The Research Council of Norway

Evaluation of Mathematics, ICT and Technology 2023-2024

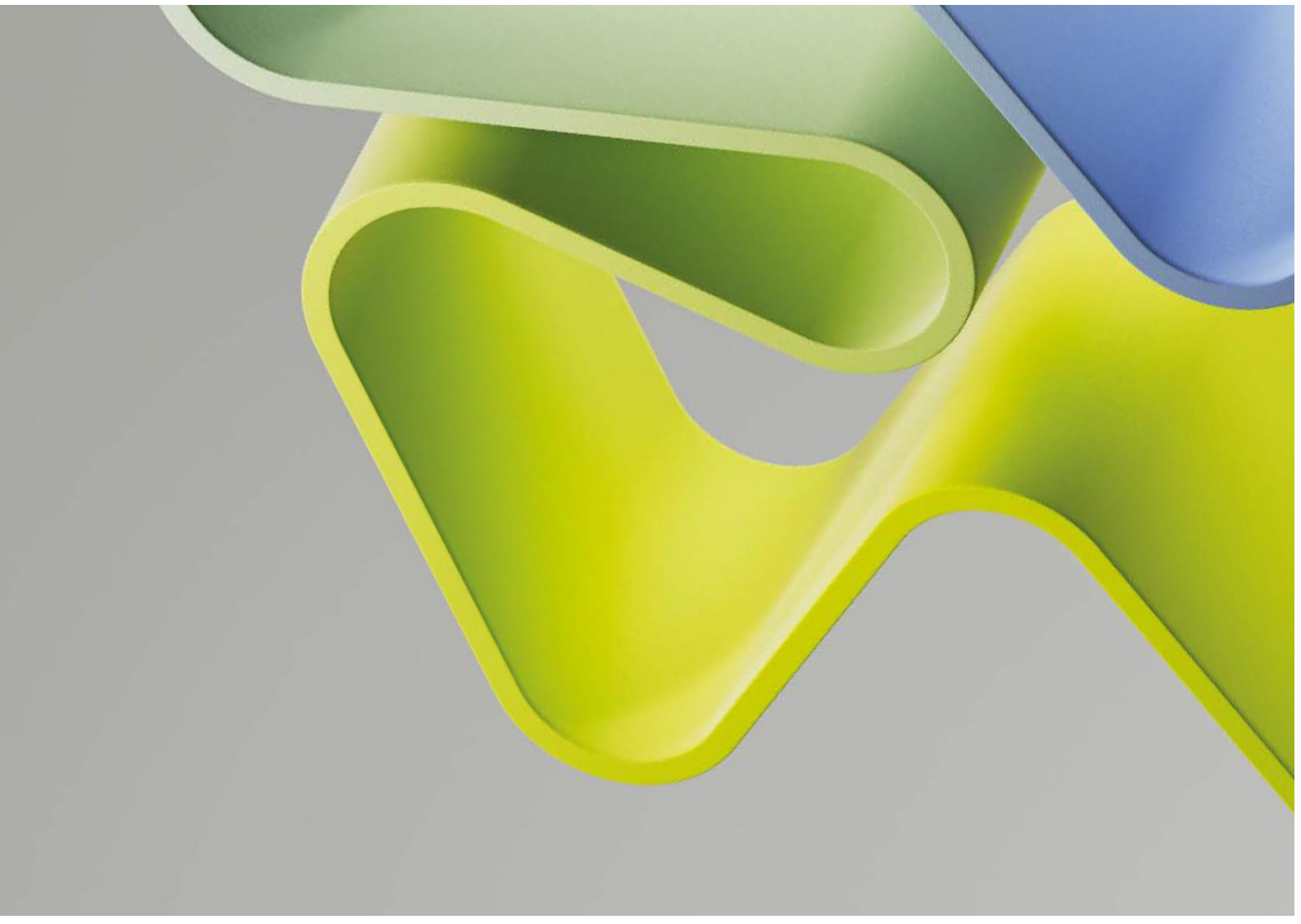
Evaluation Report for Administrative Unit

Administrative Unit: **Faculty of Engineering and Natural Sciences (FIN) - Faculty of Technology, Environmental and Social Sciences (FTMS), from 1.1.2024**

Institution: **Western Norway University of Applied Sciences (HVL)**

Evaluation Committee Higher Education Institutions 3

December 2024



Contents

Statement from Evaluation Committee Higher Education Institutions 3

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

- Department of Industrial Technology, UiT The Arctic University of Norway
- Department of Electric Energy (IEL), Norwegian University of Science and Technology (NTNU)
- Department of Marine Technology (IMT), Norwegian University of Science and Technology (NTNU)
- Department of Mechanical and Industrial Engineering (MTP), Norwegian University of Science and Technology (NTNU)
- Faculty of Engineering and Natural Sciences (FIN) / Faculty of Technology, Environmental and Social Sciences (FTMS), from 1.1.2026, Western Norway University of Applied Sciences (HVL)
- Department of Mechanical, Electronic and Chemical Engineering, Oslo Metropolitan University (OsloMet)
- Faculty of Computer Science, Engineering and Economics (IIØ), Østfold University College (ØUC)
- Department of Electrical Engineering (IET), UiT The Arctic University of Norway
- Department of Technology and Safety (ITS), UiT The Arctic University of Norway
- Department of Electrical Engineering (IT) and Cybernetics (EIK), University of South-Eastern Norway (USN)
- USN School of Business, University of South-Eastern Norway (USN)
- Department of Microsystems (IMS), University of South-Eastern Norway (USN)

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 has consisted of the following members:

Professor Lina Sarro,
Delft University of Technology (Chair)

Professor Stefania Bruschi,
University of Padova

Professor Khaled Ahmed,
University of Strathclyde

Professor Andreas Müller,
Johannes Kepler University Linz

Professor Maria Teresa Correia de Barros,
University of Lisbon

Professor Kostas J. Spyrou,
National Technical University of Athens

Description of the Administrative Unit

The administrative unit

Western Norway University of Applied Sciences (HVL) was established in 2017 as a result of a merger between Bergen University College, Sogn and Fjordane University College and Stord/Haugesund University College. HVL is in the process of increasing the proportion of its staff with research qualifications.

