The Research Council of Norway

Evaluation of Mathematics, ICT and Technology 2023-2024

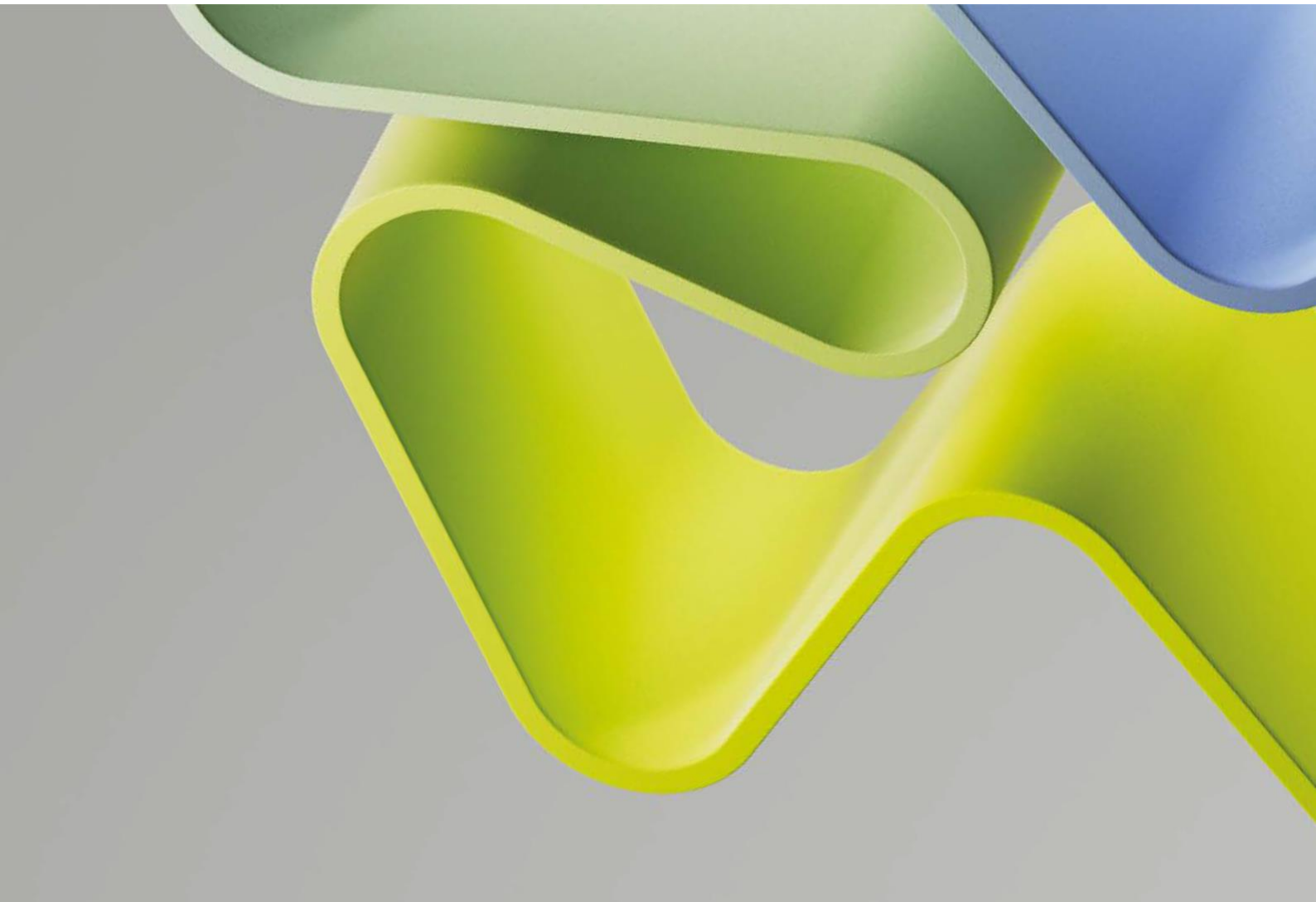
Evaluation Report for Administrative Unit

Administrative Unit: **SINTEF Digital**

Institution: **SINTEF Digital**

Evaluation Committee Institutes

December 2024



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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 units:

- 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

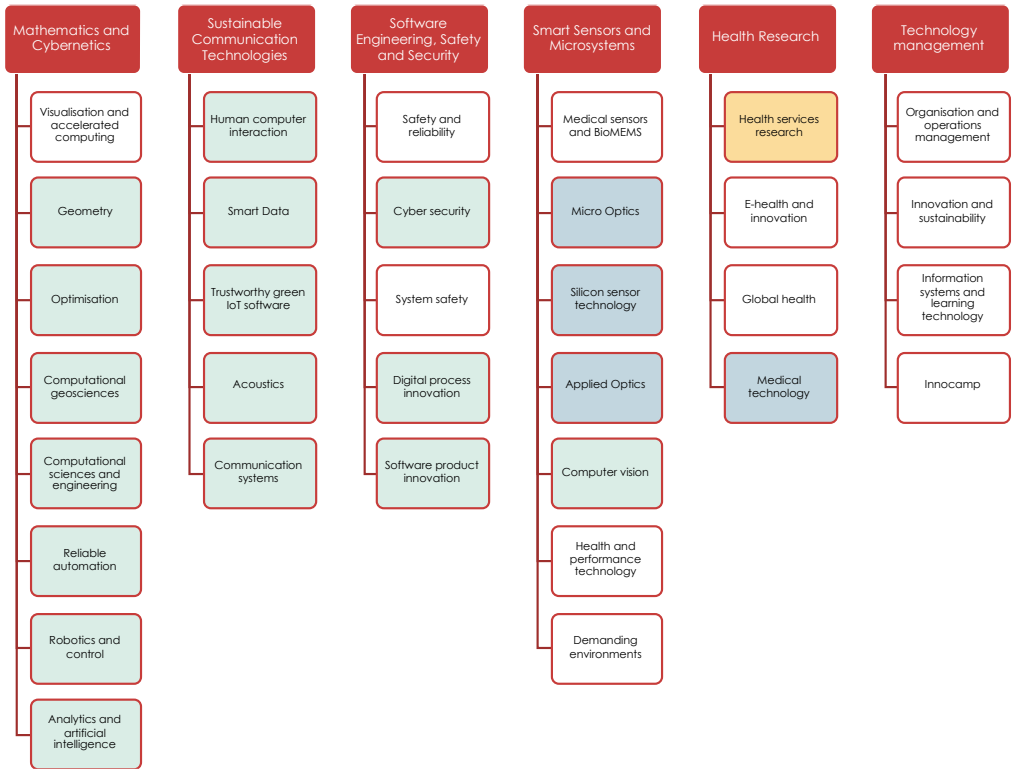
This page presents an overview of the organisation of SINTEF Digital in relation to the Evaluation of Mathematics, ICT and Technology (EVALMIT) to provide further context for this evaluation report.

SINTEF is an independent non-profit research foundation. The foundation is comprised of six research institutes, one of which is SINTEF Digital, and five further units, overseen by a central management team.

SINTEF Digital is comprised of six departments and many research groups (see figure below). The multi-/inter-disciplinary nature of both SINTEF Digital and its departments means that EVALMIT does not address/cover every research groups in every department.

In the figure below, the shaded boxes indicate the research groups which are under consideration for the EVALMIT SINTEF Digital Unit Evaluation Report. The evaluation of SINTEF Digital research groups was undertaken in both the evaluation of the Natural Sciences (EVALNAT), Medical Sciences (EVALMEDHELSE) and EVALMIT. Other research groups will be part of the forthcoming evaluation of the humanities and social sciences.

Figure 1 SINTEF Digital and EVALMIT and EVALNAT research groups



Note: Research groups evaluated under EVANAT shaded blue, groups evaluated under EVALMIT shaded green, groups evaluated under EVALMEDHELSE shaded yellow

As part of the EVALMIT evaluation of SINTEF Digital, the evaluation committee reviewed all the research group reports, and the Admin Unit Report prepared by the EVALNAT Institutes Committee.

The 'unit' submitted for consideration under EVALMIT (i.e., the 21 research groups) may be subject to strategies, processes and services implemented at the level of the department, institution or whole organisation. The Evaluation Committee has been instructed to consider

only the research groups submitted for evaluation under EVALNAT (4 research groups), EVALMIT (16 research groups) and EVALMEDHELSE (1 research group), and the data and documentation provided by the unit (e.g., the unit self-assessment reports).

As of 2022, SINTEF Digital had 448 employees, of which 87% (390) were research staff, 4% (20) were technical staff and 9% (38) were part of management and administration.

SINTEF Digital states that they conduct applied research in digital technologies and socio-technological applications. Their research involves collaboration with both the public sector and industry partners in a national and international context. They can help customers and partners exploit digitalisation, especially in the context of the green transition. Their strategy states that they aim to have a balanced portfolio of competence building research projects (lower TRL) and impact-driven projects with public-sector and industry partners (up to TRL 7-8). They also aim to achieve excellence in all their research fields. Their strategy is defined by several performance indicators, based on internationalisation, publications, commercialisation amongst others. In addition, they define 16 'Prioritised Research Areas' that range from low to higher TRL.

SINTEF Digital states that their applied research has had impacts across various sectors. They have established collaboration agreements with partners nationally and internationally across academia, industry and the public sector. In Norway, this includes the GEMINI Centre with NTNU, the University of Oslo, St Olav's Hospital and NTNU Social Research. They are also well established with research on the European level, most notably within Pillar Two under Horizon Europe. The unit also has collaborative relationships with key organisations (e.g. ESA) and research communities engaged in the European research framework programmes, such as BDVA, ADRA, EERA and AIOTI amongst many others. They also play a significant role in policy work on both national and European levels and are currently engaged with positioning the European Chip Act with national authorities. They actively contribute with strategic health input in public hearings and investigations and address challenges related to the digitalization of Norway's public health services.

