The Research Council of Norway

Evaluation of Mathematics, ICT and Technology 2023-2024

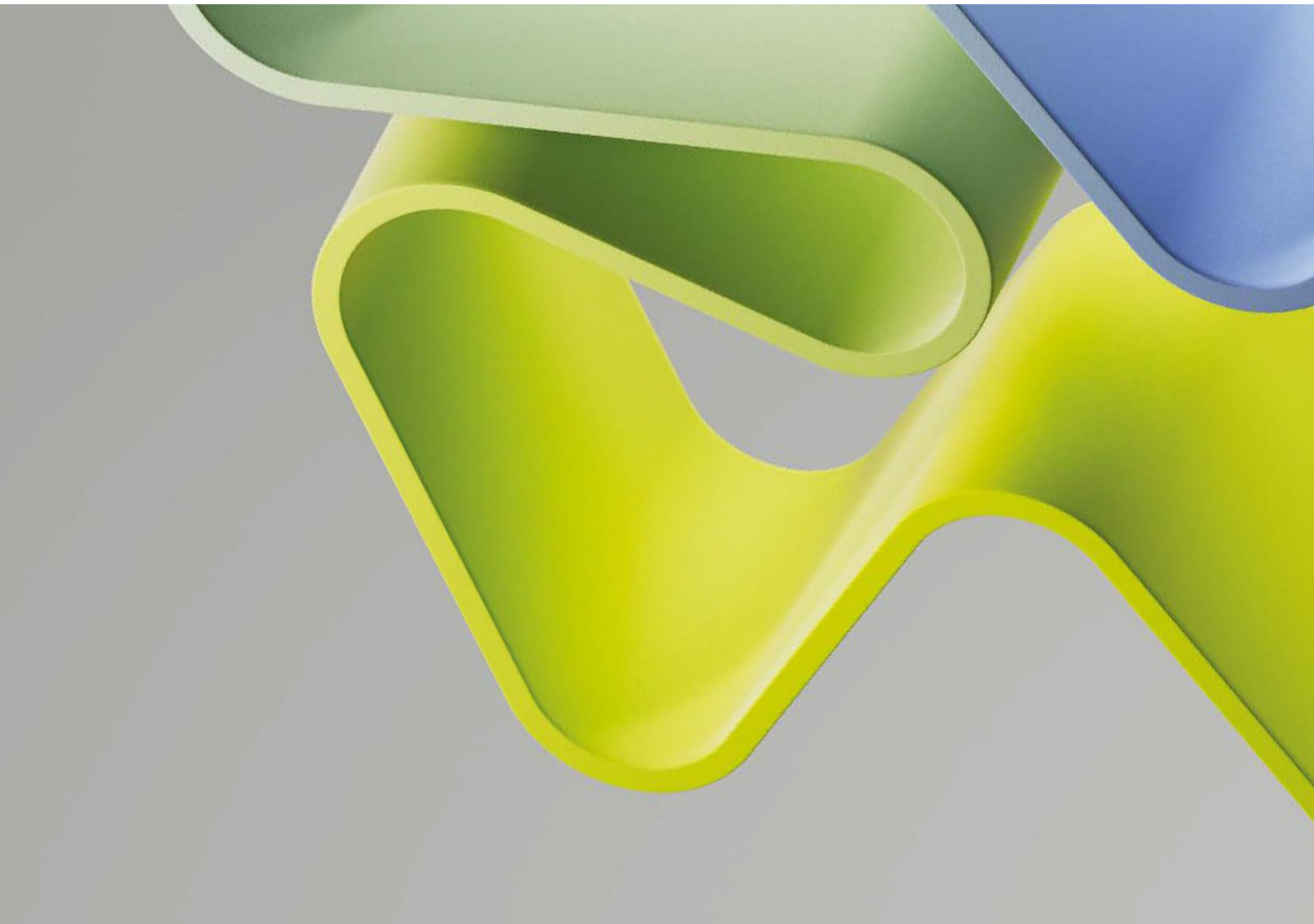
Evaluation Report for Administrative Unit

Administrative Unit: **Department of Informatics**

Institution: **University of Bergen (UiB)**

Evaluation Committee Higher Education Institutions 1

December 2024



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Statement from Evaluation Committee Higher Education Institutions 1

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

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

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

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

The Evaluation Committee consisted of the following members:

Professor Rebecka Jörnsten (Chair),

Univ. Gothenborg/Chalmers

Professor Matthias Schütt,
Leibniz Universität Hannover

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

Dr. Joanna Staneva,
Helmholtz Zentrum Hereon

Professor Björn Engquist,
University of Texas at Austin

Professor Plamen Angelov,
Lancaster University

Description of the Administrative Unit

The Department of Informatics is a medium-sized department with 120 scientific staff, including 33 associate and full professors, 16 adjunct professors, and 23 administrative and technical staff. The Department of Informatics aims to provide an inclusive work and study environment and promotes equality and diversity. Since 2017, the share of female professors has increased from 19% to 24%.

