The Research Council of Norway

Evaluation of Mathematics, ICT and Technology 2023-2024

Evaluation Report for Administrative Unit

Administrative Unit: **Simula Research Laboratory (SIMULA)**

Institution: **Simula Research Laboratory (SIMULA)**

Evaluation Committee Institutes

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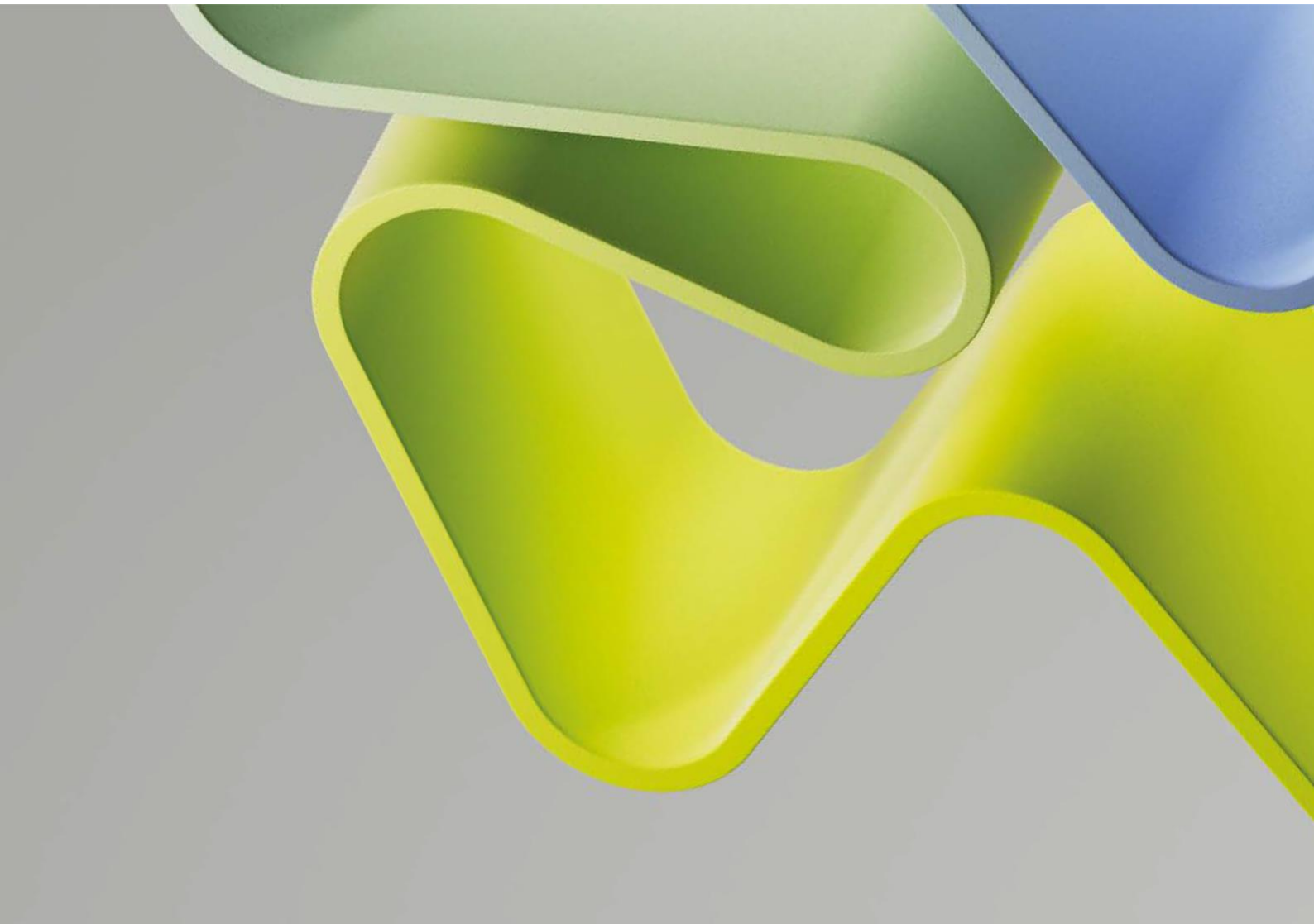

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Statement from Evaluation Committee Institutes

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

- NORCE Energy and Technology, NORCE Norwegian Research Center (NORCE)
- SINTEF Community, SINTEF Community
- SINTEF Digital, SINTEF Digital
- SINTEF Industry, SINTEF Industry
- SINTEF Energy, SINTEF Energy
- SINTEF Ocean, SINTEF Ocean
- SINTEF Manufacturing, SINTEF Manufacturing
- Norwegian Computing Center (NR), Norwegian Computing Center (NR)
- Energy and Energy Technology (ENET), Institute for Energy Technology (IFE)
- Simula Research Laboratory (SIMULA), Simula Research Laboratory (SIMULA)
- Human and organisational factors (HOF), Institute for Energy Technology (IFE)

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

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

The Evaluation Committee consisted of the following members:

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Description of the Administrative Unit

Simula is a non-profit private company, owned 100% by the Norwegian state through the Ministry of Education and Research. It comprises of five Research Groups, each of which is comprised of Research Departments, each led by a Head of Department, with a specific scientific agenda. The Research Groups that constitute Simula are Communication Systems, Cryptography, Data Science, Scientific Computing and Software Engineering.

Postdoctoral fellows, PhD students and Master's students make up some of the staff and are affiliated with projects. Permanently employed researchers may be associated with multiple projects. As of 2022, Simula employed 156 research staff, of which 49 were PhD Students, 43 were Postdoctoral Fellows, 16 were Research Engineers, 21 were Research Scientists.

