EVALMIT

Evaluation of Mathematics, ICT and Technology

Krikor Ozanyan, 7 April 2025

The EVALMIT national committee

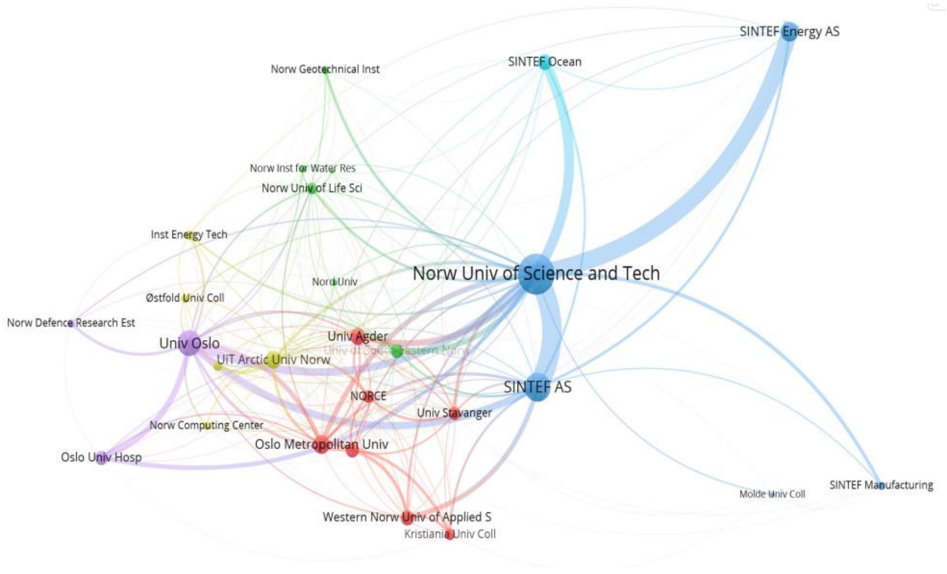
- Krikor Ozanyan, University of Manchester (Chair)
- Deborah Greaves, University of Plymouth
- Jan S Hesthaven, Karlsruhe Institute of Technology
- Rebecka Jörnsten, University of Gothenburg
- Claudio Mazzotti, University of Bolona
- Lina Sarro, Delft University of Technology
- Bo Wahlberg, KTH Royal Institute of Technology

- Erik Arnold, Technopolis (Secretary to the committee)

Mathematics, ICT and Technology research in Norway

- RCN invests roughly 40% of its budget in these disciplines
- They underpin most of the research done in Norwegian manufacturing industry
- They are key to the major policy challenges we face
  - Green and digital transitions
  - Defence, physical- and cyber-security
  - AI and its implications