The Department is led by a Head of department appointed by the faculty board (as of October 2024, The Faculty of Science and Technology) for a maximum of two four-year terms. The Head reports to the Dean of the Faculty, and participates in regular meetings with the other heads of department in the Faculty of Mathematics and Natural Sciences. The Head has overall responsibility for scientific as well as administrative issues and has authority over the allocation of resources. The Head makes final decisions in all local matters where a choice or priority must be made.

The Department's main research focus is fundamental computer science, emphasising theory and its mathematical underpinnings. All groups perform theoretical, foundational research within their field. Several research groups also engage in applied research, typically through interdisciplinary collaborations, for example, towards energy, biology, and medical research.

The research is organised in the following research groups:

- Algorithms
- Bioinformatics
- Didactics
- Machine learning
- Optimization
- Programming theory
- Secure and reliable communication
- Visualization

The main strategic goal of the Department is to host a collection of research groups internationally known for performing research at a high level in an important area of computer science. The Department aims to have internationally renowned faculty at various levels of seniority and is known for supporting young talents to develop into research leaders. The Department also aims to foster a vibrant and ambitious research environment, stimulating and supporting cutting-edge research into pressing basic research questions in computer science. This work is strengthened by external funding and includes prestigious grants like ERC, FRIPRO (NFR ground-breaking research) and SFF (Centres of Excellence).

In terms of contribution to the higher education sector, the study programmes offered by the Department are tightly connected with the research groups, enabling truly research-based education. The department emphasises teaching theoretical underpinnings, giving students competence that does not become outdated. Master and PhD students are integrated with the groups. Being embedded in an environment with faculty at the frontier of their field enables students to work on timely problems and produce publishable results.

Overall Assessment

The strategy of the AU is defined from a computer science logic and not from a logic of computer science in relation to society as it aims to address “pressing basic problems in computer science”. Alternatively, a strategy could have been “to identify societal challenges that basic research in computer science may help solving”. The strategy does not explicitly mention artificial intelligence and quantum computing. The Evaluation Committee finds that these areas are of such future importance that any informatics department should reflect on its role in relation to these areas. The management and organisation are very well aligned to achieve the goals and are appropriate and balanced.

The societal impact of the AU is realised through the high number of graduated students who find employment in both public and private sectors. Another major societal impact results from engagement in programming language committees, in contributions towards energy informatics, communication security, computational biology (including precision medicine), medical imaging and visualization, and through collaboration with industry organisations. These can all, perhaps except for the programming languages, be judged as being interdisciplinary efforts.

Faculty has not increased proportionally to the student numbers. The AU does not monitor the individual teaching load; this is handled by the research groups. It is not described if junior staff receives training in responsible conduct of research or university pedagogics. It is not described how competences and tasks are aligned, and how quality is ensured.

The AU has an excellent track record of obtaining prestigious competitive grants both at a national and European level. The AU, through its Centre for Bioinformatics, has led national research infrastructure projects for bioinformatics since 2002 and engaged in the process, establishing the European research infrastructure for bioinformatics in 2013 which Norway joined in 2014 and has later obtained status as an ESFRI landmark.

Many researchers are highly visible at key conferences within their fields. The extent and importance of international collaborations are documented through more than 70% of publications being with international co-authors.

The AU has had an increased number of full-time research staff growing from 71 in 2013 to 103 full-time research staff members in 2021 distributed as 32% professors, 20% postdocs, 7% researchers, and 41% PhD-students. Hence, the ratio of postdocs and PhDs to professors is 1:0.64 and 1:1.27, respectively. This is an appropriate ratio.

The share of women is 16% but has increased from 19 to 24% with respect to professors since 2017, but far from the goal of 40%. The number of full-time researchers in the AU has grown 45% since 2013. The number of publications has, in the same period, grown by 13%, and author shares have grown by 43%. There has been a stagnation in both over the last four years. The citation score decreased from 142 to 81 in the period 2013 to 2022.

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. The committee recommends that the research strategy is aligned with the societal impact. In the current formulation, the societal impact seems to appear arbitrarily, not through a careful strategic selection. If defined through an informatics lens only, the

