TU Delft Open Science Programme 2024-2028 Research and Education in the Open Era Strategic Plan 2024-2028

van der Hoeven, F.D.

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Research and Education in the Open Era

TU Delft Open Science Programme 2024-2028

Strategic Plan 2024-2028

Frank van der Hoeven

Version 02-02-2024

Photo by Nas Hosen

Colophon

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TU Delft Open Science Programme
Prometheusplein 1
2628 ZC Delft
+31 (0)15 27 85678
openscience@tudelft.nl

Team

Project Manager	Frank van der Hoeven;
Executive Secretary	Anke Versteeg;
Community Manager	Tanya Yankelevich;
Communication Manager	Ymke Bresser.

Contents

TU Delft OS

The next Open Science Programme at TU Delft '24-'28, taking into account the lessons learnt over the previous period '20- '24, responding to policy developments at a national level and bottom-up developments.

TU Delft OS acknowledges the need for a broader uptake of open practices by the faculties while it sees the potential of a leading role for TU Delft (inter)nationally, supporting the excellent work of its employees and students.

Why?

Open science has the potential of making the scientific process more transparent, inclusive and democratic.

Open science ...

- *Increases scientific collaborations and sharing of information for the benefits of science and society;*
- *Makes multilingual scientific knowledge openly available, accessible and reusable for everyone; and*
- *Opens the processes of scientific knowledge creation, evaluation and communication to societal actors beyond the traditional scientific community.*

Our interconnected world needs open science to help solve complex social, environmental, and economic challenges and achieve the Sustainable Development Goals.

By promoting science that is more accessible, inclusive and transparent, open science furthers the right of everyone to share in scientific advancement and its benefits as stated in Article 27.1 of the Universal Declaration of Human Rights.

Values

Quality and integrity
Ensuring that science is high-quality and scrutinized by bringing together different sources of knowledge and making evaluation of scientific methods and outputs more transparent and accurate.

Collective benefit
Recognizing that science is a global public good that belongs to all of humanity.

Equity and fairness
Ensuring equitable, fair and reciprocal access to science for all producers and consumers of knowledge regardless of their location, nationality, race, age, gender, income, socio-economic circumstance, career stage, discipline, language, religion, disability, ethnicity, migratory status or any other grounds.

Diversity and inclusiveness
Embracing diversity of knowledge, practices, workflows, languages and research topics and outputs.

("UNESCO Recommendation on Open Science," 2023)

TU Delft OS: Five Open Science initiatives

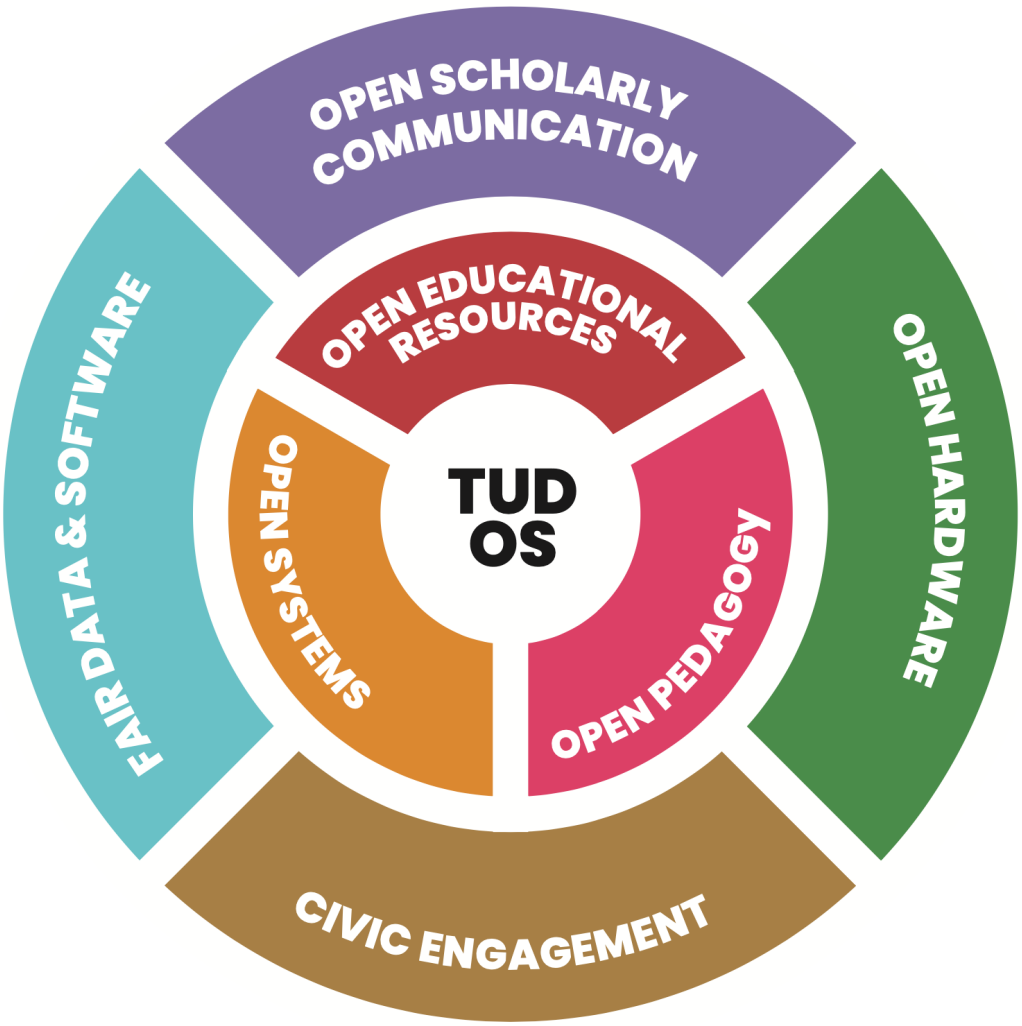
The new open science program will operate with 2 branches and 3+4 initiatives

1 program
TU Delft OS

2 branches
open education | open science

3 education initiatives
open educational resources | open pedagogy | open platforms

4 science initiatives
open scholarly publishing | FAIR
data & software | civic engagement | open hardware


OPEN SCHOLARLY COMMUNICATION
OPEN HARDWARE
CIVIC ENGAGEMENT
FAIR DATA & SOFTWARE
OPEN EDUCATIONAL RESOURCES
OPEN SYSTEMS
OPEN PEDAGOGY
TUD OS

TU Delft OS: Five common aspects

The new open science program will share five common aspects.

