

Panel's report

NORCICS SFI Norwegian Centre for Cybersecurity in Critical Sectors

0. Preamble

The centre is dedicated to the advancement of cybersecurity of digital systems and infrastructures within critical sectors. These infrastructures play a vital role in the smooth functioning of society; any failure or disruption could lead to significant supply shortages or pose serious threats to public safety. Many cyber-attacks on critical infrastructure around the globe are demonstrating the vulnerabilities faced by open societies. Alarmingly, forecasts indicate that both the frequency of such incidents and society's dependency on the effective operation of these essential systems are expected to rise. Consequently, the topic of NORCICS is not only timely but also of paramount importance for both the society and the nation.

1. Research activities

The research is structured as a matrix organization. Horizontally, it encompasses IT and OT integration, 5G, Human and Organizational Aspects and Data Analytics. Vertically, it consists of three research-oriented work packages. The application domains include critical infrastructures, industrial control systems, IoT, and smart environments. Research activities are organized into tasks that align with the rows and columns of the matrix with focus on the application domains. No changes to the research framework of NORCICS are necessary, as this organizational structure has proven to be highly flexible and adaptive. It effectively responds to the evolving geopolitical landscape, which is influencing developments in cybersecurity and significantly impacting critical sectors in Norway and beyond.

The centre has established a distinct research profile and has gained significant international recognition in the field of cybersecurity. In just a few years since its inception, NORCICS has become a strong partner for both national and international research. This is evidenced by an impressive number of spin-off projects and support in newly established European research initiatives.

The panel attests that the centre has a robust publication record. Many papers have already been published in well-regarded international conferences and journals with strong reputation. More publications in top-tier journals can soon be expected. The centre has already achieved significant national and international recognition. Members of the centre have actively contributed to public media, organized and participated in numerous workshops, served on various academic review and steering boards, and held positions on program committees for prestigious conferences. They have also acted as editors and chief editors for esteemed academic journals and have been invited to deliver several keynote addresses at academic events.

The centre has successfully filled the open positions, including PhD candidates and postdoctoral researchers. Additionally, there are another 12 PhD students and researchers collaborating with the centre, benefiting from its resources while being funded through other sources. The concept of industrial PhDs has proven particularly successful, with one PhD project already completed during the first half of the funding period of the SFI. It is anticipated that requiring PhD students to spend a semester abroad will further enhance the centre's international recognition.

Due to the current economic situation and capacity constraints user partners have left the centre. While this is an unfortunate situation beyond the centre's control, it is noteworthy that the centre has successfully attracted new user partners. By joining the new companies have increased their internal research commitments, for example by pursuing industrial PhD projects for employees, and have introduced new activities and topics of high relevance to the centre. The centre is actively working to attract additional user partners from various critical sectors. Overall, the research activities of

NORCICS are progressing very well and are aligned with both its primary and secondary objectives of achieving research excellence.

2. Innovation, value creation and benefits to society

Since the initial write up of the proposal, the centre has grown considerably and now covers a broad spectrum of innovation activities. Based on their valley of death analogy, the relation with other academics and industrial stakeholders has allowed them to position their innovation activities in the appropriate TRL scale, with an appropriate balance in terms of security, usability, and commercial potential. The integration of cybersecurity within the innovation process has been proven an enabler, playing a distinctive role in creating sustainable value of technologies for the different critical sectors. The centre NORCICS has succeeded in establishing itself as an important innovation enabler that counts in the cybersecurity field (at local, national and international levels) and intends to complete its goals with the construction of one of the most securely digitalized countries in the world, by exploring and reinforcing the cyber resilience of critical sectors.

The centre has also shown to the panel their thoughts to move from research innovations to the market, in line with business angels, investors and innovation scouts. The strategy seems to build essentially in a bottom-up manner, from the individual results associated to each task, which, in fact, are being executed as competitive innovation projects. The doctoral and postdoctoral training provided within the centre in terms of innovation is also important.

The centre maintains close relations with the economic world, on major societal issues requiring the protection of critical sectors such as industry 4.0, eHealth and telecommunications (e.g., 5G and 6G). Some of the doctoral candidates are carrying out their thesis within the framework of industrial agreements. The production of the centre also reflects a significant technology transfer activity with benefits to society. The centre production would nevertheless deserve to be better protected and exploited. The centre also seems involved in communication with the public and seems to strongly interact with the world of culture. Overall, the panel considers that the centre has implemented an excellent innovation strategy that is already producing qualitative results, targeting high-visibility actions and making a particular effort on the creation of new jobs in the area of cybersecurity (e.g., promotion of two of the postdoctoral fellows into academia and industry). The centre also presents a rich and diversified offer of stakeholders that are very well correlated with the cybersecurity community in terms of knowledge transfer and vulgarization of complex cybersecurity topics to enhance digital societies.