strategy may risk not identifying new research directions of societal importance in years to come. It is encouraged that the AU includes more emphasis on the relevance and impact of the strategy.
2. The evaluation committee recommends that the AU specifically take its role in developing artificial intelligence, machine learning, and quantum computing into the strategy.
3. The evaluation committee recommends that the AU handle that student intake has increased faster than growth in faculty numbers, such that the overall teaching load on the individual faculty member does not hamper the research while still maintaining high-quality research-based teaching. This may happen by carefully taking into account student numbers, organisation of the teaching, structure of the teaching, including didactic elements, and the number of faculty.
4. Younger professors are encouraged to receive proper training and mentoring in teaching, grant writing, and potentially disproportionally more often sabbaticals and relatively less teaching.
5. The evaluation committee recommends that the current effort to obtain prestigious grants is maintained and structures for sharing knowledge on successful efforts are introduced or strengthened to multiply the successes even further.
6. The evaluation committee recommends that the AU make sure to engage in national and international infrastructures and invest in Graphics Processing Units (GPU) resources, as machine learning and simulations will also be used by researchers from other areas of informatics.
7. The evaluation committee recommends that strong international collaborations and the publication tradition be transferred to more funded international projects.
8. The evaluation committee recommends that the department continues its positive development of gender balance and strives toward more than 40% of both genders.
9. Maintain a strong focus on fundamental research, but make sure, by strategical considerations, that the focus areas are timely and follow the needs of society.
10. It is well appreciated that machine learning and didactics have recently been introduced, even if it may be a little late. The evaluation committee recommends that the AU works systematically to ensure that important growing areas of informatics are covered and that newly introduced areas are helped to reach critical mass fast.
11. The evaluation committee recommends increasing the proportion of PhD students and postdocs to professors.

1. Strategy, Resources, and Organisation of Research

The Faculty of Mathematics and Natural Sciences is organized into seven departments, with the Department of Informatics being responsible for research and education in informatics, as well as contributing to a range of multidisciplinary efforts.

The Department of Informatics was established as a separate unit in 1984 after having existed as an activity within The Department of Mathematics since around 1963. The Department is led by a Head of Department. The Head reports to the Dean of the Faculty.

As of today, the Department of Informatics consists of eight research groups. Six of these groups take part in EVALMIT: Algorithms, Machine Learning, Optimization, Programming Theory, Selmer Center in Secure Communication, Visualization. The research groups are established or closed after careful consideration and discussion among faculty based on scientific developments around UiB and/or opportunities for funding and student recruitment. The department strategy is followed up through allocation of resources to individual groups, mainly by opening tenure-track or permanent (full or associate) professor positions linked

with those groups that are to be strengthened, and through recruitment into PhD and post-doc positions.

The Department of Informatics has recently finalized a strategy document for the period 2023-2030. This includes a research goal formulation.

The organisation into scientifically cohesive research groups is a well-known structure that have proven its potential for excellent research in many places. The formulation of dynamics of opening and closing of new groups seems more reactive than proactive. The strategy is well explained and reasonable.

1.1 Research Strategy

The research strategy of the AU is laid out as being achieved through the following activities:

- Strengthening and developing informatics as a discipline through strong fundamental research organized in groups large enough to have critical mass and robustness, with each group having at least three permanent scientific positions and a basic level of resources to conduct high-quality research that does not entirely depend on external funding.
- Working with research groups to identify pressing basic problems in computer science that can be addressed by the department and developing research programs to approach these problems.
- Working to increase the funding for research and education at the department given the increasing importance of informatics in society.
- Stimulating and supporting the research groups to seek external research funding and offering incentives to encourage researchers to apply for ERC grants and coordinate large collaborative EU applications.
- Continuing to use the TMS recruitment program and tenure track positions to attract young research talents internationally, help them build their research profile, and further their development through mentoring and leadership programs.
- Work actively with the recently established groups to help them develop and obtain international recognition and visibility.
- Promoting Open Science, FAIR data management, and Responsible Research and Innovation practices.
- Engaging in centres and infrastructure efforts, and working with external partners including Simula UiB, helping to strengthen our fundamental research.

The overall strategy for the AU includes supplementation of the research strategy with strategies for Education, Innovation, Communication, and Organisation.

The strategy of the AU may be interpreted as defined from a computer science logic and not from a logic of computer science in relation to society as it aims at addressing “pressing basic problems in computer science”. Alternatively, a strategy could have been “to identify societal challenges that basic research in computer science may help solving”, or similar. The strategy does not explicitly mention artificial intelligence and quantum computing. The Evaluation Committee finds that these areas are of such future importance that any informatics department should reflect on their role in relation to these areas.

The activities and organisation seem very well aligned to achieve the goals and seems appropriate and balanced.

The societal impact of the AU is realised through the high number of graduated students who find employment in both public and private sectors. Another major societal impact results from engagement in programming language committees, in contributions towards energy informatics, communication security, computational biology (including precision medicine), medical imaging and visualization, and through collaboration with industry organisations.