1. Values

Ethics;
Equity;
Safety.

2. Legal aspects

Copyright;
IP;
Collaboration with third parties.

3. Skills

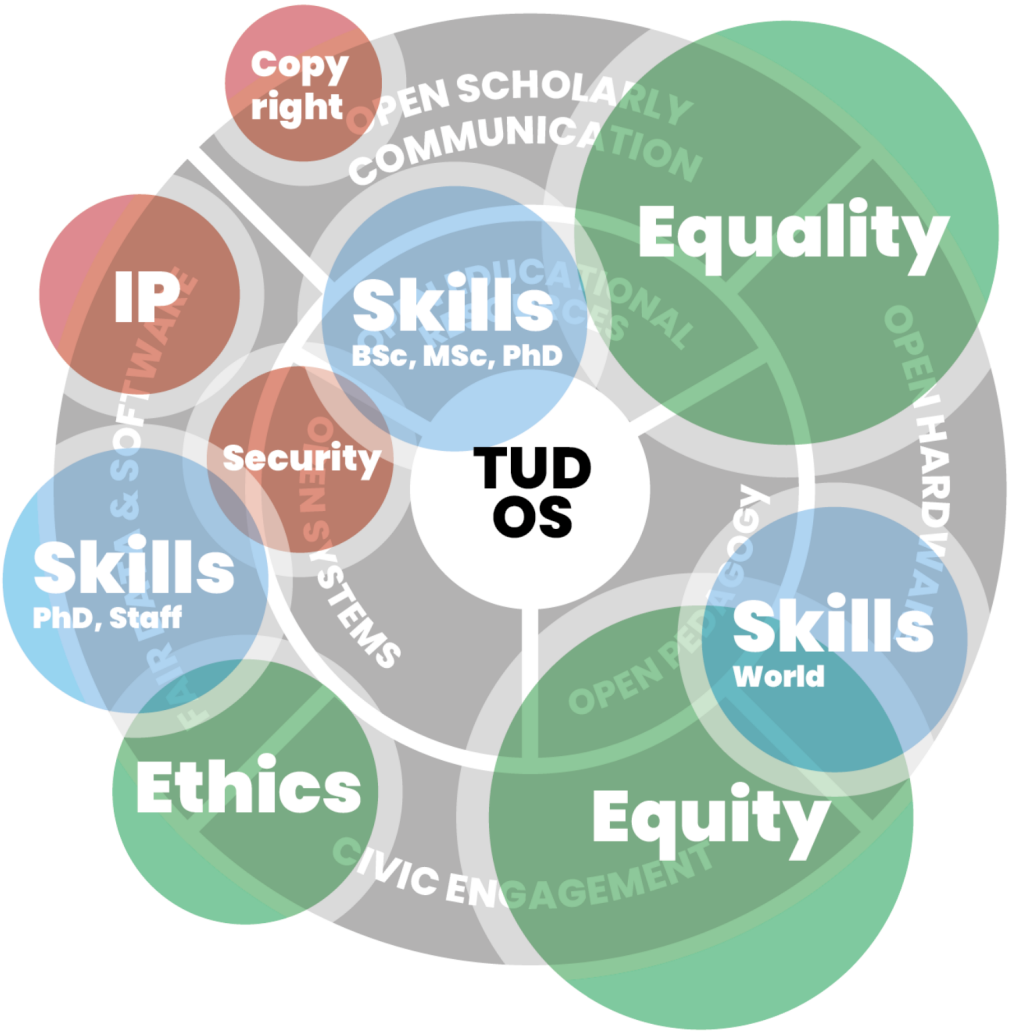
Students;
Staff;
Societal actors.

4. Open Science Community

Teaching Academy;
Open Hardware Academy; Citizens Science Lunch; DCC;
R Cafe pizza workshops; Rbanism meetings;
Open Humanities workshops;

5. Monitoring

Grassroots Program;
Policy effectiveness.


Copy right
OPEN SCHOLARLY COMMUNICATION
Equality
IP
Skills
BSc, MSc, PhD
OPEN EDUCATIONAL RESOURCES
OPEN HARDWARE
OPEN SOFTWARE
Security
TUD OS
OPEN SYSTEMS
Skills
PhD, Staff
OPEN PEDAGOGY
Skills
World
Ethics
Equity
CIVIC ENGAGEMENT

Lessons learned

The current Open Science Programme (OSP) covers 2020 - 2024, comprises 7 projects and 3 cross-cutting themes with a budget of 3 million euros, focussing on the take-off of Open Science.

Projects

- Open Education
- Open Access
- Open Publishing
- FAIR Data
- FAIR Software
- Open Hardware
- Citizen Science

Cross-cutting Themes

- Fruitful collaboration with 3rd parties
- Rewarding & Recognition
- Skills for Open Science

The collaboration between Open Access and Open Publishing, and between FAIR Data and FAIR Software has been strong, so it makes sense to continue each as a unified project.

