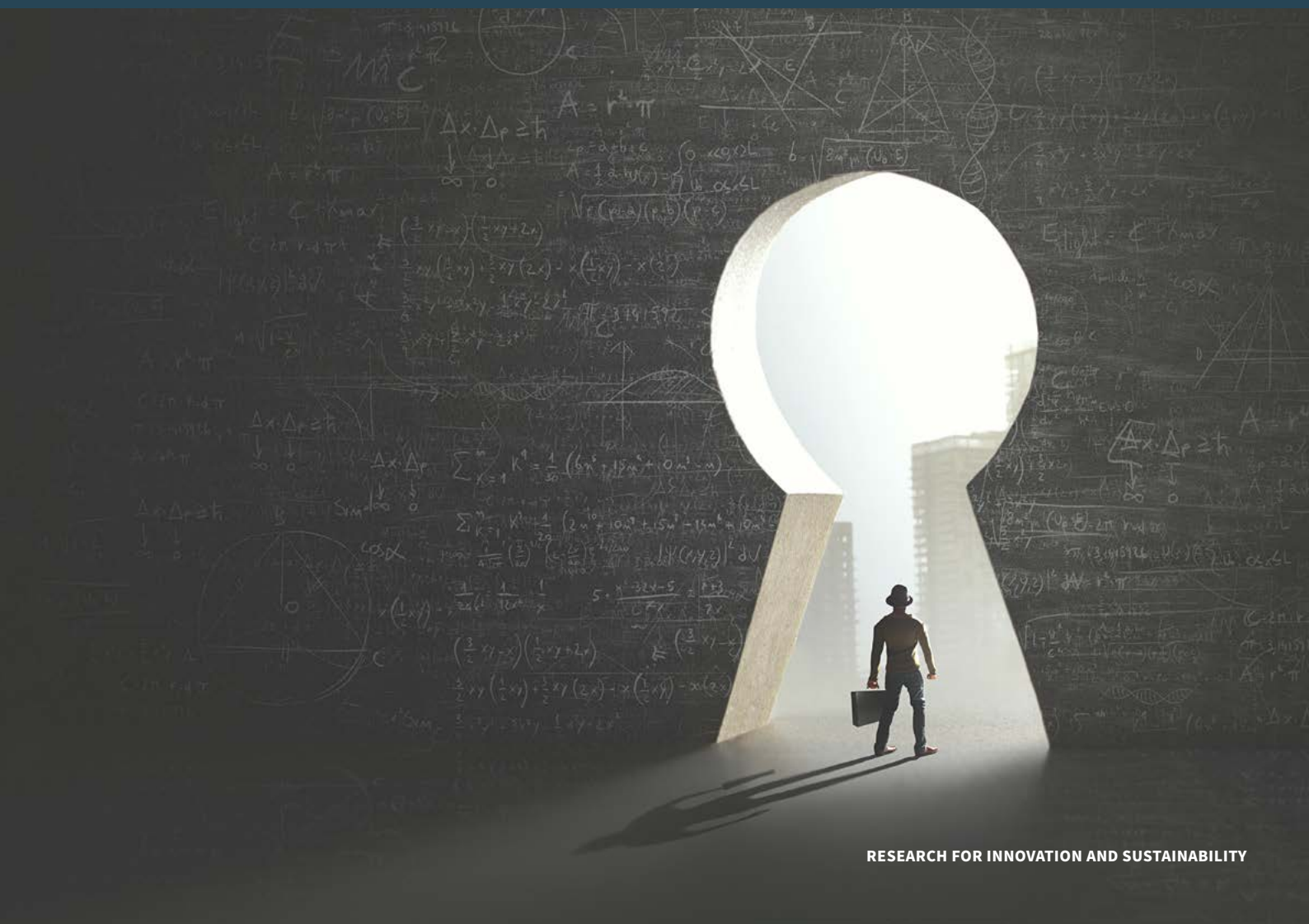
The Research Council of Norway

The Research Council Policy for Open Science

In effect from 2020



RESEARCH FOR INNOVATION AND SUSTAINABILITY

About the Research Council of Norway

The Research Council of Norway is a national strategic and funding agency for research activities. The Council serves as a chief source of advice on and input into research policy for the Norwegian Government, the central government administration and the overall research community. Moreover, the Research Council works together with research institutions as well as the private and public sectors to enhance financial and quality targets in Norwegian research and innovation activities. It is the task of the Research Council to identify Norway's research needs and recommend national priorities. The Council utilises specifically-targeted funding schemes to help translate national research policy goals into action. The Research Council provides a central meeting place for those who fund, carry out and utilise research and works actively to promote the internationalisation of Norwegian research.

Content

Summary

Open science is a very broad concept and is used to describe different, and sometimes contradictory, objectives. While open science has been an important topic on the research-policy agenda for more than 10 years, Norway has lacked an integrated approach. Therefore, the Research Council has drawn up a policy for open science to describe our position in this field.

Open science is based on fundamental norms for research ethics and is important for ensuring quality and public trust in research. It comprises scientific quality and the democratisation of knowledge as research and knowledge become accessible across academic groups, sectors and national boundaries. It promotes transparent research that is easier to verify by making research data, software and source code accessible. It moves the research front by paving the way for new approaches and methods and linking vast amounts of data across subject areas and sectors. It makes research open, while simultaneously determining the conditions for access by safeguarding and protecting personal privacy and intellectual property rights. Open science further means opening research activity to and for society by including users and the general public in research and innovation processes. It entails addressing societal challenges more effectively and promoting value creation in the private and public sectors. Open science, therefore, also deals with research-based innovation by creating a foundation for entirely new knowledge processes that can accommodate conflicting objectives, complexity and dilemmas.