Recommendations to the administrative unit:

- The Evaluation Committee recommends that the research strategy is aligned with the societal impact. In the current formulation, the societal impact seems to randomly appear, and not through a careful strategic selection. It is encouraged that the AU includes the relevance and impact in definition of the term “pressing” in the strategy. If defined through an informatic lens only, the strategy may risk not to identify new research directions of societal importance in years to come.
- The Evaluation Committee recommends strategically selecting the fundamental problems to solve to maximize both scientific depth and societal impact.
- The Evaluation Committee recommends that the AU specifically take their role in relation to development of artificial intelligence and quantum computing into the strategy.
- The overall organisation and focus on recruitment and careers of younger researchers is well appreciated, and if possible, should be further strengthened. This also includes to further strengthen the successful focus on ERC and other highly competitive and prestigious grants.

1.2 Organisation of Research

The management of the AU includes a head, a deputy head, and a head of education where the latter are appointed by the head of the AU. The internal organisation includes designated group contacts for each research group. For some groups this is also the appointed leader of the group while other groups have a flat structure where the role of group contact rotates among the professors. Groups are ensured critical mass with at least three professors. The management structure is not sufficiently well aligned to all managerial tasks. Handling personal development and well-being of employees demands a very clear management structure with a not too large management span for the individual manager. It is unclear how this mandate is delegated in the above-mentioned structure.

Full-time professors are to use 46% of their time for research, 46% for teaching, and 8% for administrative tasks. Faculty hasn’t increased proportionally to the student numbers. The AU does not monitor the individual teaching load, this is handled by the research groups. This may lead to well-known situations where older, more recognized, and established researchers use their authority to avoid less manageable teaching activities.

Professors can apply to the department/faculty for a research leave with salary - one year’s leave after six years of service, six months’ leave after three years of service at UiB. However, female tenured associate professors can apply after half the accrual period.

Recommendations to the administrative unit:

- The informal management of some groups could risk leading to less collaboration and cohesion as no-one has the formal responsibility ensuring this in the research group. The evaluation committee recommends to keep an eye on this, and intervene, if the management structure seems suboptimal.
- The informal management structure may lead to an inexpedient distribution of tasks, and it is encouraged that the department appoints managers that can handle the well-

being of all employees and provide an appropriate task distribution. The evaluation committee recommends that the department monitors the teaching load of younger professors, as dynamics from seniority and leadership, could lead to less favourable teaching duties for younger professors.

- The evaluation committee recommends that the AU and faculty seeks to maintain a manageable student to professor ratio by changing the ratio or teaching activity portfolio.
- The evaluation committee recommends that the AU ensures necessary training for teaching and for conducting research responsibly to ensure reproducible, fair, and open research.
- The evaluation committee recommends that younger professors are receiving proper training and mentoring in teaching, in grant writing, and potentially disproportionally more often sabbaticals and relative less teaching. The current mentoring programme is appreciated and further development of this encouraged.

1.3 Research Funding

For the year 2022, the department's budget, including both basic and external funding, was 168 MNOK. Of this, 57 MNOK was external funding. Approximately 64% (ca. 108 MNOK) of the department's annual budget was used for research activities. For the period 2018-22 an average of 53 MNOK was acquired from national sources of which RCN contributed 37 MNOK. International sources contributed 6 MNOK totalling 59 MNOK. The international sources included two ERC grants obtained in the evaluation period. The national grants included 14 FRIPRO projects.

In addition, the department led one TopForsk project, six projects funded by ICT programmes, two infrastructure projects, all funded by the RCN. The department was also partner in a Centre of Excellence (SFF – Center for Cancer Biomarkers), a Centre for Research Based Innovation (SFI – Sea Lice Research Centre) and a Centre for Clinical Treatment Research (FKB – Neuro-SysMed), among the largest centre grants from the RCN.

The national funding is predominantly from RCN, and international sources are predominantly from ERC. The AU has a strong track record in grants for basic research based on excellence. Strategic and interdisciplinary grants could supplement these. Since the self-assessment points to impact through collaborative efforts, this could also lead to strengthening of the impact.

Recommendations to the administrative unit:

- The AU has an excellent track record of obtaining prestigious competitive grants both at a national and European level. The evaluation committee recommends that the current effort is maintained and structures for sharing knowledge on successful efforts are introduced or strengthened, so the successes can be multiplied even further.
- The evaluation committee recommends that the AU works strategically towards being leader of Centre of Excellence.
- The evaluation committee recommends that the AU works strategically towards obtaining more ERC grants, also on the Advanced Grant level.
- The evaluation committee recommends that the AU works towards obtaining more interdisciplinary and strategic grants to increase research capacity and impact.

1.4 Research Infrastructures

The AU, through its Centre for Bioinformatics (CBU) has led national research infrastructure projects for bioinformatics since 2002. This has been funded through the RCN.

CBU also engaged in the process establishing the ELIXIR, a European research infrastructure for bioinformatics in 2013 which Norway joined in 2014 and has later obtained status as an ESFRI landmark.

The AU and CBU now leads a national consortium including UiO, NTNU, UiT and NMBU operating ELIXIR Norway supported by Nordic and European grants in addition to RCN support. CBU has engaged in enabling biobank users to analyse molecular level data in the Biobank Norway (BBMRI.NO) project. The AU engages in helping ELIXIR users to benefit from the NAIC (Norwegian Artificial Intelligence Cloud).