The research within FIN is structured into seven research fields, including: ICT and Computer Technology; Energy Nature and Environment; Ocean Technology; Fire and Safety; Innovation and Entrepreneurship; Technology in Health and Care Services; and Sustainable Urban and Social Development. In total, FIN comprises 30 research groups.

The unit has a staff of some 300, of whom 43 professors (9 women), 103 associate professors (43), 81 (24) lecturers and senior lecturers, 58 (23) PhD students and 11 (5) researchers and post-docs.

The research groups of the administrative unit

The research groups submitted to EVALMIT are:

- Glaciers Research Group (BRE)
- Landslides Research Group (SKRED)
- Nanofluids for energy and process technology (Nanofluids)
- Software Engineering (SE)
- Wind, Water and Waves (W3)

The unit’s work and strategies

The unit’s strategic goals for 2023 were:

- Strengthen the culture of research through research groups and research leadership
- Increase expertise to 70 per cent academic staff formally qualified for employment at associate professor/professor level, where at least 20 per cent have top-level expertise
- Double income from externally funded research projects and strengthen investment in R&D at the faculty
- Increase the number of publications and the proportion of staff who publish scientifically
- Have at least three industry PhDs and public sector PhDs at any given time
- Have good recruitment and completion of doctoral programmes

The unit’s work in its sector

HCL is committed to the three classical university missions of higher education research and knowledge exchange with society. It is expanding its research activities, PhD programmes and international research networks.

The future of the unit

Continuing to strengthen the quantity and quality of research and innovation are key agenda items, for continuing to build the full set of capabilities expected of university.

Overall Assessment

HVL was established in 2017 after the merger of 3 colleges with a long tradition in technology education tailored to regional needs. The HVL Faculty of Technology, Environmental, and Social Sciences, assessed here as single Administrative Unit, was formed following last year's merger of the Faculty of Engineering and Natural Sciences with the Faculty of Business Administration and Social Sciences. The university premises span five campuses, while the Unit operates across four of them. The Unit, as well as HVL as a whole, is in a process of transition following large-scale restructuring, guided by the clearly defined aim to function as full university entities at Western Norway. The faculty assessed is the largest at HVL and it can be regarded as a driving force in this process. It is a multidisciplinary faculty currently lacking a strong organisational structure for research. This results in sporadic research activities with a small number of pockets of quality of applied research (software engineering, nanofluids). The evident strong intention is to become established as a University Faculty of Technology and Business with regional and international impact.

The Unit maintains a practice-orientated profile and has identified a number of fields as being of particular interest for research development. These are: Information & Communication Technology (ICT) and Computer Technology; Energy, Nature and Environment; Ocean Technology; Fire and Safety; Innovation and Entrepreneurship; Technology in Health and Care Services; and Sustainable Urban and Social Development. ICT and Computer Technology is the field where the majority of research activities take place. However, all the fields listed are consistent with institutional and regional priorities.

To achieve its strategic goals for research, the Unit has taken specific measures to enhance its academic manpower, establish new research groups, increase the number of PhD students and raise research income. It also aims to have a high percentage of its professors in senior ranks, with a significant portion reaching the top level in terms of recognition. While acknowledging that FTMS is transitioning towards improved research capacity, it still has an unfavourable balance between teaching and research requirements for academic staff.

Research funding is limited, considering the Unit's size. Given its strong position in the region, FTMS should aim to raise its level of collaborative research income from local industry which is currently minimal. It needs also to strengthen its involvement with internationally funded collaborative research.

Research output, in terms of publication volume, is satisfactory. Relevance is good while a small proportion has substantial scientific impact. However, the Unit should actively identify research excellence as a highly valued quality in its conducted research.

The number of PhD programmes is small, serving only a small part of the FTMS' academic disciplines.

As a whole, the HVL Faculty of Technology, Environmental, and Social Sciences is taking steps to address its deficiencies and is actively working to become a hub for interdisciplinary applied research and innovation in Western Norway, in the broad field of energy, nature and the environment.

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

Recommendations

The committee recommends the Unit to:

1. Enhance the central management of research within the Administrative Unit and across the research groups by clearly allocating responsibilities and monitoring progress toward established strategic research targets. Encourage collaborative efforts within the Unit to achieve synergies and better utilisation of the resources.
2. Build upon current research strengths in the Unit and identify areas where excellent applied research is being conducted or where there is potential to be developed. Enhance the manpower and infrastructure. Recognise researchers with good international standing in their fields.
3. Continue working on attracting promising researchers. In addition, appoint distinguished full professors in three or four key research areas to provide strategic research direction, to elevate the Unit's international profile, and to serve as exemplary role models.
4. Adjust the teaching-to-research time allocation for academic staff involved in research, reducing their heavy teaching responsibilities. Educational programmes and research need to be better aligned with each other, as well as with the demands of a full university.
5. Set out a plan to significantly raise research income and achieve a balanced distribution between national and international research funding. Use the regional network more effectively for supporting research.
6. Take measures to increase the percentage of staff who are active in publishing. Motivate members to be involved in original research.
7. Establish sabbatical leave as an option for permanent academic staff for strengthening their knowledge, for networking and for gaining insights into the management of a research group.
8. Make efforts to establish at least one more PhD programme that will address the engineering disciplines served in the Faculty.
9. Further enhance efforts to attract PhD students, in particular for the fields outside of computer science which appears well-supported in this regard. Continue monitoring progress towards completion and introduce training for PhD supervisors.

1. Strategy, Resources, and Organisation of Research

The Faculty of Technology, Environmental, and Social Sciences is organised into four Departments and one Business School. Three research groups of this Faculty were submitted to the current evaluation while another two were submitted to the EVALNAT evaluation of natural sciences.

The Unit is orientated to addressing regional challenges and it has been successful in providing relevant higher education and establishing R&D networks throughout Western Norway to support this mission.