Simula's strategy is based on their vision to be an excellent research lab, solving engineering and science problems in their field of ICT, developing the competence of their professionals for their future careers and pushing the results of their research into use. Each of their five Research Groups have their own strategic goals, which involve pushing the research in their respective fields to the forefront of the discipline. Their educational framework is based on their strategic collaborations with universities in Norway and abroad, with supervision and teaching activities conducted within research units. Additional training courses for employees are provided by the Simula Academy. Simula also identify the commercialisation of their research results being a key part in their goal of producing research with value for society. This is often done in the form of developing start-up companies that make their research available to the public in the form of products and services.

Almost half of Simula's funding is in the form of basic allowance and long-term assignments from Norwegian ministries, allowing them to develop expertise in research areas over long periods of time. They maintain a close dialogue with the Ministry of Education and Research and other ministries to be able to quickly evolve their research output to best benefit society. For example, their work with the Ministry of Transport into the vulnerability of critical digital infrastructures resulted in the formation of the permanent Centre for Resilient Networks and Applications. Similarly, they created Simula UiB in response to Norway's lack of highly trained cryptographers in the face of concerns of digital espionage. Simula have applied their expertise in developing more reliable software for critical infrastructure, safer autonomous vehicles, more efficient cities, personalised healthcare, more efficient battery technology and optimised shipping routes. These are all in line with the UN's Goals for sustainable development.

In their self-assessment form, Simula highlight several strengths and opportunities that better position themselves for the future. These include their stable access to high-quality research infrastructures, close dialogue with government ministries, substantial production of Master's and PhD candidates, and their success in attracting funding from RCN and EU. They also note the ongoing digitalisation of society requiring expertise from Simula, their strong researcher-to-researcher networks and a development of their collaboration with OsloMet. In terms of weaknesses and threats, they highlight their large proportion of temporary positions (PhDs and post docs) resulting in a limited pool for internal candidates for leadership positions, complicated organisation structure and some research topics being too dependent on single researchers. They also note their dependence on specific universities for their influx of Master's and PhD students, limited financial reserves to withstand a sudden funding shock and targeted recruitment of key researchers from other institutes.

Overall Assessment

Simula's vision is to be an excellent research lab, solving important and fundamental problems of science and engineering, training highly qualified experts and leaders, and developing commercial enterprises. Overall, the evaluation committee finds that Simula is cultivating their vision at the highest level. The research and activities are very well organised as demonstrated by the carefully complied self-assessment report. It is a relatively small and agile unit, which helps it react promptly to governmental needs and opportunities.

The strategy of the AU is thought-through and clear, albeit some more concrete action plans could have been included. They are clear in that they do not engage in purely curiosity-driven research, while emphasising in the interview that they do highly value such research in general.

The research groups are successful, and some have already reached the very top of their field. Both the research and educational activities are well integrated with universities and good support and a rich environment for supervision is provided. While Simula do not grant degrees, its members very actively hire and supervise PhD students and postdocs, who form nearly 60% of the overall staff. As the faculty is not directly engaged in teaching, there are no formal sabbaticals, but mobility is encouraged and there are funding schemes in place for this. The committee thinks that there could be significant value for longer term research leaves at top research environments, and that they could help in further skills development, the ability to attract broad-based funding, and in forming new strategic research and education initiatives.

The funding base is solid and diverse, indicating a healthy and sustainable balance of activities. Simula is a natural habitat for successful start-ups and spin-offs, as shown by the several companies owned by Simula. Such activity seems to be somewhat unbalanced between different groups, though this is not necessarily a problem. There is no doubt about the institutional, cross-sectoral, and societal relevance and impact of the work at Simula, which is also evidenced by the five impact cases.

The self-assessment report and the interview revealed a proper effort being put into fair recruitment and salary evaluations. Tangible methods for enhancing diversity are in place and the unit has proved able to attract great talent. The evaluation committee views Simula as very successful in achieving its goals in all their three key areas of activity.

The CRNA has played a very important role in network resilience assessment and testbed development, as well as in policy formulation regarding restrictions on equipment providers to avoid too much concentration. Regarding infrastructure (e.g., NorNet), and adjacent to that the CRNA and the Communication Systems research group at large, the report provided little information about the future, and this was not discussed in the interview. Some of the funding has been based on infrastructure, and the committee was left wondering how related research and activities are sustained/reformed if there is no continuation plan for the funding (as indicated in the Communication Systems research group evaluation). In particular, it is not clear how this will affect the role and funding of the CRNA and the Communications Systems group, which has played a major role in, e.g., monitoring the Norwegian mobile broadband networks.

The table below addresses each of the questions raised by the admin unit in the Terms of Reference (ToR) for the evaluation.

Table 1 Evaluation Committee response to specific questions from the ToR

Specific request from the ToR	Evaluation
1. The value of further development of strategic collaboration with leading research environments internationally, esp. in North America and EU	Regarding the value of further development of strategic collaboration with leading research environments internationally, the AU already has significant previous and current strategic collaborations both in the US (e.g., UCSD) and in the EU (e.g., Inria). Based on this, the committee believes that further such initiatives could indeed be valuable, particularly for research groups that are yet to reach the highest level (as judged by the research group evaluation reports) if targeted well. Simula is clearly well-positioned to contribute input and insight for governmental decision-making and policy formulation --- as they have indeed been doing already. However, this may be slightly unbalanced between different parts of Simula. There was no discussion related to the possible participation in the national quantum strategy preparation in the self-assessment report. However, as Simula is briefly named as a pioneer in quantum software engineering, it would be beneficial to ensure that Simula takes a leading role in the formulation and execution of the quantum agenda, in synergy with its already successful activities in digital security.
2. Assess the role and capability of Simula to contribute with impartial research-based insight for governmental decision-making and policy formulation in matters of importance for society as identified by government ministries. In particular, give an assessment of the directly funded centres, CRNA and EDOS.	Related to policy formulation and governmental decision making, the centres CRNA (cf. Impact Case 2) and EDOS (cf. Impact Case 3) are both well-established. EDOS is already having a clear impact, acting as an advisory to ministries and companies nationally and abroad. It is likely that the impact will increase further, so the committee considers that consolidating it by adequate sustained funding is important.