These activities of CBU and ELIXIR are excellent examples of how contribution to local and international infrastructures can also magnify the research and the impact of the research in the centre and the AU.

The AU has been pioneering, supporting, and utilizing high-performance computing in Norway. The running of HPC facilities has been moved to the IT section and organized on a national level through Sigma2. The department is still actively contributing to the Ex3 project for exascale computing.

The IT division at UiB operates a server infrastructure for compute and storage. The AU has signed a collaboration agreement with the IT division ensuring a tight collaboration between the two reflecting the special role of the department and the mutual importance and value of a tight collaboration for the two parties.

The department has acquired a local Graphics Processing Units (GPU) - based cluster for machine learning projects. The department is engaged in the Norwegian Artificial Intelligence Cloud infrastructure project that builds e-infrastructure solutions for AI research.

The overall activities on infrastructures are in bioinformatics and HPC including GPU resources and more areas could engage in building infrastructures.

Recommendations to the administrative unit:

- Whereas the CBU has been very successful in their contribution to and utilization of national and international infrastructures, the Evaluation Committee recommends that the AU also benefits from engagement in and contribute to national and international infrastructures.
- The Evaluation Committee recommends that the AU makes sure to engage in national and international infrastructures and invest in GPU resources as machine learning and simulations will be used by researchers also from other areas.

1.5 National and international collaboration

Many researchers are highly visible at key conferences within their fields. More senior group members can help early career researchers to set up new collaborations. The extent and importance of international collaborations is documented through more than 70% of publications being with international co-authors (cf. NIFU bibliometric report).

The research groups of the AU have an excellent track record of contributing to national and international collaborative efforts. Nine national and 10 international are mentioned in the self-assessment report.

The Visualization research group is part of the leadership team for the national network for precision imaging and machine learning (PRESIMAL) and thereby has active interdisciplinary research collaborations with healthcare researchers and clinicians.

UiB and the AU, was active in forming NORA, a national consortium for research in AI.

The other mentioned national collaborations also include other interdisciplinary efforts including PhD schools and substantial industrial collaborations.

The international collaborative efforts include two funded EU projects, and the list of long-term collaborators for each of the research groups.

Recommendations to the administrative unit:

- The Evaluation Committee recommends that the strong international collaborations and publication tradition is transferred into more funded international projects. This could be done by actively seeking into or forming consortia needed for the larger international projects. This is a strategic effort where necessary supportive structures must be in place for researchers to manage this.

1.6 Research staff

The AU has had an increased number of full time research staff growing from 71 in 2013 to 103 full-time research staff members in 2021 distributed as 32% professors, 20% postdocs, 7% researchers, and 41% PhD-students. Hence the ratio of postdocs and PhDs to professors is 1:0.64 and 1:1.27 respectively.

The share of women is 16% but has increased from 19% to 24% with respect to professors since 2017. The AU use search committees encouraging excellent female candidates to apply. The AU strives to have a share of at least 40% female research personnel in permanent positions.

All professors are tenured or in tenure track positions. The department works with social activities to improve the psychological work environment.

Recommendations to the administrative unit:

- The Evaluation Committee recommends that the AU continues to grow the number of professors to maintain a reasonable teaching load and quality.
- The Evaluation Committee recommends that the department continues its positive development of gender balance.
- The Evaluation Committee recommends that activities to improve the psychological work environment are monitored for their efficacy, and especially for minorities.

1.7 Open Science

UiB has a policy to strive for openness. UiB has a publication fund where researchers can apply for funding to cover Article Processing Charges. UiB also has Open Access publishing deals with several publishers.

It is encouraged that projects include activities centred around involvement of stakeholders such as patient organizations.

FAIR principles are encouraged and in use. Research projects led by researchers at UiB shall have a data management plan, which is further enforced in practice by various third-party funders.

In general, the person who generates a result out of their research is the owner of the rights to the result unless otherwise stated. The proportion of not open access publications have increased since 2019 to 2022 from 11% to 21%.

Recommendations on how to promote open science:

- The Evaluation Committee recommends to follow the development on use of open and closed publications and use this as a regular KPI.
- The Evaluation Committee recommends to have close focus on the trend in closed access publication.

2. Research production, quality and integrity

The research at the department has in its entire lifetime been focused on fundamental computer science with a strong emphasis on theory and its mathematical underpinnings.

Currently the research groups are within Algorithms, Bioinformatics, Didactics, Machine learning, Optimization, Programming theory, Secure and reliable communication, and Visualization, and a group in didactics established outside the assessment period. The Machine learning group was established in 2018.

