# External assessment of

# the Netherlands eScience Center

## 2014-mid 2018

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# 1   Introduction

## 1.1   Scope and context of this review

On Thursday 7 and Friday 8 February 2019, an international assessment committee assessed the quality of the implementation of the strategy of the Netherlands eScience Center over the period January 2014-June 2018. The focus was on the quality and impact of the eScience Center's main activities, as laid out in the document *Strategy 2015-2020 & Beyond*, and the extent to which the eScience Center is equipped to achieve its strategic goals now and in the future. A self-assessment report of the eScience Center was provided to the assessment committee prior to the assessment. The review committee consisted of (inter)national experts with broad scientific authority and overview of the scientific field of research (see paragraph 1.2).

During a site visit of two days, the eScience Center presented the current status of the implementation of their Strategy 2015-2020 and a reflection on the self-assessment report. Collaborating researchers working on eScience Center funded projects, eScience Center board members and the eScience Center advisory committee chair also provided their views. After each presentation, there was time for questions and discussion with the committee. At the end of the second day, the committee presented its first provisional conclusions and recommendations to the directors team of the eScience Center, the chair of the eScience Center Foundation and SURF and NWO.

The assessment committee was asked to assess the organization's performance on the four assessment criteria:

1. *Quality of eScience*
2. *Scientific impact*
3. *Societal and academic relevance*
4. *Viability*

This report contains the findings of the review committee, and will be presented to the eScience Center and the board of SURF and NWO in April 2019.

## 1.2    The Evaluation Committee

The Evaluation Committee was formally installed by the NWO Executive Board represented by prof.dr. C.C.A.M. Gielen. The Committee members were:

prof. E.M. Meijer (Chair), prof. D.I. Boomsma, prof. D. De Roure, prof. S. Hochgreb, prof. S. Holmgren, prof. M.R. van Steen. A short biography of each of the members is included in Annex 1.

The Committee was supported by G.A. van Malenstein M.Sc. (SURF) and dr. F. Stephan (NWO).

Before the site visit all members of the Committee signed the Statement of Impartiality and confidentiality by means of which they declared that their assessment would be free of bias and without regard to personal interest, and that they had no direct relationship or connection with the Netherlands eScience Center. It was concluded that the Committee had no conflicts of interest.

## 1.3    Data supplied to the Committee

Seven weeks prior to the site visit the Assessment Committee received the self-assessment report of the eScience Center with additional documents, together with the Terms of Reference, the site visit program and an accompanying letter.

During the various sessions of the site visit, the Committee received extensive and detailed information from all participants: directors team, board members, eScience advisory committee chair, research collaborators on eScience Center funded projects and eScience research engineers.

## 1.4    Procedures followed by the Committee

The Committee proceeded in accordance with the Terms of Reference of the external assessment of the Netherlands eScience Center 2014-mid 2018. The assessment was based on the eScience Center self-assessment report with additional documentation provided by the eScience Center, and information provided by the interviews during the site visit.

The interviews took place during the site visit made from 7-8 February 2019. The program of the visit is included in Annex 2. During the first part of the meeting on 7 February in the afternoon, prof. dr. C.C.A.M. (Stan) Gielen (Chair Executive Board NWO) and prof. dr. ir. E.R. (Erik) Fledderus (Managing Director SURF) presented the context and goal of the evaluation. Afterwards the Committee met in a private kick-off meeting in the afternoon of 7 February to discuss and prepare for the interviews. The interviews with the eScience Center Directors Team, the Board members, the chair of the eScience Advisory Committee, research collaborators and staff took place during the site visit on 7-8 February 2019. All interviews were conducted by the entire Committee.

After completing the interviews, the Committee discussed their views on the performance of the eScience Center and determined the final assessment and the scores. At the end of the site visit, the Committee met with the Directors Team of the eScience Center, the chair of the Board of the Stichting Netherlands eScience Center and SURF and a representative of the NWO and SURF Executive Board to report on the Committee's main findings. By the end of March 2019, a draft version of this report was sent to the eScience Center director for factual correction and comments. The report was subsequently submitted to the NWO and SURF Executive Boards.