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

Recommendations

1. Ensure sustainable funding by seeking new initiatives where old ones are coming to an end (e.g., NorNet). In particular, consider the role, future strategy, and funding of the CRNA and the Communications Systems research group.
2. Ensure that EDOS has sufficient resources to realise the promise of future impact.
3. Keep supporting and encouraging commercialisation and start-ups, especially at departments that are not yet participating in such activities.
4. Encourage/facilitate cross-sectoral collaboration where it is not yet taking place. For instance, initiate interdisciplinary projects involving sectors that can benefit from the results.
5. Increase the number (and coordination) of European and international projects that are at the forefront of science to reach/maintain high scientific quality.
6. Seek to broaden the collaboration with different universities (nationally and internationally) related to teaching and awarding degrees in order not to be too reliant on a single university.
7. Revise the strategy documents at the group level and make sure there are tangible action plans for all the groups.

8. Harvest fully the cross-cutting themes of digital security and quantum engineering. Take (continue taking?) a leading role in forming and executing a national quantum agenda, which is also at the forefront of many financial bodies including the EU.
9. If financially possible, consider offering formal sabbaticals or research leaves (e.g., after every six years of service) regardless of the fact that the staff does not have teaching duties. Current mobility funding is good but does not correspond to a regular sabbatical and might be hard to get.
10. Consider increasing both national and international collaboration

1. Strategy, Resources, and Organisation of Research

Simula Research Laboratory was established in 2001, organised as a non-profit private company and owned 100% by the Norwegian state through the Ministry of Education and Research. As a limited liability company ("Aksjeselskap"), Simula is governed and run in accordance with different laws than universities and other laws different. From those ofcurrently has 156 employees, of which 49 are temporary, and there are 420 more in the companies Simula owns. Simula does not grant degrees, which is done via partner universities in Norway and abroad.

The research exclusively concerns ICT and is organised into five main research areas directly corresponding to the five research groups taking part in EVALMIT: Communication Systems, Scientific Computing and Software Engineering (2001–), Cryptography, (2016–), and Data Science (2018–). The current 10-year strategy reflects this structure and was developed based on recommendations from the previous evaluation of Simula. According to their strategy 'slogan'*, "Simula's vision is to be an excellent research lab, solving important and fundamental problems of science and engineering, training highly qualified experts and leaders, and developing commercial enterprises".*

The last point (developing commercial enterprises) is what makes Simula unique and distinct compared to most universities. Notably, while Simula's research covers a wide spectrum of topics, from fundamental to applied research, its members *do not engage in purely curiosity-driven research that is unlikely to have the potential for societal benefit*. In contrast, they emphasise the development of start-ups that make the research results available to the public as products and services. Simula has proposed several strategic initiatives to relevant ministries to answer specific societal needs and develop national policies. The field of Simula leaves it very well placed to achieve and maintain an important cross-sectoral position both nationally and internationally, as the whole world is facing the challenges of vast digitalisation leading to massive data and related threats to the privacy and security of data, companies and citizens.

There are good practices in place to foster discussion and development of strategic goals. The strategy document is clear and well-motivated, yet could use some more tangible action plans at points.

1.1 Research Strategy

As its three key areas and respective goals, Simula lists:

- Research: to solve important and challenging problems in ICT
- Education: to educate technology experts and leaders
- Innovation: to push the results of our research into use

In the beginning of the research strategy document Simula very honestly voices that they are doing well, but could be doing even better, and that this document is to answer the question "how to improve". However, the rest of the document seems to be (mostly) a rather typical list of things to do, and at points it is not very easy to grasp what the concrete actions will be. There is a genuine attempt, but the goals and methods to get there could be more tangible. For instance, how is the Cryptography (Cyber security in the document) group aiming for even higher quality? What are the main concrete goals to broaden societal impact?

Regardless of the above mild criticism, the composition of research groups seems to be a great match to the goal of solving important problems in ICT. They participate in education and undoubtedly some of their graduates will become leaders and experts in various entities. The new companies born also clearly try to push the results into use. All in all, the high-level strategy seems to be followed well. Simula seems to give a great basis for talented researchers to excel, both in research and in the resulting innovation.

In more detail, the institute has a clear division into research units, which carry out their own strategy in line with the AU's strategy of addressing fundamental research problems with important applications in society. This is demonstrated by providing the start-ups with support for growing their businesses and bringing their products and services to market. Simula has helped to develop several profitable spin-out companies from the research groups and has successfully sold its share of mature companies and reinvested the profits into Simula's core activities. By the end of the evaluation period, Simula had ownership in 40 companies, representing an annual revenue of 420 MNOK and employing 420 people. Based on this, the commercialisation aims seem to be well met.

Based on the NIFU bibliometric analysis, Simula is producing a good quantity of high-level research output. The research group evaluation reports indicate that all the five research groups are performing well, and some are outstanding and have already reached the top in their fields.

Recommendations to the administrative unit.

