The Research Council of Norway

Evaluation of Mathematics, ICT and Technology 2023-2024

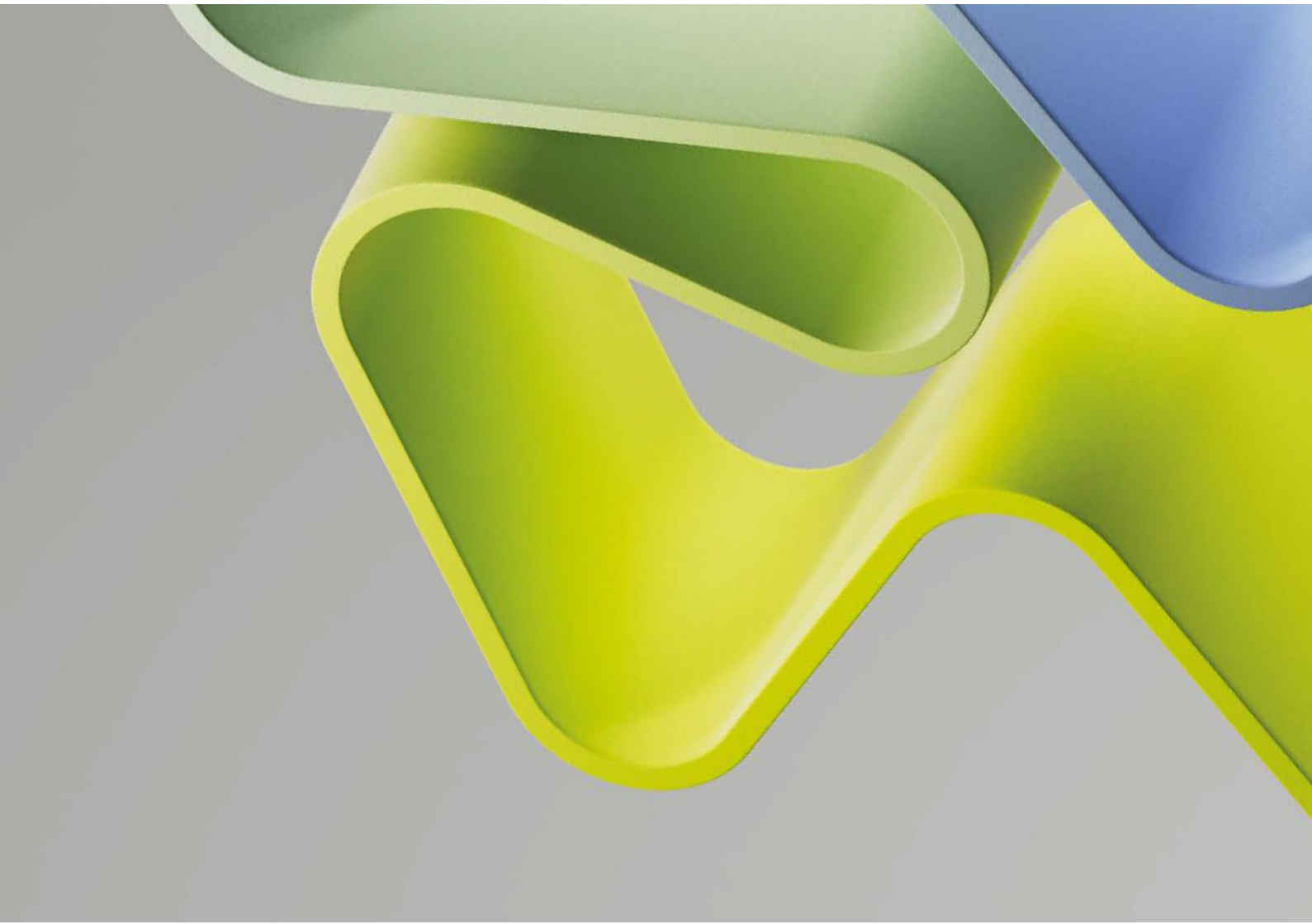
Evaluation Report for Administrative Unit