National policy strongly emphasises Citizen Science as an element of Open Science, while it is less pronounced in Delft. On the other hand, Open Hardware is where Delft is unique. Both projects have great potential to support the Civic ambitions of TU Delft and deserve further development.

The three cross-cutting themes have been relevant but didn't mature to a level where they could become a binding force between the seven projects.

The OSP has successfully set up teams on a TU level. However, integrating Open Science at a faculty level is more at a pilot/frontrunners level.

In the last two years, the OSP started with Grassroots projects. This initiative resonates strongly in the TU Delft Open Science community and tastes like more.

The budget requested by the projects for activities on top of the daily duties of the existing staff has resulted in underspending. On the other hand, the budget allocated to hiring new staff for specific actions (like the DCC) was vastly more successful. In the next version of the Open Science Programme we should prioritise the latter.

Training programmes regarding Open Science, FAIR Software and Data Management (such as RDM 101) are not able to meet the demand and are in need of more capacity, while new courses on skills need to be developed. Training existing doctoral candidates to become Research Software Engineers is an option.

In the last phase of the current OSP, activities regarding Open Education are accelerating firmly with growing involvement of the faculties.

Finally, the time of preaching and teaching the values of ‘open’ are coming to a close as more and more colleagues support the mission but experience the obstacles in practice posted by the closed digital systems procured in the past, such as our CRIS (Pure), LMS (Brightspace), Coursebase and Collegerama.

Policy context

At the start of the TU Delft Open Science Program the discussion was still shaped by the Open Access policy initiated by deputy minister Sander Dekker and the fraudulent data practices of Diederik Stapel. Dekker set a policy goal of 100% open access in 2020. Stapel made it painfully clear that data should be well managed and open for inspection and verification.

'Open science' en 'open education' worden de normen, mits de nationale veiligheid hierbij niet in het geding komt.

Omzien naar elkaar, vooruitkijken naar de toekomst Coalitieakkoord 2021 – 2025 VVD, D66, CDA en ChristenUnie

Over the past four years, we observed a broadening of the focus from Open Access to Open Science and Open Education, reflected in "coalitieakkoord' and cumulated in establishing the Regieorgaan Open Science at NWO: **Open Science NL** and the National Growth Fund programme Npuls.

At the same time, funders and publishers are strengthening their policies regarding Open Access, Data Management Plans, Open Data, ethics, security and privacy.

As such, there are solid reasons for TU Delft to continue with a programmatic activity that focuses on mainstreaming Open Science and Open Education in research and bachelor, master and doctoral programmes.

Regieorgaan Open Science NL

Late March, representatives of fifteen knowledge institutions and the Ministry of Education, Culture and Science (OCW) signed the covenant on the newly established Regieorgaan Open Science at NWO, during a meeting at TU Delft. The Ministery of OCW will fund the work of the Regieorgaan with 20 Mln euros annually. There is a discussion how the Regieorgaan and the University programs should related to each other.

The UNL bodies COS and BROS have a clear opinion on how the University Open Science Programmes (OSPs) relate to the NWO Regieorgaan:

The commitment lies with the universities and knowledge institutions to make Open Science (including Open Education) the norm and that it is embedded sustainably across the board with all actors.
The Regieorgaan only provides targeted incentives in the coming years...

The OSPs should have a broader scope than the Regieorgaan. They must work towards structural embedding in all three core tasks of universities...

The scale of investments by universities and other knowledge institutions is many factors higher than that temporary 20M€/year for the Regieorgaan. It is estimated that we spend around 400-500M€/year and this is increasing every year.

UNL Steering group Strategy, Public Affairs & Governance Position paper 30 June 2023

Npuls

In May 2023 the National Growth Fund programme Npuls kicked-off. Npuls is a programme by and for all public vocational and education training schools, universities of applied sciences and research universities in The Netherlands making use of the opportunities offered by digitalisation.

Strategy

Taking into account the lessons learned in the current TU Delft Open Science Program, and considering the UNL ambition to be more ambitious than the NWO Regieorgaan, we propose the following strategy:

Strategy

- Consolidate the next open science program into a limited set of initiatives, well positioned in the framework of Open Science and Open Education;
- Expand Citizen Science into a full-fledged Civic Engagement initiative;
- Include Open Hardware as an initiative with a unique Delft signature;
- Formulate the (cross-cutting) themes more precisely on an operational level with an emphasis on values, rights, skills and community;
- Cherish the bottom-up initiatives and therefore include Grassroots initiatives structurally in the next iteration of the OSP;
- Develop training and support for open science skills aimed at students, doctoral candidates, academic career trackers, and other staff members;
- Increase the budget to facilitate the setup of faculty Open Science / Education support teams;
- Mainstream Open Education in primary and secondary schools, BSc, MSc and DE programs;
- Embed, align or integrate Open Science (activities) in other developments at the institutional level (Digitalisation, Safety and Security, Rewarding & Recognition);
- Make ‘Open Science’ and ‘Open Education’ a mandatory requirement for all future tendering of institutional systems.

Values

Open Scholarly Publishing
Thanks to publisher deals and “Taverne”, we will soon approach 100% Open Access. Publishing expenditure is still increasing, though.

And while more and more people can read or download our work without restrictions, APCs make it increasingly difficult for large parts of the world to publish.
The next goal in Open Scholarly Communication should be achieving equity. Diamond Open Access is one of the possible solutions to attain this.

Open Education and FAIR Data &Software
The importance of ethics in education and research continues to grow as standards and requirements push for stricter rules on privacy, safety and security.

Open Hardware and Citizen Science
So far, both Open Hardware and Citizen Science employ activities that intend to do good, protect the environment, or empower citizens. Equity is here in the foreground as a primary driver for research. It requires a more pro-active ethical approach than in projects where the interest of society or citizens is more in the background.