- Regarding high quality science, three out of the five groups are already very well established, while the remaining two (Data science, Communication systems) still have some way to go to achieve excellent scores.
- In this light, the groups already scoring 4-5/5 should aim at more concrete ways to benchmark themselves and measure performance. Identify any remaining weaknesses and make tangible plans to deal with them.
- The groups scoring lower, 3-4/5, would benefit from finding more funding and top-level collaborations, taking up leading positions in projects and scientific outputs, and by further emphasising quality over quantity.
- The data science group is very broad, consider focusing more and seeking more synergies between different departments and topics.
- Although this is difficult, gender balance should be improved, with clear strategies implemented to achieve this also at the group level. On the level of Simula, excellent practices are already in place, so ensure that these are followed throughout, and that staff is familiar with related issues.

1.2 Organisation of Research

The organisation of research at Simula has a clear and well-justified structure and seems to meet the different strategic goals very well. In short, the Simula groups consist of research companies (Simula Res. Lab., under which are SimulaMet and Simula UiB) and

commercial/innovation companies (Simula Consulting and Simula Innovation, the latter owning the 40 spin-out companies). Simula Academy oversees the provision of educational resources (though student supervision is carried out by the research groups).

Simula is governed and run in accordance with different laws from universities and other public bodies, which allows more freedom for fast-moving and targeted recruitment of promising talents. This should help in attracting and maintaining talent as well as reorganising research activities smoothly to answer new societal needs and reflect policy changes.

Groups are composed of research departments (NB: terminology a bit non-standard and misleading) led by a Head of Department, staffed with different combinations of researchers, engineers, Postdoctoral Fellows and PhD students, and usually with affiliated master's students. The staff consist of different levels of researcher and research engineer positions. On the educational side, Simula supervises MSc and PhD students and collaborates with different universities via Simula Academy to facilitate teaching and awarding degrees. Postdocs and PhD students make up as much as 50-60% of staff. This brings opportunities for internationalisation and career advancement, both by bringing in and passing forward international talent. Mobility of both junior and senior staff is encouraged by targeted funding schemes, but formal and regular sabbaticals do not exist. Internationalisation is also fostered via joint programs with Inria and UCSD.

Overall, Simula comes across as a great working environment with excellent support for its staff. Diversity is treasured and there are excellent practices in place for fair recruitment and salary negotiations.

Recommendations to the administrative unit.

- The Data science group's different departments are very broad and the synergies between them are not obvious. As mentioned already above, this broad structure should be revisited to gain more focus.
- Targeted (peer-)support should be organised to help different groups to improve on their weaker points, e.g., increase their output quality and focus their strategy (Data science), explore startup possibilities (Communication systems), or explore more interdisciplinary research opportunities (Cryptography). There are groups that excel in some or even all of these aspects so make sure to leverage this to the fullest.
- Even though the staff do not engage much in teaching activities, periods of research leave at top institutions could still help internationalisation and increase the visibility and quality of Simula's research. Consider how the AU could make it possible to offer regular sabbaticals of, say, 3-12 months, to its (permanent) faculty.

1.3 Research Funding

As an example, let us start with a summary of Simula's funding in 2022: In total, 272 MNOK towards research and 20 MNOK to other activities. This consisted of basic allowance (27%), agenda-based ministry funding (21%), public sector (OsloMet to SimulaMet) (10%), RCN (29%), EU (7%), contract (4%), and other funding (2%).Simula seems to obtain ample funding for its activities from all sectors, balanced slightly differently in different research groups, as one might expect. This is reflected well by the generally high quality of the research produced as verified by the NIFU bibliometric analysis. On the level of individual groups, the funding greatly varies. Below is a short summary about each group's funding.

Scientific computing: In the 5-year period this group has had over 75 projects funded by the RCN and EU as well as by contract research for industrial and internally funded strategic

initiatives. Some of the most prestigious grants include a Centre of Excellence (SFF), partnership in three Centres for Research-based Innovation (SFI), and an ERC Starting Grant.

Data science: Activities are supported internally by SimulaMet and some external funding mainly from RCN. There is also some contract research. EU funding sources are missing and could be a point for improvement.

Cryptography: Base funding (also pays for some admin support) of about 10 MNOK per year plus 2.6 from RCN and 15 MNOK from other national sources. Moderate EU funding was obtained starting in 2020. The budget from industry, public sector, and teaching is relatively small. Could seek more funding from industry and public sector.

Communication systems: Dramatic decrease in external research funding in recent years, at least in some part to do with infrastructure-related funding, if the committee has understood well. The group's research evaluations seem to have decreased, which is probably not unrelated.

Software engineering: Substantial research funding: more than 95 MNOK from RCN and over 40 MNOK from other national funding sources, mostly ministries and other national programs. For this they leveraged available infrastructural resources. 12 MNOK of international funding and 1 MEuro from industry and private sources. Activities that have a large, even global, impact are not adequately reported or described. For example, the DataSED team publishes the popular CVEfixes dataset, a curated collection of publicly disclosed Common Vulnerabilities and Exposures (CVE) records widely used by software development actors.

Simula provides a wide range of support, including general administration, high-performance computing infrastructure, administrative support for grant proposals and data management, and access to various databases including subscription-based library access.

Recommendations to the administrative unit.

- Seek ways to secure more EU funding via strong collaborators, strong initiatives in areas where there has already been success or which are in the core of EU funding strategy (e.g., quantum).
- Strengthen the gender balance and invest in top quality PhD and postdoc supervision, which can also help in securing further funding.
- How are current infrastructures (e.g., NorNet) going to be maintained and updated, or if discontinued, what is the next step to replace their contribution to resources? This is something the AU should make a clear plan for and assist/reorganise any groups exposed to these challenges.
- The Software engineering group is quite small for its total budget. How are the resources divided between the four departments? Review and readjust if need be. Simula could support the group to seek more competitive international funding that could further enhance international visibility and standing.