The Research Council's Policy for Open Science is based on the principle that research and innovation processes are to be "as open as possible, as closed as necessary". To embrace the various aspects of open science, the policy has three main objectives:

- to contribute to a well-functioning science system;
- to contribute to sustainable societal development;
- to strengthen the public trust in science.

The policy clarifies the Research Council's role in promoting open science through a list of measures. These measures have been formulated at the overall level to indicate the direction we are encouraging developments to follow. As implementation efforts proceed, these measures will be more clearly defined. It is essential that this takes place in cooperation with other relevant stakeholders.

The policy outlines measures related to the following:

- knowledge about and competence in open science
- testing of open science and innovation in projects
- access to and reuse of scientific results
- data infrastructures for handling and making research data accessible
- career development and research assessment
- transparency in research funding processes
- responsible research and innovation
- openness in innovation processes
- rights to research results
- research as the premise for societal development
- involvement of users and the general public in research and innovation processes through user participation and citizen science.

Open science will influence how research is funded, conducted and evaluated and how results are shared and verified. This will be resource-intensive and will require cultural changes in scientific communities, institutions and organisations. Therefore, effective cooperation between researchers, research institutions and other relevant national and international stakeholders will be necessary to successfully implement the measures in this policy. Open science is a rapidly developing field both nationally and internationally and this policy will need to be updated regularly.

1 Introduction

A key value in all research-based knowledge development is the independence and critical function of research. Essential dimensions are academic freedom, the autonomy of research institutions and the ideal of openness in research.

The digital transformation and development of technologies create new opportunities for efficient production and sharing of research and for allowing society to participate in research processes. It has become more feasible than previously to realise the ideal of openness in science.

Open science means transparency and knowledge-sharing in research processes to make knowledge accessible across academic groups, sectors and national boundaries. The concept of open science encompasses the entire research process – from the start-up via funding and implementation of the research through data management, analysis, scholarly publication, scientific synthesis and communication activities. Open science has a wide scope and is also used to refer to open cooperation, open peer review, open working methods, open educational resources, research integrity, accountability, and involvement of users and citizens.

Open science can be viewed from at least two angles: as a criticism of the current research system, and as a resource that will benefit society and trigger innovation. The first of these implies a desire to shift the research system towards greater sharing, transparency, participation and societal responsibility. In the second approach, greater openness entails an expectation that researchers and research institutions will share in collective knowledge building and work together to address major societal challenges. This builds on the belief that publicly funded research is a public good. Therefore, research must be made as openly accessible as possible and be available for use by different stakeholders in society.

SITUATIONS WHERE THE LEVEL OF OPENNESS MUST BE BALANCED AGAINST OTHER CONSIDERATIONS:

- Research based on clinical studies, personal data or in-depth interviews may make it necessary to anonymize or regulate access to data according to specific terms and conditions to protect personal privacy.
- Different interpretations and practice of the legislation regulating health research make it difficult at present to share data in both national and international research collaboration.
- In subject fields and research projects involving companies, secrecy and protection of intellectual property may be accepted.
- In some cases, patent protection of core ideas may be required to ensure that society can benefit from the results.
- Digital infrastructures and systems are becoming increasingly complex and vulnerable to threats, which increase the need for information security. This may make it more difficult to share and provide open access to certain types of research.

Open science has been placed on the national and international research-policy agenda. There is a political expectation that open science and innovation will facilitate value creation, sustainability and international collaboration. These were key elements behind the European Commission's strategy, *Open Innovation, Open Science, Open to the World*, and new requirements relating to openness will be incorporated into the EU research and innovation framework programme, Horizon Europe. The European Commission has stressed the importance of growth and value creation in its approach to open science, with continued emphasis on research ethics and research integrity.

In Norway, research policy has been targeted towards ensuring that publicly funded research results are to the benefit of society. The accessibility of research data first became an object of serious focus in 2007 when the OECD recommended principles and guidelines for access to publicly funded research data. Norway formally agreed to the OECD's recommendations and guidelines in connection with the white paper on research, Report no. 30 to the Storting (2008-2009), *Climate for Research*.

Meld. St. 27 (2015-2016), *Digital agenda for Norway in brief – ICT for a simpler everyday life and increased productivity,* white paper from the Ministry of Local Government and Modernisation, describes measures for making public data accessible in Norway. An important point is that public agencies shall have an overview of what data they handle, what the data signify, what they can be used for, what processes they are part of, and who can use them. As follow-up to the white paper, the Ministry of Education and Research developed the *National strategy on access to and sharing of research data* in 2017. The strategy sets out clear expectations for research institutions and proposes measures to increase access to and reuse of research data.

In 2017, the Government launched the *National goals and guidelines for open access to research articles* with the aim of making all publicly funded Norwegian research articles openly available by 2024. Plan S is an initiative that was launched by several national research agencies together with the European Commission in 2018. Plan S is designed to ensure immediate

open access to all research publications resulting from publicly funded research from the time of publication, and to promote the transition from subscription-based to open access journals. This is in line with the Government's objective of making research more accessible.

As open as possible, as closed as necessary

The Research Council policy is based on the principle that research and research processes are to be "as open as possible, as closed as necessary".

There are various dilemmas related to making research more open. In some cases, considerations related to security, protection of personal privacy, copyright, intellectual property rights and trade secrets will conflict with objectives regarding increased openness.

The nature of various disciplines and subject fields means that researchers and research institutions have different traditions and potential for moving towards open science. In certain fields, the sharing of results, methods, models and source code is an important prerequisite for the further advancement of research. In other fields and areas, openness requirements may be incompatible with concern for protection of personal privacy, confidentiality or trade secrets.