A national research effort, with a centre of gravity in Trondheim



Norwegian MIT co-authorships 2020-2022

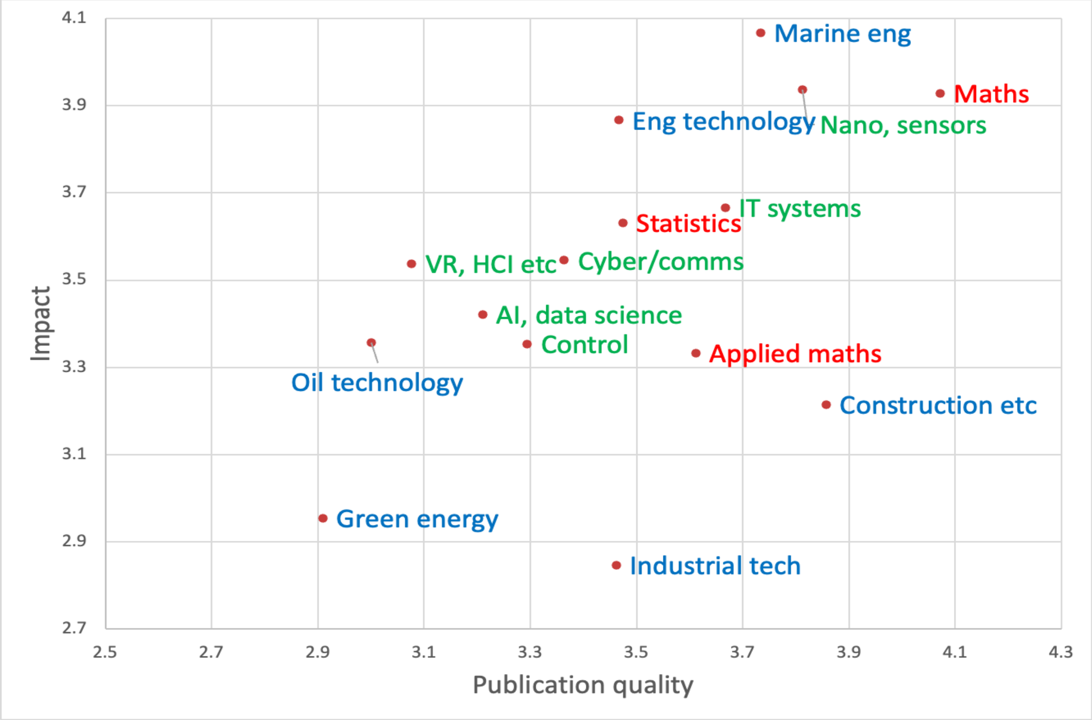
Sector	Institution/institute	Number of publications	Modified author shares	Share mod. author shares
Higher education sector	NTNU	2121	1476.2	35.1%
	UiO	557	352.2	8.4%
	UiA	372	257.1	6.1%
	UiS	300	203.9	4.9%
	UiT	288	188.6	4.5%
	UiB	287	187.3	4.5%
	HVL	251	153.4	3.6%
	USN	200	152.7	3.6%
	OsloMet	205	128.9	3.1%
	NMBU	147	90.9	2.2%
	Østfold	88	57.4	1.4%
	Other units	264	161.0	3.8%
Research Institutes	SINTEF	314	199.8	4.8%
	SINTEF Energy	178	112.7	2.7%
	SINTEF Ocean	92	56.3	1.3%
	NORCE	90	53.2	1.3%
	Other units	496	297.0	7.1%