1.4 Research Infrastructures

National involvement includes an RCN-funded research infrastructure project hosted by Simula: *Experimental Infrastructure for Exploration of Exascale Computing* (eX3, 2017 – 2023, total: 61 MNOK, RCN: 37.5 MNOK, Simula share: 55 MNOK). This is an experimental HPC research infra and part of the Norwegian Roadmap for Research Infrastructures. There seems to be an opportunity (pending ministry decision) for eX3 to become part of *SLICES,* a

large multi-site European infrastructure which is on the ESFRI Roadmap since 2021. *eX3* (and *SLICES*) seem very valuable as they offer a unique heterogeneous computation cluster with a variety of devices and freedom to experiment, unlike typical supercomputers. Other than the future prospect with *SLICE*, there is no current direct involvement in ESFRI.

Simula has been operating the *NorNet* network experiment infrastructure since 2011. However, as pointed out in the self-assessment report, *NorNet Core* is no longer available as public research infrastructure, and is used mainly for auditing national communication capacity. *NorNet Edge* remains operational as a national infrastructure, but there are no plans for renewed investment, and it is in the process of being decommissioned. The effects of this on the funding and performance of the Communication Systems group was not discussed in the report.

Internationally, Simula has participated in three ESA research projects since 2012.

It is very important that Norway continues its active participation in the EuroHPC to maintain access to the European supercomputers. Simula is a partner in two EuroHPC projects and in the new Lumi-Q project, which will establish one of the EU's first six quantum computers. As with Norwegian participation in the ESFRI Landmark *Elixir,* this is important to the field of ICT at large as well as to the life sciences.

FAIR principles are followed well, unless prevented by IPR or confidentiality matters.

Recommendations to administrative unit.

- Consider carefully the status and future of NorNet and its impact on Simula research groups and their funding. Is there an exit strategy when NorNet funding is discontinued?
- Try to enforce Norway's participation in EuroHPC and Elixir.

1.5 National and international collaboration

Simula specifically targets long-term agreements with leading research organisations. Agreements are in place with, for example, Inria, TU Berlin, and UCSD. In terms of innovation, Simula partners with several academic, private, and public organisations (e.g., hospitals) in Norway. Substantial national collaborations take place with UiB and OsloMet in the form of jointly owned research companies.

With UCSD Simula has the SUURPh research and PhD training program, which is one of the most notable international collaborations. With Inria, Simula has so-called Inria Associate Teams, which can apply for funding from Inria to engage in joint research and mobility. Via SIMBER, Simula collaborates with UC Berkeley, the Lawrence Berkeley National Lab, and Organos Inc., a great example of cross-sectorial collaboration.

According to the bibliometric analysis, UiO stands out in the number of national co-publications by an order of magnitude. Same goes with China among international co-publications, no less than half of the 10 most prevalent co-authoring foreign institutes.

In summary, Simula has an impressive number of high-profile national and international collaborators, which adds greatly to research activity and quality and helps meet its stated vision. Owing to its unique profile, Simula has facilitated cross-sectoral, interdisciplinary, and non-academic collaborations. Some balance could be sought in terms of Oslo and China heavily standing out in co-publications.

Recommendations to administrative unit.

- The level and type of collaboration varies a lot from group to group. Provide specific support (perhaps from one group to another) in order to start new types of collaboration and to target top institutions.
- According to the bibliometric analysis, University of Oslo (UiO) is emphasised in the number of national co-publications. While a high level of collaboration with UiO is great, consider if this could be balanced out by strengthening other national collaborations.
- There are a few European universities and institutes on the list of (main) international co-publications, but there could certainly be more. Consider ways to strengthen European collaboration, both on the individual level of researchers as well as higher-level strategic collaborations.
- Consider how politically sensitive collaborations might be replaced if the global geopolitical situation becomes more tense.

1.6 Research staff

Simula has two different personnel categories: research scientists and research engineers. Both categories have three levels, with possible promotions to senior and chief levels. Positions are permanent at all three levels. The non-permanent positions consist of PhD students and postdocs, who represent over one-half of the overall staff. PhD positions are for three years, with an option to prolong if needed and justified, provided funding is available. Attention is paid to ensure high quality supervision in order to minimise the need for such extensions. Postdoc positions are for 2-3 year and may lead to a permanent position. In addition, there are part-time adjunct positions, typically limited to one year with a 20% contract.

In total, out of 156 staff members 40 (=26%) are female. Women are concentrated more on the lowest level of positions, which according to the interview is due to recent hiring of female staff (and not due to women not being promoted). The share of positions on different levels from research scientist to chief research scientist is quite heavily concentrated on chief research scientist. There are no researchers aged 62 or above, so overall the committee does not see a problem provided new recruitments will guarantee an inflow from lower positions to higher positions.

Research staff do not teach, so there are no standard sabbaticals, but research leaves can be granted, especially to research staff members with heavy administrative or managerial duties. Funding schemes are available to support mobility. The staff appears to have ample time for research.

According to the documents provided and the information gathered in the interview, excellent processes are in place to ensure a diverse candidate pool in recruitments and for retaining and supporting staff, in particular minority representatives. Salary evaluations are automated in a sense that it does not require any initiative from an individual employee.

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

- Ensure there is a sufficient inflow of staff to the lower-level positions of research scientists to avoid difficulties when senior personnel retire.
- Ensure salaries are and remain competitive to retain key personnel and attract top candidates.
- Although the staff does not engage much in teaching activities, regular periods of research leave at top institutes could still help internationalisation and to attract top candidates for open positions.