Legal aspects

In the coming years, we will deal with copyright questions related to publications and open educational resources and resolve copyright violations within our current LMS (Brightspace). In addition, we need solutions for intellectual property rights issues regarding software and hardware, especially when third parties or citizens are involved.

Skills

Regarding skills, we must distinguish between the groups we need to train and the skill sets required within the different fields of Open Science. The current Open Science Program will deliver a concise overview of these.

In the case of Open Hardware and Citizen Science, many of those we want to teach will be situated off-campus.

Open Education will predominantly concentrate on BSc, MSc and PhD students and teaching staff.

FAIR Data and Software has PhDs and staff as the main target group.

Community

The Open Science Community Delft (OSCD) forms the main community and is part of a network of similar comminuties in NL and abroad.

Open Hardware has setup the **Open Hardware Academy**.
Citizens Science meets for **CS lunch lectures**.
The **DCC** is a place where Open Science minded people come together.

The **Teaching Academy** could play a similar role.

Furthermore: a number of smaller, but growing initiatives have also developed in the past two years, namely:

R Cafe, a group of R enthusiasts from across the TU Delft community who meet monthly to discuss questions from the very broad “Why should I use R?” to the hyper-specific “Why is my code not working?!”
Rbanism initiative, created and maintained by the TU Delft Department of Urbanism.
Open Digital Humanities group organises periodic lecture meetings to explore how to bring the motto of TU Delft of “impact for a better society” in line with technological innovation driven by our researchers

Monitoring

Now that TU Delft has implemented various Open Science principles in its organization, it is time to also pay attention to the evaluation of the university’s Open Science program. Open science evaluation is a relatively new area both in research organizations and in the scientific literature. The development of evaluation frameworks and specific guidance would enable scientists and practitioners to evaluate the effects of universities’ Open Science programs and gain insight into what combined instruments of Open Science programs have the most positive effects compared to other instruments and examine whether the financial investments in Open Science programs are paying off. Therefore, we argue that part of the next Open Science Programme should also include the development of evaluation frameworks for measuring the effects of TU Delft’s efforts in terms of Open Science.

For the evaluation of TU Delft’s Open Science program, the TU Delft Library will collaborate with the Open Data Research Lab of the Faculty of Technology, Policy and Management (TBM) to examine potential Open Science evaluation activities.

Anneke Zuiderwijk, Associate Professor of Open Data and Director of the Open Data Research Lab, is already taking the first, essential steps in investigating what framework can be used for the evaluation of Open Science programs of Dutch universities through her NWO-funded 4OpenScience (pilot) project (started in August 2023).

While the evaluation framework to be developed in the 4OpenScience project will be relatively broad and generic, further specification is needed for each Open Science pillar, such as FAIR data, FAIR software, and citizen science, and for specific research disciplines. In collaboration with the Open Data Research Lab, we propose to include the following evaluation activities in the next Open Science Programme.

- An evaluation framework that can be used to identify the positive and negative effects of the FAIR Data pillar of TU Delft’s Open Science Program.
- Evaluating the positive and negative effects of various small-scale projects under the umbrella of the Open Science Program.
- An evaluation framework for Data Stewardship service.
- A feasibility study and design on embedded support on Open Science at faculty/ department/ group level.
- An institutional workflow for handling research data.

TU Delft OS

1 programme

TU Delft OS

2 branches

open education | open science

3 education initiatives

open educational resources | open pedagogy | open platforms

4 science initiatives

open scholarly publishing | FAIR data & software | civic engagement | open hardware

TU Delft OS

TU Delft and UNL have emphasised that in the transition towards open, research and education should go hand in hand. However, in national policy making, in external funding (NWO, Npuls) and in assessment protocols these are still considered as two separate fields.

In this context it makes sense to put open education on the same level and not consider this as an initiative equal to publishing or software. Instead we should indentify within open education more specific initiatives equal to open science.

This approach results in one program with two branches: open education and open science.

Open education comprises three initiatives:

1. Open Educational Resources
2. Open Pedagogy
3. Open Platforms

Open science comprises four initiatives:

1. Open Scholarly Publishing
2. FAIR Data & Software
3. Civic Engagement Hub
4. Open Hardware

Open Education

Open education will be a significantly larger pillar in TU Delft OS compared to the current OSP. To support our ambitions for open education, we have formulated the following goals:

- By 2028, open education is regarded as the norm in the BSc, MSc, and PhD programs at TU Delft. This is reflected by the following goals:
- TU Delft formally recognizes the process of creating and using open educational resources in courses as part of the evaluation criteria for our academic staff as they progress in their academic careers.
- There is a technical infrastructure for creating, publishing, and sharing open educational resources, managed by the library and available to all TU Delft staff.
- All TU Delft teaching staff are provided with regular opportunities for professional development in open education skills.
- The use and creation of open educational resources become an integral part of the didactic approach in the design of courses. This is reflected through the adoption of open pedagogy in the TU Delft vision on education.
- A regular internal funding opportunity is established for grassroots projects in open education.
- At least 200 unique BSc, MSc, and/or PhD courses at TU Delft are designed around Open Educational Resources.

It all results into three initiatives supported by a grassroots program:

Open Educational Resources;
Open Pedagogy;
Open Platforms.

Action: Facilitating grassroots initiatives

The 2023 Open Education Stimulation Fund is proving to be a success for the program. There are currently 11 projects halfway through their project term. The projects show that by organising a good selection process, we can fund projects that are almost completely self-sufficient. We will therefore organise a yearly Open Education Stimulation Fund call during the entire program term of OSP Next. To facilitate this process, the advisory board members of the open education program pillar will serve as reviewers. To make the grassroots call feasible, we require a project manager (0,4 fte), to manage the following tasks:

- Organising the yearly call
- Putting together a review board
- Organising the promotion of the call for proposals
- Organising the review process
- Organise kick-off sessions, mid-term evaluations and final evaluations for the
- projects
- Create and manage a community around the projects
- Yearly evaluation of the Open Education Stimulation Fund.