## 1.5 Aspects and assessment scale

The Terms of Reference required the Assessment Committee to assess the eScience Center's performance based on four assessment criteria:

*1. Quality of eScience*
-Indicators include: Reuse, generalization and sustainability of eScience tools; Adoption of eScience tools in scientific community; Recognition of eScience expertise, and Quality and scope of eScience tools and publications (manuscripts, workflows, data, software);

*2. Scientific impact*
-Indicators include: Enabling and acceleration of scientific and scholarly research; Contribution to high quality science and scientific breakthroughs; Quality and scope of publications; Marks of scientific recognition;

*3. Societal and academic relevance*
-Indicators include: Breadth and diversity of involved stakeholders; Impact on national and international programs; Impact of outreach activities; Leadership on digitization (academic relevance); eScience Center seen as an innovation partner; Collaboration with industry/public-private collaboration; Societal relevance during the past period;

*4. Viability*
-Indicators include: Performance of internal organization; Demand for eScience from the academic community; Relevance of the eScience Center in the academic landscape; Strategy for the years ahead including governance and leadership skills and adoption of the advice resulting from the 2013 evaluation; Vision for the future of eScience and eScience Center; Transfer of knowledge about eScience to the institutions in relation to the scalability limits of the eScience Center.

The first three assessment criteria are derived from the main activities of the eScience Center, which are: Developing Versatile Cross-Disciplinary eScience Tools; Enabling Scientific Breakthroughs; Coordinating eScience Activities. The eScience Center performs these activities primarily in collaborative problem-driven projects with academic partners, which are granted after calls for proposals (see page 11 of the document 'Strategy 2015-2020 & Beyond'). While the research in these projects is conducted under the responsibility of the project leaders, eScience should lead to enabling and acceleration of the research and therefore have scientific impact. Viability is added as the final criterion, referring to the extent to which the eScience Center is equipped for the future, based on the performance of the internal organization and the strategy to deal with external developments.

These four assessment criteria were rated according to a four-point scale, with  1. Excellent; 2. Very good; 3. Good; 4. Unsatisfactory.

The committee was asked to provide recommendations for improvement for the eScience Center on each criterion, based on developments in the field of eScience. In addition, the committee was asked also to reflect on research integrity and diversity. The latter topics were considered only in qualitative terms.

# 2 Institutional framework of the Netherlands eScience Center

## 2.1 Mission

The Netherlands eScience Center is the Dutch national centre of expertise on the development and application of research software and digital methodologies. Its mission is: enabling digitally enhanced research through efficient utilization of data, software and e-infrastructure.

The organization strengthens and accelerates research in all academic disciplines by taking advantage of digital technologies and methods. The eScience Center serves as a frontrunner in national and some international initiatives, and it bridges the ambitions of scientists and scholars and the capabilities of digital technologies. The main activity is to carry out collaborative problem-driven research projects in various academic domains, after open calls for proposals. With openness and collaboration as core values, the eScience Center pioneers and promotes the practice of open science. The efficient reuse of existing software and the development of sustainable software lie at the heart of the organization's work. The core expertise areas of the eScience Center are optimized data-handling (e.g., real-time data, interoperability), big data analytics (e.g. data mining, machine learning, visualisation and natural language processing) and efficient computing (e.g., distributed, accelerated and cloud computing). The expertise is mainly disseminated through collaborative projects, but also through workshops, presentations, and online channels.

## 2.2 Activities

**Collaborative research projects**
Collaborative research projects are carried out after inviting researchers to respond to open calls for collaborative proposals. Principal Investigators from Dutch universities and academic research institutes can submit project proposals.

Proposals are reviewed by international peers and are assessed and ranked by an independent evaluation committee. Most projects have a duration of 3-4 years and have a size of around €500k. By providing at least half of the funding in-kind (in the form of eScience Research Engineers that work on the project), projects are carried out collaboratively and as efficiently as possible. The eScience Research Engineers reuse expertise and software from previous projects and other disciplines.

There are two main types of annual project calls: Accelerating Scientific Discovery (ASDI) and Disruptive Technologies (DTEC).