Norwegian MIT publications 2022

MIT overall

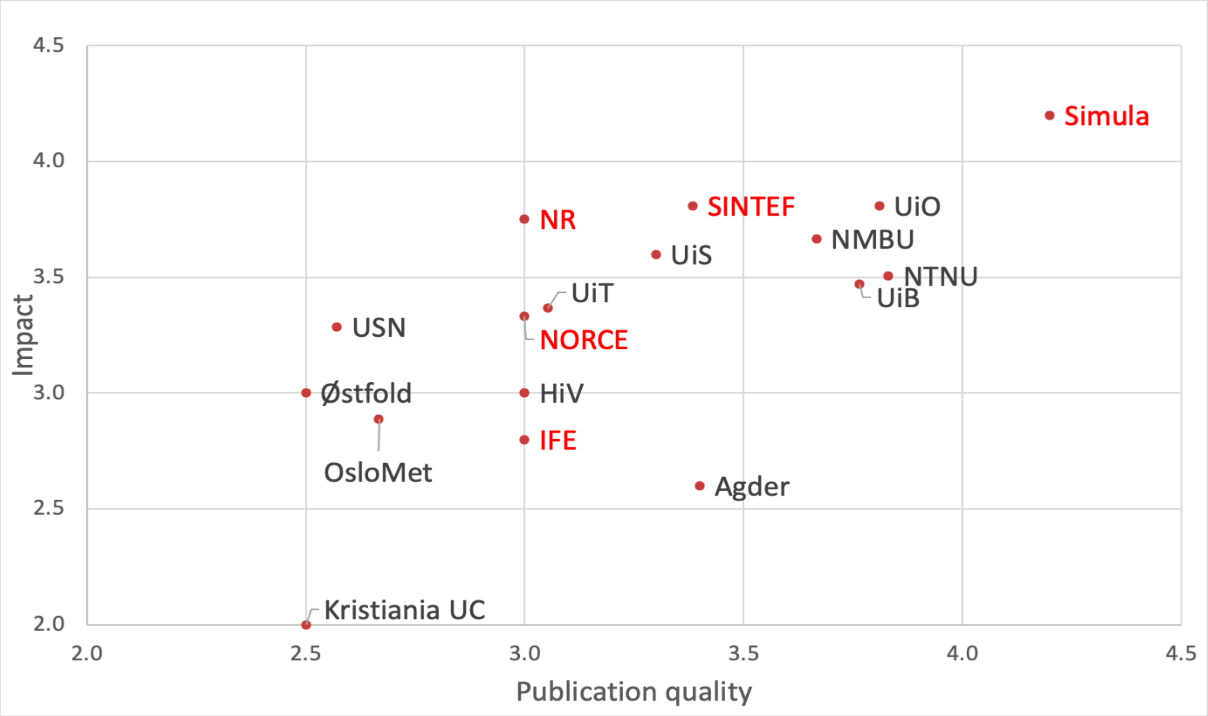
- Mathematics: traditional universities strong in pure maths and stats; institutes better in applied maths
- ICT: NTNU and SINTEF have leading positions, but growth in ICT industries has made it easier to establish some strong research groups elsewhere, including at newer universities and colleges
- Technology: NTNU and SINTEF are also central here, especially when relating to traditional Norwegian industries

The research group evaluations show research quality and societal impact are related in MIT areas



technopolis group

Traditional universities score high, new ones less so, institutes are mostly in the middle



technopolis group

Mathematics – SWOT

Strengths	Weaknesses
• High-performing groups have active international research networks • Balance traditional and emerging research topics • Active interdisciplinary collaborations bring high societal impact • Dynamic research environments with a healthy balance between senior, junior faculty, PhDs and postdocs	• Underperforming groups lack cohesive research strategy and have limited internal collaboration • Groups without networks or clear research profiles have lower visibility and productivity/impact • Gender imbalance • Several groups have an under-sized PhD programmes, limiting productivity, knowledge transfer and impact
Opportunities	**Threats**
• Use mobility grants, develop long-term recruitment pans • National initiative to increase the number of students in mathematics • More collaboration with regional stakeholders to increase societal impact • Smaller groups should identify strengths and develop clear research profiles; consider consolidation • More ambitious publication strategies	• Falling student numbers • Less funding for fundamental research • Investing in topics that cannot be maintained long-term • Lack of long-term recruitment strategies in the face of generational turn-over, gender imbalance, lack of agile research agenda • Static, narrow research agenda misses opportunities with global impact • Lack of clear benchmarking leading to poor strategic planning

technopolis group

ICT _ SWOT

Strengths	Weaknesses
• Several strong groups, some at international level • Strong industry links in these cases • Tackling both fundamental and applied research • Strong groups had bigger PhD student cadres and successful programs	• Weaker groups lacked scale, focus, clear strategies and industry connections • They generally lack industrial and international networks, and are often hindered by being inward-looking • Weaker groups did less dissemination, eg through conferences • Low institutional funding for institutes limits ability to do more path-breaking research
Opportunities	**Threats**
• Increasing EU networking and funding • Improve dissemination • More rapid take-up of newer technologies • Opportunities to leverage AI in engineering and other applied fields • Increase industry interaction to raise quality and impact • Stronger mentoring relationships between old and new institutions.	• Lack of resources to increase strategic focus and scale • Too strong emphasis on applied work at the expense of smaller scale fundamental work • Insufficient local support • Lack of gender diversity