In their self-assessment report, SINTEF Digital identify several internal strengths and external opportunities to better position themselves for the future. For example, they identify their Micro and Nano Laboratory as the only independent silicon processing line in Norway, offering a number of applications for partners. They also foresee their expertise in ICT combined with a breadth of research groups making them very relevant in the context of digitalization and the green transition within Norway. They also plan to establish more strategic cooperation with academia, especially NTNU and the University of Oslo. On a European level, they hope to participate in initiatives such as the EU Missions and in EU funding programmes (e.g. Digital Europe, EDF, Europe's Rail and EU4Health). In addition, SINTEF among the top three as the 'most attractive employer' in Norway for young talents. This should secure an influx of competence in the future. SINTEF Digital note their dependence on competitive funding as a challenge, where around 79% of their total income from contracts won in open competition involve public funding directly or indirectly. In the context of severe funding cuts to national level ICT funding, this presents a risk to the institute in the longer-term.

Overall Assessment

SINTEF Digital is one of the flagship Administrative Units (AUs) in the Mathematics, ICT and Technology Institutes sector in Norway. It is large, distinct and has been evolving over many years, accumulating cases of success and demonstrable impact. The AU's technical competence positions it at the forefront in the context of the national digitalisation strategy and EU's twin-transition.

Undeniably, SINTEF Digital is leading nationally in its specific technical areas, research market niche and domains of social responsibility. It maintains good international visibility in a strongly competitive landscape, while experiencing some globally common organisational, technical and financial volatilities and challenges. In these circumstances, it is doubtful whether being just world-recognised is the ideal starting point to venture into the future. The AU would gain from an internal debate on the distinction between world-recognised and world-leading positions, and what substantial advantages may be unlocked by achieving the latter status by at least a small number of SINTEF Digital research groups (by all means accounting for relevance to national and sectorial priorities and local specifics).

As a Research Institute, SINTEF Digital balances, among others, the need for expertise building with the provision of research services. The business model is based on public and private funds sponsoring the search for solutions of current interest to the government, the economy and society as a whole. In those terms, impact creation is intrinsic to SINTEF Digital's business. Projected onto the EVALMAT research assessment exercise, it would be advantageous to distinguish between:

a) primary impact, by the successful completion of a certain fixed contract (c.f. the statement used in one of the impact cases: "SINTEF Digital has over a 30-year period operated as a virtual R&D department for … one of Norway's major tech companies") and
b) secondary impact, generated by the adoption and further use (possibly inter-disciplinary and/or trans-sectorial) of the research product.

Such a distinction is not envisioned in the used impact reporting template and neither primary nor secondary impact are trivial to quantify; the latter is particularly easy to under-estimate. At the same time, secondary impact is potentially longer lasting, affects a wider set of problem-solving activities and warrants substantial weight in decisions on public funding. Therefore, at least a semi-quantitative approach, based on estimates by the final user(s), would enhance notably the quality and usefulness of impact reporting and assessment. The user-centric approach is essential and well developed in SINTEF's ecosystem; therefore, it would be relevant to apply it for the understanding of the overall value of the research outcomes and impact.

The Guidelines followed by all AUs for completing the self-assessment require a reflective component: to "comment in a reflective and evaluative manner how the AU operates" (p.4). Unfortunately, the reflective element in the submission is overall weak. The interview highlighted specific issues brought up by statistical data and it was implied that for developing meaningful long-term strategy it is imperative that such statistics are accessed regularly, and findings are used for reflection.

The AU has a constructive approach to SWOT analysis, which is put forward in a clear and helpful manner.

The main strengths are identified as

- world-class expertise,
- robust project portfolio, strong in both national and EUfunding,
- wide coverage of the ICT value chain,
- strong performance on spin-offs.

These are obvious prerequisites for a leading national role, but SINTEF Digital needs to take the step beyond acknowledged expertise and establish a World-leading position for at least the best of its groups, considering in depth the national priorities and local specifics. Benchmarking with EU peers and calibration of the degree of basic funding will be essential for self-evaluation and strategizing. Current infrastructure is based on a single facility, which will age – thus the AU needs a strategy for upgrades (or decommissioning), replacements, etc.

The main weaknesses are lack of support to cross the low-to-high TRL line and weak multi-disciplinarity. The former resonates with the perception of insufficient financial support, while the latter seems to be attributed to an underdeveloped internal expertise market. However, SINTEF Digital manifests by far the largest net expertise seller-to-user ratio, internal to SINTEF, thus multidisciplinarity is already underpinned by the ubiquitous character of the digital technologies.

The strongest positive shaping opportunity appears to be the building of world-leading expertise in well managed research groups. However, the AUs appears to target mostly establishing strategic collaborations, rather than additional operational aspects: dynamic research group structure, creative publication practices, career development, etc. Internationally the opportunities are identified as the implementation of the Twin Transition, synergy with Academia and larger share of industry-funded projects.

Threats are defined as “external”, while a deeper and fair introversion might have been more constructive. Lack of enabling publication policy, unclear career incentives (such as research leaves/sabbaticals), unsolved gender balance, would be more realistic to manage procedurally rather than searching for an expanding financial resource in a nominally stagnating funding climate.

The table below addresses the requests raised in the Terms of Reference (ToR) document.

ToR request	Response
Research at the institute has a generic character and is performed across many fields and along the TRL scale. The committee is asked to assess if the balance over time among innovation activities, applied research and more basic research is appropriate, both across the institute and in the individual groups?	In the absence of a clearly qualifying set of data and/or definitions, offered to distinguish the three groups in question, this is addressed to a varying degree (and as much as possible) in parts of this report. Overall, no drastic discrepancy is detected and established balance appears to be acceptable. Most groups wish to have more resources for basic research. This strongly concerns competence building and is vital for achieving World leadership status for the strongest groups.
The committee is asked to assess to which extent the institute addresses and serves relevant (established or upcoming) sectors for the green and digital transformation for society at large (public and private sectors).	In the self-assessment there is no fact-based reflection or analysis on which the requested assessment of relevance to “twin-transition” can be based. Overall, there appears to be no major sector within remit, which is left out from the AU’s field of view.

One of our roles is to create research results that contribute to societal impact. The committee is asked to evaluate how we fulfil this role and how we manage to balance short-term market needs and long-term technological development (application pull vs technology push).	This is addressed as much as possible in section 5 of this report. It would be advantageous in the future to distinguish between primary and secondary impact and reflect on how the relative weight of these affects funding decisions in a competitive landscape.
SINTEF Digital has a unique role and character in the Norwegian RTD system. Our basic funding amounts to 7-10% of total revenues, while the remainder is mostly won in open competitions. Under this condition the committee should evaluate to which extent the institute can achieve its mission and consider the impact of this on the research groups.	The Committee is reporting in detail on the five ToR criteria a) to e). All of these are relevant to the question “to what extent the AU can achieve its mission” and have been addressed in the corresponding section of the report. Issues regarding the impact of the particular level of basic funding on the Research Groups are also addressed by the Expert Panels in their evaluation of individual Groups.
An increasing amount of Norway's research budget is distributed through international financial instruments, e.g., the EU framework programme, and shifted towards innovation. The evaluation committee should consider the impact of this on the research groups and their ability to perform long-term strategic development of enabling technology for a better society.	Relevant here is the Retur-EU funding stream - at the interview it became clear that 100% of Retur-EU goes to the group doing the work on the project. This is helpful in the pursuit of better visibility and World-leading status. There is no specific Term of Reference on international funding comparison with competitors, thus it would have been appropriate to include the reflection of SINTEF Digital on these matters. Issues regarding the impact of the particular level of basic funding on the Research Groups are also addressed by the Expert Panels in their evaluation of individual Groups.
Is the organisation of the institute and its research groups appropriate (size and topics of research groups, human and economic resources and so on)? How does the committee evaluate our mixture of leading expertise and broad competence, including international visibility to fulfil our role and deliver the expected impact of our research? To which extend does SINTEF Digital, as a generic institute, succeed in exploiting synergy with domain-oriented institute within the SINTEF group to maximise the societal impact of our research?	The multiple and broad questions raised in this request are addressed under all 5 ToR assessment criteria in their relevant section of the report. The AU has by far the largest net seller-to-user ratio, internal to SINTEF, therefore “One SINTEF” makes the best use of the AU’s competence. There are some ambiguities/discrepancies regarding the labelling of the Research Groups - is there a Smart Cities Group or Smart Data? – if the groups were re-organised/re-labelled, that should have been discussed in the self-assessment.
To which extend is our infrastructure (physical and digital laboratories and systems) adequate to support our work? What further measures could be taken to support research groups at the highest level?	This is addressed by Expert Panels at Group level. Having active access to international infrastructure is conducive to achieving better visibility and World leading status.
Assess the individual research groups visibility (e.g., through scientific	Addressed in the Section 2. preamble on p.12. An additional suggestion is to enhance links with

excellence, innovation, etc.) on national and international level and how this is used to achieve more success in competitive research calls and acquiring industry contracts from demanding clients.	professional organisations with industrial presence (e.g. IEEE has clear strategy for links with industry and the AU already publishes mostly with IEEE).
Assess our ability and capacity to promptly adapt to and respond to emerging research and technology trends, as well as market changes.	A vital prerequisite for that is the set of individual skills and procedures for competence building. Internationalisation is a proven way to avoid the moment when infrastructure and organisation becomes the hurdle, by fostering access to new ideas and facilities. This will serve well domestic clients as well, particularly those who cannot afford their own R&D groups. The issue has not been explicitly reflected upon in the self-evaluation and in the absence of cases in point or clear examples it is not reasonable to attempt such assessment.
Much health research and health services research are conducted within the specialist health services who receive funding over the national budget. The evaluation committee should consider the role of health services research group within the institute sector, collaboration with the health care sector and if the funding for such research is optimally distributed.	The HS Research Group was assessed by an Expert Panel within EVALMEDHELSE and clustered together with the other SINTEF Digital Research Groups for Institutes Assessment Panel of EVALMIT. Thus, there is no other health services group to compare with within the panel's remit. The overall recommendations for achieving optimal operation of the HS Group are sharper focus on the digitalisation of Health Services, links to Universities and clearer strategy for patient and public involvement
Assess the group compared to other health services research groups within the institute sector, when it comes to framework conditions (e.g., financing, pricing), competences, and results.	The HS Research group was assessed by an expert panel within EVALMEDHELSE. Within the remit of the EVALMIT Institutes evaluation panel, there are no clear lines of comparison with peer groups, starting from the definition of what constitutes a health services research group. (The SINTEF Digital Medical Technology Research Group was evaluated in EVALNAT and confirmed as a "medical development" group, not Health Services.) Therefore, it is not appropriate to attempt the requested assessment.
In addition, we would like your report to provide a qualitative assessment of SINTEF Digital 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.	SINTEF Digital current strategy expires in a couple of months. By this time, the AU should have published its new strategy starting from 2025. Furthermore, there is no access to or evidence of interim strategy reviews, which does not allow reflection upon achievements, current or potential,