The ASDI call targets researchers from all academic application domains. Projects have the following goals: (1) contributing to scientific breakthroughs within their own discipline, (2) stimulating the use of innovative digital technologies and methods in the discipline, and (3) developing and sustaining research software and methodologies that can be applied in other disciplines. To achieve a far-reaching impact in all of science and scholarly research, four major academic domains are targeted separately: (1) Environment & Sustainability, (2) Life Sciences & eHealth, (3) Humanities & Social Sciences, and (4) Physics & Beyond (e.g. high energy physics, astronomy, material sciences and fluid dynamics).

The annual DTEC call targets computer and data scientists. The goals of projects are as follows: (1) strengthening the technological competences of the eScience Center and (2) supporting the transfer and adoption of ICT knowledge to academic disciplines.

The eScience Center collaborated so far with researchers in more than a hundred research projects at many universities and research institutions in the Netherlands

The eScience Center also participates in externally funded projects, which allows the organization to further develop and apply its technological competences. These projects include industry projects, public-private partnerships, project follow-ups and European research projects (e.g. H2020).

**eScience Technology Platform**
In the eScience Technology Platform, R&D activities are stimulated that strengthen and disseminate the organization's own expertise. Dissemination takes place by training activities at universities and institutes. Also, the Research Software Directory (RSD) was developed: an online software portfolio that makes software easily accessible and easily findable. The RSD can be installed by any research institute, allowing them to link software source codes to software descriptions, tutorials, metadata, persistent identifiers (e.g. DOIs), associated publications (e.g. articles, presentations and blogs), author information and contact information. The eScience Center uses the RSD to make all its stable and mature software tools available to the national and international research community.

**eScience coordination**
The eScience Center is involved in various programmes, platforms and policy initiatives to promote the optimal (re)use of research software and digital methodologies in academia. Examples include ePLAN (the national platform for data-intensive and compute-intensive research in the Netherlands), PLAN-E (the platform of European eScience Centres), the Big Data Route of the National Research Agenda (NWA) and the National Platform Open Science. The eScience Center also collaborates with SURF and domain partners on implementing the FAIR principles in scientific research. Each year, the eScience Center organises the national eScience symposium, attracting 350-500 participants.

## 2.3    Organizational structure and staff

The eScience Center is an independent foundation, employing 59 people (52.8 FTE) on June 30, 2018. The general management is carried out by the Directors Team. The Management Team is responsible for managing the research projects and line management of all eScience Research Engineers. The Technology Leads develop and update the technological vision and strategy of the Center.
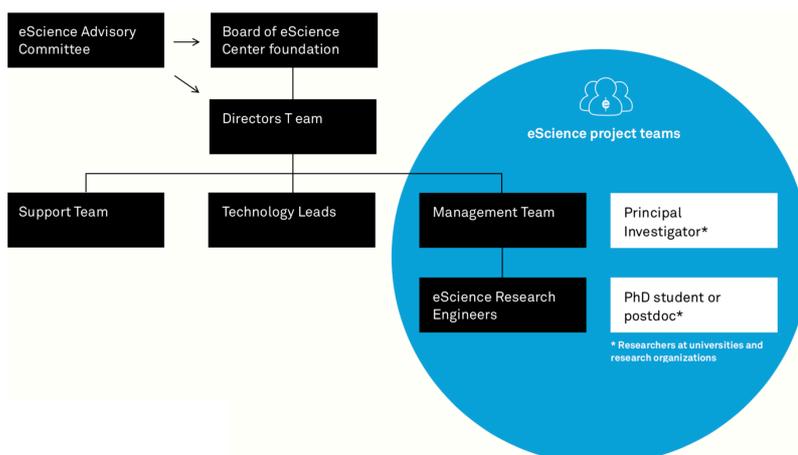