Research has not been the main priority, with the Unit’s resources primarily devoted to delivering undergraduate training and postgraduate specialised courses. The overall level of manpower, management and infrastructure is not sufficient for supporting research with international impact.

The university has made successful efforts to increase the number of active researchers; yet, in some parts of the Unit, there seems to be little interest in engaging in research. While the funding received supports a few individual research activities, it is not on par with the

size of the Faculty. The Unit is well-established in its region, but this has not translated into funding from local industry, which could help strengthen its research identity. The diversity of academic disciplines, combined with the Unit's physical presence across four campuses, works against the development of a cohesive research mindset, even though this could, in principle, facilitate regional networking. These are threats thwarting the Unit's efforts to assume a leading role in selected technological fields. The Unit has been actively working, however, to address these weaknesses.

The PhD programmes offered have a broad scope, and they are well established in the Faculty. However, they only partially serve the range of available disciplines.

The publication output is satisfactory in quantity and reasonable overall in quality. However, this does not necessarily reflect a vibrant research environment or a strong prospect for achieving excellence in applied research.

Given the shortcomings, the Unit has set out strategic goals and appears to be consistently confronting its institutional starting-point, aiming to strengthen its research capacity.

1.1 Research Strategy

The Administrative Unit's recent reorganisation and its broad range of core academic disciplines highlight its central role for HVL's aim to become a leader in green technology, in sustainability, in digital transformation, and in some aspects of safety. While merger and restructuring can, in principle, enhance the capacity for interdisciplinary research across the Unit's three main fields—technology, environmental sciences, and social sciences—the limited research background, lack of physical unity, and diversity of the disciplines present significant challenges to achieving this goal.

The Administrative Unit has set also its own strategic goals which are appropriate for strengthening its research identity and culture while supporting the transformation of HVL to a full university. These goals are in the right direction and must be pursued consistently with appropriate strategies that prioritise establishing an effective internal organisation for managing research. However, with limited administrative resources at Faculty level, it will be difficult to establish a productive research environment. Progress should be tracked through the development of relevant KPIs to ensure effective monitoring of progress towards set targets.

Located in a region heavily reliant on the oil industry, the Administrative Unit needs a long-term strategy that leverages its geographic advantages and expertise to become a transformative force during the ongoing energy transition. A positive step in this direction was that the Unit identified research priority areas that are well-suited to this goal. However, it is essential to develop activities based on excellent applied research in these areas to attract promising researchers to join the Unit.

This strategy should simultaneously aim to strengthen national and international research networks, attract investment for key infrastructure—including the creation of laboratories for a sounder research base—and allocate internally clear research management roles, learning from the organisation of the well-established technology faculties of Norway. Such matters are only partially addressed currently at a strategic level.

Academic staff in the Unit have heavy teaching loads. Several undergraduate and seven masters level programmes are on offer, with the two most recent masters programmes starting in 2023. The competing demands of teaching and research do not appear to have

been effectively addressed in the Unit's strategies. Educational programmes and research need to be better aligned.

The Unit should aim to attract established academics to full professor positions in strategically important areas. It is also essential to motivate collaborative actions of the scientific staff with prominent international researchers (including academic exchange visits) and to support more widely participation of academic staff in international scientific/technological events.

The Unit runs one PhD programme in Computer Science – Software Engineering, contributing also to an interdisciplinary PhD programme focused on innovation and regional development. These programmes only partially encompass the range of disciplines offered within the Unit. It could thus enhance its research profile by setting as a strategic goal to become capable to offer competitively additional PhD programmes – for example, currently, there is no PhD programme in the interest of the engineering activities of the Faculty (in particular for civil, mechanical, maritime, chemical, environmental and biomedical engineering), despite these appearing in the names of its academic departments.

Recommendations

- Continue reorganisation towards developing a more cohesive Faculty with a clearer identity in the fields of Technology and Business.
- Enhance administrative resources for managing research at Faculty level and monitor progress towards set strategic targets.
- Strengthen across-the-Faculty synergies and organi se better utilisation of resources.
- Set 3-4 strategically important areas and appoint distinguished full professors to lead teaching and research in these areas.
- Support and nurture existing areas of research excellence.
- Offer additional PhD programmes, with at least one focusing on the engineering disciplines taught in the Faculty.

1.2 Organisation of Research

The fields of research identified by the Unit as priorities are as follows: Information & Communication Technology (ICT) and Computer Technology; Energy, Nature and Environment; Ocean Technology; Fire and Safety; Innovation and Entrepreneurship; Technology in Health and Care Services; and Sustainable Urban and Social Development. While individually these are important fields of research, they are loosely connected to each other and, for the faculty, the overall picture is sparse.

Currently, the Unit hosts more than thirty research groups connected with the seven identified research fields. The management of the research activities appears quite unclear. The self-assessment document did not fully describe the Faculty’s organisation into departments; whether research groups are allocated to these Departments or these run across some of the Departments; how each Department is motivating research efforts; and how is research managed at the faculty level. It is also not clear whether the Departments host research-appropriate laboratories. The Heads of the Departments should have a good overview of the ongoing research in the groups and, if necessary, more responsibility need to be granted to them. The role of research group leaders needs to be enhanced with additional time allocated to them for managing the research of the group.

The research groups are spread across different departments and campuses. A large portion of the research activities is focused on software engineering and applications across the various disciplines of the Unit (for example for improving health services). Notable research is also being conducted in robotics and sensors; simulation technology; nanofluids applied for renewable energy and "energy smart" communities; fire safety; ecosystems and the environment (climate driven changes on nature and environment including changes of glacier systems, slope stability and landslides, biodiversity, terrestrial and marine ecosystems). A number of impactful publications are noted relating to policies for regional green restructuring, resilience of power systems, modelling languages for distributed systems and model driven engineering. In general, however, the research activities do not seem to fit into a specific structure.

New research groups (such as the Landslides research group and the Wind, Water and Waves research group) are still at early stages of development. They are staffed with recent PhD graduates who are called, by-and-large, to develop their research portfolios and networks without receiving mentoring from senior established researchers. In addition, internal collaborations appear relatively weak, indicating that there is room for improvement. This would provide a better utilisation of available resources while contributing to establishing a research character for the Unit.