Administrative Unit: **Department of mechanical, electrical and chemical engineering (MEK)**

Institution: **Oslo Metropolitan University - OsloMet**

Evaluation Committee Higher Education Institutions 3

December 2024



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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

Department of mechanical, electrical and chemical engineering (MEK)

Oslo Metropolitan University - OsloMet

The administrative unit

Like other new universities in Norway, OsloMet results from a merger of previous further end higher education colleges. This unit's roots are in the Oslo tekniske skole, founded in 1873 and providing 4-year engineering education. In 2012, the then university of applied sciences set a goal of becoming a university and the unit has been replacing retiring teachers with research-qualified people. OsloMet acquired university status in 2018. A first professor was appointed in 2019, and a PhD programme was established in the same year.

The self-assessment report indicates that the unit has: 7.4 FTE professors (3.4 women) and 14 (4) associate professor. There are 2 (male) assistant professors and 3.8 (1.9) research fellows, plus 10 (3) technical staff.

The research groups of the administrative unit

As the unit's name suggests, the range of (especially Batchelors-level) teaching is wide. However, research focuses on Mechanical Engineering, Robotics and Control, and Biomedical Engineering in three research groups:

- Automation, Robotics, and Intelligent Systems (ARIS)
- Mechanics, Mechatronics and Material Technology (M3T)
- Advanced Health Intelligence and Brain-inspired Technologies (ADEPT)

The unit's work and strategies

There appears to be no published strategy specific to MEK. It is part of the Technology, Art and Design faculty, whose strategy emphasises the development of research capacity and income across the themes of smart cities, urban ocean and intelligent health fields as well as increased capability in innovation for sustainability. The aim is to develop AI as well as universal- and user-orientated design.

The unit's work in its sector

Education remains central to the unit, which mostly produced Batchelors degrees, but it also has an obligation to develop engineering PhDs.

The future of the unit

From a research perspective, a key task is to further develop research capacity to be able to compete on a more equal basis with the established universities.

Overall Assessment

The Department of Mechanical, Electrical and Chemical engineering (MEK) unit is a department of the Oslo Metropolitan University (OsloMet), which became a university in 2018. Since then, the unit went through a major restructuring in terms of its strategic directions as well personnel. The unit remains highly committed to establish a full-scale higher education programme. It now offers an MSc programme, which was developed together with the computer science department, and since 2019 it offers a PhD programme. Part of the restructuring is to hire active researchers who are motivated to shape and foster new research activities in the department and so to improve scientific indicators to a level that is expected from a university department. The involvement of industrial partners is a key aspect to which the department pays attention to when developing higher education programmes and defining its research strategy.

MEK comprises three research groups that are in the process of establishing themselves in their areas of research: Mechanics, Mechatronics and Material Technology (M3T), Automation, Robotics, and Intelligent Systems (ARIS), and Advanced Health Intelligence and Brain-inspired Technologies (ADEPT). The unit conducts research on simulation techniques, e.g. applied to maintenance of wind power plants, digital health with focus on brain-related modalities, autonomous systems and machine learning in robotics. However, the research foci defined by the groups appear to be too many and too general. It is certainly important for a new department to define ambitious goals, but they should remain feasible, in particular given OsloMet's limited research funding and its goal to deliver high-quality research-oriented higher education. The unit's engagement in research-oriented teaching may potentially serve as a vehicle for recruitment of young researchers.

The unit's approach to higher education and to research is well aligned with OsloMet's vision to closely connected research and education, and to develop knowledge to solve societal challenges.

In relation to the unit's role in an organisational transitioning to its new status as a university, MEK is clearly making progress. While Norway has adequate external research funding instruments, the institutional funding structure reflects OsloMet's past as a teaching institution and this is slowly changing over time. Some of the research conducted is able to support PhD training but the organisational focus on teaching means it will take time to extend this capability. While there is inevitably some spill-over between education and research, the two also need to be pursued separately, especially if MEK wants to do research at a high level.