The Board of the foundation directs the eScience Center. It has five members, two of whom are selected by NWO and SURF, who serve as Chair and Vice Chair. In addition, there is at least one representative of the Dutch scientific community applying eScience methods, one member representing ICT science, and one member representing industry. The Board operates independently from NWO and SURF and is the prime decision body.
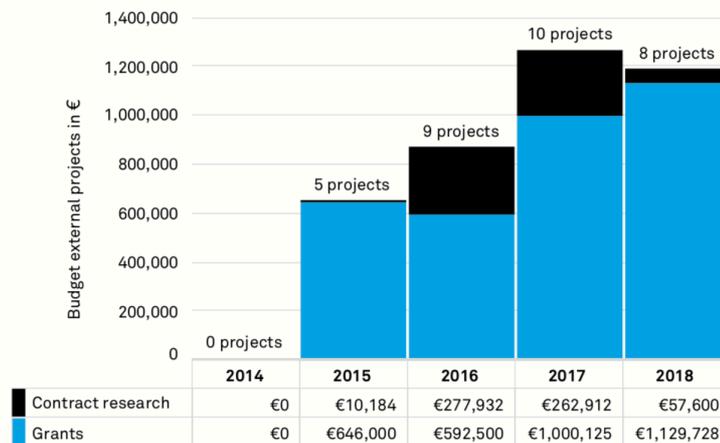
NWO and SURF provide the base funding for the eScience Center; the eScience Center provides both organizations with an annual plan, proposes an annual budget and reports back on the past activities in an annual report. SURF and NWO also issue an external evaluation every 5 years to independently review the quality, impact and viability of the eScience Center. The eScience Advisory Committee consists of independent national and international eScience experts, who convene twice yearly and advise the Board and the Directors Team on issues such as long-term strategy and project portfolio development.

**Human resource management**
Much attention is given to personal and professional development. Special attention is given to diversity, gender balance, work stress and regulations regarding undesirable behaviour. Working conditions are described in the Collective Labour Agreement for the Research Institutes (Cao-OI) and the associated Implementing Regulations. The development and performance of all employees is discussed annually. In this process, line managers and employees discuss and approve the personal and professional goals and targets for each year. A works council, which advises the Director on behalf of the staff, was established in 2017.

## 2.4    Finance

The eScience Center receives annual structural funding of around €5.4m from SURF and NWO, based on multiyear collaboration agreements. The last renewal of this agreement was in October 2015, ending in 2020. Around €3.5m of the structural funding goes directly to projects, and 10% of the structural funding is ring-fenced for the eScience Technology Platform. Other costs relate to eScience Coordination activities such as workshops and colloquia (~5%) and indirect costs (~20%).  In addition to structural funds, the Center generates external income, such as H2020 projects and project follow-ups. This annual external income increased from €0 in 2014 to €1.26m in 2017.



|  | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|
| ■ Contract research | €0 | €10,184 | €277,932 | €262,912 | €57,600 |
| ■ Grants | €0 | €646,000 | €592,500 | €1,000,125 | €1,129,728 |

In the evaluation period, the eScience Center saw income streams increasing: funding from collaborative calls with funding partners and income from external funding increased (primarily H2020 projects).

| | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|
| Structural funding from NWO | 2700 | 3438 | 2700 | 2743 |
| Structural funding from SURF | 2700 | 2700 | 2700 | 2700 |
| External funding (grants & contract research) | 147 | 187 | 474 | 442 |
| Additional funding from funding agencies for collaborative calls | | | 500 | 1040 |

The eScience Center's expenditures can be split in two categories of activities: Core process and Support process. The Figure below depicts the share of the budget that was spent on these activities (blue=core process; grey=support process) in 2017.
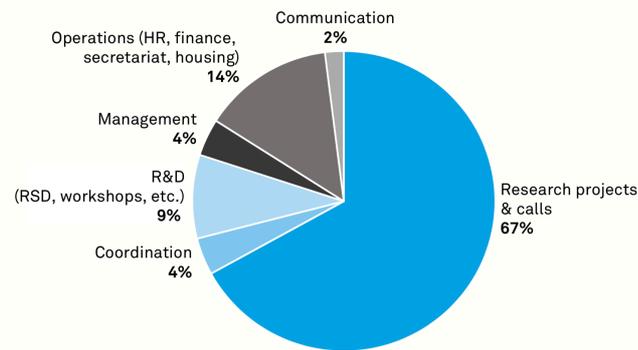
# 3 Assessment of the Netherlands eScience Center

This chapter contains the assessment of the Evaluation Committee, based on the four assessment criteria as described in paragraph 1.5.