1.7 Open Science

Simula actively promotes open science and reproducible research and provides training tools for this purpose and in line with the FAIR principles. Researchers are encouraged to publish in open access forums and use open access repositories. Code and data are made available when not prevented by IPR or confidentiality issues. They also publish their own open access *Simula SpringerBriefs on Computing* (cf. Impact Case 5).

Simula has made contributions towards open-source software and tools, such as *Jupyter Notebook* and *Binder* infrastructures. 150 open code repositories and 30 open data sets are available. *Simula CodeSchool's* teaching materials are also openly available.

GDPR policies are in place and employees are informed about them, and a series of online learning modules must be taken regarding GDPR, specific policies and data handling. Policies regarding ownership of research data, data management, and confidentiality are described in detail but are in place, as one may expect from an institute heavily involved with contract research, start-ups and spin-offs.

Recommendations on how to promote open science

- Say what proportion of existing code/data is made open access rather than giving the absolute number of repositories. This information may not be readily available, but the different departments should be able to estimate this. If the share seems low, consider whether all non-open material is justifiably so.

2. Research production, quality and integrity

The five main areas and their stated research goals are:

- *Communication Systems*: Combine long-term research on fundamental questions with present-day relevance.
- *Scientific Computing*: Continue to push the forefront of its core expertise, and actively incorporate machine learning to augment and expand traditional computational methods.
- *Software Engineering*: Conduct industry-relevant research, and actively foster sound collaborations with industry and other research organisations.
- *Data Science (previously called "machine learning")*: Simula will expand and further develop machine learning expertise by strengthening the link between theory and algorithms, and between algorithms and high-impact applications that are of particular relevance to society.
- *Cryptography (previously called "cyber security")*: become an excellent research group in the field of cyber security and cryptography, educating highly qualified IT security experts for the benefit of Norwegian society.

The research groups at Simula are doing well and the research ethics are high. Some of the groups can be regarded as among the top in their field, while some others still have room for improvement. The group-level evaluation grades range between 4-5/5 to three groups and 3-4/5 to two groups (Data Science, Communication Systems).

Special strengths of the groups relate to providing a supporting environment, producing high quality publications with a high level of contributions, and having a significant societal impact. According to the group evaluations, the lower grades are earned due to lack of top-tier publication forums, too broad a research environment, a lack of PhD students, a low level of interdisciplinarity, a low level of lead positions in projects and publications or a lack of start-ups arising from the research.

At the AU level, the scientific production in the period 2012–2022 resulted in 1221 journal papers, 1155 papers in peer-reviewed conference proceedings, 31 books, and numerous invited talks and non-academic outreach activities. Most of the scientific contributions were published in journals and presented at conferences that are very highly regarded in the respective research communities. According to the bibliometric analysis, the overall publication quality and quantity is on a high level, but variation between groups exists. The share of 10% most cited publications has been around 19% on average.

Some more detailed data about the most common publication forums is given in Table 1 of the Simula NIFU report. However, the data seem ambiguous at best. For instance, *Association for Computing Machinery (ACM)* is included twice (36+20), and the committee assumes *IEEE* (as a publishing association) must overlap with I*EEE conference proceedings* (including several venues) and individual IEEE publication outlets. This is a general problem of automatically produced bibliographic data, and the committee assumes the AUs could not affect how it was produced.

Simula has an agreement with the Norwegian Agency for Shared Services in Education and Research (SIKT) for providing the service of an independent Data Protection Officer (DPO). The DPO is typically consulted regarding data management questions, preparation of data management plans, advice for description of data management in connection to proposals, etc.

Transparent spending of funds and compliance with financial policies is controlled and checked. Simula has a Code of Ethics in place and is a member of joint Integrity Committee in Norway handling breaches of research ethics and serving as a forum for discussing and aligning ethical guidelines and practices.

2.1 Research quality and integrity

Research group Scientific Computing overall assessment

The SC group is very strong, and it has no obvious weaknesses. It produces world leading research output. One minor area for improvement might be the narrow focus on computational neuroscience and cardiology. The group has an excellently organised research environment and organisation that supports the production of high-quality research. The group has attracted significant EU funding and has extensive international collaborations. The involvement of clinicians and medical researchers makes the research highly relevant outside academia. The open-source software tools the group has built are a very important contribution.

Research group Data Science overall assessment

The group is addressing very pertinent research problems and considering relevant applications. However, the synergies between the three research departments are not obvious. The goals in the benchmarks of the group are worthy and achievable. The group also shows a good involvement in education. The group has obtained an adequate amount of external funding. However, it seems that more effort could be made to obtain funds to support the research activities. The scientific production is solid, with some papers showing high citations. The activities lean towards applied research, with an emphasis on addressing compelling real-life applications and societal problems. In particular, several systems or prototypes have been developed and deployed. However, the group is clearly weaker in terms of fundamental scientific contributions. Overall, the level of research excellence is comparable to international groups working in this research field.

Research group Cryptography (SUiB) overall assessment

SUiB has a clear and focused strategy for top quality research and education at master's, PhD and postdoctoral level. The group has developed into a strong player in a short time. There is very strong funding acquisition from national sources and some at EU level. There are good collaborations with industry and the public sector but the funding from these sources should be increased and the collaborations should be expanded. The publication output is outstanding, the output in trained people is very strong and the results also have a broader societal impact at an international level. Some of the research also has strong economic impact. The group is active in international collaborations, the organisation of scientific events and in outreach to the broader public. The group is clearly internationally outstanding in terms of research output and very good to excellent in terms of collaboration with industry and public sector partners.