All groups perform theoretical, foundational research within their fields and publish in the premier journals and conferences. Several groups also engage in applied research, typically through interdisciplinary collaborations for example towards energy, biology, and medical research.

The citation score has decreased from 142 to 81 in the period 2013 to 2022. This is critical and must be analysed. If the AU conducts research in areas that are not popular any longer this must be made clear.

On top of national regulations, UiB's has its own ethical regulations. These include 10 key points based on the ethical guidelines drawn up by the National Research Ethics Committees. It is not described how the AU have implemented measures to ensure that research staff follow the guidelines including educational activities to ensure compliance.

The number of full-time researchers in the AU have grown to 45% since 2013. The number of publications has in the same period grown by 13% and author shares grown by 43%. There seems to have been a stagnation in both over the last four years. Publications are mainly in informatics with some part (15%) in mathematics and a small but seemingly growing part in multidisciplinary natural sciences.

The publications and their impact have not developed as successfully as the number of students and staff.

Recommendations to the administrative unit:

- The Evaluation Committee recommends to maintain the strong focus on fundamental research, but make sure, by strategical considerations, that the focus areas are timely and follow the needs of society. It is well appreciated that machine learning and didactics have recently been introduced, even maybe a little late. It is recommended that the AU works systematically to ensure that important growing areas of informatics are covered.

- Several informatics areas are driven not by theoretical achievements but by new practical endeavours such as the deep learning revolution. Not focusing on the practical developments risk missing developments that also have opportunities for impactful fundamental research. The Evaluation Committee recommends that the AU works systematically towards ensuring that practice can also influence theory.

- The Evaluation Committee recommends looking critically to which degree the AU maintains to conducts research in areas that grow out of fashion. If this is the case, this must be a deliberate choice or changed.
- The Evaluation Committee recommends that the AU surveys the compliance to ethical guidelines.

2.1 Research quality and integrity

Six research groups of the AU are part of the EVALMIT evaluation. None of them are outstanding in their organisation, societal impact and user involvement. The general lack of involvement of users and societal impact is also followed by a decline in citation impact of the groups, and a strategy that focusses solely on pressing problems in computer science, but does not address developments in society including artificial intelligence and quantum computing.

Some groups are doing excellent and outstanding in research quality, and in general the groups contributions to this have been very favourably evaluated.

Research group Optimization (OPT) overall assessment

Given such a small group with very little external funding, it is impressive that they can produce as much high-quality research as they do. The benchmarks and goals as stated make it difficult to assess if they will be able to meet them or not, but the group is committed to carry out high-quality research. However, if the group secured more funding for basic research and were able to hire more postdocs or more faculty members they would be able to increase their research profile. The group is not world leading in an international context but does publish in good-quality international journals. The group has done a lot of applied research on applied optimisation problems, but as of yet has not engaged stakeholders in the wider community. The recently started Ocean Charger project that they are members of has the potential for greater societal impact.

Research group Machine Learning (ML) overall assessment

The group is performing adequately in an international context. The scientific quality of papers itself is good, but they have not had much impact yet. The group is still young and has been growing in terms of members and external funding.

Research group Algorithms (Algo) overall assessment

Members of the group have impressive research track records and they are publishing in the top venues in their field. The group has also built extensive research collaborations with leading institutes worldwide. The group has been very successful in attracting external funding. Most significantly, it has been awarded four European Research Council (ERC) grants. The group has a strong involvement in education. Members of the group are also supervising students at the Master and PhD level. with a commitment to the quality of the mentoring. The group also participates in EX3 national infrastructure for computational high[1]performance computing (HPC) resources. Overall, the level of research excellence is excellent when compared to international groups working in this research field.

Research group Selmer Center in Secure Communicaton (SC) overall assessment

The group's publications are known for their very high quality and demonstrate great academic rigor and relevance in their field of study. The participation of renowned scholars strengthens the international reputation and academic credibility of the group. The presence of adjunct and emeritus professors provides a wealth of experience and ensures continuity

of knowledge and expertise, which has had a positive impact on the group's research output and outreach in the past. The research group relies heavily on its more senior professors for key research and outreach activities. This reliance might be a problem in the future as these members step down from their active roles. As the group does not have European and industrial funding (funding comes mainly from national sources), it has limited resources and opportunities for collaborative and practical research, which limits the group's options. With only 30 MSc students in ten years, the group's role in training new researchers is relatively small, which could have a long-term impact on the availability of qualified researchers in the group

Research group Visualization Research Group (VisGroup) overall assessment

The VisGroup aims at assuming a leading role in application- oriented basic research in visualization, at the local, national, and the international levels, focused on high quality research. Moreover, the group undertakes teaching in visualization as part of undergraduate studies. Also, the VisGroup offers an MSc study program that balances visualization design with technical skills. The VisGroup has focused on high-quality basic research in visualization as evidenced by a reported 30% of all publications in level-2 journals (defined as “top-20%”). In 2022, CSRankings (Computer Science Rankings) ranked the VisGroup of UiB as the ninth-best visualization research group world-wide. The research group has high visibility in the international visualization community organising and participating in program committees of major international conferences and in editorial teams of very good journals such as the Computer Graphics Forum.