Opening the research process to greater participation and involvement of diverse societal stakeholders raises important questions about representativeness, ability to influence, and protection of personal privacy. Whereas certain groups may have a political agenda and the potential to exert influence over research processes and results, other groups may be vulnerable and in need of protection. In interactions with other societal stakeholders, it is important that researchers adopt a role that encourages different types of competence and expertise to supplement each other, based on established standards of quality assurance, personal privacy and research ethics.

The principle, "as open as possible, as closed as necessary" requires each individual project to assess how to address various aspects of openness in the best possible manner, and in accordance with the applicable rules, when there are important elements related to security, protection of personal privacy, legal conditions or competitiveness to consider. Integrity and responsibility in research play a fundamental role in determining levels of openness, and guidelines for this have been developed both nationally and internationally.

2 Open science at the Research Council

The Research Council has drawn up several guidelines and requirements related to open science:

- Since 2000, the Research Council has stipulated as a requirement that research data must be stored in a safe and secure manner for a minimum of 10 years. A policy on open access to research data has been developed (2014, 2017) and states that data are to be "as open as possible, as closed as necessary" with certain exceptions.
- As from 2018 the Research Council has stipulated requirements relating to data management plans for projects allocated Research Council funding.
- Since 2009, the Research Council has stipulated requirements regarding open access to scholarly publications resulting from the research it funds. Beginning in 2021, open access publication in line with Plan S will be mandatory for new projects.
- In 2017 the Research Council became a signatory to a joint statement from the World Health Organization (WHO) which entails that all clinical trials receiving Council funding are to be registered in an approved database prior to project start-up, and that the results of the trials are to be made publicly available. To follow this up, the Research Council has drawn up specific guidelines for the registration and disclosure of medical and health-related clinical trials involving human subjects.
- In 2018 the Research Council signed the San Francisco Declaration on Research Assessment (DORA). The declaration contains a set of recommendations relating to best practice for evaluating the quality of research output. It intends to halt the practice of correlating the journal impact factor to the merits of a specific scientist's contributions. It also states that the impact factor is not to be used as a substitute measure of the quality of individual research articles, or in hiring promotion or funding decisions.
- The Research Council has developed a framework for Responsible Research and Innovation (RRI), based on its programmes for enabling technologies. The Council has drawn up principles concerning rights to the output of research and development projects in the aim of ensuring that project results will be of benefit to society.
- The Research Council has long provided funding for research and innovation in collaborative projects in which companies and key stakeholders (public entities, users, user groups, etc.) work together with research institutions to develop R&D expertise and capacity in areas of importance to society and the business sector, and thereby promote value creation and renewal in the private and public sectors.
- A wide range of activities have been launched to encourage interdisciplinarity, involvement and new forms of collaboration.
- User participation has been incorporated as a working method under many Research Council programmes, and the Research Council is also involved in citizen science projects where the general public is involved in various ways.

2.1 Objectives of the policy

The Research Council's definition of open science derives from definitions employed by the European Commission, the FOSTER Plus project and the OECD. Based on these, we are employing the following definition:

> Open science refers to scientific practice in which processes and results are made openly accessible under conditions that promote quality and knowledge development, including the sharing and utilisation of the research-based knowledge in a socially responsible manner.

The Research Council's policy for open science has three main objectives:

- To contribute to a *well-functioning science system* by making the system more efficient while at the same time building on principles relating to research integrity and autonomy. Open science makes it easier to reuse research and analyse results. This can make it less difficult to verify and reproduce studies, which can in turn enhance the quality and reliability of the research.
- To contribute to *sustainable societal development* by promoting more rapid access to knowledge for society, including research-based solutions to societal challenges as well as responsible value creation in the private and public sectors alike. Open access to research results and knowledge development is necessary to encourage critical thinking, to take knowledge-based decisions targeted more towards sustainable development, and to achieve the UN Sustainable Development Goals.
- To *strengthen the public trust in science* by promoting the role of research as a knowledge provider in society and by opening for inclusion and participation in research and innovation processes without compromising its autonomy and critical approach. Inclusion and participation must take place within the framework for research integrity and uphold principles of personal data protection and intellectual property rights.

These three objectives call for openness in different ways, and they generate a need for new instruments, skills, expertise and tools that poses challenges both to the research system and to the role of the researcher.

Open science is a rapidly developing field both nationally and internationally and this policy will need to be regularly updated. In addition, several of the measures will be difficult to implement and will have implications for the role of the researcher and for research. Therefore, measures requiring special evaluation will be determined as the policy is implemented.

3 Measures

The measures outlined below show how the Research Council seeks to stimulate a development towards open science. Some of these measures will be implemented via the Research Council's own activities and funding instruments. Some of the problems and measures presented will require collaboration between the Council and other stakeholders such as relevant ministries, the Norwegian Directorate for ICT and Joint Services in Higher Education and research (UNIT) and Universities Norway. Depending on the thematic area and type of measure involved, cooperation with other stakeholders such as universities and university colleges, committees on research ethics, various councils and commissions, service providers, companies, and industrial and special interest organisations, may be of relevance.

3.1 A well-functioning science system

Traditionally the research system is based on a set of common core values such as universal criteria for integrity and best practices in research, shared ownership of scientific results, academic freedom and critical thinking. Research integrity is essential to ensuring high quality in research and plays a crucial role in promoting public trust in research and research institutions.

Open science and innovation are linked to the objective of achieving a well-functioning science system in Norway and internationally. Global research activities are expanding rapidly, and more and more individuals are pursuing higher education and careers in research. Research results are being generated continually. At the same time, there is growing divergence in access to research funding and infrastructure, access to data and research publications and access to publication channels.

