to the lack of skills, costs, and trust issues. The relevance is therefore clear, with evident needs and demonstrated high savings by those who adopt the approach. The importance is very high, as there is an ongoing standardization process for Industry 4.0 that will bring generalization and larger adoption potential. The core strenghts are the cohesion of the consortium, intiated in the SIRIUS SFI centre, that has continued to work together in new initiatives, and the span from theory to practice.

Comments to impact case 3: Machine learning for improved cardiac ultrasound

The case developed from 2014 on, in part in collaboration with GE rederach for uptake, and it concerns the use of Deep learning techniques to improve the analysis of cardiac ultrasound images. Improvements in segmentation and the synthesis of plausible labelled images contribute to the increased precision, training speed, and deliver real time diagnosis of several valular disease conditions.

With the increased prevalence of cardiac valves anomalies in an aging population it is important to be able to improve the detection and measurement of parameters on the basi of non-invasive images of internal organs. The work is therefore very relevant, and important in both research and societal respects. The strength is the formation of a team that has been able to establish and then grow this research with evident success over a decade, and it has led to uptake by GE and others so that these technques are now embedded in commercial equipment.
It would have been nice to distingush the period of research from the net period of impact (delivery of results), as done in other impact cases.

Comments to impact case 4: Low-cost miniaturized UWB antenna

The invention and design of several generations and variants of a UWB antenna, in close collaboration with the company Novelda, which resulted in game changing capabilities for near field wide band embedded sensing. This has been commercialized and widely adopted by many global companies, with impact on standards. The research stared in 2011 and the big impact took off in 2020.

The relevance is high and evident: having for example cheap and small proximity sensors allows to detect objects (or their absence) in real time at the edge, and is changing the field in a number of application domains. The importance is very high, for many industries that need to detect and track “things” with speed and precision. The example of child presence detection is illustrative of the use for safety, the example of “user away” for laptops is another, where security/privacy (lock screen) and sustainability (go to sleep mode) are clear benefits.

One core strenght is having accompanied the development form the product idea to the design/materials experiments to the commercialization, especially in the tight collaboration with NOVELDA. It’s also important that the initial studies showed the feasibility and put the topic on the radar of the research arms of many competitors.

One weakness of the presentation is that it does not address that the two key scientists, Prof Dag T. Wisland and Prof Tor Sverre Lande are also the foudners of NOVELDA. The facts that a key project is “owned” by Novelda and some resutls are not published due to NDA take a different nuance in this context. Founding a company from academia and growing it for 35 years is per se a great achievement, but it would have been more transparent to state this and openly frame the developments and milestones in this context. In other countries an issue of indirect unfair competitive advantage (use of knowledge, public funds) would be raised in such a constellation, unless properly disclosed upfront.

Comments to impact case 5: Transport Services (TAPS)

Since 2009, this group works on the creation of a *self-contained* transport level protocol implementation with a correspoinding API: TAPS. This means that it enables users to just use the API without needing to now interna of how the layer is implemented. The group is contributing to IETF and the software is open source on github. The impact period is since 2018.

Having self contained implementaitons of layers is key in true virtualization as it allows independence of what is inside (implementation) so that one can just use the API, and what is underneath, i.e. there are no dependencies on the lower layers, that also require

knowledge and stifle change. The work is therefore relevant and important.
The contributions to and work with IETF are a great means to impact as it is the core of the community for standardization and adoption.

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.

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
University of Oslo	Department of Informatics	Language Technology Group
		Digital Security
		Design of information systems
		Programming Technology
		Nanoelectronics research group
		Analytical Solutions and Reasoning
		Networks and Distributed Systems
		Robotics and Intelligent Systems
		Information Systems
		Digital Innovation
		Scientific Computing and Machine Learning
		Digital Signal Processing and Image Analysis
		Software Engineering
		Reliable Systems
		Entrepreneurship group

Terms of Reference (ToR) for the administrative unit

The board of the Department of Informatics, UiO mandates the evaluation committee appointed by the Research Council of Norway (RCN) to assess the Department of Informatics based on the following Terms of Reference.

Assessment

You are asked to assess the organisation, quality and diversity of research conducted by the Department of Informatics 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 3 aspects in your assessment:

1. Research profile and research conditions

The Department of Informatics considers the following aspects to be defining for its profile as the largest and leading university environment for informatics in Norway. The committee is asked to pay attention to this background information.

Research at the Department of Informatics comprises a broad range of sub- disciplines; this is a prerequisite to fulfill our societal responsibility and also a strong part of our identity.

Good research conditions are challenged by everyday teaching activities and candidate future activities, given a large and ever growing student body with an increasing diversity in backgrounds and demands.

2. Societal and scientific challenges: Green Informatics

Starting from 2023, the department has chosen Green Informatics as a new strategic focus area, to enhance environmental sustainability, advance digital transformation, and to develop methods, technology, and processes that support The European Green Deal (cf. the strategic plan for 2023-26). The committee will consider how the department at large, including relevant research group profiles and their plans contribute to these goals, and give advice on how the department can facilitate development toward Green Informatics.

3. Informatics as a discipline vs. enabling technologies

Research at the department covers both research on informatics as a scientific discipline in its own right and informatics as a collection of enabling technologies. Also, the department is constantly challenged on excellence vs. societal impact. These conditions lead to weakened recognition of informatics as a scientific discipline. The committee is asked to give its advice on how to emphasize and promote informatics as a scientific discipline in its own right.

In addition, we would like your report to provide a qualitative assessment of the Department of informatics 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.

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 current strategic plan of the Department of Informatics

earlier strategy documents for the period 2013-2022 (automatically translated)

Interviews with representatives from the evaluated units

Interviews with the Department of Informatics 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 the Department of Informatics 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 Informatics and RCN]. The Department of informatics 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 the Department of Informatics (attn. Chair Stephan Oepen, oe@ifi.uio.no, and Head of Administration Cecilie

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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