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

Recommendations

1. Disentangle the SINTEF Digital strategic landscape, by prioritising compliance of day-to-day operations with its internal strategy beyond 2025
   i) Develop and publicise long-term strategy well in advance, e.g. 6 months prior to expiry.
   ii) Uphold the current quantitative style of setting measures of success
   iii) Review progress regularly at interim internal assessments, potentially introducing timely corrections.
   iv) Benchmark strategic goals against global leaders to facilitate meaningful self-evaluation.
2. Keep track of the career destinations of employees and students, to advise efforts in recruitment, further education and career development support.
3. Improve all employees' personal visibility and web-presence for positive impact on individual researchers and research teams, as well as on the overall visibility of SINTEF Digital.
4. Protect the currently established channelling of Retur-EU income directly towards the group implementing the project.
5. Position SINTEF Digital as the data security driver, within SINTEF and beyond, with regard to FAIR principles and the emerging <data.sintef.no> (DSN)
   i) Introduce procedures for regular update of the security requirements
   ii) Define and publicise best practice, aiming at national and international exposure and customer/partner needs.
6. Reverse the SINTEF Digital lag in international co-publishing (also, see recommendation 4 concerning Retur-EU)
   i) Build a solid understanding of the nature of this metric
   ii) Discuss, establish and target its optimal range for SINTEF Digital.
7. Establish and run a clearly defined and fair for all research leave/sabbatical scheme conducive to
   i) Upholding commitment to building competence, relevant to future needs
   ii) Securing a fresh inflow of ideas and approaches that could be otherwise missed because of routine pressures.
   iii) Providing SINTEF Digital researchers with career advantages on a par with their colleagues in academia.
8. Enhance activities involving Citizen Science to boost the AU's public image and provide a closer outlook at problems and concerns of high value to local communities.

1. Strategy, Resources, and Organisation of Research

SINTEF Digital, as an Administrative Unit (AU) within SINTEF, has put strong emphasis and has a clear vision on developing a strategic approach to managing its operations. As part of a larger organisation, it adopts strategy across administrative boundaries, implementing the "One SINTEF" approach through the 15 Strategic Corporate Initiatives defining areas of corporate focus. The AU is active in most of those, as evidenced by an open-ended list of 8 Strategic Corporate Initiatives, where it spends at least 15% of its core funding. In terms of Technology Readiness Level, the multidisciplinary project portfolio covers the whole range from contribution research to commercialisation, with the main activity being at levels 3 and

4. In its strategy, SINTEF Digital acknowledges that the relationship between commercial development and organisational development must be taken into account.

Overall, SINTEF Digital is an active and reliable player in the corporate "One SINTEF" strategy, ensuring a good level of cohesiveness and strategic positioning at the corporate level as well as in the outer world. At the same time, SINTEF Digital is conscious of its own distinctive character "dedicated to creating a digital future for everybody".

The organisation of research facilitates compliance to corporate policies, as well as career development of staff and education, e.g. recruitment of students and continuing education of staff.

1.1 Research Strategy

SINTEF Digital's research strategy is advised by top level governmental White Papers, as well as RCN guidelines and SINTEF Corporate strategy, focusing on social challenges, general R&D policies and trends. It is reported that projects are tagged according to relevance to Sustainability Development Goals, Strategic Corporate Initiatives and Prioritised Research Areas, to be used for internal reporting and analysis. Of closest relevance to the AU's everyday research practice is its own 5-year strategy, which is due for update in the immediate future. This "Strategy in the lead up to 2025" document is best placed to account for the distinctive character of SINTEF Digital, as well as to provide the important link between the external strategic landscape and its own goals and directions. Thus, SINTEF Digital finds itself the object of elaborate, multi-dimensional and multi-level strategic mapping. It comprises:

- 17 UN Sustainable Development Goals (to underpin digitalization and digital transformation)
- 16 Prioritised Research Areas/fields (PRAs) grouped into 3 levels (taking basic technology to systems and then to complex sociotechnical entities)
- 14 Strategic Corporate Initiatives (SCIs) (to better meet market and societal demands for research and innovation)
- 9 Strategic Approaches (how specialist expertise contributes to competitiveness and impact)
- 8 Criteria for Success grouped in 6 Defined Target Activity Areas: Clients (6% annual increase in net revenue, >4.5 average client satisfaction); Outstanding Communities (1 publication/year/researcher); Balanced Portfolio (equal number of expertise-building and innovation vs commercialisation projects); Internationalisation (≥30% of sales(?) due to international projects); People (50% of staff involved in international projects at any time, ≥75% of staff hold a PhD); Commercialisation (≥1 commercialisation/year).

It is commendable that the internal strategies and research priorities are clearly defined and 8 quantitative criteria for success are made explicit. However, it is difficult to judge to what extent these criteria are met to date, as there is no reflection on the outcomes of interim internal assessments.

Outreach strategies concern the policy of open access to publications, as well as outreach resources and events. The publication policy is that of SINTEF corporate: entering into consortium agreements mainly to cover the costs of open publication and adopting Green Open Access by providing infrastructure for self-archiving of author-accepted manuscripts. The SINTEF Podcast series consisting of a hundred videos "Smart explained" to date, is introduced in a cover clip by SINTEF Digital's communications advisor and strongly overlaps

with SINTEF Digital's expert areas. The SINTEF national annual conference "Digital Future" appears to be organised and driven by SINTEF Digital (last edition in the end of 2024)

Open Science policies are borrowed from RCN and SINTEF Corporate, as well as EU initiatives GO FAIR Initiative and RRI. However, the latter is more than 10 years old, thus some reflection is due on how the concept has evolved and what new challenges have emerged.

Overall, it is clear that the research strategy adopted by SINTEF Digital, embodying corporate strategies and priorities, enables a thriving and innovative research environment, aimed at high quality and productivity.

Recommendations to the administrative unit.

Given its excellent awareness and achieved compliance with important global and national agenda, SINTEF Digital will benefit from disentangling its strategic landscape. Of primary importance to its day-to-day operations will be its internal strategy beyond 2025. The quantitative style of setting measures of success should continue. However, these will be much more useful if progress is reviewed regularly at interim internal assessments, potentially prompting advantageous corrections. Such planning is likely to result in improved competitiveness as an AU and would enhance the value of SINTEF Digital in the corporate framework. Furthermore, benchmarking of strategic goals against global leaders will facilitate meaningful self-evaluation.

1.2 Organisation of Research

Overall, the AU's organisation and composition is suitable for conducting its research activities. SINTEF Digital has direct access to the corporate SINTEF management team via its Executive Vice President. This contributes to the institutional strategies and objectives being projected efficiently onto the activities of the AU. On the lower horizontal, the six departments of SINTEF Digital act as independent financial units, with individual annual budgets and performance targets. They are led by Research Directors, sitting on the SINTEF Digital management team. This level is facing the set of customers and partners, at the same time holding responsibility for staff career development and recruitment. Together with Research Managers of individual research groups, issues such as mobility, internationalisation are addressed, resulting in a cohesive and adequate strategy down to the operative role at research group level, delegated to Research Managers. Newcomers are paired with senior staff, to the benefit of career advancement.

The AU utilises the SINTEF School, as a corporate continuing education instrument offering a set of mandatory courses. Basic courses are expected to be finalised by staff within the first 1-2 years of employment, possibly including more advanced training, e.g., in line management.

The AU facilitates education by recruiting promising master and PhD students associated with research projects. Several senior staff hold part-time positions in Academia, e.g. 20% FTE appointments have been held in NTNU by 18 researchers and UiO by 8 researchers employed in SINTEF Digital. Annually around 30 summer students have been recruited from these two Universities, who typically stay on to work towards their Master's degree.

The split of staff numbers between research, technical and management staff is healthy and matching the ambitions of the AU. The gender balance, particularly when broken down by age, displays a low fraction of women in the higher age bracket. This is likely to be corrected in a natural way, though not quickly, as recruitment patterns at younger age brackets (also in

terms of seniority of roles) indicate that a firm engagement of women would be maintained and grown in the future.

Annual appraisals appear to be part of a solid set of procedures concerning assessment of progress and promotions. Research mobility is assured to a reasonable degree and is of personal, as well as institutional, benefit.

Recommendations to the administrative unit.

The AU may consider keeping a track of the career destinations of its employees and students. This can advise how to make recruitment, further education and career development support more efficient.

Support of employees in terms of improving their personal web-presence will be highly motivating for individuals and would impact positively on the visibility of SINTEF Digital as well.

1.3 Research Funding

In the last five years, the research groups of SINTEF Digital won 83% (taken as the total of national grants, contract research and international grants) of their R&D budget. This is roughly the fraction of the non-core funding (Basic grants + Retur EU) in the average budget. It is unclear from the self-assessment whether the goal to reach 30% fraction of EU funding is on its way to be achieved by next year; the 5-year average is 19% and although the number for 2022 was already 25%, the interview indicated that the fairly steep outstanding increase required to meet the target has not been achieved. Retur-EU is a valuable and generous approach to level economic costing among different funding sources. Although the self-assessment provides no evidence or comment on possible SINTEF Digital internal mechanisms and procedures to pass this support onto the group winning and running the project, the interview indicated that such a policy is in place.

Recommendations to the administrative unit.

Realistic planning of the EU-generated component growth should be at the centre of attention and the status quo should be widely discussed at interim reviews. The existing procedures for the utilisation of Retur-EU income in a way allowing to channel 100% of that support specifically towards the group implementing the project should be upheld and protected in the future. This can have a substantial motivational value and will help enhancing the fraction of EU income.