The project manager will manage these activities together with a project team including an OE specialist and a communications expert.

Open Educational Resources

We have budgeted 15.000 euro per Open Textbook. Typically, costs of producing an Open (interactive) textbook vary between 3.000-6.000 euro. To scale our publishing capacity up to the level required to realize our ambitions for 200 open textbooks, we need additional capacity for TU Delft Open Publishing for the following tasks:

- A process manager (scale 9, 1.0 fte) for organising and managing the quality control process of textbooks, including copyright and similarity checks, copy-editing, collecting the metadata and facilitating the publication of textbooks on the website.

- A community manager (scale 10, 0.5 fte) for Open Interactive Textbooks. This profile is responsible for the wider implementation of the emerging software Jupyter Books, that is used by our teaching staff to write open interactive textbook. This person should have technical expertise with Git, Markdown and Jupyter, as well as be able to organise and manage a community of practice around working with the Jupyter Books software.

Open Pedagogy

Per 1 January 2024, we intend to start with Open Education Advisors in three faculties. Each of these OE advisors will have a 0.5 fte appointment through the OSP Next per faculty. The profile of these Open Education Advisors is based on the findings of the pilot project at the BK faculty and has the following goals:

Gaining insight into the educational processes and challenges of the BK faculty and assessing how open education would fit into this vision and strategy as a potential solution to challenges.

Creating an overview of the current state of open education at the faculty, including current practitioners of open education, people willing to engage with it, and people who are not inclined to engage with Open Education at this point.

Using these insights, identifying potential open education related projects at the faculty with an emphasis on pedagogy.

Open Platforms

There is a need to find and adopt a solution that facilitates all types of content in a single storage location. The development of the technical infrastructure has many on- and off-campus stakeholders, including the Library, Extension School, ESA, and ICT, as well as national programs like NPULS. TU Delft OS could be the linking pin for defining and formulating the requirements for an infrastructure for publishing educational content, which is developed with open standards. This includes the requirements for the tendering of tools, systems, and platforms.

To coordinate this effort, the open education program pillar requires a software architect (0.5 fte), who can translate stakeholder requirements into potential technical solutions. In this process, it is essential to scope out various vendors for platforms and systems that are required for the infrastructure.

The OE program requires a business analyst to evaluate the products offered by vendors,

based on our technical and stakeholder requirements. We will involve our central ICT services for this business analyst, who will contribute on a project basis.

As part of the development of technical infrastructure, we propose to have our open education training program implement the technical infrastructure itself as part of training and workshops.

An OE trainer (0.4 fte) will be responsible for organising, preparing, and providing training on a variety of open education related skills for teaching staff who want to make it a part of their professional development. This skills training includes working with tools and platforms, but also other open education related skills.

Open Science

Open science comprises four initiatives:

Open Scholarly Publishing
FAIR Data & Software
Civic Engagement
Open Hardware

1. Open Scholarly Publishing

Action 1: Embedding Open Scholarly Communication Advocacy in the faculties

Appoint experts for the faculties of design, science and engineering:

i. To provide advice on OA publishing, funding and policies;
ii. To feedback loop continuously to improve TU Delft OPEN Publishing practices/services and align them with the publishing needs (OA, accessibility, innovation, collaboration, copyright, communication, etc.) of the academic community to TU Delft OPEN Publishing;
iii. To be the linking pin between the researchers/teachers and the library in order to provide the best publishing services;
iv. Community building.

Action 2: (Open) Peer Review innovations

2.1. Peer-review of data and software pilot- (in collaboration with FAIR Data and FAIR Software)

Concept of the pilot: recognising data and software as valid research outputs; making the methodology of data and software production more open and transparent, optimising reuse of data, enhancing reproducibility and, promoting principles of Open Science. The pilot is currently led by 0,5 FTE (contract ending March 2024). To complete phase two and three we need to keep the current FTE in place.

Create (1 FTE) a new position such as coordinator, peer-review innovations that is part of the scholarly communication & publishing team.
Phase one of the pilot focused on a) engaging people and communities interested in data, software, open publishing and open science b) Seeking collaborations through events c) writing a guideline and idea for implementation d) testing the peer review guidelines in the Journal The Evolving Scholar.

Phase two and three will focus on the related documentation, integrating peer- review data into a publication workflow and on writing a policy document and developing a long-term sustainable strategy

2.2. Using AI to assist with the peer-review process such as reviewer recommendations, reviewer assistance (ReviewMate), Content Analysis and Fact-Checking (Authorea).

Action 3: Integrating emerging technologies to enhance the scholarly communication process

3.1. AI to assist in publishing quality: Using AI to assist with language & grammar checks

(Writefull, ChatGPT);
3.2. Blockchain technologies to assist in publishing integrity with Orvium through the Evolving Scholar: Decentralized Peer Review and Reputation Systems; verified authorship and attribution;
3.3. Collaborative writing tools for books;
3.4. Exploring Interactive Publishing Solutions for Engineers.

Action 4: Investigations of new Rewards & Recognition mechanisms

4.1. Reviewers recognition: transparent assessment of the content quality with open reviewer reports and DOI assignment for citations and tracking possibilities. For example badges, ORCID, Publons, etc.;
4.2. Authors recognition: Investigation and implementation of a new citation index.