The predominant approach to assessment of research and researchers is largely based on quantitative performance targets and number of publications within a hierarchy of journals. Access to many, often prestigious, scholarly publications is governed through subscription-based periodicals and is dependent on the ability of institutions and nations to pay. A large proportion of the research data, methods, models and source code on which research results are based is not made available for verification and further use. In addition, there is a lack of expertise and mechanisms for the long-term storage, processing and management of research data.

Addressing these challenges will require openness in all steps of the research process. This applies to basic research as well as to applied, contracted research activity. Openness can make it easier for researchers to gain insight into each other's work methods, data and results, and enhance transparency and efficiency in the research process.

Open science can help to make research and knowledge more accessible to society, both as a foundation for education, public discourse and critical thinking and as a source for more knowledge-based government administration and policy design. The enormous volume of research results being published makes it increasingly difficult to conduct state-of-the-art reviews on a given topic or other, similar activities. More openness regarding underlying data will make it easier to draw up integrated knowledge analyses and scientific syntheses.

Open science also plays a key role in innovation and value creation. Knowledge sharing and exchange require mutual trust between project partners and adherence to principles of research ethics. Even when there is a need to protect trade secrets, intellectual property assets and intellectual property rights, it is important that risk, costs and earnings are distributed according to agreed-upon principles in, for example, public-private partnerships.

3.1.1 Open science skills and expertise

Researchers in all stages of their careers need the requisite knowledge and tools to be able to practise open science and comply with the affiliated ethical guidelines. The need for advanced digital competence will entail differentiation of the role of the researcher and give rise to a new type of expertise in the form of data stewards.

EXAMPLES OF RESOURCES THAT PROMOTE OPEN RESEARCH PROCESSES:

There are many different services and resources that facilitate openness during different stages of the research process:

Examples include:

- AllTrials.net, an initiative for registering all clinical trials carried out and reporting their methods and results.
- Runmycode, where scientists can share data and code and arXiv.org and bioRxiv.org, which provide open access to preprints of manuscripts in mathematics, physics and other natural science subjects, biology and life sciences.
- ResearchGate and Academia.edu, which are online communities providing resources for collaboration between researchers across research areas.
- GitHub, a platform for developers to share and develop software.
- SciStarter, a resource for recruitment, training and implementation of citizen science projects.

Training is an institutional responsibility. However, it is important that the responsible authorities, universities and university colleges, research institutions and the Research Council cooperate at both the national and international levels to establish national training and competency measures at all stages of the research process and educational pathways.

The Research Council will:
- use its funding instruments to help to increase expertise within open science and issues relating to research ethics.

In cooperation with other relevant stakeholders, the Research Council will work to:
- encourage training and the provision of necessary information in open science, including about the FAIR Principles for data management (Findable, Accessible, Interoperable and Reusable), which are based on national and international guidelines on research integrity and accountability.
- promote training measures for data stewards and other key competencies related to open science at the institutions.

3.1.2 Testing of open science and innovation in projects

Open science and innovation may lead to new approaches in the way that research is conducted. This will create a need to test out new methods, technology and tools, develop standards and guidelines, design courses and training programmes, and find ways to involve different stakeholders in society or to study how open science and open innovation can promote gender balance and diversity.

OPEN SOURCE CODE: FROM INTERACTIVE DANCE TO CLINICAL STUDIES OF PRETERM INFANTS

Musicology researcher Alexander Refsum Jensenius developed a method for analysing the movements of dancers and musicians. A software package based on the method is often used in connection with interactive dance/music performances and is available as open source software. A series of coincidences led to a collaboration with researchers studying preterm births. It turned out that the method of analysis made it possible for researchers at the Norwegian University of Science and Technology's Department of Clinical and Molecular Medicine to identify babies at risk of developing cerebral palsy (CP) at a much earlier stage than the clinical tests traditionally employed. (https://www.ntnu.no/ikom/general-movement-og-cerebral-parese)
Dr Jensenius is Deputy Director of the RITMO Centre for Interdisciplinary Studies in Rhythm, Time and Motion, which receives funding from the Research Council. (https://www.hf.uio.no/ritmo/)

The Research Council will:
- create a framework through calls for proposals, among other things, that will enable applicants to test out different aspects of open science and innovation.
- identify and highlight good examples of open research and innovation.

3.1.3 Open access to publications

It is essential for the research community and society at large that research results are disseminated by means of effective systems for quality assurance and publication. Research publications must be open to all if research results are to be a public good. Achieving this means phasing out the subscription-based model for scientific publication that restricts access for the research community and the general public.

Open access to research publications has long been an objective for Norway. The Government has implemented national guidelines for open access to peer-reviewed articles, encouraging funders, institutions and researchers to cooperate at the international level to achieve open access.

In 2018, the Research Council adopted Plan S, an international initiative to realise full and immediate access to peer-reviewed publications. Research funders that have joined Plan S, cOAlition S, stipulate as a requirement that publications resulting from research they have funded are to be made immediately and openly available, under an open licence that gives the general public free access and reuse rights to the research results.

Under Plan S, research may be made openly available in one of the three following ways:
1. publication via open access journals/platforms;
2. making peer-reviewed research works immediately available in open repositories;
3. publication in journals participating in collective agreements (e.g. "publish and read" agreements) aimed at transitioning from a subscription-based model to open access.

The Research Council will:
- incorporate Plan S requirements into its General Terms and Conditions for R&D Projects receiving funding in response to calls issued as from 1st January 2021.
- provide funding to cover costs for open access publication as a part of the indirect expenses in research projects.