All the research groups in MEK work in interdisciplinary fields. The degree and effectiveness of the interdisciplinary approach should improve further as MEK increases its research interaction with industry from its current relatively modest level. MEK research has significant potential for impact in industry. This is largely dependent on closer interaction, and the unit would benefit from increasing its degree of international cooperation as its research capacity increases. MEK would benefit from developing a unit-level strategy with clear priorities and targets, against which progress can be judged.

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

Recommendations

1. Define a clear research strategy and focus. In view of the applied nature of research, it is important to strengthen collaboration with industrial partners.

2. Develop a better balance between education and research throughout the organisation. Limit the focus to fewer research areas and, within those areas, to fewer aspects, to allow the groups to develop strategic knowledge and expertise on specific topics where they can excel scientifically and get international visibility.
3. As far as possible, given the strong emphasis on education, the organisational structure should be more aligned with a departmental research strategy, rather than only align with educational goals.
4. In course of becoming an established and recognised research entity, it will be crucial to educate a first generation of PhDs. If possible, MEK should use these PhDs to foster relations and to establish long term collaborations with industrial partners.
5. MEK should capitalise on its research-oriented teaching and use it to recruit future researchers.
6. Reflect on the role of the non-academic partners in the research and develop a strategy to leverage the collaboration with non-academic partners to increase the societal impact.
7. The unit should make use of available national infrastructure to leverage its research effort.

1. Strategy, Resources, and Organisation of Research

The Department of Mechanical, Electrical and Chemical engineering (MEK) is organised as three research groups: Mechanics, Mechatronics and Material Technology (M3T), Automation, Robotics, and Intelligent Systems (ARIS), and Advanced Health Intelligence and Brain-inspired Technologies (ADEPT).

The research at the MEK department is supported by the Head of department, with the overall responsibility for the research activities and research personnel, the Head of research, who also has the institutional personnel responsibility for PhD students and PhD recruitment, the Head of studies, with responsibility of the educational programmes and their relation to research, and the faculty's R&D administration. The R&D administration also supports innovation and commercialisation activities, supported by an innovation team at OsloMet level. Each research group is managed by a research group leader, who is appointed by the head of department. Although the research groups are organised independently of the educational programmes, there is a significant overlap between research and education. As teaching loads are significant, the department tries to merge some research elements into the teaching (in particular labs). Professors and docents can spend 45% of their time for research, Senior Lecturer and Associate Professors 45% of their time, while lecturer can allocate 25% of their time to research related activities.

Relative to its scientific age and structure, the department has a good publication output. The publication activity and measurable research output needs to be improved, however, in order to establish the research groups in the international arena.

The employees are well balanced regarding gender and internationals.

1.1 Research Strategy

From 2012, MEK was part of a university college for applied sciences until OsloMet became a university in 2018. The department changed significantly between then and 2022. In 2019, the faculty formulated an R&D-strategy for the period 2020-2024, which focused on Urban Ocean and Intelligent Health. The latter are highly relevant for electrical engineering and chemistry-groups at the department. On the other hand, since all academic staff members in the area of

mechanical engineering (currently 9) have joint from 2020 onwards, their activities are not well reflected in this R&D strategy. The department is continually expanding, and the most important criterion applied during recruitment is the ability to teach the relevant B.Sc. and M.Sc. courses and do research in a field relevant for the department. It is a goal of the department to work closely with relevant public actors and industry. As such the unit's activities are well aligned with OsloMet's strategic goals.

Recommendations to the administrative unit.

- The department needs a clear research strategy. The three groups should identify their core topics considering their current research and networks. The department should define a consolidated overarching research roadmap including the three groups with focus on synergies, interaction, and resource allocation/sharing.
- Strategic alliances with other national and international partners should be established. This could be done at the university level, but it would be more successful if it goes through personal contacts of the group members.