Action 5: OA funding & mandate

5.1. Funding for books co-creation with commercial, non-commercials entities to bring books from TU Delft authors. Funding in alignment with the NWO policy & funding for OA books;
5.2. Retention rights;
5.3. Adaptation and translation;
5.4. Flipping journals to diamond OA models.

Action 6: Developing a curated professional platform for TU Delft OPEN Publishing

Our vision is to develop a platform that connects TU Delft OPEN Publishing with the research community. Our aim is twofold: 1) to create a new user-friendly website that guides researchers through the publication process and 2) create a content platform as a centralized resource, enhancing the visibility of our publications.

Action 7: Public engagement

Bridging the gap between academia and the general public to make societal impact and facilitate dissemination.

- Introduce plain language summaries findings & key messages in all our publications. For example, the summaries could be used to promote the book on the website or in a press release or marketing campaign;
- Appoint a (science) communication specialist (1 FTE) to promote our scholarly content, to engage the community and attract authors, editors and reviewers.

Action 8. Monitoring and Evaluation

Moving forward we bring experts to educate us and help us make the right decision. We propose two important type of evaluation:
8.1 Quantitative Metrics Analysis
8.2. Ethical Impact Assessment
We will work closely with the team analytics however we will need a project lead (1 FTE).

2. FAIR Data and Software

The Digital Competence Centre (DCC) is an initiative that developed under the current Open Science Programme at TU Delft. The DCC is designed to benefit researchers at all levels to make research data and software FAIR, improve research reproducibility, and apply computing practices to increase the efficiency of the research process.

Modern research increasingly relies on digital tools for collecting, processing, and storing data, as well as writing reusable code, (co-)developing software, and sharing results with the research community. To ensure effective utilization of these tools, it is essential for researchers to have the necessary digital skills, without which they will fall behind in their work.

The Open Science Programme funding to date has proved essential and should not stop but move on to the NEXT phase of development – “extend digital competence centre expertise”.

Since the DCC began, almost three years ago, it has grown to a team of five research software engineers, three data managers and a co-ordinator. The team has provided support to 57 research projects. An estimation of the project work hours from the calls for support can be seen in the DCC dashboard. In addition, the DCC provides training and ad-hoc consulting work.

The demand for DCC support has grown, due to increased awareness of both funding bodies and the research community that research reproducibility is essential. This requires the development of expertise on data management and research software development within a research team. However, researchers are often unable to hire support personnel themselves on a project or part-time basis. The DCC can meet that need, with its flexible pool of permanent staff, positioned centrally, who can rotate as needed across the faculties, sharing knowledge and skills. The central pool needs to grow, not only to meet the demand to support research funded projects, but also to continue providing the existing (free) project support and training; building the necessary awareness of Open Science, implementing FAIR principles in practice and acting as a catalyst for TU Delft’s Digital Strategy.

The demand for research support is highest from three faculties; (1) CEG, (2) ABE and (3) AS. The DCC can help to identify the specific needs of those faculties and where best to station the resources.
Two models have been identified:

- TU Delft OS funding would be used to extend Research Software Engineer (RSE) and Data Manager (DM) support in faculty teams. The faculty teams would be part of a larger network, which the DCC could have responsibility for co- ordinating and sharing the best practices and DCC assets that have been developed to date (see below for an overview of DCC assets).

- TU Delft OS funding would be used to employ the expertise centrally by the DCC, as is currently the case, but this time, with a member of the relevant faculty taking part in the hiring process. The new DCC support staff, once hired centrally, goes through an onboarding period and is then seconded to a faculty for a specific period of time to support research projects. The DCC continues to remain central but facilitates the creation and development/mentoring of faculty Research Software Engineer (RSE) and Data Manager (DM) support, to help them get started, review progress and ascertain the required time commitment. If several projects require support in the same faculty,

then this would justify a transition to model one, whereby the RSE or DM would be employed via the faculty.

Why Open Science funding?

If funding is provided by the Open Science Next programme, an internal source, then this would provide a low-risk approach for ensuring the up-scaling and continued professionalisation of the DCC support capacity (regardless of where it is stationed), underpinned by the university central services. The existing knowledge gained and the commitment that has been demonstrated by the Library and the ICT Department, together with DHPC, can be leveraged to establish a sustainable DCC, overseen by the DCC steering committee.

From the start of the initiative, the faculty DCC support staff function will report to the faculty representative that is appointed to take part in the DCC steering committee, supervised on a daily basis, by the DCC co-ordinator. RSEs and DMs work best in teams. Starting a local team with very few members could pose a risk, which can be mitigated by being part of the central DCC. The governance continues as-is. Depending on the outcome of the pilot, the DCC support staff function may be permanently funded by the faculty or may remain centrally funded.

Several DCC assets are in place for the Open Science Next Programme to leverage:
Hiring of research support personnel – Research Software Engineer (RSE) and Data Manager (DM)
Function profile;
Onboarding;
Trainings for new employees and train the trainer.

DCC support process

- A tried and tested process for support calls (inspired by the eScience Center);
- A back-office dashboard for managing the portfolio of projects from application to completion;
- A dashboard for reporting, including key stakeholders such as the Open Science Next programme.

Community

Building up research support presence in the faculties requires a strong community which is committed to its success long-term. As a sub-set of the Open Science Community, the DCC is building relationships and engaging with researchers and support staff who have valuable knowledge and expertise. In addition, the DCC has a strong relationship with the data stewards who are stationed in and funded by faculties.

Open Science Next programme resources would be needed to hire a dedicated project manager for the pilot, who would report to the DCC co-ordinator as well as for hiring RSEs and Data Managers to extend digital competence centre expertise.