Research group Programming Theory (PUT) overall assessment

The group appears to be strongest in Homotopy Type Theory, an area of great interest in the programming languages and theoretical computing community. The group is also contributing to the ISO standard for FORTRAN. Other than that, they appear to have relatively little impact. There are no proper stated benchmarks and the goals are too vague to evaluate whether they can be achieved. Even considering the more theoretical focus, the strength of the group appears low in an international context.

3. Diversity and equality

The AU follows the policies and practices implemented by the University of Bergen. Since November 2022, the department has its own Action plan for gender balance, equality, and diversity, which is tailored to its specific work and study environment.

In 2019, UiB received the HR Excellence in Research award, which recognizes that the university works towards further improving the working conditions and career opportunities of its academic staff.

According to national statistics, the proportion of female research staff has in the period 2013-2021 been constant with fluctuations on 20%. However, among senior staff (associate and full professors) the proportion of female researchers has increased from 5% to 15%. The AU’s self-assessment reports 24% female members among associate and full professors.

Recommendations to the administrative unit:

- The Evaluation Committee recommends to continue the strong focus on ensuring gender balance and include not just focus on recruitment and retention, but also on the general well-being of minorities including women in the AU.

4. Relevance to institutional and sectorial purposes

The sector specific impact fall overall in three areas:

Research: The AU conducts research at a high international level, within selected central areas of computer science. Many of the groups engage in interdisciplinary research facilitated by dedicated centres or labs (e.g., CBU, CEDAS, Energy Informatics, MMIV). The ELIXIR infrastructure supports many life science projects both nationally and internationally.

Education: The study programmes offered by the department are tightly connected with the research groups enabling truly research-based education focusing on theoretical underpinnings giving students lasting competence. Supported by among others the AU's didactics group the AU is gradually shifting towards student-active and team-based learning methods. The AU performs a systematic mapping on the national level of the informatics competence of students entering the bachelor programs to inform a transformation of study start.

Dissemination: The department contributes to popular science dissemination.

Discussing how research at the unit contributes towards master and PhD-level education provision, a focus is put on having the possibility to assign programming tasks to students which helps in achieving the desired results.

PhD students are often hired to work on a specific project placing PhD students in collaborative project, often internationally. Both master and PhD students' offices are physically integrated in the research groups.

Recommendations to the administrative unit:

- The Evaluation Committee recommends that the educational programmes are followed closely on the degree to which the students meet the requirements of the surrounding society. This could be through panels of employers or similar constructs.
- The Evaluation Committee recommends to follow up to which degree the engagement in research not just helps the research, but also the competences of the students relevant for society.

5. Relevance to society

The impact cases show three examples in sustainability, in crisis management, and to safer Fortran programming. Whereas they all have had considerable impact and have created impact beyond the activities of the researchers at the AU, they are also examples from an AU in general having more modest societal impact. This may be related to the also modest involvement of users.

This said, these examples are very prominent cases of impact, where the most measurable impact comes from the optimized routes of cables offshore whereas the new personal ID may have profound impact on the Norwegian society in the longer run.

5.1 Impact cases

Comments to impact case 1: Optimized cable routes in offshore wind farms

The Optimization Group developed computer code for optimizing the layout of the cables connecting offshore wind turbines to the electrical onshore grid. in 2016, the ownership rights were transferred to Multiconsult, who needed the software for their consultancy

projects in the offshore wind business. A constraint-generating algorithm that filters out superfluous constraints was developed.

Results were published in international energy and operations research journals, where six publications are mentioned.

The collaboration between the private entity Statkraft and UiB was established in 2013. In spring 2016, Multiconsult expressed interest in acquiring the ownership rights to the software, to which Statkraft at that time still had proprietary rights. Through an agreement with UiB, these rights were waived, and ownership rights were transferred to Multiconsult later in the same year.

Impact in the reverse direction has been observed in terms of research and master student theses reflecting industrial needs revealed during the above-mentioned collaboration.

This impact case illustrates a truly collaborative effort where understanding of domain specific needs are necessary to solve the right problem. The problem was solved to such a degree, and in such a concrete way as computer code, that it could influence practice in an important and resource intensive area.

Comments to impact case 2: Title: Type-safe templates in the Fortran programming language

Researchers at the AU significantly contributed to the development of a type-safe template feature for Fortran to enable generic programming with flexible code reuse.

The DMPL project (Design of a Mouldable Programming Language, 2010-2015) funded by the Research Council of Norway had the outcome of the language Magnolia based on Goguen/Burstall institution theory: integration of formal specifications and program code with a powerful type-safe generic reuse mechanism.