1.2 Organisation of Research

Until 2020 there were two research groups at the MEK department: DIAMED (Diagnostic technology and improved medicine) and ARIS (Automation, Robotics, and Intelligent Systems). In 2020 it was decided to refocus research at the department, and the two existing groups ADEPT and ARIS were complemented by a Mechanical Engineering research group. Each research group is managed by a research group leader who is appointed by the head of department, who has overall responsibility for research activities and research personnel. There is a head of research, who has an advisory role, and is responsible for personnel and PhD recruitment. The head of studies is responsible for the educational programmes at the department, and for creating synergies between research and education. The research groups are organised independently of the educational programmes, but there is, in practice, a significant and reasonable overlap. At OsloMet, teaching obligations are significant for most of the R&D-personnel. To mitigate this, research elements are included in student projects. In this way, by defining these projects properly, it is expected that useful data are collected and/or generated, relevant analysis can be carried out, and even laboratory or simulation tasks with relevance for research projects can be undertaken.

Aiming to generate synergies of education, research, and overall strategic goals, MEK adopted an approach in alignment with the National Curriculum Regulations for Engineering Education. This strategy should create a unified environment where education, research, and outreach activities align with the overarching objectives of sustainability, innovation, and societal impact.

The department is clearly faced with a significant challenge in aiming to do leading-edge research in an education-focused institution. It has managed this very well after completing a major overhaul of the three research groups. When establishing these groups almost five years ago it was natural and strategically plausible to define their areas of research as broadly as possible. The projects conducted by the groups suggest that some specific topics emerged, which could become pillars in a sustainable research strategy for the department. A first generation of 'home grown' graduated PhDs will be helpful.

Recommendations to the administrative unit.

- Group members need to be given resources (including time) to pursue innovative research. Conducting research projects with student involvement is a rewarding endeavour, but this may not work when aiming at high-calibre research. Changing B.Sc. and M.Sc.

courses to accommodate research project needs (as suggested by the department) may not be practicable.

- It is difficult for faculty members with significant teaching loads to take time off and dedicate it to research (actually conducting projects, preparing proposals). If funding from RCN, UTFORSK or INTPART is not available, the department (with help of OsloMet) should provide time and budget that allows researchers (usually group leaders) to focus on research organisation and administration.

1.3 Research Funding

The department's total budget in the period 2018-2022 was in the range of 27-31 MNOK, excluding salaries. MEK receives ca 75% of its income from the Norwegian ministry of Education and Research for providing B.Sc. and M.Sc. study programmes (basic funding and "ECTS production"). The remaining 25% is from internally (OsloMet) funded PhD–positions as well as externally funded R&D projects. The latter are mostly RCN funded and some EU funded. Revenues from the study programmes are primarily used to free researchers from their teaching loads. Income from externally funded projects (RCN, EU) is primarily used for salary of PhD-students. The funding from RCN varies between 1-4 MNOK and from EU in the range of 0 to 4,5MNOK.

As MEK is a relatively young unit, the funding situation of the individual groups is rather different. The M3T group did not have the opportunity to build up a substantial funding, and seems to run on startup funds. Overall, the department's budget is mostly obtained from its educational sector. This leaves limited room for strategically investing upfront in research to help building a substantial foundation for the envisioned research. The EU Horizon 2020 grant in 2018 under the Marie Sklodowska-Curie Actions was essential for financially supporting researchers.

<u>Recommendations</u> to the administrative unit.

- The department should implement a mechanism to support preparation of larger international project applications, e.g. national or EU, helping with administrative and organisational issues.
- If MET aims to do research projects at a competitive level, it will be important to have some core funding for research independent of teaching revenues. To this end, the department should consider establishing an annual budget for strategic research, which should be allocated by a dedicated committee. The funding could, for example, be used for PhDs in promising areas that the groups intend to enter but for which there are no running projects.
- Ideally, each group (or a team comprising researchers from different groups) should be given a 'seed fund' to establish a basis for continued research. Balancing the size of the groups would be advisable.