## 3.1 Strategy and targets of the Netherlands eScience Center 2015-2020

The eScience Center's mission is: enabling digitally enhanced research through efficient utilization of data, software and e-infrastructure. The main activity is to carry out collaborative problem-driven research projects in various academic domains, after open calls for proposals.

The Committee appreciated the way the status of the current strategy targets were presented during the two-day site visit.

The document 'eScience Center Strategy 2015-2020 & Beyond' mentions 14 Measures of Success & Targets for the period 2015-2020 on page 35. The eScience Center's progress with respect to these measures is presented in the numbered list below and covers the period of the external review (2014 to mid 2018):

1. Gain national recognition as the primary driver for the development and application of eScience approaches by funding and contributing to >10 new projects (full projects and path-finding projects) per year: approximately 20 projects have been granted per year as result of the call strategy;
2. The eScience Center funded projects to be conducted in collaboration with all 13 Dutch Universities and at least 5 additional knowledge institutes: collaboration was established with all Dutch universities in funded projects and with over 5 knowledge institutes;
3. Demonstrate a track record of scientific discovery through the application of eScience published in at least 2 peer-reviewed publications per year per project with eScience Center (co)authorship. The eScience Center employees published extensively: 182 peer reviewed papers with authorship of eScience Center employees and 201 papers acknowledging the eScience Center;
4. Demonstrate portability of eScience Center developed eScience technologies via at least 5 peer-reviewed publications demonstrating transfer of technology between disciplines:
eScience Center employees published 90 eScience papers on software, data or digital methodologies, many showing interdisciplinary reuse and transfer of knowledge;
5. Provide coordinating activities for Dutch organizations and initiatives involved in the application of data-driven and compute-intensive research approaches: the eScience Center initiated and is engaged in coordinating activities on application of digital technologies: ePLAN, PLAN-E, NWA, NPOS and NL-RSE. In addition, the eScience Center initiated or contributed to workshops and training activities (e.g. data and software carpentry);
6. Demonstrate global recognition as an eScience expertise centre and valued collaborator including contribution to 5 successful Horizon2020 proposals and collaboration: the eScience Center is currently partner in 8 H2020 projects, and was selected as organizer of fourteenth International IEEE eScience Conference in 2018;
7. Contribute as stakeholder to the provision of national policy on issues such as e-infrastructure, data-stewardship and software sustainability: the eScience Center has been involved in policy making through NPOS, ePLAN, NWA, large-scale research infrastructures and meetings with ministries;
8. Establish 1 new cross-disciplinary data-driven or compute-intensive public-private partnership per-year: the eScience Center started a number of Public-Private partnerships, including VLPB (plant breeding), Eli Lilly (pharmacy), MARIN (marine industry) and the eScience Center partnered with Shell in a joint call. Several PIs involved private partners in eScience Center projects;
9. Develop, share and promote an open source/access portfolio of eScience technologies and approaches through an open repository (eSTeP) including models for software sustainability and

dissemination that are portable to the wider community: the eScience Center released the Research Software Directory (including all their software) and made technology available for use by other institutes, supplemented with tutorials, online guides and workshops;

10. Generate independent funding to extend eScience engineer team by at least 25%: during the review period, the eScience Center staff doubled and the eScience Center obtained up to 1.1 million euro/year additional funding;

11. Demonstrate career progression for eScience engineers in academia and industry: over the reviewed period, employees continued their careers, for example at eBay, The Hyve, ING Bank, DTL, VU Amsterdam, NuoDB, Utrecht University, Vliegtickets.nl, Eindhoven University of Technology, SURF, Huygens ING, ClearPeaks, CWI;

12. Encourage new eScience professorships in collaboration with partner Universities: Rob van Nieuwpoort was appointed as professor Efficient Computing for eScience at the University of Amsterdam;

13. Co-promote (with existing academic community) PhD and MSc students: eScience Center professionals acted as co-promotors of several PhDs and MScs at VU Amsterdam, University of Amsterdam and Wageningen University;

14. Co-organize regular eScience training events for PhDs etc: the eScience Center organized almost 20 workshops on eScience skills, with over 300 attendants.