The Unit should take further steps so that niche areas of excellent applied research are developed via a more systematic approach. With the current teaching overload of academic staff, this is a daunting task. Work organisation in the Unit is still determined by the focus to offer a variety of undergraduate and postgraduate programmes. Adjustments to teaching loads should be implemented, authorised by the Heads of Departments, for staff engaged in externally funded research.

Some training/induction for PhD students is offered internally, and also externally through collaboration with other research schools. A minimum 3-month stay abroad is mandatory for PhD students in Computer Science. These are actions in the right direction and they should be offered also to the other PhD students.

Sabbatical leave is currently unavailable to most academic staff, although group leaders may apply for a six-month scientific update leave after four years of service. Sabbaticals should be introduced gradually for all permanent Faculty since they allow academic staff to experience a working research environment, gaining insights on how research is conducted and managed.

Some synergies between research and education take place, mainly via research carried out as part of a master’s thesis. Several master's theses based on work conducted in field laboratories highlight one of the Unit's strengths.

Outreach activities by staff and PhD students mainly involve participation in conferences and also in some special events such as the annual Research Days and the courses of the Nordic Research School in Innovation and Entrepreneurship.

<u>Recommendations</u>

- Relieve academic staff involved in research from heavy teaching duties. Align to a university teaching model.
- Continue efforts to increase the number of active research groups in the Faculty. Set targets and monitor progress.

- Encourage stays abroad for academic staff in order to deepen their knowledge and improve their research competence.

1.3 Research Funding

Between 2019/2020 and 2023/2024, the Unit has nearly doubled the support that it provides for research activities, measured on the basis of the allocated time for research. On average, the share of research in the Unit's budget is about 17%. For the 5-year 2018-2022 period, 68.2 MNOK (2023 estimate) of the basic grant received from the Norwegian Ministry of Education and Research was used for R&D activities. In general, it is apparent that the Unit is investing more in research, by committing funds to enhance relevant activities.

The RCN is the main source of research funding, providing on average about 23.3 MNOK of the 45 MNOK per year received from national grants (thus accounting for more than 50% of the Unit's income from national grants). The funding received from the EU is on average about 3.3 MNOK per year and other international grants contribute about 1.24 MNOK, so access to international funding is limited. Increased involvement in EU projects would enhance opportunities for collaboration with institutions in neighbouring countries and across the EU, while supplying valuable funds for supporting research manpower.

The total research funding secured between 2018 and 2022 (though with the period of the grants extending beyond 2022) was 187.5 MNOK. Grants and contracts from industry amount to slightly less than 8 MNOK though it is not clear whether this is all research funding, or it covers also consulting and other services. Given the number of Faculty members, the funding received is low. To achieve a leading role in key technological fields, the Unit should aim to increase its research funding from a greater diversity of sources. It should devise a clear strategy for attracting funding from private sources exploiting its established presence in the Western Norway region.

<u>Recommendations</u>

- Devise and implement a plan to raise research funding. Use the regional network more effectively for securing research funding. Substantially boost efforts to engage in collaborative research funded by the EU.
- Provide training to academic staff to enhance their skills in fundraising and research networking.

1.4 Research Infrastructures

As the Administrative Unit spans a wide range of disciplines, improved access to various national and international infrastructures would significantly enhance its research capabilities. The Committee does not have a clear picture of the laboratories and their equipment that are available within the Faculty. However, to consistently support research activities across a range of technological fields, easy access to such facilities is indispensable.

At present, it appears that access to research infrastructures is possible only for certain disciplines. For bioresources, medicine and health, long-term access has been established at the national infrastructures Biobank Haukeland, PROBE, MIC and the Zerbrafish. For climate and the environment at EARTHLAB. For nanotechnology and advanced materials at ELMILAB. For innovation and entrepreneurship in the AFINO network and learning centre.

In addition, access to certain international infrastructures has been gained. The main one is at CERN through the participation of researchers of the Unit in the ALICE and ATLAS experiments. Researchers have been involved also with the European Space Agency via the

GridEyes project. Researchers from the field of ICT and Computer Technology have access to the Centre for High Power Radiation Sources of the Helmoltz Zentrum Dresden - Rossendorf and to the TU Dresden's DT neutron generator. Engineering-related groups of the Unit need to pursue access to advanced research infrastructures of Norway or of other countries through the EU.

Recommendations

- Academic and research staff should take initiatives to gain access to selected national and international laboratory facilities. Such access is crucial for its technological disciplines.

1.5 National and international collaboration

Faculty members are engaged in collaborations with a focus on applied research and innovation. Partnerships were reported for areas such as robotics, health, shipping, aquaculture, wind, solar electric power/grid. The Unit has collaborated with several Norwegian institutions and also with international institutions such as CERN, Imperial College, Lund University, Austrian University of Technology, and others.

These collaborations often result in joint publications and also help the members of the Unit to gain a wider perspective on interdisciplinary research needs, especially for the priority areas of renewable energy, green technology and digital transition.

Co-authorship of journal articles with international collaborators is over 70% which is far above the national average. This is often interpreted as a strength, yet here it could imply also that the Unit has not achieved full capacity for independent research. It could also be explained as a carryover effect due to a number of newly hired academic staff who continued publishing with their previous research partners.

Given the current research capacity, the collaboration profile looks reasonable on the academic side, offering added quality to the Unit. Such collaborations need to engage, however, a larger percentage of the academic and research staff. Moreover, they should be extended to cover also industrial partnerships focused on research, since funding from industry is quite low. These would trigger research on new topics and enhance further the possibilities of securing research funding from relevant national and international agencies.

Recommendations

- Build new collaborations with industry on research topics of regional interest. Consider possibilities of establishing industrial PhDs, endowed professorships etc.
- Continue enhancing academic partnerships and develop new links, in particular, with other universities and research institutions in Europe.