1.4 Research Infrastructures

The groups have adequate infrastructure, which is also used for teaching. Research at MEK uses local OsloMet resources as well as resources made available by others in their projects and networks. Laboratories at Oslo University Hospital have been important for some of the medically orientated research projects. OsloMet offers access to high-performance computing and large-scale data storage to researchers through Sigma2 (a national infrastructure initiative). At the groups' current stage of development stage, the infrastructure available seems to be adequate.

Recommendations to administrative unit.

- The needs for additional infrastructure should be included in a research strategy that the department will have to implement.
- OsloMet should provide funding to establish facilities that give MEK the means to conduct research that is innovative and unique, over and above its project-related funding.

1.5 National and international collaboration

As a young department in a fairly recently established university, MEK has mainly relied on personal contacts to establish national and international collaborations. This has resulted in several collaborations in the area of biomechanics, VR, wind energy, and fluid mechanics, which are in the core of the research groups' activities. A department-wide collaboration has not yet been implemented. Although not listed in the table 4a/b) of the self-assessment report, local companies are involved in some of the research projects, which is a positive aspect.

Recommendations to administrative unit.

- The groups should aim to join larger public funded or industry funded research projects and thus to grow their own scientific network.
- It will be crucial to establish a stream of PhD graduates and to give them the opportunity to join the research groups. The groups have rather narrow areas of research, and is important to establish a solid basis for sustained research.

1.6 Research staff

The department has gone through a consolidation phase involving significant labour turnover. As result MEK seems to have reached a stable situation. Approximately 40% of the staff members are foreigners who moved to Norway. This is advantageous for establishing international collaborations. However, it can also be challenging for collaboration with local industry and may pose a risk to MEK's sustainability from foreigners returning home to pursue their careers there. However, the mobility of researchers seems to be limited by their teaching commitments, while the 40% share of female employees is very good.

Recommendations to the administrative unit

- The unit should consider how to reduce the teaching load for researchers involved in projects. This could be a temporary 'buy out' scheme, partly supported by recycling project funds
- OsloMet should provide PhD/PostDoc positions to help generate a stable research environment for the groups. This could be done for a limited time in form of a startup package for each group. It should be accompanied by establishing a joint research agenda among the three groups.

1.7 Open Science

OsloMet has adopted the FAIR principles for the management of research data, but this has not yet been fully implemented.

For publications, researchers are asked to prioritise standard open licenses, such as Creative Commons licenses. OsloMet has made it mandatory to make all peer-reviewed scientific journal articles and peer-reviewed conference articles available to OsloMet's open archive (oda.oslomet.no). It is not clear how OsloMet funds OA publication fees. Nevertheless, the number of gold OA publications is steadily increasing.

OsloMet actively encourages employees and students to contribute to results that can be acquired for commercial utilisation. The university retains the right to commercialise research outcomes, contingent upon available resources and potential success, with net profits from such activities distributed as outlined in specific agreements. The university is committed to open access principles and has an open digital archive for scientific publications, with ongoing efforts to align with the FAIR principles in data management.

Recommendation on how to promote open science

- Make sure that authors have resources for publishing gold open access.

2. Research production, quality and integrity

MEK conducts research on health technology, automation, robotics and intelligent systems, and computational mechanics. It is structured into three research groups.

- Mechanics, Mechatronics and Material Technology (M3T) with focus on materials modelling and testing, computational and experimental fluid dynamics, structural mechanics, impact simulation, acoustic analyses, mechatronics, and multi-physics simulations.
- Automation, Robotics, and Intelligent Systems (ARIS), with focus on monitoring and predictive maintenance, machine learning for robotics and automation, fleet optimisation for maritime applications, computer vision and cognitive systems, modelling and simulation for industrial (Digital Twin) and health applications.
- Advanced Health Intelligence and Brain-inspired Technologies (ADEPT) with focus on brain related technologies for digital health using machine learning and artificial intelligence.