3. Civic Engagement

TU Delft hosts several initiatives designed to engage local and international communities in research, education and/or collaboration. These include: *TU Delft Science Centre, TU Delft Global, TU Delft OS, TU Delft Library, Green Village, Climate Action Program, Studium Generale, WaterLab, Delft X, Botanical Garden, Open Hardware.*

In order to coordinate the efforts of these initiatives and unify the agenda driving TU Delft towards a more civic university model, we propose to create a Civic Engagement Hub.
The Hub will be a connecting place (online and offline) for researchers, teachers, students, support staff and society that facilitates collaboration and co-creation for impact and mutual benefit.
The idea of hubs to foster Citizen Science and societal participation in research is closely related to the concept of Science Shops in various parts of the Netherlands. The model has also been discussed with NWO, who are currently developing a funding model for Citizen Science and has been positively received. However, various tools and resources that are required to successfully engage in Citizen Science and participatory research are relevant to other initiatives beyond Citizen Science.

The Civic Engagement Hub will focus on the following areas:

- Citizen Science and Participatory Research
- Public Engagement
- Science Education & Science Communication

Goals of the Civic Engagement Hub:

- Drive societal engagement with scientific research and innovation.
- Showcase tools, resources and partnerships that facilitate effective collaboration between society and science.
- Use partnerships to strengthen national and international advocacy for societal engagement with research and innovation.
- To better connect science and society in a manner that fosters equal partnership-based collaboration, involvement of other societal stakeholders, such as municipalities, local libraries, IHE Delft Institute for Water Education, civil society organisations and other educational institutions is imperative.

Thematic focus breakdown

The three pillars within the Civic Engagement Hub have a specific work focus, briefly described below:

Citizen Science & Participatory Research

- Develop and curate tools and resources for [citizen] researchers;
- Establish a team of experts to support researchers in Citizen Science research upon request (including an Engagement Coordinator hired as part of the TU Delft OS Faculty Team);
- Develop and implement Citizen Science policies within TU Delft, pooling together financial resources and making Citizen Science and participatory research financing available for diverse research teams;
- Create and grow a community of practitioners to enable peer-to-peer learning and collaboration.

Public Engagement

- Support researchers who wish to open their research to society in an accessible and engaging way;
- Organise public events/workshops/exhibitions to demonstrate and strengthen the connection between research/science, society and innovation.

Science Education and Communication

- Connect, coordinate and foster all the science education and communication efforts (including events, facilities and programming) throughout TU Delft. For example, Meet the Professor, the Library and Studium Generale programme, Media Centre, TU Delft Global Initiative, Open Hardware, ESA, and education and engagement efforts by multiple faculties;
- Create a pre-university programme for primary and secondary schools for 4TU in the Netherlands. This will include teacher training and Citizen Science modules. Close collaboration with the Open Education initiative will be a logical step;
- Facilitate public use of existing TU Delft labs for education and innovation purposes by communities outside of TU Delft.

4. Open Hardware

Open hardware, or open-source hardware, refers to hardware whose design is made publicly available, enabling anyone to study, modify, distribute, create, and sell the design or hardware based on that design. The Open Hardware initiative at TU Delft seeks to further integrate open hardware into the Open Science movement. This project supports students and researchers in making their hardware projects open and provides training activities and learning materials to advance community goals.

Main Goals for TU Delft OS:

- Showcase the relevance of open hardware: Demonstrate that open hardware is an integral part of open science by leading by example and assessing its significance in science, engineering, education.
- Integrate open hardware into education: Take steps to incorporate open hardware best practices and values into the engineering curriculum at TU Delft, fostering a culture of open collaboration.
- Adapt to evolving faculty needs: Monitor and address the evolving needs of faculties regarding the usage, development, reward, and recognition in open hardware. The role of the Research Hardware Engineer (RHE) is to support researchers and others with open hardware, with the long-term goal of integrating it into their daily work. This support may include workshops, academies, open office hours, or consultancy services.
- Recommend policy and measures: Provide recommendations on policies and measures needed to advance open hardware at TU Delft and nationally. This includes mainstreaming a research hardware engineer position whose role is to support and facilitate open hardware initiatives university-wide or per faculty. These recommendations aim to provide a strategic roadmap to promote open hardware effectively.

The common thread connecting open hardware projects is the strong emphasis on societal impact. There are at least five areas where open hardware projects enable organizations to have a major impact:

- Social empowerment by democratizing knowledge, tools, and resources.
- Distributed economic growth by inspiring others to create derivatives, start new companies, and enhance the competitiveness of established companies.
- Distributed technical advancement by accelerating innovations and introducing new methods through continuous development with version control.
- Environmental sustainability by simplifying repairs, preventing vendor lock-in, and enabling the manufacturing of spare parts or upgrades.
- Collaborative working by stimulating open hardware academic and industrial cooperation, facilitating knowledge exchange and collective problem-solving, and amplifying the impact on future projects.

Considering the overlap of these impact areas with the missions of research universities and universities of applied sciences, it's crucial to systematically embrace and support the open hardware route.
To do so, the following actions are proposed:

Action 1. Open Hardware Academy

After a successful pilot of the Open Hardware Academy, the team plans to:

- Run the academy twice a year and expand the pool of technical lessons.

- Reward participants of the Open Hardware Academy with ECTS credits and/or offer it as an elective course.
- Establish community-supported/sponsored projects as a pathway to participate in the Academy. This ensures that students and researchers receive regular opportunities for professional development in their open hardware skills.

Action 2. Open DEMO

The Electronic and Mechanical Support Division (DEMO) is the largest production unit of hardware at TU Delft. TU Delft OS will provide support for projects wishing to make their hardware open. A Research Hardware Engineer (RHE) will collaborate with researchers, assisting with documentation and publishing of all relevant data with support from student assistants.