1.6 Research staff

According to Statistics Norway, in 2021 the Faculty of Engineering and Natural Sciences (predecessor form of the Unit) had thirty-six professors, eighty-nine associate professors, twenty-one researchers and postdocs and forty-four PhD students. The average age of professors and associate professors was, respectively, fifty-two and forty-six. The number of researchers more than doubled between 2013 and 2021, indicating that the Faculty is making progress toward achieving its strategic goal of strengthening its research base. The high number of associate professors may be attributed to several recent appointments resulting from HVL’s efforts to achieve full university status.

According to the Unit's self-assessment, citing data from the 2022 DBH reports, the total research staff numbered two hundred ninety-nine members, with 35% being women. The share of women among professors and associate professors was also about 35%. Considering that a major part of the Unit works in technological fields where women are underrepresented, gender balance is relatively good but still below the objective set by the university of achieving a 60-40 balance. Over the years, the Unit has offered women additional research time as an incentive to either pursue a PhD or advance to professor level.

For permanent staff, mobility is possible in the context of funded collaborative projects. Funded short leaves are also possible for research group leaders. The university should consider the introduction of sabbatical leaves for the permanent academic staff.

Temporary positions account for about 1/3 of the total. Research time allocation should take into account that newly employed and younger researchers need to time for developing deep knowledge on their topic of research, as well as for building their communication skills, for learning how to write research proposals, etc. There were 48 PhD students (40% women) and the 8 postdocs (25% women). The ratio of PhD students to Faculty members is low. However, it emerged during the interview that the number of PhD students, as of October 2024, is seventy-seven, which indicates a very significant increase (possibly relating, to some extent, to last year’s merger). Nevertheless, it is not clear how the Unit (and the university in general) is pursuing its strategic goal of increasing the number of PhD students and how these are spread with regard to the research groups, especially for the technological fields.

Recommendations

- Motivate members to be involved in original research and raise the percentage of staff who are active in publishing.
- Introduce sabbatical leaves for permanent academic staff with a track record in research.
- Implement measures to provide newly hired academic staff with dedicated time for self-development in research.
- Expand the number of PhD students in disciplines beyond computer science where the numbers are already strong.
- Introduce training for PhD supervisors and continue monitoring the completion progress of PhDs.

1.7 Open Science

The Unit follows the university's open access policy. Publicly funded research is published in open access journals, or the articles are deposited in the institutional archive in agreement with the article's publisher. The university offers a number of open-source software tools. At the Unit level, initiatives support open science through participation in EU collaborative projects that promote access to research data for energy research, engagement with health sector networks providing open access to educational, research, and innovation content, and other related efforts.

Regarding the ownership of research data, the Unit follows the Employees’ Inventions Act with exceptions where other legal restrictions override.

The Unit promotes the FAIR principles encouraging the researchers to publish openly and deposit research data for wider access (e.g. in the institutional archive). Moreover, the Unit

leads an EU H2020 project towards a FAIR and open data ecosystem in the low carbon energy research community.

Recommendations

- The Unit should offer training to academic and research staff for promoting wide adoption of the FAIR principles.
- The Unit should intensify its efforts to establish a system for storing laboratory research data that ensures access in line with the FAIR principles. It should consider developing strategic collaborations to facilitate and accelerate this system's development while ensuring compatibility with international trends.

2. Research production, quality and integrity

The Administrative Unit makes a significant contribution to the field of Informatics and has consistently demonstrated its presence and impact over the years in the fields of Chemistry and Material Science, Geosciences, Multidisciplinary Technology, and Geography, not all of which are part of the current evaluation.

According to the bibliometric statistics of NIFU, for 2022 the Unit produced as a whole 405 publications (with 429.7 annual average from three-year data) which is an output comparable to that of full university faculties. Moreover, the Unit's average publications per person-year was 1.21, the highest among the HVL units. As regards citations, the mean normalised citation score appears to be above the average score of full universities. However, the interdisciplinarity score of the unit is among the lowest in Norway indicative of a low spread in the academic fields being referenced in the publications. Co-publishing with top ranked institutions is on the lower side but nonetheless substantial given that HVL is not yet a full university.

The Unit has submitted for assessment five research groups (the two were submitted for EVALNAT but the evaluations of these research groups were accessible by this Committee). They covered topics that can be classified as belonging to the fields of: renewable energy; software engineering; offshore and maritime technology; glaciers; and landslides. All relate well to the institutional priority areas, and they have potential for important societal contributions if they are properly managed and supported.

The Unit organises one PhD programme in Computer Science – Software Engineering. In addition, it has strong involvement in a cross-disciplinary PhD programme titled Responsible Innovation and Regional Development. In the past two years, the Unit achieved twenty PhD graduations, thirteen of which were in computer science. A good number of these PhD students are externally funded. According to the Unit, further increase of the number of PhD students is hindered by their funding model. However, it is essential for the Unit to increase the number of PhD students while also achieving a better distribution across the various fields within the Unit. With regard to this, additional PhD programmes (individual or collaborative) need to be established, aligned to the available breadth and depth of expertise, giving thus the opportunity to all its active research groups to host PhD students.

2.1 Research quality and integrity

The reports of the expert panels for the three-plus-two research groups submitted to the evaluation are summarised below.

Nanofluids for Energy and Process Technology Research Group (Nanofluids) overall assessment