The overall research aims at diverse areas. The groups do have certain overlap which could allow for cross communication and potential joint research project. The research is organised along the strategies of the individual groups rather than along a research strategy of the department. This is so because the groups are still in the development phase. As a consequence, no PhDs have been awarded yet. Nevertheless, the publication outcome is good thanks to the effort of the individual researchers. Research is strongly linked to industrial applications.

2.1 Research quality and integrity

Research group Automation, Robotics, and Intelligent Systems (ARIS) overall assessment

The ARIS group was established in 2017 and restructured in 2020 after OsloMet achieved university status. It aims at applied and interdisciplinary research in collaboration with industry and with the public sector. Research is conducted in different application fields such as intelligent health, urban and industrial applications, ocean research, and predictive maintenance. This applied interdisciplinary research in collaboration with local and national industry and public sector in areas with high societal relevance and high potential impact is a strength of the group. The research group produces work with a scientific quality that achieves some international recognition. The group has played a very considerable role in their research process, but the link with an overarching vision is modest. The strong commitment to education and training restrains it from becoming a strong research group, which is true for the other two groups. The institution is still organised in accordance with educational goals while access to internal and external funding is limited. This slows down their building up of strategic expertise.

Consequently, the impact and visibility of the research group at international level is still modest.

The group contributes as a partner to larger projects, which may result in publications with many co-authors. Other publications, however, are often prepared by individual researchers arising from their own work or result from a focused collaboration with a single partner that the researcher initiated.

Research group Mechanics, Mechatronics and Material Technology (M3T) overall assessment

The M3T group was established in 2020 after OsloMet became a university in 2018. It seems still to be in a startup phase and is still defining its area of expertise. The benchmarks provided by the group are formulated in a general manner. It appears that the group has received limited start-up funds. The group has made an energetic effort to establish itself, but by nature of the small group, publications are restricted to a limited number of narrow fields. It is not obvious to identify connections of the research output with current or future industrial partners. The group is application oriented and thus it is important to identify industrial partners for the particular research foci, respectively to align its research with the need of industry partners. The publication output is good given that the group is rather young. Currently publications are authored by a research staff member. It is expected that PhD students will also be engaged in the publications.

Research group Advanced Health Intelligence and Brain-inspired Technologies (ADEPT) overall assessment

The ADEPT group aims to pursue a cross-disciplinary concept merging engineering and technology with medicine and human biology, and to generate synergies. The OsloMet academic environment makes it possible to bring together senior academics from various specialties relevant to the research theme. Currently the group members are from OsloMet's Faculties of Technology, Art and Design, and from Health Sciences. 4 members are from industry, 1 from hospital, and the rest are from international Universities. There are 2 PhDs affiliated with the group. However, combining the diversity of skills and experience requires a clear and manageable focus, aligned with the up-to-date funding atmosphere, the accessible external partnerships and realistic plans for the recruitment of younger researchers.

The strongest potential of the group seems to be the ambitiously chosen research theme, combining several aspects of brain-related research. However, the group is working towards national and international visibility in a fairly competitive research area. Past funding has helped towards that goal and a number of publications have been generated in the recent years. It has exposure to international collaboration as a former member of a large Horizon 2020 project (2018-2022) and publishes internationally in established outlets, although not consistently in the highest tier. The achievements in the organisational and quality dimensions are reasonable, but there is still substantial room from improvement: funding and publications are largely based on a couple of substantial grants, which have now ended, and suitable follow-ups are required. The group, however, may need to identify narrower immediate foci and milestones.

3. Diversity and equality

OsloMet has a dedicated person responsible for overseeing and managing diversity efforts. It has a diversity committee composed of individuals with interdisciplinary backgrounds. The MEK department adheres to the policy and set of practices set in place by OsloMet to protect against any form of discrimination and actively to promote diversity.

About 40% of the staff members are internationals. The gender balance of the unit is good. In average 36% of the employees are female (professors 43%, Associate professors 18%, Researchers and postdocs 50%, PhD-students 50%).