## 3.2    Quality of eScience

*eScience output*
From 2014 to June 2018, the eScience Center experienced an increasing number of submissions to their calls for collaborative projects. Despite the rise in funding as a result of collaboration with other funders, the acceptance rate however fell from 30% in 2014 to 6% in 2018. A total of 35 large collaborative research projects were initiated under the Accelerating Scientific Discovery (ASDI) call and 9 large collaborative research projects under the Disruptive Technologies (DTEC) call. Over the years, the eScience Center has increasingly partnered with other funders, which resulted in an increased number of in-kind eScience Center FTEs. The diversity of the projects is large, ranging from natural language processing of Arabic texts to accelerating pipelines of pulsar search in radio astronomy. The output in terms of e.g. publications and software tools is extensive.

*Recognition of eScience expertise through collaboration*
The recognition of the eScience Center is shown through the rise of applications in open calls and in addition the centre is asked to join national and international research initiatives. A vast number of publications in domain-specific journals as well as computer science journals and invitations to advisory boards and conferences are a clear demonstration of the acknowledged scientific role of the centre. The strong expertise has enabled the centre to play leading roles in local, national and international programmes. In addition, the centre acquired a wide range of projects from external funding programmes.

**Rating: 1 (excellent)**

The Evaluation Committee is impressed with the eScience Center's quality, as shown in the presented projects and therefore entitles the eScience Center as 'Center of Excellence'. The broad recognition of the advanced expertise of the centre is convincingly demonstrated as discussed above. The eScience Center is seen as a unique centre, different from the setup of e-science (centres) in other countries and with a balanced geographically spread of projects. The collaboration of eScience Research engineers with academic researchers, in particular the way of working in spending 50% of their time at the Principal Investigator's location and 50% at the eScience Center, is seen as highly valuable.

**Recommendations for improvement for the eScience Center**
The committee supports the vision that the centre focuses on 'scientific excellence' as its core business, rather than a 'supporting role', the latter currently being approximately 10% of the work package. It is however important that in the dynamic field of e-Science the centre develops a clear plan how to maintain its currently excellent position in the years to come. This plan should also include the connection with the increasing number of e-science initiatives at universities and eScience activities in the Netherlands and abroad.

## 3.3    Scientific impact

*Advancement and acceleration of research*
The eScience Center is carrying out research projects in various academic domains, see chapter 2. In each domain, new software and methodologies have led to the advancement and acceleration of research, resulting in scientific publications. In the period 2014-2018 there has been a strong increase in the number of peer-reviewed scientific publications authored or co-authored by the eScience Center. Apart from publications, the eScience Center output also to a large degree consists of research software, workflows and digital methodologies. In the scientific community there is however only limited consensus on the use of metrics to measure software impact unambiguously.

**Rating: 2 (very good)**
The Evaluation Committee acknowledges the growing impact of the eScience Center in the evaluation period. However, it has its concerns about the next phase for the centre. The strong decrease of the acceptance rate of high-quality proposals in open calls may endanger the impact of the centre in the longer run. If the funding is not increased the committee advises to explore a different set up of the calls to ensure a higher success rate.

The committee recognizes the difficulty of measuring impact of software; however, the currently used monitoring principle of scientific impact is perceived as insufficient for an eScience centre.
Further the eScience Center should be able to offer support at different levels to enhance its impact: e.g. better balance resources for smaller projects compared to large thematic projects.
Finally, the eScience Center may take a more active role in outreach and knowledge dissemination.

**Recommendations for improvement for the eScience Center**
The committee proposes a review of the way calls are structured as well as the selection process for projects. Changes may involve 1) procedure within calls 2) thematic focus within project calls. The development of the core competences, embedded in a clear view on the technology strategy of the eScience Center, should be aligned with the call strategy.
Concerning the reuse of software/dissemination, the committee advises to develop a clear set of performance metrics and monitoring tools also in order to promote dissemination.