In cooperation with other relevant stakeholders, the Research Council will work to:
- monitor open access publication of research articles;
- monitor the impacts of Plan S on the research and publication system at the international level.

3.1.4 Making research data accessible

A large proportion of the research data, methods, models and source code on which research results are based is not made available for verification and further use. Since 2014 the Research Council has stipulated requirements concerning the secure storage and accessibility of research data from Council-funded projects.

Since 2017, the Research Council's policy for open access to research data has been based on the FAIR Principles. The requirement that data are to be shared in keeping with the FAIR principles means that associated protocols, methods, software and source code must also be shared within subject areas and projects when this is of relevance for verifying and reproducing research. If data cannot be made openly accessible for reasons relating to personal privacy or other concerns, it is usually possible to release metadata which can provide valuable insight into the type of data being dealt with in the project.

THE FAIR PRINCIPLES

The international FAIR Principles were drawn up as a set of guidelines to facilitating the reuse of research data. The acronym FAIR stands for *findable, accessible, interoperable* and *reusable*. The FAIR principles entail that data and metadata must be findable , accessible, interoperable and reusable, provided that this is ethically and legally justifiable. Data and metadata must also be machine-readable, possible to integrate with other data, and have good enough scientific and technical quality to enable them to be reused. For more information on the FAIR principles, see: https://www.force11.org/group/fairgroup/fairprinciples

HEALTH ANALYSIS PLATFORM

The health analysis platform provides easier access to health data and creates a framework for advanced analyses across a variety of data sources such as health registries, basic data, journals and other sources of health-related information. At the same time, the platform strengthens protection of personal privacy by providing, among other things, improved data-accessing services, better capabilities for providing or withdrawing consent and more effective means of tracking the use of data. The project seeks to establish a national infrastructure for access to and analysis of health data.
Source: https://ehelse.no/helsedataprogrammet/helseanalyseplattformen
Kilde: https://ehelse.no/helsedataprogrammet/helseanalyseplattformen

The Research Council will:

- encourage adherence to the FAIR principles for data and metadata resulting from Research Council-funded projects.
- require that datasets are made accessible along with their accompanying protocols, methods, models, algorithms, software and source code.
- take steps to ensure that direct expenses associated with making data openly accessible according to the FAIR principles are clearly identified in grant applications.
- require that medical and health-related clinical trials involving human subjects are registered in an approved database prior to project start-up. Project results are to be made publicly accessible as soon as possible following conclusion of the trial.

In cooperation with other relevant stakeholders, the Research Council will work to:

- develop generic guidelines for data management plans in line with international practice.
- ensure that Norwegian research data are in compliance with international standards and protocols for data and metadata.
- make it possible to link citations and data reuse to researchers and research projects.

3.1.5 Data infrastructures for open science

A data infrastructure is a research infrastructure designed for collecting, processing, storing and providing access to and/or enhancing the utilisation of data by facilitating meta-analyses and the reuse of research data. National infrastructure that is well coordinated and rooted in academic groups and institutions facilitates access to and secure processing of research data. The Research Council has stipulated that infrastructures granted funding must be made accessible to all relevant users and must accommodate user needs.

The public sector manages vast amounts of data and registries that can be utilised more effectively in research and innovation. Taking full advantage of this potential will be contingent on open, transparent stewardship and infrastructures that make data easily accessible in a secure manner that adequately protects personal privacy. Data sharing and interfaces that make it possible to carry out analyses across established subject fields and sectoral boundaries will add value to research data and provide an important knowledge base for developing integrated solutions that meet the needs of society and users.

Knowledge-based data infrastructures require constant development and upgrading in order to meet the needs of researchers, so there is an ongoing need for investment. In addition, there are major costs associated with operating this type of infrastructure. Long-term plans for the funding of data infrastructures based on different sources of income can help to make these infrastructures more resilient.

The Research Council will:

- work to ensure that national infrastructures comply with international standards and certifications that make it possible to share data across national borders.

EUROPEAN OPEN SCIENCE CLOUD

The European Open Science Cloud (EOSC) was launched by the European Commission in 2018. The EOSC is a virtual environment of services for storing, processing, analysing and reusing research output across national borders and academic areas. Further development will promote a network of services and infrastructures that support open science and open innovation.

- stipulate that data infrastructures allocated Research Council funding must cooperate with relevant national and international stakeholders and be made accessible to users and user communities.
- require all infrastructure projects funded by the Research Council to draw up a robust funding plan to ensure future operations and maintenance and the long-term storage, processing and accessibility of research output.

In cooperation with other relevant stakeholders, the Research Council will work to:
- promote the linkage of national data infrastructures with Nordic and international initiatives, such as the European Open Science Cloud (EOSC).

3.1.6 Career development and research assessment

Researcher motivation and appreciation of open science are essential for achieving greater openness. Openness must be of benefit to researchers in both an academic and a career perspective. The Research Council will adapt its research assessment procedures to make it more attractive for researchers to adopt open science practices. A national and international dialogue on the development of criteria and norms for assessing researchers and research outputs is of great importance.

The Research Council signed the San Francisco Declaration on Research Assessment (DORA) in 2018, and supports the principle of assessing research on the basis of its own merits rather than on the basis of the venue of publication when reviewing applications for research funding.

Peer review forms the basis for quality assurance of research results and project proposals. Discussions are taking place at the national and international levels on whether greater transparency in assessment activities will improve feedback and the general process. One aspect of peer review involves making all assessment-related communications public so that it is possible to verify and comment on all steps of the process.

The Research Council employs "single-blind peer review" in its grant application assessment procedures, which means that the reviewer assessing a grant proposal knows the identity of the applicant. The Research Council publishes the identities of its referees after the review process has been concluded.