This group specialises in nanofluid technology for industrial applications in renewable energy and engine technology. It is comprised of two faculty members and 4 partially affiliated scientific staff (at associate professor level). Considering the personnel resources, the field of expertise is rather wide and somewhat dependent on the non-permanent faculty expertise. On the other hand, it can be considered beneficial that the group covers the whole value chain from modelling and materials to end-user applications. It was formally established in 2020 and some of its members are very active in publishing in international journals. This provides visibility but the limited access to high level labs for such kind of specialised work is a definite limitation that needs to be faced by the university, especially since it appears to be the only group of Norway with international presence in the field of nanofluids. The group succeeded to secure funding from RCN that was/is used for PhD and postdoc training. This offered opportunity for some, small scale but important, cooperation with industry. No clear recruitment strategy for permanent faculty was given by the group as it only relied on external funding and PhD students. Its goals and planned activities are described at a rather general level and are missing clear benchmarking. External funding is very limited. Nevertheless, the group is publishing actively in high quality peer-reviewed international journals and have had substantial contribution to the published work. Some international mobility and cooperation in delivering joint webinars is noted. It is not specified whether there is clear research focus in these cooperations. Discipline leaders need to be identified, and the university should establish related permanent positions. The group has reported research contributions in reducing energy loss during heat transfer; in the modelling of the plugging process employing CFD and the discrete element method; in the use of nanofluids for solar collectors (which advanced to partnership with the local technology transfer office and patent application); and a few more. In general, the group shows good potential for growth but there should be a concrete development plan and opening up towards a wider range of uses of nanofluids. Furthermore, the problem of access to suitable high-level facilities needs to be solved, permanent positions for scientific staff need to be set up; and, last but not least, a strategy for attracting funding, ideally in conjunction with selected industrial partners, should be formulated.

Software Engineering Research Group (SE) overall assessment

Strategically established a few years ago for introducing PhD education at HVL, it is an active research group with good international presence. It is comprised of 11 Faculty members, 2 adjunct professors, 1 postdoc and 10 PhD students. The number of PhDs and postdocs are relatively low which can be explained as demands for teaching are quite high. The focus areas of R&D work are, software for process modelling; interoperability and security, cloud-based applications; robotics; software for networked embedded systems; mobile applications, smart software. The organisation of the group (e.g. better definition of member’s roles, formal allocation of more time for research, etc) can be improved in order to align with a high-level research environment. The group is involved in RCN funded projects and in an EU multi-partner Horizon 2020 project. The funding level is relatively low (a major part of it is the basic funding from the State) but it is steady in time and has a good diversity of sources despite the limited amounts. The funding should grow in the next years. The group has established a good industrial network, receiving also some direct funding from industry. In general, the group is robust producing good quality publications and contributes to education at all levels (BSc, MSc, PhD), even though the university as a whole may not yet be considered as a research university. Gender balance is poor and should be improved. Also, in the last 3 years the group has produced about 50 journal papers and 15 Conference

papers. The Conference papers are rather few and the researchers' presence in international conferences should be enhanced. Societal impact of the group is good as the group's work has practical orientation (e.g. software tools for the healthcare domain). The group also contribute to national infrastructure by leading the software development of the SmartOcean Data Service initiative.

Wind, Water and Waves Research Group (W3) overall assessment

This is a young research group with focus on offshore wind energy (more generally, ocean renewable energy technologies), aquaculture and maritime technology. The experimental work is carried out in the MarineLab (featuring basically a towing tank) which belongs to the HVL's Department of Mechanical Engineering and Maritime Studies (Faculty of Technology, Environmental and Social Sciences) but is managed by W3. The group endeavours to contribute to the development of innovative hydrofoil boats and autonomous/remotely operated underwater vehicles. Also, to the development of offshore wind, tidal and wave power plants. Major research areas of the group include the optimisation of foils, rotor concepts and wake interactions in wind/tidal farms. The Group includes currently 5 mid-rank Faculty members, a lecturer and a department engineer. The number of PhD students is still very small (1) and there is no postdoc. Also, the funding comes mostly from the basic state funding and from RCN. The scientific staff should be motivated and supported to apply for competitive research grants at national and international level. The group contributes to the education of about 40 BSc students and 10-15 MSc students per year. Some collaborations with other institutions have been developed, mainly for accessing testing facilities, such as with NTNU, SINTEF Ocean, University of Oslo and University of Manchester. Members of the group have good scientific visibility, publishing quite regularly in good standard journals and giving presentations in relevant conferences. However, industrial and international funding could be increased. It is understood that a university traditionally orientated to practice is trying to develop niche areas of research that would be relevant to the local needs. In this transition is currently found the W3 group which, having reached a critical mass of Faculty members, should place emphasis now on recruiting good junior researchers (PhD students and postdocs), attracting funding and enhancing its network of industrial partners.

Glaciers Research Group (BRE) overall assessment

The Glaciers research group was submitted for the evaluation of natural sciences 2022-2023 (EVALNAT). Its 11 members (considering all appointment levels, including 1 professor) are young with well-balanced specialisations and they conduct glaciological and cryospheric research at high scientific standard. The group have published some strong papers in specialised journals of the discipline but in general they could put more emphasis on publishing. Their main topics are glacier biogeochemistry and hydrology; and glaciological measurements based on ground-penetrating radar. The group faces a number of issues obstructing its growth. Despite the fact that the research topic is of high relevance to the university and should definitely be a priority one, there is lack of funding for PhD positions and lack of investment for research infrastructure (owed to the current status of HVL as a university of applied sciences). Funding for supporting the research is provided mainly externally through national (RCN) and European projects. The group's research is field-orientated, carrying out research from Svalbard to Antarctica. By its nature, it relies heavily on a network of international partners. In this regard, access to stations owned by external parties needs to be granted (e.g. in East Greenland). The group is very active in knowledge transfer and outreach, collaborating also with non-academic stakeholders in tourism

production and agriculture. The overall performance is well within the range of what can be expected, and there is clear potential for future improvement.

Landslides Research Group (SKRED) overall assessment

A young group very relevant to HVL's strategic goal to solve challenges from sustainable perspective. It comprises fairly early-career researchers focusing mainly on field monitoring of slope stability from the perspective of avoiding landslides. The group provided good evidence of strategic thought and planning, including alignment with the institutional strategy and clear plans for growth. Given the age of the group, output is still modest in terms of research funding, publications and societal impact. Its visibility nationally and internationally is also limited. The breadth and depth of the expertise of the group is strong, but its growth is likely to be hampered by the lack of access to PhD students. Moreover, the provision of mentoring and the stimulation of interaction with established researchers of the field (e.g. through academic exchanges, invited seminars etc) could help the group to reach its strategic goals sooner. Although the group has a good international network, international collaborations are still developing and funding comes so far only form national sources. The university offers the standard academic support and access to shared laboratories. As the group's research is field-orientated and thus expensive, it is essential the research group to agree with the Faculty on a plan of development, involving mutual commitments on investment and on actions for securing research funding. The group should consider identifying some thematic areas that can take advantage of the available internal expertise (such as the one identified, for low-cost slope monitoring technologies) and then work systematically towards reaching a leading status nationally and internationally. Some public outreach activities are noted via public lectures, museums and the media.