1.4 Research Infrastructures

SINTEF Digital, representing SINTEF, has a major stake in NorFab, as the leading Micro- and nanotechnology research infrastructure in Norway. The main infrastructure facility hosted by SINTEF Digital is the MiNaLab, which is a 800 m^2 clean room, managed by the Department of Microsystems and Nanotechnology. MiNaLab has a complete Si processing line for 150 mm wafers with state-of-the-art equipment for production of Si-based semiconductors and microsystems. This appears as a much desired facility, capable of attracting the attention of national and international customers and partners. Participation in other national infrastructure includes the Norwegian Artificial Intelligence Cloud (NAIC), the Smart Building Hub (energy efficiency and smart grids), NorPALabs (management of end-of-life upstream infrastructure) and OceanLab (serving the complex of needs in the maritime and marine sectors). This spread, together with the pivotal role in semiconductor nano-manufacturing, allows the AU to support its groups in a substantial variety of projects, spread across essential sectors of national economy.

Internationally, the AU participates mostly in the European Space Agency with notable relevance and significance to the Agency's capabilities: communications systems, flash-LIDAR, air-quality monitoring for the International Space Station (ANITA) and tissue-equivalent crew dosimetry. This is evidence of the rich expertise base of SINTEF Digital and the quality it is capable of delivering. CERN infrastructure is utilised for the work on extremely radiation-hard sensors for detector systems (European Organization for Nuclear Research). The European Synchrotron Radiation Facility (ESRF) beamlines are used for work on 3D Si micro-dosimeters, which is widely published and reported at conferences. Beyond Europe, SINTEF Digital has delivered for the Sanford Linear Accelerator custom radiation detectors, recently used for the characterisation of the COVID spike protein.

Direct participation in the European Strategy Forum on Research Infrastructure (ESFRI) projects is via instrumentation for the CO_2 Field Lab in Svelvik for the European CO_2 Capture and Storage, as well as technology (Si micromachining and advanced material deposition) required for the novel solid-state detectors for the European Spallation Source.

Both physical and digital infrastructure is accessible for researchers in the AU. The former is mainly via the INFRA Programme of RCN and larger EU projects. The latter is mainly used for the purpose of high-performance computing, data management, scientific software and software development.

The AU is committed to uphold FAIR principles in their entirety and plans to combine datasets across disciplines within the new infrastructure platform <data.sintef.no> (DSN).

Recommendations to administrative unit.

In view of the emerging DSN, in addition to the FAIR principles serious thought should be given to data security. Given its expertise profile, national and international exposure and customer/partner needs, SINTEF Digital should be one of the drivers to introduce procedures for regular update of the security requirements and generate best practice in this regard.

1.5 National and international collaboration

Nationally, the 10 collaborations highlighted by the AU are spread across academia (AI, cybersecurity), industry (food and precision agriculture) and the public sector (healthcare); in many cases involve two or all three sectors. As a more special category of collaboration, the AU has a collaboration platform with top national academic institutions, NTNU and UiO. Part-time positions facilitate access to summer students and candidates for Master's and PhD programmes, which is crucial for recruitment of future employees. Theme-based GEMINI centres are also actively used for the same purpose, together with involvement in 13 Centres for research-based innovation and 8 Centres for Environmentally Friendly Energy Research. Furthermore, the unit acts under the Corporate SINTEF collaboration agreement with Equinor (to provide sustainable value creation and assist Equinor becoming a broad energy company) as well as with the Kongsberg Group (in the business areas of maritime, space, defence, digital and new energy sources). Largely, the national collaboration profile meets the aspirations and vision of the AU. It also facilitates interdisciplinary collaborations and cross-sectorial interactions, as well as public partners' involvement.

International collaborations involve leading research agencies, such as the European Space Agency (optical ranging), National Aeronautics and Space Administration, NASA (terrestrial underwater exploration), bilateral collaboration with the Finnish National Institute of Health and Mental Health Finland (policy and services assessment and development), as well as participation in the Marie Sklodowska-Curie Innovative Training Network (funding for

European PhDs). Individual collaborations involve European universities, such as the University of Milano-Bicocca (data management), University of Verona (health), and research institutions, such as the Big Data Value Association (AI and Big Data) and CNRS/INRA Lab in Sophia Antipolis (computing). SINTEF Digital recognises the need to substantially increase the turnover from projects with European funding. The extensive network activity resulting from EU projects allows SINTEF Digital to be incorporated into the relevant communities typically in hot areas such as AI, IoT, Healthcare, Energy, Digital Economy, Robotics etc. This allows optimal positioning and input into strategy building, setting the innovation agenda, leading work on position papers and others. Overall, the international collaborations appear to provide substantial added value to the research quality of the unit.

The impact of collaborations on the quality of research delivered by the unit is difficult to judge. However, it may be worth noting that the AU collaboration shares in national and international publishing are 38% and 45.1%, respectively, against the averages of 21.9% and 53.8% for all EVALMIT AUs. Thus, while the overall share of collaborative papers is similar to the average, the AU's profile is fairly balanced between national and international co-authorship, while the average is substantially skewed towards international partnership. This is a fact worthy of reflection, for the better understanding of the current research culture and for efficient strategizing on the future.

Recommendations to administrative unit.

It seems SINTEF Digital is lagging the average on international co-publishing. Although this applies to SINTEF as a whole, the AU has the ability and experience to build solid understanding of the nature this metric and what is its optimal range for SINTEF Digital.

Also, see recommendations in section **1.3 Research funding**, concerning Retur-EU.

1.6 Research staff

The SINTEF Corporate "People Strategy" clearly sets out, although on a quite general level, principles of diversity and inclusion, collaboration, teamworking, ethics and fundamental values. All employees have access to e-learning programmes, personal mentors, as well as personal interviews with managers for new starters. Leave of absence is practiced for researchers who are on a PhD programme. However, research sabbaticals seem to be very seldom and are managed on a case-by-case basis. It appears that there is no policy or procedure related to it and there is no evidence that such practice is encouraged at all.

Most of the temporary positions are in the scientific staff category and constitute around 10%, which does not cause concern.

The share of female researchers grew in the last decade, although not at a constant rate, from 18% to 25%. This is still lower than the national average for women in science and engineering. At the same time, female researchers on the average are slightly younger than males. This suggests that although the gender balance will be shifting towards better representation of females, this alone will not be likely to yield the desired outcome in the envisaged timeframe. It is also worth noting the apparent gender disbalance in one of categories: 82% of management and administration roles are held by women. However, it is encouraging that still 77% of all female staff are employed in the scientific staff category, which has by far the most significant share (87%).

The share of researchers 62 years and older is stable and does not cause concern.

Recommendations to the administrative unit

The AU may consider weighing the benefits of running a well-defined and fair sabbatical scheme. This can be based on the broad definition of this tool as “an extended period of time intentionally spent on something that's not your routine job". This will be conducive to a fresh inflow of ideas and approaches that could be missed because of routine pressures. Furthermore, such an opportunity would grant SINTEF researchers a career advantage enjoyed by their colleagues in academia.

1.7 Open Science

SINTEF Digital has in place a host of Open Science policies, which are set at the corporate level, to manage open access (publications, data, educational resources), open-source software, open peer review and citizen science. Training for implementing these policies is also available.

A major facility in this respect is SINTEF Open, an institutional depository implementing Green Open Access by securing access to Author Accepted Manuscripts. Nearly 70% of research publications are deposited in SINTEF Open and accompanied by bibliographic statistics several times/year. Access to research data is subject to a separate and individual to projects Research Data Management policy which ensures openness, confidentiality and compliance with FAIR principles. The AU uses broadly the European Open Science Cloud and in particular, its service Zenodo for Open Science Data. Citizen science is mentioned only in passing, bundled together with stakeholder involvement, only in project context.

Recommendations on how to promote open science

Citizen science, as a great vehicle for enhancing the AU’s public image and providing a closer outlook at problems and concerns of high value to local communities, should be given higher attention in the AU’s strategy and operations.

2. Research production, quality and integrity

IEEE appears as the most preferred publisher for the AU, although the outputs are spread across many outlets. The target of 1.0 publication point per year and per researcher by 2025 is set clearly, but there is no update from the quoted 2022 number of 0.78. Each Prioritized Research Area has established an internal group with a high level of expertise and internationally recognized senior staff. The areas are “owned” by a member in the AU’s management team. The Prioritized Research Areas consume at least 40% of the core funding and are actively used to encourage collaborations across departments and research groups. Project applications are managed in yearly open calls followed by a two-step evaluation procedure.

SINTEF Digital have generated around 324 publications in 2022, which corresponds to roughly 27% of SINTEF’s output. This is 83% of the 2025 target and accounts of the progress closer to this term are not available. Projected onto the modified author shares, the AU’s contribution to SINTEF is very similar, at around 26%. SINTEF Digital has the highest percentage of all author shares across SINTEF, 3.8%.

Of all publications, 77% are Open Access, which being a good position to be in, still allows room for improvement. The breakdown with respect to Open Access publishing reveals a clear preference for archival mode of access (50%) compared to Gold Open Access (27%). It is worth noting that these two options differ in the kind of peer review they involve, as the former can offer only voluntary peer feedback, while the latter requires formal peer

assessment via editorial board procedures. It is up to the AU to balance optimally these two options and either can be used to reduce the percentage of publications that are not Open Access. As one possible metric of quality and impact, the share of the 10% most cited publications (14%) is the highest across the 6 SINTEF groups and higher than the average across research groups in academic institutions (e.g., NTNU). In terms of co-publication with peers, the manifested preference is towards international co-publication (45%) compared to national (38%). However, this is better balanced compared to the national average (56% vs 27%) and across SINTEF (53% vs 22%). The data on co-publishing with top-ranking world-class institutions show the AU's author share at 38%, which is a top result across SINTEF and evidences a solid team involvement and capacity to develop collaborations further.

The AU benefits from the SINTEF corporate Management System, which is certified for quality assurance, environment and health & safety. Projects above a certain budget threshold are subject to internal audits and there is a defined corporate "whistleblowing" procedure.

2.1 Research quality and integrity

Twenty-one research groups across 5 departments of SINTEF Digital were submitted in EVALNAT, EVALMIT and EVALMEDHELSE, out of the total 34 groups in 6 departments, yielding 62% of all groups, as shown by coloured shading (see page 2). This pertains mostly to the coverage of research expertise, rather than individual researchers, because of the different group sizes. The Sustainable Communication Technologies department is represented in full, while others are represented more sparsely, to a different degree. Less than half of the research groups in Health Research were submitted.