Fully open peer review of grant applications would entail that the application and all parts of the assessment process are open, and that the entire process is public. Open peer review provides a greater opportunity to give credit for peer-based efforts as a form of scientific production, as the peer review is visibly part of a scientific "ecosystem". Mechanisms are also available today to document contributions made as part of a closed peer review.

The Research Council will:
- establish routines for assessment where key factors include harmonisation of requirements for CVs and documentation across the entire range of research output.

In cooperation with other relevant stakeholders, the Research Council will work to:
- facilitate a joint national and international process for assessment of researchers and research in accordance with the DORA declaration.
- discuss open peer review and potential measures for promoting its use.

3.1.7 Transparency in funding and assessment processes

Research funders comprise a central component of the research system. Openness about how research is assessed and funded is important, both to ensure a well-functioning science system and to strengthen trust in research funders.

The Research Council will:
- consider how to make its own application and funding processes more open.

In cooperation with other relevant stakeholders, the Research Council will work to:
- promote greater transparency in the assessment and funding of research.

3.2 Sustainable societal development

Society is faced with major challenges such as climate change, increased migration and social inequities. Addressing these challenges will require innovative thinking and new solutions developed in cooperation between public entities, research environments, the general population and the business sector.

The UN Sustainable Development Goals establish a framework and objectives for research, innovation and responsible societal development. Open science can promote achievement of these goals by, among other things, encouraging cooperation and making research results and resources more easily accessible.

Open science for sustainable societal development entails creating a foundation for curiosity-driven research that generates knowledge and triggers new breakthroughs. Basic

research is a vital source of new knowledge that can prove beneficial in different, often unexpected, ways.

Addressing complex societal challenges also calls for research that can be integrated with innovation activities in both the private and the public sectors. Challenges of this type extend across subject areas and disciplines, across sectors and policy areas and across national borders. The incorporation of different perspectives will provide a basis for dialogue on potential long-term impacts and dilemmas. More rapid exchange of knowledge through open science creates an opportunity to find solutions to international challenges and to share best practices for sustainable development.

3.2.1 Responsible Research and Innovation

The Research Council has initiated a variety of activities designed to encourage interdisciplinarity, involvement and new forms of collaboration in keeping with open science approaches. These activities focus on new work methods and interaction with various stakeholders in research, the business sector, the public sector and other relevant stakeholders in society, and are targeted towards technology development, innovation and societal perspectives.

The Research Council will:

- continue and further develop measures for socially responsible open science and innovation, including promoting the application and expansion of the Research Council's framework for Responsible Research and Innovation (RRI) in line with international development in the area.
- include societal stakeholders who do not have a research background in the Council's committees and boards when relevant.

DATA SHARING AND TESTING OF NEW PRINCIPLES FOR TREATING PATIENTS

In 2017 the Research Council and several other research funders became signatories to a joint statement from the World Health Organization (WHO) which entails that all clinical trials receiving Council funding are to be registered in an approved database (e.g. www.clinicaltrials.gov) prior to project start-up. The results of the trials are to be made publicly available.

Among other things, this has led to the development of better prognostic models for cancer patients based on combined data from numerous studies. https://www.nejm.org/doi/full/10.1056/NEJMsb1702054

3.2.2 Openness in innovation processes

Open innovation comprises innovation processes where knowledge development and value creation take place in cooperation between various actors, such as companies, private and public entities, research groups and civil society organisations. A key objective is to achieve value creation and benefit to society. It is important to note that benefit to society entails value far beyond the benefits related to specific value creation, encompassing, for example, new insight, long-term perspectives and alternatives, ethical reflection and sustainable societal development.

The Research Council's ongoing activities regarding openness in innovation processes will be viewed in connection with, among other things, the Government's efforts to design incentives for the commercialisation of research results.

The Research Council will:

- announce funding for projects that experiment with open innovation, for example test arenas, the Research Council's Idélab initiative , platforms for knowledge sharing and living labs.
- further develop guidelines for openness and sharing that promote access to project results and methods.
- take steps to define ways in which the Council can encourage openness in innovation processes.
- promote cooperation between relevant stakeholders from the business and public sectors and link together projects to ensure idea development and the exploitation of project results.

3.2.3 Rights to research results

In keeping with the principle, "as open as possible, as closed as necessary", there is a need to find a good balance between requirements for publication of results and considerations relating to copyright and intellectual property rights. Achieving open innovation requires clarification, prior to project start-up, of the rights of all parties involved, of who is to contribute to what, and of how the rights to the results developed will be shared.

The Research Council has drawn up principles concerning rights to the output of research and development projects receiving full or partial Council funding. The objective is to ensure that project results will be of benefit to society both by means of the development and dissemination of knowledge and through commercial utilisation.

In cooperation with other relevant stakeholders, the Research Council will work to:

- build competence relating to open innovation processes, including issues relating to the distribution of rights.
- develop standard agreements for collaborative projects which include prerequisites for open science and innovation processes in public-private partnerships.
- further develop principles for intellectual property rights adapted to open innovation.

3.3 Strengthening public trust in science

Publicly funded research of high calibre is an important part of the foundation for a democratic society. Public trust in science builds on research autonomy, academic freedom and the independence of research institutions. Open, inclusion-based research processes and open access to research results can provide a greater degree of insight into the prerequisites for research-based knowledge. Making knowledge more accessible can make it easier both to verify research results and to find solutions to complex problems that encompass multiple areas and sectors.

At the same time, there is a need for a more conscious approach to how research results are presented, understood and utilised. The emergence of fake news and conspiracy theories and misuse of research make it important to encourage critical reflection and sound judgment. The responsibility for public trust in science does not rest with researchers alone but must be shared by the knowledge sector as a whole.