3. Diversity and equality

The Unit follows the Norwegian law and HVL’s policy for gender equality. These require promoting gender equality and diversity actively and give a yearly account of relevant efforts. HVL operates a coordination group for equality, diversity and inclusion where members of the Faculty of Technology, Environmental, and Social Sciences regularly participate. One of the aims is to achieve better gender balance with aim to reach a 60/40 ratio. A recent initiative in the Unit was a programme for professor qualification designed specifically for women. RCN funding was recently secured to support initiatives which promote diversity and equality in the Unit.

4. Relevance to institutional and sectoral purposes

The Unit offers 7 Master level programmes and one PhD programme while being heavily involved also in another PhD that runs across all HVL Faculties. This portfolio of postgraduate courses for education and research aligns with the sectorial objective of Norwegian university colleges to provide education and research at high international level.

The PhD programme in Computer Science—Software Engineering supports HVL’s strategic priorities of technological advancement and innovation while addressing regional challenges and meeting industrial demands for digital transformation. The cross - faculty PhD programme in Responsible Innovation and Regional Development was established as part of the HVL's strategy to become full university. It was organised by the Mohn Centre for Innovation and Regional Development, a research group belonging to the Unit.

In addition to contributing to digitalisation, the Unit has engaged in some research activities focused on safety, economy and the transition to green technologies to achieve sustainable

development (with particular focus on ocean technology and renewable energy). The initiative HVL "Robotics and the Technoloft project" facilitated the introduction of robotics in the regional industry. The "smouldering fires" project has provided education and increased awareness among fire brigade and companies on how to avoid and handle such dangerous incidents. The "mobilisation for research-based innovation in the region" initiative helped towards establishing a culture for innovation based on research while also providing policy advice on achieving industrial restructuring driven by green priorities.

The Unit has participated in a several innovation projects funded by public and private sources. Patents have occasionally been awarded as a result of these collaborations. Commercialisation is supported through partnerships with the industry, consistent with HVL's policy and guidelines for intellectual property rights.

5. Relevance to society

The range of interests in the Unit address all Norwegian government's priority areas for development, referring to ocean and coastal areas, health, climate, environment and energy, enabling and industrial technologies, societal security and civil preparedness, trust and community.

As regards the ocean and coastal areas, the Unit has contributed to sustainable aquaculture technology, ocean monitoring, ballast water treatment and technologies for offshore wind. In the "health" area, the Unit reported that it contributed to utilising health data and integrating to diagnostic and treatment methodologies. For "climate, environment and energy", the Unit reported contribution towards reduced greenhouse gas emissions, ship ballast water treatment and sustainable land development. For "enabling and industrial technologies", the Unit contributes steadily via research on software development and sensor networks. For "societal security and civil preparedness" the Unit hosts a strong fire safety research group. Lastly, in relation to "trust and community", the Unit reported that research is carried out on relevant topics such as improving living spaces. Therefore, the Unit is well placed to address Norway's priority areas. Nevertheless, it could rationalise and enhance its organisation and infrastructure, so that, given its large size, it could provide more balanced contributions.

5.1 Impact cases

The five submitted impact cases are commented below:

Comments on impact case 1: Smouldering fires

A team from HVL, consisting of four members from the Faculty of Technology, Environmental, and Social Sciences, has developed significant expertise in the specialised area of smouldering fires (i.e., non-flame, relatively low-temperature fires). Early detection and avoidance of smouldering fires is a societal need and an active field of research. The group's expertise originated from a PhD completed in 2013 and a follow-up RCN-funded project. This research aligns closely with the Administrative Unit's declared fields of interest ('Fire and Safety'), serving as a strong example of how expertise can be gradually developed in a topic of international research significance. The group's expertise is recognised by the local industry, as they were consulted to better understand the causes of two large-scale industrial fires (at a waste recycling plant and at a storage silo for fishmeal). The main topics of research are: the spontaneous change of a fire from smouldering to flaming; the parameters that underpin the onset of smouldering fires; the early detection of smouldering fires from emitted aerosols; and the effect of cooling on smouldering fires. The team's research has been published in the top fire science and technology scientific journals. It can

be concluded therefore that this research had an impact in scientific terms as well as in the local industry towards setting up safer material storage procedures.

Comments on impact case 2: HVL robotics and the Teknoloft project

This impact case describes the creation of capability at HVL in in order to support the regional industry in introducing robotics. The group has rapidly expanded from one researcher in 2018 to five permanent staff researchers. Two associate professors led efforts. There are also two PhD students and four postdocs that were due to be hired. Substantial funding was received, mainly from RCN but also from other sources, including some international and private funding for innovation and collaboration in robotics. These developments come under the thematic framework of the Technoloft project at HVL which is intended to create expertise in physical human-robot interaction (robots working alongside humans). Such an area of research would be very relevant and important for establishing HVL as a research university in western Norway. Moreover, as the regional manufacturing industry is characterised by low volume and sometimes tailor-made products, the introduction of such technologies could bring large productivity gains. Three PhDs were completed in association with this project, focused on different facets of the human – robot interaction for industrial applications. A good level of funding (about 150 MNOK) seems to have been secured for the decade 2018-2027. However, the team still lacks a strong outlet in published work, which could be explained by the fact that the activities are orientated to supporting the local industry through high-level consultative actions rather than to pursuing original research in robotics that could be published it top level scientific journals.

Comments on impact case 3: Pilot floating solar plant

This project was led by the advanced nanomaterials research group at HVL, in collaboration with a local photovoltaic industry partner, as well as academic and industrial partners in Sri Lanka. The aim was to design, develop and install a pilot floating photovoltaic system in Sri Lanka. Two Faculty members and one PhD researcher participated in the project. The strength of the project is its apparent industrial/economic/social impact and its international outreach. However, the research objectives were not clear, and the research impact was not discussed, nor was it explained how HVL's nanomaterial expertise contributed to the study.