Research in SINTEF Digital is also organised along 9 Research Areas, each with a dedicated Research Manager. Overall, the organisational environment in SINTEF Digital is very strong and facilitates the production of excellent research. In the other two dimensions, the performance of the submitted SINTEF Digital research groups is on the average good, leading to strong. It was not possible to identify any trend connecting unambiguously the level of funding with the quality of research. It is notable that the achievements reported in the Societal Impact dimension are better than those in the Quality dimension. Most of the submitted groups are at the forefront of their research areas, however, the claims for national prominence are much more convincing than evidence of international standing. SINTEF Digital is deservedly a desirable partner nationally and has a convincing international presence.

However, none of the submitted research groups appears to be a clear World leader in their field of expertise. While such a goal does not currently appear in benchmarks and KPI lists (with small exceptions), the overall research power of SINTEF Digital, as revealed in this evaluation exercise, is conducive to the formulation of such strategy and planning towards its implementation in the medium term. Having one or more World-leading SINTEF Digital research groups in the next 5 to 10 years will be a desirable disruption step, generating best practice and bringing out the potential for a multiplicative institutional impact.

Summaries of the assessment of the research groups is presented in the appendix.

3. Diversity and equality

The AU's unit's actions, to protect against discrimination and ensure equal treatment and opportunities for its employees, is reliant exclusively on SINTEF Corporate strategy 2019-2030, which is expecting an update in 2024. This approach is reasonable, as it ensures the

high quality of concepts, procedures, auditing and other components of the policy, as well as the “One SINTEF” objective. It is also justified by the absence of related issues specific to the AU, thus recruitment practice targets a wide range of competences and skills, and inclusivity in terms gender, age, cultural background, and personal qualities is upheld. Since 2022 SINTEF has a Gender Equality Plan. SINTEF Digital may wish to consider the detailed impact, on their workforce, of statements (in the submitted as extra document <SINTEF’s People strategy.pdf>, p.11; also cited in the self-assessment, p.15) as “It is important for SINTEF to ensure a healthy gender balance by boosting recruitment quotas for women among our research scientists and managers.” This is in view of the fact that gender is a protected personal characteristic and, in environments which are competing internationally with SINTEF for research talent, positive discrimination in any direction is illegal. In the interview, it was confirmed that the AU does not practice gender quotas for recruitment.

SINTEF periodically updates its equality report, the 2022 edition of which features a section on the AU with measures implemented in that year. The AU plan for 2023 included setting-up a Diversity Committee to link agendas on Diversity and Activity and Reporting Obligation. Unfortunately, there is no evidence of the progress to date, as this is not mentioned in the submitted self-assessment; however, the interview confirmed that said committee has started work.

4. Relevance to institutional and sectorial purposes

SINTEF Digital has a corporate responsibility for the SINTEF commitment towards the health sector. This responsibility is mainly managed by the AU’s Health Department (HD) and its research groups, joined by several other research groups. The aim is to create and develop future solutions for a sustainable and better healthcare system, by focusing on medical technology and health services, which are Priority Research Areas in the AU’s strategy. They are also key research areas in the RCN-funded SINTEF SCI on Health and Welfare. This enables the AU to act as an R&D and innovation partner for the municipal- and specialist-healthcare services, user organisations, industry, and public healthcare administration. Partnerships are established with Norway Health Tech, the Norwegian Smart Care Cluster and Oslo Cancer Cluster. The AU is a member of several public organizations of interest such as Norwegian Cancer Society, Cancer Mission Hub Norway and E-Health in Norway. Cooperation agreements are in place with larger municipalities such as Trondheim and Oslo, as well as separately with several hospitals across the country, such as St Olav's Hospital, Oslo University Hospital and Sunnaas Hospital, giving the AU access to a well-developed and representative set of institutions. This is beneficial in view of potential rolling out of successful practice into other socially significant structures.

On EEA level, the AU is a health technology partner in the European Association of Research and Technology Organizations (EARTO) and member in the RCN’s reference group for Health.

The AU is an active contributor with strategic input to the Ministry of Health and Care Services, the Directorate of Health and the Directorate for E-health. Work with media is also well developed and serves sectorial purposes: a regular column in news site for Medicine and Health (Dagens Medisin), podcasts, chronicles in regional and national newspapers and participation in professional and strategic leadership conferences in the health sector.

The AU has a long track record of successful spin-off / start-up companies based on own research results. This is facilitated by close cooperation with the SINTEF Technology Transfer Office, which helps and guides the assessment of the innovation and

commercialisation potential of new technology / research products. The governing policies for this are again corporate and not specific to the AU. Reported spin-offs are Zivid AS (3D stripe protection camera), Sensibel (optical MEMS microphone), Minuendo (adjustable earplugs), Nomoni (acoustics) SpinChip (multi-analyte in-vitro diagnosis patent), OSAC (fisheries patent); start-ups are Invivo (MEMS pressure sensors patent),Tunable (FP Filters for gas analysis patent), Aidee (cuffless blood pressure monitor patent) , Tellu AS (digital services platform licensing). Although the strategic KPI of one commercialisation per year has not been reached yet, the total of 6 spinouts and 4 start-ups is an impressive achievement, in proof of the AU's commitment to commercialisation. However, to uphold this KPI in the future and make it a meaningful steer to their operations, SINTEF Digital would benefit from internal discussions on the reasons for lagging behind the target and possibly consider alternative metrics/targets.

The AU works within a SINTEF corporate unit, which it leads, and coordinates the work related to SINTEF's societal contract to contribute to debate and politics with advice and knowledge. SINTEF Digital is contributing to the "21 Strategies" national framework for various industries and themes essential for national restructuring. "Digital 21" is chaired by the AU and aims to facilitate the development and adoption of new technology in line with increasing digitalisation. This includes co-leading the work on digitalisation in the Energy area ("Energy 21"). The AU participates in the national debate on research related issues at political gatherings, as well as organises own national events on how the digitalisation is shaping the national landscape.

Users outside SINTEF are being involved by a set of approaches and initiatives, such as actions research, citizens' involvement, living labs, hackathons, etc. Use-case partners are involved in priming events, to analyse existing identified needs, as well as to introduce/discuss emerging methods and approaches to solve problems of particular interest.

5. Relevance to society

SINTEF Digital achieves considerable impact of its research, as evidenced by the submitted impact cases. Of these, the TOMRA-Titech sorting machines case stands out, while the others are more difficult to gauge, although they are a clear success in their directions.

As a Research Institute, SINTEF Digital balances, among others, the need for expertise building with the provision of research services. The business model is based on public and private funds sponsoring the search for solutions of current interest to the government, the economy and society as a whole. In those terms, impact creation is intrinsic to SINTEF Digital's business. Projected onto the EVALNAT research assessment exercise, it would be advantageous to distinguish between:

a) primary impact, by the successful completion of a certain fixed contract (c.f. the statement used in one of the impact cases: "SINTEF Digital has over a 30-year period operated as a virtual R&D department for … one of Norway's major tech companies") and

b) secondary impact, generated by the adoption and further use (possibly inter-disciplinary and/or trans-sectorial) of the research product.

Such a distinction is not envisioned in the used impact reporting template and neither primary nor secondary impact are trivial to quantify. The latter is particularly easy to under-estimate. At the same time, secondary impact is potentially longer lasting, affects a wider set of problem-solving and warrants substantial weight in decisions on public funding. Therefore, at least a semi-quantitative approach, based on estimates by the final user(s),

would enhance notably the quality and usefulness of impact reporting and assessment. The user-centric approach is essential and well developed in SINTEF's ecosystem; therefore, it would be relevant to apply it for the understanding of the overall value of the research outcomes and impact in particular. Some comments and examples are given below on case-by-case basis, where appropriate.

5.1 Impact cases

Comments to impact case 1: TOMRA-Titech - reversing vending machines and automated sorting machines

The impacted areas are in the sorting of waste, of food and of mining raw material. Particular recent contributions are on the TOMRA flow technology, the Autosort Flake sorting machines and on the high-precision spectrometers. QVision500 was introduced to the meet industry in 2009. The relevance and importance are excellent, the most prominent strength is the economic impact on the operations of a global player such as TOMRA.

The underpinning research has evolved through the years, e.g. sorting plastic bottles has started with simple optical components and image recognition, with more recent solutions utilising state-of-the-art for robust low-resolution reading of barcodes, fraud detection and dirt detection. At the base of the achieved impact is the research resulting in the design of the high-speed scanning spectrometer, as a data source. This is complemented by the development of suitable electromagnetic and X-ray detection techniques for food and metal fractions. Particular effort is invested in applied spectroscopy on a process line ("in-line spectroscopy"), applied in a variety of scenarios. The underpinning research is protected by 1 patent and published in 4 journal articles.

The main impact is with TOMRA Sorting Solutions where SINTEF Digital contributes to 4 different sorting solutions:

- Waste sorting: High-speed dedicated spectrometer design and data analysis for large-volume belt sorting – distinguishing all the 7 major polymer/plastic types and carton from different paper qualities.
- Food Sorting: Dedicated high accuracy spectrometer design and geometry, quantitative data analysis (in collaboration with NOFIMA).
- Mining Sorting: Design of high speed electromagnetic detection
- Reverse Vending Sorting: Dedicated spectroscopy, camera system design and data analysis for plastic bottles and beverage cans - 82,000 TOMRA installations in 60 countries, capturing 46 billion used beverage containers annually.

It is commendable that trans-sectorial impact has been achieved, with research results in applied optics and data processing being applied to the areas of mining efficiency and sustainability. This has the additional value of easier quantification of the economic impact due to the partnership with TOMRA.

Comments to impact case 2: MRST (transforming research on reservoir simulation)

The impact results from the release of high-quality open-source code for research and simulations in porous media and flow modelling, in the form a MATLAB toolbox (MRST), with more than 65 modules. Just less than one-third of these modules have been developed with external national and international collaboration. The relevance is evidenced by the deployed technologies, importance is supported by the international interest and the main strength is the promotion of open research.