4. Relevance to institutional and sectoral purposes

The MEK department covers a wide range of topics, ranging from robotics and sensors to computational materials technology and biochemistry. The department is aligning and developing its educational programmes to societal needs. It organises annual seminars, in which industry is invited to evaluate the study programmes to ensure their relevance.

Regarding practice for innovation and commercialisation, OsloMet has established an innovation team at the central level, serving all units of the institution including MEK. Any member of staff can seek advice from the central innovation team. At the faculty level, there is an innovation advisor who supports researchers on innovation matters and who will, were relevant, refer them to the central innovation team.

A Vice-Dean for Innovation was appointed to the faculty in 2021. The faculty developed regulations, policies, a forum for innovation in research, and action plans to provide a structured framework for fostering innovation. It is acknowledged that there is still a legacy of a lack of innovation culture, which needs to be overcome.

The research activities in the department are instrumental for the three masters programmes/specialisations in the department. The master programmes/specialisations are coupled to and driven by the three R&D-groups. The teachers and supervisors in the masters programmes/specialisations are all active researchers. Masters students are also involved in externally funded projects. Most often they are involved through master projects, but sometimes there are funding to involve some students as research assistants in the projects. Masters students may also be involved in projects with industrial partners.

5. Relevance to society

MEK makes a significant contribution to the higher education at OsloMet. Its BSc programme is already well established and accepted. The recently launched MSc programme, which is jointly coordinated with the computer science department, will be another important contribution to higher education. MEK's PhD programme is still in its ramp-up phase.

The department also contributes to research, but its research impact is much less visible than its educational impact. This is again due to the genesis of the unit and OsloMet. Nonetheless, the department has real potential to become a recognised research entity. Leveraging this potential will require a clear and inclusive strategy for the department capitalising on the expertise of the three groups, which does not yet exist. The research topics of the three groups are complimentary but too diverse, which makes it difficult for the department to generate scientific output that has a more significant impact.

5.1 Impact cases

Comments on impact case 1: ADEPT impact case

This impact case covers the research of the ADEPT group at large rather than describing a topical or project related research. ADEPT is working in the area of diagnostic and preventive healthcare, and develops methods to predict and diagnose neural circuit disorders in brain, while also promoting preventive measures that are mostly related to movement and body mechanics. It is anticipated that the knowledge generated can be applied to develop technologies for advancing effectiveness and efficiency of electronic circuits. Three publications came out of this research.

The research is highly relevant in general, yet a clear focus seems to be missing. It allows the group to conduct research on neural brain activities and the use of modalities, such as functional near-infrared spectroscopy (fNIRS) and electroencephalography (EEG). This research topic also enables conducting cross-disciplinary collaboration within the unit, but also with other units of the faculty, in particular the medical department. It is important, however, to define a concrete plan for exploitation and continuation, which is currently missing. There is certainly a societal impact, as movement disorders are an important issue for an aging society. This impact will strongly depend on the exploitation strategies implemented. The practical relevance is already documented by the involvement of the company Gaitline.

Comments on impact case 2: Simulator knowledge transfer from petroleum to water industry

This impact case comprises a sequence of three successive projects that demonstrate a procedure for transferring the methodology of process simulation used in the petroleum industry to the water industry. The topic is relevant given that population growth and climate change will put increased demands on the water supply and wastewater systems. Simulation-based training, safety maintenance, and monitoring by means of a digital twin is still unexplored in the water industries. The first project was related to the process simulator training programmes in 2011-2017 (with Equinor as the project partner). The second project, running in 2015-2019, was to build an online feedback system that enables process operators to train on individual technical skills prior to the team simulator training sessions. It was shown that online-feedback systems help steer trainees' focus. A subsequent project, running since 2020, addresses digital tools and competency development in water industry. The latter is more distantly connected to the two preceding projects, but fits the impact case well. This project produced three journal publications and three conference contributions.