Comments on impact case 4: Development and application of the ballast water treatment system KBAL

This impact case describes the development of a novel ballast water treatment system, achieving disinfection through a combination of a pressure/vacuum technique with UV-irradiation, in order to eradicate invasive microorganisms found in the seawater used for ballasting a vessel. The topic is an important one and it represents a priority for the International Maritime Organisation (UN Agency). The project has been managed at HVL by a team of four Faculty members, two of whom were previous PhD students at HVL working on this project. The company Knutsen OAS developed the system and the HVL team investigated various aspects of it, such as, the detection of microorganisms in disinfected water and the effectiveness of disinfection according to various techniques. Moreover, methods of rapid analysis of water’s quality and steps towards identification of optimal UV doses were among the practically useful outcomes of these investigations. Funding has been provided by RCN and Knutsen OAS. These significant research contributions in ballast water treatment technology were reported in established scientific journals. It is recommended that the group should build upon its success by considering how to sustain and expand research activities, widening the scope to new potential problems. Effort towards developing an alternative application of the technology in aquaculture is noted.

Comments on impact case 5: Mobilisation for research-based innovation in the region

Activities are reported intended to combine research with technological mobilisation in the region of West Norway. The activities were managed by the HVL's Mohn Centre for Innovation and Regional Development which is part of the assessed Administrative Unit. The Centre offers a master level programme in Responsible Innovation and Sustainable Value Creation; and a PhD programme in Responsible Innovation and Regional Development. The Centre benefitted from funding from RCN for strengthening regional research-based innovations and also from the regional research Fund Vestland. A number of schemes were applied for strengthening and substantiating the university-industry collaborations. By collaborating with numerous local companies, some of which previously had minimal or no R&D activities, the Centre demonstrated the benefits of research and assisted them in developing organisational structures and networks that facilitate the introduction of innovation. It also assisted in establishing industrial clusters and promoting sustainable industrial restructuring. These activities were well supported by the university in terms of scientific staff, with ten Faculty members participating. The reported publication appeared in established scientific journals demonstrating a good balance of applied research and industrial 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 with minor adjustments.

Limitations

The Committee judged that the Administrative Unit self-assessment report was insufficient to assess all evaluation criteria fully. However, the interview with the Administrative Unit filled gaps in the Committee's understanding, and the information was sufficient to complete the evaluation.

List of administrative unit's research groups

Institution	Administrative Unit	Research Groups
Western Norway University of Applied Sciences (HVL)	Faculty of Technology, Environmental and Social Sciences (FTMS)	Software Engineering (SE)
		Glaciers Research Group (BRE)
		Nanofluids for energy and process technology (Nanofluids)
		Landslides Research Group (SKRED)
		Wind, Water and Waves (W3)

a

Terms of Reference (ToR) for the administrative unit

The dean of the Faculty of Engineering and Science, Western University of Applied Sciences mandates the evaluation committee appointed by the Research Council of Norway (RCN) to assess the Faculty of Engineering and Science based on the following Terms of Reference.

Assessment

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

a) Strategy, resources and organisation

b) Research production, quality and integrity

c) Diversity and equality

d) Relevance to institutional and sectoral purposes

e) Relevance to society

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

Western University of Applied Sciences (HVL), which stretches over five campuses on the Western coast of Norway, was established in 2017 through a merger of three University colleges. HVL offers a diverse range of undergraduate and postgraduate programs across various fields. The University has a clear professional-oriented profile and a strong innovative focus and maintains close ties with industry partners and public sector to address regional challenges. In 2024, the application for HVL as University (status) will be sent. HVL is currently organised into four faculties, each of which is comprised of a diversity of disciplinary perspectives and academic/research cultures. Our efforts should be seen in context of the specific *geographical, economical and institutional preconditions.*

1. The Faculty of Engineering and Science, which stretches over four campuses, is closely connected to working life in the region. We develop and share knowledge within our professional profile areas in close collaboration with business and society. An organizational adjustment is currently underway, and by January 2024 the Faculty will have merged with the Faculty of Business Administration and Social Sciences (*geographical and organizational preconditions*).
2. The institution has a central administration since 2017, with limited administrative resources at the faculty level. As strong relationships between faculty and central administration are needed for a healthy and productive work environment, good operational systems and communication is essential for organizational effectiveness and institutional performance, including research performance.
3. Traditionally, there has been significant differences between Norwegian higher educational institutions, with regard to the relationship between research and education in the task profile. How basic funding is distributed by the Government to

different institutions, based on objectives and activities, significantly impacts research results achieved, as the research component in the funding model has favored the older Universities versus University colleges (*institutional and economical preconditions*).

4. The Faculty offers a total of seven master's programmes. Two programmes, established by 2023, include a five-year integrated master's degree/civil engineer in Sustainable Energy Technology, and a to-year master's degree in ICT Engineering. The latter offers two fields of study: Engineering (civil engineer) and Data science. Such masters qualify for further postgraduate studies offered at the Faculty's relatively young phd-programs 1) Computer Science: Software Engineering, Sensor Networks and Engineering Computing (established 2018), and/or 2) Responsible Innovation and Regional Development (established 2019) (*institutional-educational preconditions*).
5. Campus Bergen represents the largest of the five campuses at HVL. The main building constitutes laboratory infrastructure mainly supporting the Faculty's many undergraduate practical training-oriented programmes, challenging research infrastructure space and expansion. This also directs staff (engineers) tasks towards education versus research (*institutional preconditions*).
6. Based on HVLs clear professional-oriented profile, addressing regional industry/public sector challenges, as well as addressing global challenges, which direction and weight should the Faculty prioritize research wise?

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

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
- strategy documents: HVL (2019-2023 and 2023-2030), the faculty (2019-2023)

Interviews with representatives from the evaluated units

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

Statement on impartiality and confidence

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

Assessment report

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

Appendices

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

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