Technology – SWOT

Strengths	Weaknesses
• Thriving Information Engineering and Power Engineering • Research groups at NTNU and SINTEF in general stand out • All research groups are covering research fields of strategic relevance for Norway • The infrastructure and equipment are generally modern • Strong industry collaboration and industrial grant funding • Marine technology/ocean engineering research is very strong • SINTEF, NTNU, UIT and USN have strong societal impact due to excellent research collaboration and/or knowledge transfer partnership with industry.	• Weak strategic planning in many units limits impact, especially at some of the smaller universities, even though topics should have high impact • Lack of succession planning and over-reliance on individual research leaders • Lack of gender balance • Few PhD students compared to scientific staff • Relatively little international collaboration • Groups are fairly reliant on RCN funding. • National grants and industrial collaboration can limit the number of high-quality publications and the international comparison.

Opportunities	Threats
• Leveraging global challenges l to enhance visibility and funding. • Expanding collaborations with international and industrial partners • Opportunities for some smaller universities to increase research, knowledge transfer and capacity to create significant impact • Digitalisation and sustainability are critical emerging topics of this panel with plenty of opportunities to excel at international level • Increase competences through interdisciplinary collaboration and more intense use of shared national research infrastructures • RCN and institutions could ring-fence funding for new research groups for a limited period. • Consider longer-term diversification in emerging areas • Redirect support from O&G companies to emerging research areas • Develop techniques for O&G infrastructure exnovation	• Some structural inefficiencies and high teaching loads. • Limited societal impact in some groups • Lack of strategic planning for research prevents goal attainment • The trend for funding to be increasingly for interdisciplinary work can reduce the funding available for low TRL-level (basic) research, draining the pipeline for future innovations • Retention: international academics and industrial experts returning to 'home' countries due to changes in governmental policies. • In some areas it is difficult to attract and retain academic staff since industry offers competitive salaries. • The continued strong demand for oil & gas engineers risks preventing the development of training and demand for new skills and talent.

Overall – success-factors in Norwegian MIT

- Bigger, resilient research groups with critical mass
- High quality applied research
- Close contact with industry and other knowledge users helps shape research agendas
- Research group-level, specific strategy
- Members of international research networks
- Ambitious publication strategies
- High ratios of junior researchers and PhD candidates to professors

Common issues

- Poor gender balance in MIT fields (a global problem)
- Difficult to recruit students
- Strategy-building capacity needs strengthening
- Path dependencies in university, industry and regional structures impede change towards new themes
  - Norway often slow to tackle new needs, eg new AI programme
- More fundamental research needed to maintain contact with and appropriate leading-edge knowledge
- Bibliometrics suggest some sub-fields need strengthening, especially in technology

Women make up 25% of MIT university researchers in Norway, versus 51% across all fields