The topic addressed in this impact case is relevant and important as training and safety assurance will have to embrace process and plant simulation. Training on simulators was shown to increases process operator efficiency by 30% and to avoid three shutdowns per year on average. While these are initial test results, a real impact can be expected in the long term. Future requirements and necessary investments in infrastructure (fresh water, wastewater, energy efficiency, minimisation of environmental impact) will require such tools. However, actually to have an impact will require involvement of major stakeholder (in Norway or internationally). Further research along this line would strengthen the expertise in machine learning at MEK, and also contribute to the masters course on virtual sensors and control offered at the department.

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

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

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

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

A one-page summary of the Administrative Unit was developed based on the information from the self-assessment, the research group assessment, and the interview. The Administrative Unit had the opportunity to fact-check this summary. The Administrative Unit approved the summary without 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
OsloMet	Department of mechanical, electrical and chemical engineering (MEK)	Automation, Robotics, and Intelligent Systems (ARIS)
		ADEPT (Advanced Health Intelligence and Brain-inspired Technologies)
		Mechanics, Mechatronics and Material Technology (M3T

Terms of Reference (ToR) for the administrative unit

The board of Faculty of Technology, Art and Design (TKD), Oslo Metropolitan University (OsloMet) mandates the evaluation committee appointed by the Research Council of Norway (RCN) to assess Department of Mechanical, Electrical and Chemical engineering (MEK) based on the following Terms of Reference.

Assessment

You are asked to assess the organisation, quality and diversity of research conducted by Department of Mechanical, Electrical and Chemical engineering (MEK) 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 two 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 six aspects in your assessment:

<u>Concerning the establishment of OsloMet as a University.</u>

OsloMet – Oslo Metropolitan University was established with status as a national public University on 1. January 2018. Prior to the University status, the institution was the largest University College in Norway, known as Oslo and Akershus University College. Oslo and Akershus University College was again a result of previous mergers of educational institutions of applied sciences over several decades.

The Faculty of Technology, Art and Design (TKD) was established in 2011, when Oslo University College and Akershus University College were merged. The faculty consist of artistic research, applied art, art in education and design, in addition to the engineering and technology departments (Department of mechanical-, electronic- and chemical engineering, Department of information technology and Department of built environment).

The recent establishment of OsloMet as a University and its context is relevant for assessing the conditions as research performing organization. The development, based on its history, is with an emphasis on developing applied education for professional occupations. The research focuses on the professions that are part of the faculty study program portfolio. In addition to research on working life and professions in general. Our research has a practical approach to meet the needs of society and employers, and our research ambitions are to have a close relation with professional practice and up-to-date, student-active forms of

learning. Ideally our research will be relevant and capable of solving future societal challenges, and our graduates will be educated with relevant expertise in their respective fields.

In this context we ask you to pay a particular attention to the following aspects:

1. Are the financial instruments in Norway adequate for us as a professional university of applied sciences?
2. Is our research at our departments suitable to support a research-based Ph.d. program in engineering science?
3. What part of our research activity can be perceived as interdisciplinary? Are we able to communicate interdisciplinarity? Do we have useful internal and external partnerships to foster interdisciplinary collaboration? How can we make better use of interdisciplinary possibilities?
4. Is our research sufficiently integrated into our education portfolio, and vice versa?
    a. Are we able to increase the quality of our research from our educational practice, and are we able to increase our educational practice from our research?
    b. Are we able to find synergies between research and education that fulfils our mission of being profession oriented/applied professions.
5. Does the department MEK facilitate effective knowledge transfer to industry and stakeholders?
6. How constructive is the department MEK's engagement with industry and to which extent does the research benefit the sector (some overlap with 3 and 4 above).
7. Are we utilizing international cooperation in a useful way to develop our educational and research activities?

In addition, we would like your report to provide a qualitative assessment of Department of Mechanical, Electrical and Chemical engineering 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
- OsloMet strategy 2017-2020
- OsloMet Strategy 2020-2024
- R&DI Strategy at TKD 2020-2024

Interviews with representatives from the evaluated units

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

Statement on impartiality and confidence

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

Assessment report

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

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)

The Research Council of Norway

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