The research related to Magnolia has continued and the library now contains more than 750 specification modules composed from 1350 individual axioms, 800 generic implementations and 250 applications.

Professor Magne Haveraaen, Department of Informatics, UiB, was invited to present developments for the ISO Fortran standards committee in 2019.

This project has a deep informatics and programming language research that informed practical programming language standardisation. The depth of this impact on Fortran is not described. The use of templates popularized by C++ and transfer to Fortran is very impactful.

Comments to impact case 3: Characteristics of the New Personal Identifier

The Norwegian personal identifier (PID) system is used across all parts of public administration in Norway. The project shortfall in current implementation makes development in cost-efficiency, and ease of use necessary. The Selmer Center proposed four alternatives for the new PID during 2012-2013. The Tax Directorate assessed the impact of each option, and the new PID with sufficient capacity and minimum economic and administrative cost is planned for adoption in 2032.

Requirements was set to 1) capacity for the current registry population at least until 2150; 2) each person should have a unique personal identifier; 3) compliance with current regulations for privacy and security.

The Selmer Center were commissioned to evaluate the capacity of the existing PID and to assess new PID alternatives. They delivered three detailed evaluation reports 2012-2013 examining 8 alternatives based on various criteria, including comparison between information-bearing and non-information design, capacity, error detection and correction, length, ease of memorization, alphabet and size of the character set, compatibility with past and future systems, expandability, uniqueness, implications for software

The recommended Alternative 1 for the new PID is planned for adoption from January 2032.

This impact case has a profound impact on the Norwegian society as the digitalisation and use of PID is projected to increase dramatically over the years to come. This stands as a very strong research-based impact.

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 and asked to note that the Faculty has as of October 2024 changed name to the "Faculty of Science and Technology".

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 Bergen	Department of Informatics	Research group Optimization
		Research group Machine Learning
		Research group Algorithms
		Research group Selmer Center in Secure Communicaton
		Research group Visualization Research Group
		Research group Programming Theory

Terms of Reference (ToR) for the administrative unit

The council of the **Department of Informatics, University of Bergen**, 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 five aspects in your assessment:

1. The Faculty of Mathematics and Natural Sciences is organized into 7 departments, with the Department of Informatics being responsible for research and education in informatics, as well as contributing to a range of multidisciplinary efforts. It should be noted that other departments at the University of Bergen cover research directions in informatics mainly connected to the social sciences and human computer interactions.

2. The Department of Informatics was established as a separate unit in 1984 after having existed as an activity within The Department of Mathematics since around 1963. As of today, the Department of Informatics consists of 8 research groups. Six of these groups take part in EVALMIT: Algorithms, Machine Learning, Optimization, Programming Theory, Selmer Center in Secure Communication, Visualization. The Didactics group was not included in EVALMIT as it was established after the cut-off date set by RCN for this evaluation, and the Bioinformatics group (Computational Biology Unit) is taking part in the Evaluation of biosciences (EVALBIOVIT).

3. The Department of Informatics has recently finalized a strategy document for the period 2023-2030 (enclosed), which builds on what has been the unwritten strategy for the department during the last three decades. As the department has experienced a relatively large expansion in staff over the last few years, the document will ensure continued broad ownership of a highly successful approach.

4. The Department of Informatics delivers extensively on both informatics and multidisciplinary educational tasks. Firstly, the Department of Informatics offers informatics education that leads to BSc, MSc, Siving and PhD degrees. On the bachelor level, we offer study programs within bioinformatics, computer technology, data security and mathematics-informatics-economy. Our MSc program offers one study direction for each of the research groups. Since 2023, we offer an integrated five-years master program (Siving) in data science. In addition, we contribute to an integrated master program in Information technology and economics, master programs in Energy, and a

bachelor program in Artificial Intelligence. Our introductory course in informatics and programming is compulsory for most bachelor study programs at the Faculty of Mathematics and Natural Sciences and is taken by more than 1000 students each year. The number of students at our department as well as the number of degrees and study points generated has increased dramatically over the last 10 years (roughly four times) and more than 10 of our courses regularly have more than 150 students.

5. When assessing the research output of the research groups at the Department of Informatics, it should be noted that within the fields addressed by several of the research groups, specialized conferences play a central role. Presentations and publications at the most prestigious meetings carry equal or more weight than journal publications.

6. 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

Research strategy for the Department of Informatics 2023-2030

Strategy MNF Dypere innsikt - felles innsats - sterkere innflytelse 1 **2016-2022**:

Revised strategy MNF **2020-2022**: Kunnskap som former samfunnet. Natur - teknologi – bærekraft

Strategy MNF **2023-2030**: A natural science powerhouse

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 natural sciences 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 council of the Department of Informatics and the RCN no later than two weeks after all feedback on inaccuracies has been received from the Department of Informatics.

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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