Proportion of women researchers in Norwegian MIT

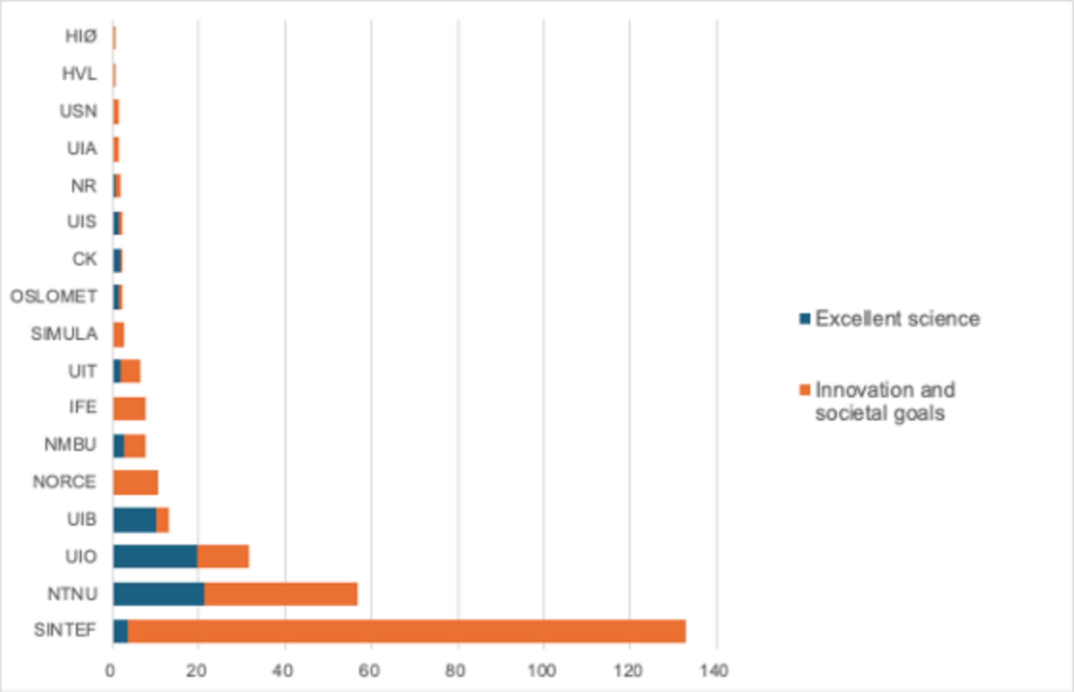
	Professors	Associate professors	Researchers & postdocs	PhD students	Total
2021	15%	26%	24%	29%	25%
2017	12%	27%	26%	28%	24%
2013	10%	24%	23%	27%	22%

technopolis group

Generous infrastructure provision

National infrastructures	No of user AUs	International infrastructures	No of user AUs
Sigma2	11	ESA	12
NorFab	8	CERN	11
eX3	7	ELIXIR EMBL	6
Manulab	5	ECCSEL	7
NorPALabs	5	European Synchrotron Radiation Facility	4
ELIXIR.NO	4	ESS	3
Norwegian Advanced Battery Laboratory Infrastructure (NABLA)	4	LUMI Supercomputer	3
Norwegian Artificial Intelligence Cloud (NAIC)	4	SIOS Svalbard	3
NcNeotron/ESS	4	EuroHPC-JU EuroHPC Joint Undertaking,	2
OceanLab	4	Europ Bio-imaging ERIC	2
Norwegian Biorefinery Laboratory (NorBioLab)	4	ESRF-EBS	2
HydroCen	4	39 others	1 each
SmartGrid	3		
ZEBLab	3		
CCSEL Norway CCS RI	3		
HighEFFLab	3		
Smart Building Hub (SBHUB)	3		
14 other infrastructures	2 each		
64 other infrastructures	1 each		

Scope to win more Framework Programme funding outside Trondheim …



Framework Programme income 2020-2022 (NOKm)

Impact cases

- Impacts easily cross disciplinary and industry boundaries
- Few cases involve the creation, packaging and transfer of intellectual property
- Where spin-offs occur, they tend to be in into established industrial clusters, rather than in new fields
- Only one clear case of an AI-based impact (Tsetlin machines)

Recommendations 1

- Increase the ability of Norwegian MIT research to react to and initiate change in a timely way, in response to changes in technology and needs; create new research capacity at significant scale where needed, for example in catching up in the field of AI
- Safeguard the foundations of MIT by increasing support to fundamental research, especially in Mathematics, without reducing the effort in applied work
- Review national aims with respect to increasing the research-intensiveness of newer parts of the higher education system, and establish mechanisms such as ‘pairings’ between new and established institutions and research groups to strengthen capacity

Recommendations 2

- Continue and strengthen the policy aim to increase participation in the EU Framework Programme
- Review the effectiveness of policies to reduce gender inequality in research to date and reduce gender inequality through career support to female researchers; investigate the policy implications of increasing recruitment into the research community from abroad

technopolis group

Abidjan · Amsterdam · Berlin · Bogotá · Brighton · Brussels · Frankfurt/Main · Lisbon · London · Paris · Stockholm · Vienna