3. Internationalisation

The internationalization efforts have been well-developed, and the project consortium is strongly connected to other ongoing research activities and centres in the field. This is outlined in the project application, as well as in the following year's report and self-evaluation document. However, some challenges have been encountered. A major issue is time constraints, particularly for PhD students and researchers who are heavily engaged in their operational work, making it challenging for them to actively drive and participate in networking activities. Senior staff also face mobility limitations due to their schedules and commitments. While opportunities for international exchange and travel exist for researchers and industry professionals, high co-financing requirements have made participation challenging. Despite these challenges, company-led spin-off projects have successfully linked organizations to international networks, increasing collaboration and creating new connections with companies and academic.

Looking ahead, solutions should be explored to help senior staff engage internationally, such as using regular online meetings instead of travel. Hosting international events during the second half of NORCICS should also be a priority to boost global collaboration. Encouraging a better balance between junior and senior staff travel could improve mentorship and teamwork. Overall, while the panel

acknowledges the success of internationalization efforts, addressing these challenges and maximizing the use of available resources will be essential for strengthening global connections in the future.

4. Researcher training and engagement in education

In NORCICS, doctoral students play a vital role in the centre's research projects, leading the planning and execution while developing essential skills in project management and research delivery. To further enhance their skills and foster cross-collaboration, they actively organize meetings, collaborate on joint work, and contribute to new research initiatives. Through these activities, they also gain valuable training in administrative and leadership tasks. Even though most of the doctoral students have been hired at NTNU, the majority are not graduates of NTNU. However, NTNU's graduate program has seen strong interest, particularly in cybersecurity, with students demonstrating high engagement and enthusiasm.

Promoting mobility is a key priority, though time constraints and funding limitations can make participation challenging. Efforts continue to provide international exchange opportunities to enhance research exposure and global collaboration. Doctoral students are well integrated into the research structure through study plans, follow-up seminars, and structured supervision, with each student supported by a main supervisor and a co-supervisor.

Beyond technical training, students receive courses in leadership, presentation skills, and industry collaboration, preparing them for diverse career paths. Industry partners also participate in training programs, fostering stronger academic-industry collaboration. Recruitment continues through industry and public PhDs and externally funded projects, though recent legal changes have restricted postdoctoral hiring.

5. Organisation, management and funding aspects

In terms of organisation, NORCICS is well structured with an appropriate management strategy. As a structure specific to NTNU, the unit relies heavily on the services and resources of the institution and implements the strategy of NTNU in terms of human resources and general scientific positioning. The feeling of belonging to the unit is obscured by the structure of the school into teaching-research departments. The overall funding of the centre seems to provide a sufficient level of resources with a good balance among the different staff activities. The panel observed that funding has properly leverage a powerful policy in terms of research and innovation excellence. The centre is also well structured with a consistent management structure, including research and innovation boards complemented by ad hoc working group activities driving operational workshops.

As a centre hosted by NTNU, the centre seems to rely heavily on the services and resources of the institution deployed across the different departments of NTNU. This helps the centre to implement their guidelines according to NTNU's strategies, for example, in terms of gender parity, human resources, recruitment and general scientific positioning. The panel considers that this situation has allowed to the centre to fully concentrate on the ambitious agenda of their original proposal, without any detriment to excellence of the program.

The panel comes to the conclusion that the centre is active in dealing with local and global business networking clusters, etc. and similar institutions, with the goal of spreading knowledge about the existence of the centre and being assisted to promote their activities, inform about the value of their own organization, whose final goal is to attract potential new partners. The centre is also aware of potential new critical sectors that could be included in the future, to build a stronger organization after the funding period. Finally, the panel identified that challenging aspects of the NTNU as a host, already with strategies to handle multiple location of their departments located at the different sites (e.g., Gjøvik, Trondheim, etc.) has provided the needed discipline and resources as well to maintain the cohesion in the teams and the centre as a whole.