The underpinning research is on simulation technology developed for specific clients or purposes, in amalgamation with standard methods and models, and subsequent validation in a relevant environment. Among these, a novel automatic-differentiation, object-oriented simulator framework appears to be of prominence. It is notable that the delivery of said underpinning research strongly aligns with the Open Research principles and reproducible research. the underpinning research is published in 1 journal paper, 1 book, 1 user guide and 1 conference paper.

The most tangible impact is commercial, exemplified by operationally deployed technologies using the MRST toolbox: INTERSECT multiscale sequential fully implicit simulator, ExxonMobil field-planning and reservoir management tool, ResInsight reservoir modelling tool and carbon storage trapping estimators included in AutoDesk Forma. Further impact is in education and on research teams world-wide, evidenced by the number of the toolbox downloads (around 10K/year in the last 2 years), 970 citations in papers and theses, as well as the growing attendance in the biennial MRST symposium.

Although the commercial impact is not quantified, it is clear that the deployment of MRST by SINTEF Digital researchers has been a success. The additional impact is in raising the international prestige and standing of the Institute, creation of SINTEF-wide best practice, etc. In spite of the open-source character of the underpinning research, it would be recommendable to request from the users of deployed technology to offer their quantitative estimates of the commercial gains that can be attributed to their free use of MRST. It would be also important to reflect on how the total impact credit can be split among the group of contributors to MRST.

Comments to impact case 3: Mental health services research

The impact results from the generation of data of interest to mental health services for their needs in planning on national and municipal level, management, development of services and policy. Relevance and importance are excellent, the strength is in crossing the trans-sectorial line – from digital (data) technology to healthcare.

The underpinning research is represented by 4 RCN projects on mental health and disability, as well as work-package leadership in EU-funded REFINEMENT project on the effect of financing systems on mental health, together with 5 universities and 3 other Institutes. Overall, the underpinning research was performed in collaboration with 8 national academic and governmental institutions and 8 international collaborators (universities, research institutes and charities). The underpinning research is published in 6 journal papers.

The main impact appears to be the generation of knowledge and deployment of expertise in an advisory role to authorities dealing with mental health and substance abuse. The direct impact is by provision of data for decision making (annual collection of data from all national municipalities since 2007), own evaluations based on that data (leading to the discontinuation of the “package pathways”), while e.g. feeding data into top-level national debate produces an indirect impact (e.g. in evaluating mental health care pathways). Further exposure of professional organisations and the general public through the media enhance the impact and create the appropriate level of acceptance of said decisions. The academic impact can be quantified by 418 citations of the published underlying research.

Difficult as it is, to quantify impact on policies and practices in healthcare, efforts should be made to identify criteria and measures of success reaching beyond the narrative, e.g. by making references to the size of the budgets expended centrally and/or by municipalities on solving such issues, etc.

Comments to impact case 4: Cyber security in the energy sector

The impact is through implementing projects with O&G and Energy industries on cyber security of critical infrastructure. Perceived contributions are towards threat identification, risk analysis, generation of guidelines and baseline security requirements, running preparedness exercises, continuous awareness raising, facilitating the adoption of these inputs by industry and enabling industry arenas for collaboration and common practices. Relevance and importance are excellent, the biggest strength is the timely reaction to recently emerged problems.

The underpinning research is in several RCN-funded projects, such as DeVID (risk evaluation of smart meters), FME Cineldi (modelling cybersecurity risks resulting from power grid digitalization), SecureGrid (gaps in cybersecurity and risks in the national power transmission network, developing a mitigation roadmap), Stop-IT (cyber-physical threats to the water infrastructure and ICT security and robustness in the petroleum industry. This research is published in 2 journal papers, 2 conferences and one Doctoral thesis.

The main impact-generating contributions have been the output of several cybersecurity guidelines, risk analysis and best practices for the O&G industry and for Smart Meters, as well as establishing the Industry Forum for Cybersecurity of Industrial Automation and Control Systems (CDS-Forum).

The offered sources to corroborate the impact are either to documents seen as the impact itself, or reports and communications that such documents exist. Attempts to gauge the scale of the impact remain fully qualitative as no quantitative measures have been developed to convey that scale. To a large extent, impact was generated in collaborations, thus it would have been appropriate to report the estimated own credit share for each impact contribution.

Comments to impact case 5: Decision support tools for aviation safety

The impact is through the development of a local turbulence forecaster SIMRA, deployed at around 20 national airports, as well as of aircraft noise calculations, available online. Relevance and importance are excellent, the strength is in the indispensable value on a local scale, from serving the needs of communities to regulatory assistance to decision making on a national level.

The underpinning research is in terrain-induced turbulence modelling upgrade to enable forecasting and real-time predictions. Recent versions of SIMRA use AI and train extensively surrogate models and in combination with analytical models to augment the resolution of wind fields reconstruction. These achievements are also useful for analysing the suitability of bridges. The research has been published in 2 journal and 1 conference papers, 1 book chapter, 2 SINTEF reports and two closed access depositions with the Norwegian National Library.

The main impact is the deployment of the SIMRA system after 2009. SIMRA is currently deployed to serve 20 airports. It has passed several verification test projects and has also been used for planning of new airports, such as in Lofoten in 2016, by the analysis of 4 alternatives, leading to the choice of Leknes. More recently, SIMRA to assess wind- and turbulence conditions for new bridges to be built across fjords in mountainous terrains in connection with the Ferry-Free E39 project. NORTIM has been adopted nationally as the official method for aircraft noise calculation and has been essential in legal proceedings, creating trans-sectorial impact.

The research leading to impact seems to be sharply focused and delivering results. However, there is no benchmarking against similar products or problem solutions outside the country, as evidence of quality. The claim that SIMRA was “the world’s first and only real-time turbulence alert system” needs evidence-based clarification in terms of its operational parameters and possibly comparison with e.g. the MetOffice (UK) Operational Suite containing the 3DVOM model since 2007.

Attempts to gauge the impact, at least crudely and semi-quantitatively, would have enhanced the case.

Methods and limitations

Methods

The evaluation is based on documentary evidence and online interviews with the representatives of Administrative Unit.

The documentary inputs to the evaluation were:

- Evaluation Protocol that guided the process
- Terms of Reference
- Administrative Unit's self-assessment report
- Administrative Unit's impact cases
- Administrative Unit's research groups evaluation reports
- Bibliometric data
- Personnel and funding data
- Data from Norwegian student and teacher surveys (only for HEI's)

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

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

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

A one-page summary of the Administrative Unit was developed based on the information from the self-assessment, the research group's evaluation reports, and the interview. The Administrative Unit had the opportunity to fact-check this summary. The Administrative Unit approved the summary with minor adjustments for clarity.

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
SINTEF	SINTEF Digital	Computational Geosciences (COMG) Communication Systems (CS) Computer Vision (CV) Acoustics (ACOU) Software Product Innovation (SPIN) Applied Optics (AO)* Silicon Sensor Technology* Optimization (OPT) Cyber Security (CyberSec) Human Computer Interaction (HCI) Robotics and Control (RobCon) Analytics and AI (AAI) Health Services Research / HSR* Micro-optics* Geometry (GEO) Computational Science and Engineering (CSE) Trustworthy Green IoT Software (GIoT) Reliable automation (RA) Smart Data (SD) Digital Process Innovation (DPI) Medical Technology*

* Evaluation of research groups conducted under the EVALNAT

Research Group Assessments

Research group Geometry (GEO) overall assessment

The group GEO at SINTEF focuses on applied mathematics with a geometric flavour. It is rather small (5 scientists and 1 PhD fellow) and is not concerned with any teaching activity but instead wholly devotes itself to research output, measured in terms of published papers and software development. It interacts with other research groups, mainly with University of Oslo (UiO) mathematics and informatics. It also contributes to the needs of industry in terms of the Norwegian Additive Manufacturing ecosystem. The scientific focus is on n-variate functions and the use of splines to represent those. They developed locally defined B-splines and are also involved in the use of neural networks. It is important for Norway to have participation in scientifically hot fields such as neural networks. The output of the group is of consistent and of high quality, as demonstrated by a continuous sequence of grants funded by various funding agencies, mainly the RCN. The interaction with UiO has led to co-supervision of 5 PhD fellows 2012-2022, which is highly beneficial to UiO. There are challenges for the future. For instance, developing new numerically oriented geometric research directions is important and may depend on successful recruitment in the coming years. The social dimension is covered by the availability of produced software and various outreach activities, and it is deemed that they offer high added value for Norway.

Research group Optimization (OPT) overall assessment

This research group complements other groups within SINTEF and is well integrated within SINTEF’s digitalisation strategy. The group is very successful at securing funding from industry and has participated in several international projects. Despite the majority of the funding coming from applied projects within industry, the group has been successful in publishing academic research at a good international level. Because of the concentration on applied projects in industry, the group is very successful in technology transfer of cutting-edge academic research. Given the funding model and organisation of SINTEF, the group makes a significant societal impact in Norway. Given the success of publishing good-quality research, it is a pity that there is not enough time for group members to engage in more basic research. Engaging in more basic research would enable the group to renew its set of academic tools that can then be applied to industrially relevant problems

Research group Computational Geosciences (COMG) overall assessment

The research group demonstrates outstanding performance across various dimensions, including organisational structure, research quality, and societal impact. Its dynamic organisational model and cohesive research strategy have facilitated rapid progress towards research objectives. The group's scientific output upholds high international standards, contributing significantly to advancements in computational geosciences. Moreover, its impactful societal contributions, particularly in open-source software development and knowledge transfer, underscore its relevance and influence beyond academia. While the group exhibits notable strengths, opportunities for improvement include enhancing interdisciplinary collaborations, maximising industry engagement, and optimising resource utilisation. Overall, the research group is well-positioned to achieve its goals and maintain its competitive edge in the international research landscape.

Research group Computational Science and Engineering (CSE) overall assessment

The goals of the group are generally well aligned with a continuation of past accomplishments and successes. The emphasis on open-source software is an important element while the goals to develop projects across the entire range of TRL seems very

ambitious. The strength of the group is clearly on the more applied projects, often in collaboration with industry or major governmental application drivers. Overall, the group has performed well during the last decade and has had major impact for certain projects, e.g. software for predicting turbulence over land to support safety considerations in airports – a project that has been implemented at all airports in Norway. The research efforts are mostly directed towards maturing and further developing new ideas produced elsewhere and this is perfectly fine – that is exactly the niece where the group have a competitive advantage, in particular when this allows for the development of mature and professional software solutions. Financially, the group has a high degree of self-financing and is successful in attracting such funding. The host institution appears to provide a strong and supporting environment in which the group can thrive. In collaborations with the Norwegian University of Science and Technology (NTNU), it also contributes to training of doctoral students and the group has been involved in development of winter/summer schools with a focus on machine learning in science – a very active and timely area where the group has already positioned itself, including also in an international context.