Another means of making research more open vis-à-vis society is to allow a wider array of societal stakeholders to participate in research and innovation processes that involve mutual learning. Opening up research fields, research questions, and the choice of theory and method to different experiences, perspectives and understandings can make research more relevant and easier to utilise.
Greater openness and involvement in research and innovation also entails a risk that research will be misused. Researchers may come under pressure from users who are participating in projects and who wish to influence the output or the research process itself, which compromises the integrity of the research. If users manage to set an unwanted framework for projects or exert pressure on researchers, it can jeopardise the autonomy of the research activity and potentially diminish public trust.

3.3.1 Research as the premise for a knowledge-based society

Research is an important component of the common knowledge base underlying the decisions taken in and for society. The Research Council is seeking to create a deeper understanding of what research is and how it is carried out. This means giving the general public access to research results and insight into the research process.
In addition to making journal articles and research data accessible, it is essential that research is disseminated in a manner that promotes knowledge development and facilitates its application. The scope and complexity of research output has increased, creating a need for professional state-of-the-art reviews that provide an overview of research fields and topics.
The Research Council will:

- further develop arenas for research communication.
- promote scientific knowledge bases and syntheses within different subjects and thematic areas.
- attach importance to effective research communication when assessing grant applications.

In cooperation with other relevant stakeholders, the Research Council will work to:

- identify the need to enhance competence among researchers in relation to new forms of collaboration, communication and dissemination of research.

3.3.2 User participation

User involvement is a widespread practice in a number of research areas and in many Research Council activities. The primary objective is to ensure that research questions, activities and output are of genuine relevance and can be used in the best possible way. It is important to point out that some research activities are not well-suited to user participation. This will be a function of the problem being addressed, the subject field and the text of the Research Council's call for proposals.

While the definition of who the user is depends on the project and subject area, project partners should have expertise in and knowledge about the research question that is being addressed. Users may be decision-makers and public authorities, businesses, public sector stakeholders, special-interest organisations with experience in the specific field, who provide professional and/or financial resources for the implementation of the project. Partners are to contribute actively to the design and execution of the project, to dissemination of the findings, and to ensuring that new knowledge is put to use.

There is a need for greater awareness concerning the ethical challenges that arise in collaborative efforts between researchers and non-researchers. Researchers and partners are both responsible for ensuring that research is conducted according to sound ethical principles.

User involvement in research can be resource-intensive and may have drawbacks for results and scientific quality. The users

USER-IDENTIFIED RESEARCH AS A FUNDING INSTRUMENT

The objective of user-identified research as a funding instrument is to initiate research projects in areas shown to be of high demand among users of health services. The objective is to be able to implement the results of this research in the health services relatively quickly.

Experience gained from the National Institute for Health Research (NIHR) shows that user-identified research increases knowledge of importance to public health, and improves the platform for decision-making for the health services and the authorities.
Involvement of users and the public in publicly funded research is also a means of promoting participation in research.

CHECK THE ARTIFICIAL TURF ON THE SPORTS PITCH (2017)

How many rubber pellets are carried off in clothing and shoes?
"Check the artificial turf on the sports pitch" was a project carried out by pupils at 286 Norwegian schools, who studied the type of rubber pellets used in artificial turf fields and how much of this adhered to footwear and clothing.
The project was a collaborative effort between the Research Council, the Environmental Education Network at www.sustain.no and the Norwegian Institute for Air Research (NILU), in addition to Akvaplan-niva AS, SINTEF Ocean AS and the Institute of Marine Research.

and research groups must each have a clear understanding of their roles in the research process and the parts in which both can take part versus those that must be carried out by researchers themselves. There is a need for greater insight and expertise regarding how to involve partners in a manner that promotes ethically justified processes.

The Research Council will:
- identify and further develop guidelines for user participation in relevant Council-funded research and innovation projects.
- establish, maintain and finance national meeting places for user involvement across subject fields, research areas and actors.

In cooperation with other relevant stakeholders, the Research Council will work to:
- promote dialogue on the need for, and potential development of, a shared platform for user involvement in research and innovation.
- develop ethical guidelines adapted to research projects that incorporate user participation.

3.3.3 Citizen science

Citizen science is about engaging people (individuals, groups or institutions) with no background as researchers to become involved in research activities in cooperation with researchers or research institutions.

Citizen science projects may involve collecting research data, such as when members of the population help researchers to gather and register data. There may also be projects where the general public plays a key role throughout the entire research process. Such projects give participants insight into scientific thinking and enable them to acquire research-based knowledge. The projects may be targeted towards scientific, societal or political objectives, depending on the type of research in question.

Citizen science projects pose many challenges, and there are various difficulties associated with incorporating people who have little prior research knowledge. It can widen the existing knowledge divide if the participants who become involved – and thus gain influence – only represent those who have the most resources. Groups fronting a political or other agenda, or who have financial interests, may also exert undesirable influence on projects.

The involvement of different societal stakeholders in the research process is still a relatively new field, and there is little systematised knowledge on how these processes work in practice. There is a need for further testing and training in this area to provide input for further development.

Citizen science should follow the same ethical guidelines as other research projects, such as crediting collaboration and dealing with any conflicts of interest. Nevertheless, it may be necessary to adapt ethical guidelines to accommodate the special challenges related to citizen science projects. There may also be a need to design processes to quality assure methods for measuring and evaluating data.

The Research Council will:
- develop a set of criteria for the evaluation of citizen science projects in line with international guidelines and standards.