6. Gender aspects

NORCICS set a gender balance goal of at least 25% women among young researchers, which has been exceeded across all categories, with particularly strong representation among funded PhD candidates. NORCICS remains committed to NTNU's gender equality policy, actively working to balance male and female participation. Equity, Diversity, and Inclusion (EDI) principles are embedded in recruitment and mobility strategies, with ongoing evaluations to measure their effectiveness in education, hiring, and mobility. Additional measures may be introduced to further enhance inclusivity. However, improving gender balance at senior levels remains a priority. Addressing the drop-out rate of women in academia and attracting female senior researchers to the project or affiliated initiatives will be essential. Moving forward, NORCICS aims to strengthen collaboration with the ADA project of NTNU to provide female young researchers with networking opportunities beyond NORCICS industry partners.

7. Plans for final three-year period

There is no need for significant changes in the general methodological approach of the centre in conducting research. The focus on cybersecurity of digitalized systems and infrastructures in critical sectors remains highly relevant. During the final three years of the funding, special attention should be given to the evolving geopolitical situation and the resulting intensified threat landscape. New regulations aimed at enhancing cybersecurity resilience are currently being implemented in major economies, including the EU NIS2 Directive, the U.S. National Cybersecurity Strategy, Singapore's Cybersecurity Masterplan 2024, the EU Cyber Resilience Act, and the EU AI Act. These developments will impact the global alignment of the centre, particularly concerning its user partners, and must be closely monitored. As mentioned during the evaluation meeting, initiating new projects in areas such as trustworthy AI, privacy in IT/OT convergence, trusted collaboration, transitioning from 5G to 6G, zero trust in supply chains, and cybersecurity for space infrastructure aligns well with the centre's overarching vision. Additionally, emphasis should be placed on preparing critical sectors for diverse threats; for instance, NORCICS could assist operators by providing training in simulated environments, such as digital twins and cyber ranges. The existing efforts of the centre to raise awareness among operators in critical sectors who have not yet joined about the benefits of participation are highly commendable. Having the Chair of the Executive Board come from an industry partner could provide valuable support for expanding outreach.

8. Future activities beyond the centre period

At the end of the first half of the SFI, the centre has already begun working towards ensuring the sustainability of NORCICS beyond the funding period. The collaboration with the Center for Cyber and Information Security (NTNU CCIS) has already been active for a long period of time. A closer partnership model between the two leading organizations could benefit both parties and serve to sustain the centre after funding ends.

A dedicated workshop aimed at establishing a post-RCN-funded NORCICS is planned for Q4 2027; however, the panel recommends holding this workshop earlier, in Q4 2026, followed by a series of workshops over a six-month period. The centre has demonstrated significant economic potential by initiating a project portfolio exceeding 1 billion NOK already by the end of 2023. This suggests that public investment in long-term support for NORCICS is likely to yield quick returns.

In addition to maintaining a stable financial situation, it is essential for the key researchers at the centre to offer them long-term professional perspectives. To retain them in the country, it is suggested to explore opportunities for establishing tenured professorship positions in cybersecurity and/or critical infrastructure cybersecurity at NTNU or other Universities nationwide.

9. Conclusion and recommendations to the centre

During the first half of the funding period the centre NORCICS has performed exceptionally well. However, there is always room for improvement. You may want to consider from the panel the following recommendations:

- The centre could benefit from an expansion into additional critical sectors (e. g. telecommunications, water management, maritime). Consider adding more user partners to enhance the centre's capabilities.
- Generalization of research results. Demonstrate universal validity by evaluating the research results within and across various critical sectors. In this regard, supply chain security could serve as an effective example.
- So far, the needs of user partners have primarily driven and influenced research tasks. Consider also taking the opposite approach, by initiating your own research tasks and sharing your findings with the companies to their benefit.
- To foster inter-task cooperation, install a regular weekly PhD seminar in which every PhD student must present on a 6-month basis. The seminar should be publication oriented with the goal to find common research interests among the PhDs leading to joint publications.
- Invest in innovative methods to enhance cybersecurity training and awareness. There is significant potential in cyber ranges, both in collaboration with user partners and for the benefit of students in your Master's programs. Explore opportunities for joint activities with the Norwegian national cyber range.
- Reschedule the planned workshop for the continuation of NORCICS after RCN funding to 2026.
- While the centre already shows commitment in terms of gender equality policies, as well as Equity, Diversity, and Inclusion (EDI) principles, additional measures could be introduced to further enhance inclusivity and improving gender balance at senior levels.
- Engage with relevant policymakers and politicians (through the Head of Department, Dean, etc.), as well as the Chamber of Commerce and similar business organizations (via user partners), and NTNU alumni to raise awareness about the benefits of joining NORCICS. Their support could help expand into additional critical sectors and attract more user partners. Support from partner organizations SINTEF and NTNU CCIS may also be valuable in this effort.