Research group Communication Systems (CS) overall assessment

The research topics of wireless communication and navigation are very promising and applicable in many areas. In particular, the combination of wireless and wired communications is in high demand and has a wide range of applications. However, there exist many challenges. The main problem for the group is its focus on short-term innovation projects, with very few projects dedicated to fundamental research. This lack of longer-term research topics affects the quality of their scientific work. In addition, the group relies heavily on external funding, especially from industry, which is difficult to secure due to the small size of the telecommunications sector in Norway. Despite these obstacles, the group performs very well in applied research. At the societal level, the main contributions come from the educational programs for master's and doctoral students and the economic benefits and competitive advantages they provide to their customers. These efforts highlight the group's important role in both education and industrial development. Nationally, the group is a strong player in driving industrial progress, but internationally it lags behind leading institutions in fundamental research and academic prestige.

Research group Trustworthy Green IoT Software (GIoT) overall assessment

The Trustworthy Green IoT Software (GIoT) group is doing research in the areas of software engineering, AI engineering, cybersecurity, privacy, cloud computing, and IoT. The group is strong and well-positioned at an international level. The main positive features of the group are the capability to attract international funding, high-quality scientific publications, and contributions to standardisation bodies. Aspects that can be improved are related to the supervision of PhD students and the development of interdisciplinary research.

The group provides some benchmarks regarding funding, PhD supervision and growth, but lacks concrete plans and quality measures regarding scientific publications, as well as comparison with relevant international research groups.

The GIoT group has an adequate composition and level of infrastructures to conduct high-quality research, as depicted by the publications they have produced in recent years. The group shows very good capability to obtain external funding and develop high-quality research, as demonstrated by the ongoing and concluded projects. The number of PhD students seems low considering the size of the senior team. Contributions to teaching are not sufficiently presented. Societal and knowledge transfer activities are very good, with a relevant contribution to the open-source community.

Research group Cyber Security (CyberSec) overall assessment

The Foundation for Industrial and Technical Research (SINTEF) CyberSec has a good strategy in funding and research collaborations. The group has developed as a strong partner on the national security landscape, especially in topics like Secure Software Engineering, Smart Grid, Cloud Computing, 5G etc. There is a strong commitment to teaching and student supervision. The publication output is good but mostly focused on journals. Hence, there is room for improvement in publications, especially considering their international collaborations and successful past and current projects. The group had some relevant collaborations for security startups, which contributed to several societal contributions.

Research group Human Computer Interaction (HCI) overall assessment

The areas of the research group are timely and relevant, and the research projects largely operate within these areas. The group has worked to increasingly focus on delivering high quality research and the report contains several well-cited papers by multiple authors in the group and with external collaborators. However, the publication venues of the research papers listed are not classic HCI top tier venues. To meet its academic ambitions regarding international leadership, the group should consider publishing in top-tier HCI conferences and consider how they can contribute to international academic leadership through engaging in academic services beyond peer-reviewing.

HCI is a well-organised research group with a clear and ambitious research agenda. The group has worked to increase its external funding and the research group successfully attracts substantial funding from a broad range of sources including national and EU funding. The group has managed to increase the level of external funding significantly during the past years and seems to be on a very good track in this aspect. The research group has close links with industry through the project portfolio where external partners are involved in projects and in developing the project portfolio. The group is also involved in education through supervising a large number of BSc and MSc projects.

Research group Computer Vision (CV) overall assessment

The Computer Vision (CV) group is part of the Smart Sensor System Department within SINTEF. Their strategy is to focus on knowledge and technology transfer, primarily to Norwegian industry. Their competences are in 3D structured light imaging, deep learning on point clouds, and drone/robot vision. They have long standing collaborations with companies such as Zivid, a spin-off from the CV group, TKS Agri SA, and others. They are well embedded within the SINTEF ecosystem. The group aims “to cover all aspects of computer vision from the sensing to the perception using the frontier of the research areas to develop robust prototypes for the industry, including fast or embedded implementations.” This goal as well as the stated objectives are ambitious, but the project portfolio partly justifies that, especially within the Norwegian ecosystem. Their focus is clearly not on research publications or education, but on software and systems delivery. Their international standing is currently limited and could be improved by more open-source software projects.

The CV group is very strong in knowledge and technology transfer within Norway. Their partly long-term collaborations with the same partners indicate that they can deliver applicable solutions to the Norwegian industry. They do not publish much, nor do they have extensive international collaborations, which makes it difficult to assess their international standing. However, they significantly contribute to the Norwegian society

Research group Reliable automation (RA) overall assessment

The Reliable Automation Group (RAG) at SINTEF benefits from a robust administrative framework, ensuring ample support for its operations. The group's strategy encompasses four diverse research themes, involving collaborations across various SINTEF departments. Despite its medium size, the group's diversity may pose challenges in maintaining a critical mass within each theme. Nevertheless, RAG's strong network of national and international collaborators significantly bolsters its projects and initiatives. RAG's alignment with the broader institutional strategy is well-articulated, although at the group level, the strategy and its benchmarks are somewhat briefly stated, leaving some ambiguity in their pursuit. Funding-wise, RAG has secured a commendable amount, with a balanced mix of national and international grants, as well as public and private funding. This diverse funding background is crucial for the group's operations and future endeavours. The group's publications are of high scientific quality, featuring a variety of co-authors, though citation levels vary. Given the recent publication dates of some papers, citation counts are expected to grow over time. RAG's collaboration efforts are extensive and robust, contributing significantly to the industries they target through software tools and other deliverables. In an international context, RAG stands strong, with significant contributions to industrial development in Norway and Europe through its collaborative projects. The group's high level of industrial engagement and delivery of practical solutions underscore its impact and relevance on a global scale. Overall, RAG is well-positioned to achieve its goals, leveraging its solid support structure, strategic collaborations, and diverse funding sources to drive forward its research and industrial contributions.

Research group Robotics and Control (RobCon) overall assessment

The Robotics and Control Research Group at SINTEF emerges as a strong entity within the organisation, having critical mass across its diverse areas of focus. However, this breadth of expertise poses challenges in achieving organisational unity, particularly in correlating seemingly disparate areas such as fuel cells and S robotics. Strategically, the group has articulated rational instruments to advance its research agenda, aligning with its capabilities effectively. Over the past five years, the group has demonstrated resilience in securing robust funding, with a commendable balance between national/international grants and private/public funding. This external funding plays a significant role in sustaining the group's operations. Publication output reflects a commitment to scientific excellence, with high-quality papers featuring diverse and relevant co-authors. While citation rates vary, several papers have garnered notable attention, underscoring the group's impact within the research community. Collaboration is a cornerstone of the group's approach, evidenced by a solid network of especially industrial collaborators and a high level of engagement. While research spans various domains within technical sciences, documentation of wider multidisciplinary activities is lacking. A standout strength lies in the group's emphasis on direct technology transfer, aligning closely with SINTEF's core mission. The active engagement with industrial partners underscores the group's commitment to driving technological innovation to address real world challenges. In an international context, the group exhibits strength through its diverse funding sources, collaborative networks, and focus on technology transfer. However, there may be opportunities to enhance visibility and collaboration on a global scale to maximise impact and opportunities for knowledge exchange.

Research group Acoustics (ACOU) overall assessment

Strengths and weaknesses: The specific strength - and a challenge at the same time - is the extremely broad scientific expertise. The strength results from very experienced scientists with excellent international reputation and involvement. The challenge is the danger of losing

continuity over the years. Another strength is the infrastructure and testing laboratories which is unique in acoustics in Norway. The self-assessment does not include a benchmark, however, but SINTEF and NTNU together can surely compete with any similar acoustic centre in Europe such as at DTU Copenhagen or KTH Stockholm. Overall performance: The Acoustics group at SINTEF performs with a very good quality within a very impressive breadth of expertise, although the group is rather small. The publications are high-ranked journals and of good quality, but the main factor of excellence is the success in user-oriented publication and generation of technological progress for the economy and for the society at large (health and well-being).National and international context: On national level there is no institution which could compete with SINTEF acoustics in terms of infrastructure and expertise. Norwegian key industries of various branches rely on their service, wherever acoustic knowledge and technology paves the way to a solution. Thus, a large variety on the Technology Readiness Level (TRL) scale from small to large industry and public services with very successful startups. Internationally, the involvement is mainly identified in membership and leadership in standardisation.

Research group Software Product Innovation (SPIN) overall assessment

SPIN conducts user-centric and design science-oriented research on a high international standard. Their ability to attract funding is very strong, resulting in a well-balanced project portfolio including projects financed by RCN, industry, public sector, and EU. They have very good representation in international projects, participating in 24 EU projects over the last five years, which is impressive (as coordinator of five large projects). SPIN demonstrates a high level of research output and productivity, that certainly is comparable with the highest international standards. The group contributes highly to society. Their close collaboration with users and clients results in research with a high societal impact. Some weaker points could be noticed. The gender balance could be better. Overall quality of publications could be improved to strengthen research output further.

Research group Digital Process Innovation (DPI) overall assessment

The research group has several strengths that contribute to its overall performance and likelihood of achieving its goals. These strengths include research excellence, collaboration and partnerships with universities and industry clients, societal impact through research and community outreach, and successful funding and resource management. However, the group also faces weaknesses such as keeping up with technological advancements, talent acquisition and retention, and navigating regulatory and ethical considerations. Despite these challenges, the research group is well-positioned to achieve its goals due to its strong research foundation, track record of impactful publications, and collaborations. The research group's overall performance is commendable, with a clear strategy, resource management capabilities, and a comprehensive approach to societal contribution. In an international context, the research group has a strong presence, with extensive publications, collaborations with international partners, and participation in EU-funded projects.