In cooperation with other relevant stakeholders, the Research Council will work to:
- develop knowledge networks about quality assurance methods for measuring and evaluating data collected by the general public.
- establish knowledge networks related to public participation in research.
- develop an ethics framework for dialogue with the general population and the implementation of citizen science projects based on internationally accepted principles.

4 Annex

Definitions

Data management plan (DMP)	A data management plan is a document describing how research data from a project are to be managed, from project start to finish.
Data infrastructure	Data infrastructure is research infrastructure designed for the purpose of processing, storing, curating and providing access to and/or enhancing the utilisation of data. Research infrastructure comprises advanced scientific equipment and large-scale equipment facilities within all scientific disciplines, including large-scale national laboratories, equipment components and research installations.
Source code	Source code is a set of instructions for computers written in a human-readable format. Source code is subsequently translated into machine code to be run by a computer. Open source code is software code that has been made accessible to all potential users.
Research data	Registration/recording/reporting of numerical scores, textual records, images and sounds that are generated by or arise during research projects. These may, for example, be data that are generated through new analysis by combining existing input data, or entirely new data that are generated through new data collection. Research data are always a direct result of research activity, regardless of whether the data are based on input data or whether they are collected from scratch (research-generated data/output data).
Metadata	Metadata are data used to define or describe other data.
Open science	Open science refers to scientific practice in which processes and results are made openly accessible under conditions that promote quality and knowledge development, including the sharing and utilisation of the research-based knowledge in a socially responsible manner.
Open access to research data	Open access is understood as the principle that research data should be accessible to relevant users, on equal terms, and at the lowest possible cost. Access should be easy, user-friendly and, if possible, internet-based.
Open access to publications	The results of publicly funded research are to be available to the public.

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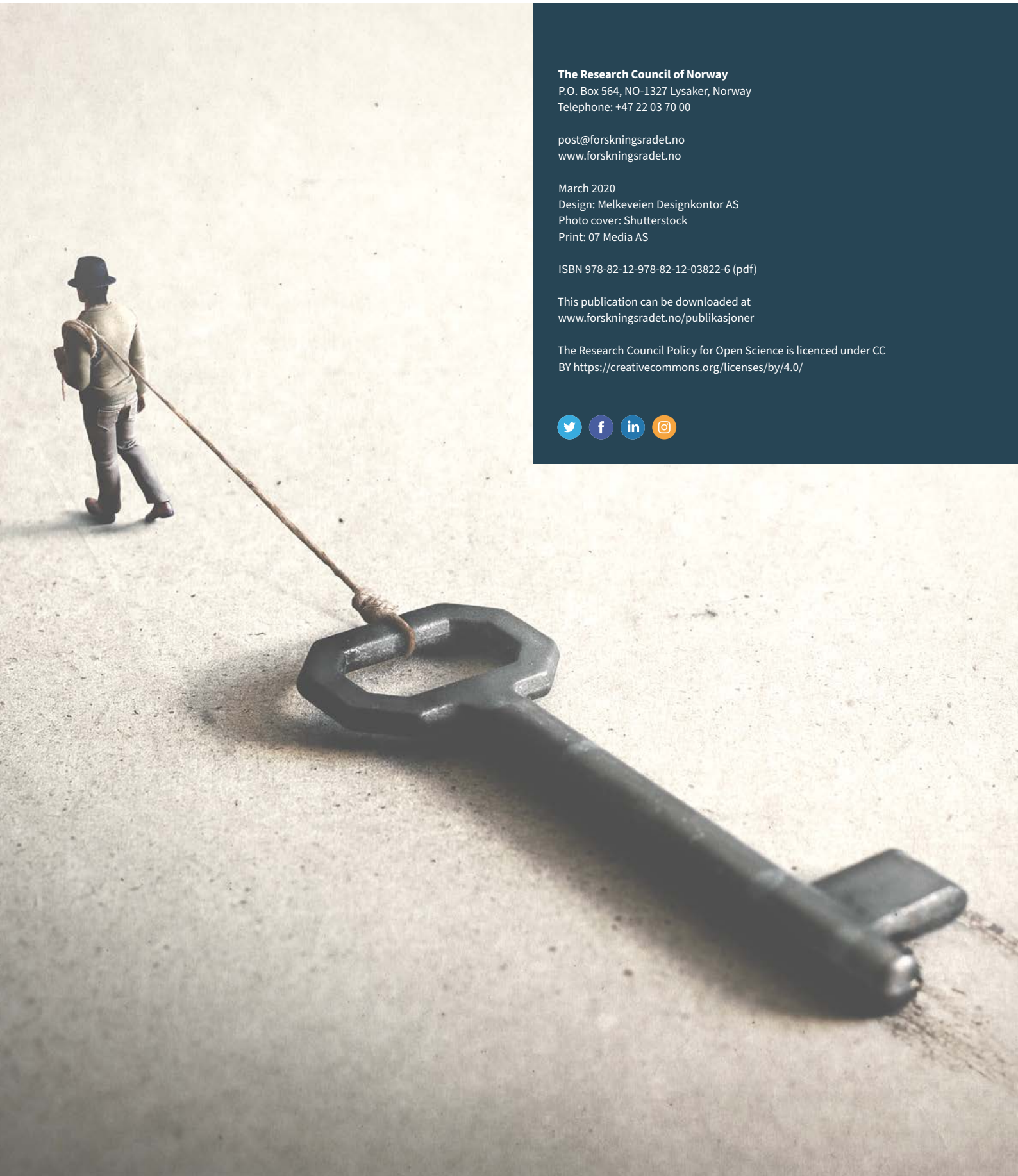

The Research Council of Norway
P.O. Box 564, NO-1327 Lysaker, Norway
Telephone: +47 22 03 70 00

post@forskningsradet.no
www.forskningsradet.no

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