Research group Communication Systems overall assessment

As part of SimulaMet, this group benefits from a strategic partnership with Oslo Metropolitan University, which enhances its educational and research capabilities. Despite its small size, the group has experienced professors among its members.

The group has a strong academic foundation in the field. This expertise enables it to conduct sophisticated research and provide high quality education. The strategic partnership with Oslo Metropolitan University provides additional resources and opportunities for collaboration that enhance research capabilities and educational outreach.

One major problem is its dependence on external funding, which has declined significantly in recent times. This financial instability threatens the continuity and scope of its research projects. The lack of initiatives to commercialise their research or create start-ups also limits opportunities for practical application and additional funding streams.

Research group Software Engineering (SE) overall assessment

The group's strategic focus is well-aligned with Simula's strategy and national and international research priorities. The group is able to secure substantial external funding and produce high-impact research outputs. The group's extensive network of collaborations across academia, industry, and non-academic partners in the public sector enhances its research quality and impact. The three teams within the group VIAS, DataSED and ComplexSE perform very well, with national and international funding. The IT management group seems to be fully dependent on national funding and to be focused on national goals. Even with these differences, the group has excellent research activities overall and addresses societal needs through contributions to early researcher training (PhD students in cooperation with universities), to practice through projects, and to the improvement of regional and governmental (infrastructure) management. In terms of research quality, the group maintains a high standard, with regular publications in top-tier journals and influential projects that push the boundaries of the discipline. Its strategic use of resources, leveraging both national and international funding, along with excellent infrastructural support, e.g., for Quantum computing and high-performance computing (HPC), positions the group well to continue its trajectory of impactful research. The challenges towards excellence are primarily the national dimension of the IT Management group, and gender imbalance within its core faculty (particularly at the tenured levels). Additionally, although the group has declared its ambition to keep and increase its international and global relevance, there are no stated benchmarks (e.g., which other institutions they compare themselves with) or KPIs, giving the impression that there are no concrete goals.

3. Diversity and equality

Simula has excellent processes in place for ensuring diversity and retainment and progressing of women in their careers. Having said this, the gender balance needs improvement, and hopefully these good practices have Simula on the right path.

Typically, half of the workforce originate from outside Norway and a bit less than a third of the employees were women during the evaluation period. As usual, gender balance is better at lower levels, which according to the interview is due to recent hirings rather than women not achieving promotion.

Simula's recruitment guidelines require qualified candidates of both genders to be called in for an interview. For those recruited from abroad, Simula facilitates a positive transition to the Norwegian workplace through administrative support, social activities and Norwegian language training. All new employees are invited to introductory seminars to clarify expectations and highlight opportunities available to Simula's employees.

In 2013, Simula achieved the initial goal of increasing the proportion of women in research positions to 25% and now aims to increase the total proportion of women to 40% of all employees by 2028. In 2013, Simula got Research's Gender Equality prize from the Ministry of Education.

4. Relevance to institutional and sectorial purposes

Simula's core activities contribute to its sector-specific role of "increasing competitiveness and innovation power to address major societal challenges". These core activities include high-level academic research as well as industrial and public sector collaborations, allowing Simula to engage in projects directly with problem-owners via contract research. The materials provided make it very clear that Simula is a key cross-sectorial player in research and innovation.

Simula Innovation (SI) acts as the technology transfer office (established in 2004). During 2014-2019, a new process for augmenting the innovation and commercialisation activities at Simula was launched and is still in use. By the end of 2022, nine successful commercial spinouts had taken place. Added by the companies from Simula Garage, SI's portfolio includes ownership in 40 companies with a total annual revenue of 420 MNOK and 420 employees.

Simula provides a lot of support for innovation and commercialisation via the Simula Garage, whose staff have an operational role in identifying innovation potential in the research group. After this, SI is dedicated for early-stage investments.

Education opportunities at Simula include MSc and PhD thesis projects, graduate level courses, as well as postdoc positions. Junior staff are integrated into research groups and ongoing projects. Simula researchers also teach MSc and PhD level courses at the partner institutes. Junior staff are encouraged to do research exchanges at top institutes abroad.

As a research institute, Simula has developed expertise in its core areas for two decades, allowing it to engage in various application areas. For instance, Simula has contributed to cardiac modelling to advance personalised medicine and drug development. Other contributions include secure software systems for autonomous vehicles and maritime traffic and building Norwegian expertise on national and digital security. These contributions promote healthcare cost handling, sustainability, and protecting national infrastructure (Impact Case 1). Simula's EDOS centre has produced guidelines for software development

in the public sector and actively participates in the national digitalisation board (Impact Case 3).

The research conducted by CRNA holds major telecom companies accountable for network maintenance and directs policy making to prioritise development in underserved areas (Impact Cases 1 and 2).

5. Relevance to society

Simula's research and other outputs, including the spin-out companies, have high relevance to society as evidenced by the five impact cases. Their strategy is well aligned with the Norwegian Long-term plan for research and higher education by targeting researcher training and development to produce qualified ICT experts and trained communities in Norway. The educational outreach includes the *CodeSchool,* which teaches programming skills to adult learners.

Simula responds to societal challenges (e.g., national safety and security, digitalisation, resilience of networks) in several ways via (contract) research, informing and affecting policy making, and training experts to solve future problems.

UN Sustainable Development Goals mentioned include:

- Goal 3: Good health and well-being: Access to personalised healthcare is promoted using digital twins for medicine to vulnerable populations, patient-specific computational modelling of the heart, and contributions to streamlined drug development.
- Goal 4: Quality education: Educational outreach and high-level expert training.
- Goal 7: Affordable and clean energy: Very recent projects targeting the Green Shift via more efficient battery technology, optimised shipping.
- Goal 9: Industry, innovation, and infrastructure: Fundamental understanding of AI and data science combined with Simula's other research areas allow to deliver R&D services to customers in public and private sectors.
- Goal 11: Sustainable cities and communities: Reliable software for critical infrastructure, more efficient computational systems, safer autonomous vehicles, and more energy efficient cities.