Research group Smart Data (SD) overall assessment

The main strengths of the research group are their support from its admin unit, their international positioning and contact with international organisations due to a high participation and leadership in European projects and their involvement in different relevant international networks. Among the main weakness are the gender imbalance, the lack of a mobility programme, the low number of publications and the low connection with the general public in terms of publications and dissemination activities. This evaluation reflects the excellent performance and contribution of the research group in terms of research, in a

national and international scope. The research group has scored quite high in most of the dimensions, with a good organisational environment, a good international positioning, producing high quality research and a good societal impact. The group is very strong in an international context, mainly in a European landscape. The number of European projects, and the collaborations with other research organisations in an international level reinforce this strength.

Research group Analytics and AI (AAI) overall assessment

The Analysis and AI group has a clear vision and seems to be well managed with good collaboration. The researchers are mainly still in the earlier part of their career and a better balance of researchers and senior researchers would strengthen the group. The group mainly focuses on hybrid AI, machine learning for optimization, and time-series analysis for anomaly detection, all being areas that are immediately applicable in industry. The research output includes some output of international quality, but still seems to be far from the ambition of regularly publishing at NeurIPS, ICLR, ICML. The research group has a substantial impact through their research collaborations with industry directly and their engagement SFI NorwAI as managing industrial liaisons. The group lacks access to state-of-the-art GPU infrastructure in order to match the ambitions of the group as modern AI and deep learning technology demands models at scale. The success criteria of the research group are inherited from SINTEF and are of more traditional KPI nature and does not stand out as benchmarks for creating visionary development. In an international context the group has excellent industrial collaboration but should improve on the excellence of the best publications.

Research group Health Services Research / HSR overall assessment

The research group in Theoretical Subatomic Physics and Cosmology (TSPC) has aligned its benchmarks with the overall strategy of the Department of Mathematics and Physics to produce outstanding research and research-based education in mathematics and physics. The group has transformed significantly since the 2010 Research Council of Norway (RCN) National Evaluation of Physics, growing, and attracting competitive external and internal funding. Their research primarily focuses on QCD at finite temperature and density and Cosmology and Gravitational waves, with additional research strands adjacent to these topics. They have a coherent recruitment strategy and intend to pursue external funding, particularly from EU/ERC. The group contributes to excellent research-based education in Physics and Mathematics at various levels and has strong international connections, collaborating with colleagues worldwide and hosting international conferences and workshops. The group's publications are of high impact and have received wide recognition. However, the group's societal impact rests on students' education and outreach events to educate the wider public. Thus, a broader outlook on impacting society beyond education and outreach is lacking. There is little information on the training opportunities for PhD students and postdocs, as well as how the career development of staff is supported.

Research group Silicon Sensor Technology overall assessment

The narrow/focussed aspects of the research are covered by the group very well working in their respective areas as can be seen by a set of reasonable publications. However, the broader context and setting of their work is not detailed in the self-assessment. Although a small group, they should look towards broadening their funding opportunities, including the quantum technologies industry, which is particularly important to the applied aspects of the work. They need to take the lead in areas such as societal impact. The group, which appears only focussed on a less than optimal workplan to obtain academic publications,

needs a proper well-developed strategy in place; such a strategy is not well evidenced in the self-assessment. The strategic plans for the current research in the broad context of impact and the future development of the group is unclear. A more thorough self-assessment with significantly more current and future strategies is necessary to evidence the overall setting of the group's research, rather than the short lists and generalities, would help.

Research group Applied Optics (AO) overall assessment

The Applied Optics (AO) group is a very strong and well-organized group in applied optics that possesses very interesting and relevant expertise in the areas of NIR spectroscopy and image sensing. The group attracts competitive funding, and the research is published in recognized journals of good standards. The group does well in terms of interactions with relevant industries and through their active participation in many projects. The benchmarks set by SINTEF related to the position of the group in the scientific environment, knowledge generation, and innovation are fully implemented. The group might benefit from setting also its own benchmarks. Collaborations and partnering with ESA and NASA endorse a technically high level of the group. Compared to groups in similar research environments, there is a potential for further strengthening the academic impact.

The group has very good international links and an excellent track record of high-quality outputs and engagement with externally funded projects. The group's activities are aligned well with its research goals. The panel believed that the group is likely to continue to achieve its stated research goals. It was noted that the group is very successful in raising external funding which is noteworthy. It is also noted that career progression has not been considered and there is no discussion of mentoring/recruitment processes. How the group defines societal impact is not clear from their self-assessment and the panel suggest that they could improve exploitation of their research results.

Research group Medical Technology overall assessment

The group has a good number of staff and appears to be quite stable. They are developing activity in six areas that are complementary but may not have critical mass in each of these. They are collaborating internationally, but do not appear to have a strategy in place to increase their engagement with internationally funded programmes. It is also less clear what the overlap is between the process chemistry and functional materials aspects of the group.

The overall outputs are fewer than would be expected for a group of this size and it is curious that they elected to only include a small number of outputs in their self-assessment. Compared to international standards the contribution of scientific papers is sparse and seems to be covering a wide range of topics. However, the relevance of research focusing on digitalisation of services could play a much larger role in the groups research portfolio than described as digital solutions could have a large societal impact and could be a relevant priority for this research group in the future.

Research group Micro-optics overall assessment

This is a strong group with close collaboration with industry and university, capability to attract competitive funding and extensive experimental facilities. The field of research is highly important, non the least with the emphasis on carbon neutrality and resource efficiency, thus a field of high importance. Overall, the group activities match very well with the research goals. There has been success in critical funding especially one large grant is noted. Looking ahead for future securing continuous funding remains an open issue. Yet the focus on recycling and digitalization appears to be well chosen. Overall, it is judged based on the documentation that it is a very strong organisational environment, research and

publication quality and contribution is excellent, and societal contribution is very considerable, and societal partners have considerable involvement in the research process.

Terms of Reference (ToR) for the administrative unit

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

Assessment

You are asked to assess the organisation, quality and diversity of research conducted by SINTEF Digital 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* and *life sciences* evaluation protocols, respectively. 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 twelve, ten common and two *life sciences* specific, aspects in your assessment:

1. Research at the institute has a generic character and is performed across many fields and along the TRL scale. The committee is asked to assess if the balance over time among innovation activities, applied research and more basic research is appropriate, both across the institute and in the individual groups?

2. The committee is asked to assess to which extend the institute addresses and serves relevant (established or upcoming) sectors for the green and digital transformation for society at large (public and private sectors).

3. One of our roles is to create research results that contribute to societal impact. The committee is asked to evaluate how we fulfil this role and how we manage to balance short-term market needs and long-term technological development (application pull vs technology push).

4. The institute is driven not only by its own scientific interests and those of our academic partners, but primarily by applied needs which can benefit industry and the public sector. The impact of the institute's work in industry/public sector should be evaluated, including how the institute partner with collaborators and clients.

5. SINTEF Digital has a unique role and character in the Norwegian RTD system. Our basic funding amounts to 7-10% of total revenues, while the remainder is mostly won in open competitions. Under this condition the committee should evaluate to which extend the institute can achieve its mission and consider the impact of this on the research groups.

6. An increasing amount of Norway's research budget is distributed through international financial instruments, e.g., the EU framework programme, and shifted towards innovation. The evaluation committee should consider the impact of this on

the research groups and their ability to perform long-term strategic development of enabling technology for a better society.

7. Is the organisation of the institute and its research groups appropriate (size and topics of research groups, human and economic resources and so on)? How does the committee evaluate our mixture of leading expertise and broad competence, including international visibility to fulfil our role and deliver the expected impact of our research? To which extend does SINTEF Digital, as a generic institute, succeed in exploiting synergy with domain-oriented institute within the SINTEF group to maximise the societal impact of our research?

8. To which extend is our infrastructure (physical and digital laboratories and systems) adequate to support our work? What further measures could be taken to support research groups at the highest level?

9. Assess the individual research groups visibility (e.g., through scientific excellence, innovation, etc.) on national and international level and how this is used to achieve more success in competitive research calls and acquiring industry contracts from demanding clients.

10. Assess our ability and capacity to promptly adapt to and respond to emerging research and technology trends, as well as market changes.

Two *life sciences* specific aspects:

11. Much health research and health services research are conducted within the specialist health services who receive funding over the national budget. The evaluation committee should consider the role of health services research group within the institute sector, collaboration with the health care sector and if the funding for such research is optimally distributed.

12. Assess the group compared to other health services research groups within the institute sector, when it comes to framework conditions (e.g., financing, pricing), competences, and results.

In addition, we would like your report to provide a qualitative assessment of SINTEF Digital 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* and *life sciences* secretariats, respectively, at Technopolis Group.

The documents will include the following:

- a report on research personnel and publications within *mathematics, ICT and technology* and *life sciences*, respectively, commissioned by RCN
- a self-assessment based on a template provided by the *mathematics, ICT and technology* and *life sciences* secretariats, respectively

Interviews with representatives from the evaluated units

Interviews with representatives from SINTEF Digital and the departments involved in the scientific evaluation (Health, Mathematics and Cybernetics, Smart Sensors and Microsystems, Software Engineering, Safety and Security, and Sustainable Communication Technologies) will be organised by the evaluation secretariat. Such interviews can be organised as a site visit, in another specified location in Norway or as a video conference.

Statement on impartiality and confidence

The assessment should be carried out in accordance with the *Regulations on Impartiality and Confidence in the Research Council of Norway*. A statement on the impartiality of the committee members has been recorded by the RCN as a part of the appointment process. The impartiality and confidence of committee and panel members should be confirmed when evaluation data from the involved units at SINTEF Digital 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* and *life sciences* secretariats, respectively. The committee may suggest adjustments to this format at its first meeting. A draft report should be sent to SINTEF Digital´s organisation director Fabrice Lapique and to the contact persons for the involved units at SINTEF Digital and RCN. The contact persons for the involved units at SINTEF Digital should be allowed to check the report for factual inaccuracies; if such inaccuracies are found, they should be reported to the life sciences secretariat no later than two weeks after receipt of the draft report. After the committee has made the amendments judged necessary, a corrected version of the assessment report should be sent to the board of SINTEF Digital and the RCN no later than two weeks after all feedback on inaccuracies has been received from SINTEF Digital

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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