The vision here is that a large number of projects that go through DEMO could comfortably fit into open hardware. However, due to a lack of resources, expertise, and time, they are not fully documented and published as such. This represents low-hanging fruit, as the effort could create a collection of open hardware research outputs that showcase a wide variety of research that would otherwise be absent.

Action 3. Open Dreamhall

The Open Science Program at TU Delft is occasionally approached by third parties seeking support for their hardware projects. We aim to make these projects as iconic as Nuna and the SDE projects. Recently, we established contact with an American vendor committed to making the design of its tractors open hardware. If this project succeeds, it has the potential to serve as a flagship example of successful collaboration between academia and industry in the field of open science. This project could result in the world's first viable open-source tractor, with the goal of empowering farmers around the world. Leveraging our state-of-the- art facilities and talented students, we can lead the way in advancing the design of this open-sourced tractor.

Action 4. Faculty Support

Research hardware engineers will be available for faculties as an on-demand service. The RHEs offer expertise in open hardware development and assist in complex projects, addressing technical challenges and providing guidance. The support of the RHEs is flexible per faculty to meet the specific needs of each department.

Action 5. The Open Hardware Uncompetition

A national/international open hardware competition asks participants to develop/improve open hardware projects. In traditional competitions, participants compete with each other, and secrecy regarding improvements is a key advantage. In the open hardware competition, cooperation and collaboration coexist with competition, and one of the key criteria for winning would be the proper documentation and sharing of their project, enabling anyone else to reproduce it. An example of this would be to create improvements to the matchbox scope, including but not limited to using alternative materials, robust construction, improved magnification, exploring other microscopy regimes, developing embedded software to identify samples for improved ease of use, and creating an app for easily sharing microscopy images and tracking their provenance, among other features.

Action 6. Open Hardware Stimulation Fund

A fund will be awarded to researchers who want to convert their projects into open hardware initiatives. The fund will support the development of projects along open hardware lines, whether that involves resources to build the hardware, support with documentation, or assistance in maintaining the research output.

Action 7. Open Hardware Masters and PhD

In addition to the development of open hardware projects, open hardware itself is a topic ripe for research and study. This includes identifying best practices in open hardware projects, exploring possible business models involving open hardware, investigating funding models to support open hardware development, and providing recommendations for academia.

Action 8. (Inter)National Knowledge Exchange

Open hardware initiatives are emerging worldwide. To unify these efforts and ensure organization at a national level, a white paper will be written. This process requires constant follow-up and implementation of the suggested action points.

TU Delft OS team

With a larger programme and more staff actively engaged in open science, there is a need for an improved framework for sharing information, making decisions, identifying opportunities, exchanging ideas and experiences, and establishing a presence in strategic networks, both nationally and internationally.

Rewarding & Recognition

Software and hardware engineers are currently categorized as support staff, but this is about to change. In 2024, the implementation of the Rewarding & Recognition programme should commence. Research and hardware engineers will likely transition out of the TU Delft OS programme after four years and integrate as full- fledged researchers, just like any other engineer in Team Science. TU Delft OS needs to actively participate in this process.

Chiefs of Open Science

UNL hosts the so-called Chief of Open Science meeting, which brings together the directors of university libraries and the managers of open science programmes to discuss national policy matters. The next OSP should maintain this presence at the national level.

International Representation

The international presence of TU Delft in the field of Open Science could be strengthened by becoming an active member of open science networks in Europe and worldwide.

Open Science Community

Work on the Delft Open Science Community continues and is strengthened through grassroots open calls and the creation of a strong and diverse Community Board ready to further coordinate efforts of the community within each of the TU's faculties.

Grant Support

TU Delft OS has a responsibility to obtain external funding, which doesn't happen automatically, especially because the library doesn't have a tradition of securing grants or grant support. During the first OSP, we acquired €250,000 for citizen science. We intend to continue this approach and obtain a substantial portion of the €20 million that NWO makes available annually. For this, we require 0.4 FTE support.

Open Science Board

Monthly meetings with representatives from five initiatives: Open Education, Open Publishing, FAIR Data and Software, Civic Engagement Hub, and Open Hardware.

Initiative Meetings

Each initiative meets with representatives from all involved faculties each month. TU Delft OS Team facilitates these meetings. We can chair them or we just provide catering.

Steering Group

The steering group will reflect the links with other developments at TU Delft and will thus be expanded.

Faculty Team Pilots

A significant investment in staff creates the opportunity to establish Open Science teams at each of the eight TU Delft faculties for the first time. Of course, the composition of such a team may vary based on each faculty's size and needs. There is no one-size-fits-all approach. In 2024, we aim to start three pilots, one at a design faculty, one at an engineering faculty, and one at a science faculty. The preferred strategy is for the Open Science Programme to establish a presence at the faculty level, with the faculties taking responsibility for additional departmental needs.

Faculty Team	A	B	C
Data Steward **EXISTING**	**1**	**1**	**1**
OpenScholarly Publishing	**1**	**1**	**0**
OpenEducation Support	**1**	**1**	**2**
Research Software Engineers	**1**	**2**	**3**
Data Managers	**2**	**2**	**0**
Research Hardware Engineers	**0**	**1**	**1**
Citizen Science	**1**	**0**	**0**
Total	**7**	**8**	**7**

Three examples of how a Faculty Team may be composed, including the existing Data Stewards based on the 2024 budget, assuming three pilots. The TU Delft OS can in this way setup tailor made teams that will drive the mission of making open science and open education the norm at each of the eight faculties.

Governance TU Delft OS

OS Team
Project Manager
Executive Secretary
Community Manager
Communication Manager
Funding Advisor
Secretary

Steering Group
Director Library
Faculty Dean
Director Services
Project Manager
Rewarding & Recognition
Knowlegde Security
Graduate School

Account holder
CvB
Vice-Rector

TU Delft