5.1 Impact cases

Comments to impact case 1: National Digital Safety and Security (2012—2019)

Applied research commissioned for the purpose of solving problems for the Government led by Prof. Lysne. Contributions to and shaping of national security legislations and formation of a national cybercrime centre and a coordination centre between different bodies. National regulation of Chinese 5G equipment providers. Formation of Simula UiB (cryptography and coding theory). On the research side, an example journal paper is mentioned, and a book was published in Norwegian.

The relevance and importance of this case to Norway is unquestionable. The strengths are clearly indicated by various legislations, regulations and new centres.

Comments to impact case 2: Centre for Resilient Networks and Applications (CRNA, 2012--)

In 2014--2019, Simula researchers advanced the understanding of resilience in mobile broadband networks. Based on research initiated by Prof. Lysne, the NorNet Edge platform

was unveiled by Dr. Kvalbein and his team in 2014 and consists of over 400 measurement nodes across Norway, taking a significant leap in assessing and comparing network performance nationwide.

This work led to the establishment of the Center for Resilient Networks and Applications (CRNA) in 2014 as a permanent research centre and to the development of the NorNet testbed for long-term, vendor-independent monitoring of Norwegian mobile networks. The investigation and formulation of a policy led to the national requirement that providers of 5G equipment from certain countries should not be used in more than 50% of the base stations for any given telecom provider.

The relevance and importance of this case to Norway is unquestionable. The strengths are clearly indicated by the formation of the NorNet platform and the CRNA centre, as well as by the regulation of certain 5G equipment providers (similarly to Case 1).

Comments to impact case 3: Evidence-based Digitalization of the Public Sector in Norway (2010--)

Empirical studies with results on what leads to success in and what leads to failure in software development. The development of the concept of *Evidence-based software engineering,* which received the 2014 ACM Sigsoft Award for the most influential research during the last ten years.

The research, knowledge transfer, and advisory function described in this impact case are believed to have had a substantial positive impact on software development productivity, cost control, time control, and benefits realisation in the public sector in Norway, and through this, a positive impact on the productivity, wealth and well-being of Norwegian society. The underlying principle of the work, evidence-based software engineering, is now spread worldwide as an effective way to solve challenges related to software development. The research group has been asked to advise several public organisations, including ministries, on how they should organise their software development work, indicating positive impact. They have also advised companies nationally and abroad.

The committee found that the impact description of this case was somewhat vaguely described in the document, but the interview was able to clarify this and indeed the work of EDOS seems to have already a good impact, with surely more to come.

Comments to impact case 4: Innovation and Commercialisation (2012--2022)

Nine commercial spin-out companies have been created from Simula's research and the establishment of the Simula Garage as a tech incubator, boosting entrepreneurship at Simula and collaboration with the research units. Simula's research competence has improved services and products in SI-owned companies to meet market needs for advanced technological solutions, leading to increased sales and attracting ca. 81 MNOK of innovation funding from EU and the Research Council of Norway, and ca. 124 MNOK of external private investments, to the spin-out companies. Dividends and three exits amounting to approximately 70 MNOK, which has been reinvested in tech start-ups. Building SI's investment portfolio; as of 2022, SI had ownership in 40 companies, with a combined annual revenue of 420 MNOK and 420 employees.

The relevance and importance of this case to the spin-out companies seems very high. The strengths are clearly indicated by the funding attracted and by the large number of resulting companies.

Comments to impact case 5: Simula SpringerBriefs on Computing (SSBC) series (2001—2022)

Open access dissemination for a broad audience. The 12 volumes published between 2016 and 2022 had more than 1.3 million downloads combined. One of the volumes combined with the new requirements for programming as an integral part of the curriculum in the Norwegian school system led to the establishment of the *Simula CodeSchool*. This has developed a series of courses to teach teachers the basics of Python, which they could then implement in the classroom, and, as the need for digital competence training was prevalent throughout different occupations, Simula expanded these courses to target other employee groups. More than 2,000 continuing education participants completed these courses.

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 without adjustments. The Administrative Unit approved the summary with minor adjustments for clarity.

Limitations

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

List of administrative unit's research groups

Institution	Administrative Unit	Research Groups
SIMULA	SIMULA	Data Science Software Engineering (SE) Cryptography (SUiB) Scientific Computing Communication Systems

Terms of Reference (ToR) for the administrative unit

The board of Simula Research Laboratory mandates the evaluation committee appointed by the Research Council of Norway (RCN) to assess Simula Research Laboratory based on the following Terms of Reference.

Assessment

You are asked to assess the organisation, quality and diversity of research conducted by Simula Research Laboratory 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 two aspects in your assessment:

1. The value of further development of strategic collaboration with leading research environments internationally, esp. in North America and EU
2. Assess the role and capability of Simula to contribute with impartial research-based insight for governmental decision-making and policy formulation in matters of importance for society as identified by government ministries. In particular, give an assessment of the directly funded centres, CRNA and EDOS.

In addition, we would like your report to provide a qualitative assessment of Simula Research Laboratory 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

Interviews with representatives from the evaluated units

Interviews with the Simula Research Laboratory 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 Simula Research Laboratory 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 Simula Research Laboratory and RCT. The Simula Research Laboratory 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 Simula Research Laboratory and the RCN no later than two weeks after all feedback on inaccuracies has been received from Simula Research Laboratory.

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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