## 3.4 Societal and academic relevance

The Netherlands eScience Center was founded in 2011 by NWO and SURF as a direct response to the Dutch government's request to develop a sustainable, coherent and cost-effective eScience environment and e-infrastructure across all scientific disciplines. Societal and academic relevance is a central theme. The centre has contributed to this theme in various ways.

*Breadth and diversity of stakeholders*
Through collaborative projects, the eScience Center involves a wide range of researchers, partners and academic institutes. The eScience Center collaborates with public and private partners in two ways, setting up several joint calls with public and private partners and running externally funded projects with private partners. The eScience Center makes use of national e-infrastructure facilities by collaboration with SURF and DANS, as far as there is a fit.

*Leadership on digitalisation*
The eScience Center has shown leadership on digitalisation by setting up the NWA Big Data route, by directing research programming through joint calls with national programmes such as Commit2Data, by promoting Open Science and by organising an annual symposium.

*Outreach*
To reach out to a broader audience, the eScience Center has invested in increasing its online presence. The website is now regularly visited with over 8000 unique visitors per month and a new blog is started. Throughout the years, the eScience Center has addressed the general public by featuring on national TV and in newspapers and participating in the Weekend of Science with open days and programming activities for children.

The eScience Center also organised various colloquia to reach out to relevant stakeholders. 'Meet & Greets' are successfully introduced in which eScience Research Engineers visit departments and institutes at universities obtaining a better idea of their needs. Further the centre presented itself at large, annual, research community events in the Netherlands.

**Rating: 2 (very good)**
In particular the academic relevance of the centre is highly appreciated by the committee. The committee encourages the eScience Center to engage more in public-private collaborations (PPS) also in the context of the top sector 2.0 policy stimulating longer term mission-oriented research. Furthermore, the centre could take a leading role in stimulating Open Science by making use of the opportunities provided by the Nationaal Platform Open Science (NPOS).

**Recommendations for improvement for the eScience Center**
Dissemination is key for the relevance of the centre as illustrated above. To focus its scarce resources the committee advises the eScience Center to pay much more attention - for any project - in advance to the sustainability of the developed software beyond the lifetime of the project.
More engagement in PPPs and its role in Open Science should be higher on the agenda of the centre.

## 3.5 Viability

The mission of the eScience Center is to enable researchers to optimally exploit advanced digital technologies to achieve their academic ambitions. Therefore, the eScience Center has to continuously develop their own core competences and keep them fit for use.

**Rating: 3 (good)**
The committee is impressed by the quality that the eScience Center delivers and strongly advises that the centre continues its efforts. The centre is living in a fast-shifting and moving world, which does not automatically provide guarantees for the continuation of the centre despite its current successes. It is therefore essential that the positioning of the centre, say 5 years from now, will be better defined. In the discussion with the board, the committee noticed not enough clarity about the future positioning of the eScience Center. The interaction between the eScience Center advisory committee, the board and directors team could be intensified in this respect.

**Recommendations for improvement for the eScience Center**
The committee strongly advises to review and renew the eScience Center's (long-term) strategy, especially at board level, creating scenarios for; 1) various financial situations; 2) changing demand from multiple scientific disciplines; 3) new opportunities in public-private partnerships. This also requires in-depth discussions among board, eScience Center advisory committee and directors team.
Since the eScience Center is producing software as major output, questions arise how the long-term support of software can be realized.

## 3.6    Research integrity and diversity

**Integrity**

The eScience Center has a Code of conduct for external activities, a Code of conduct for sexual harassment, intimidation, aggression, violence, bullying and discrimination and a Regulation for the protection of Whistleblowers. The Works Council started in 2017 and advices the Directors Team on policy making. Sharing policies with staff takes place during lunch presentations and by having a discussion in teams.

Research integrity corresponds to the use of honest and verifiable methods in performing, and evaluating research and reporting research results with particular attention to adherence to rules, regulations, guidelines, including giving appropriate credit to prior work where it is due, and following commonly accepted professional codes or norms. The Royal Netherlands Academy of Arts and Sciences (KNAW) issued a code of conduct, which the eScience Center subscribes to. The eScience Center has one employee who acts as counsellor ('vertrouwenspersoon') regarding research integrity. No breach of integrity was reported.

Closely related to research integrity is the open source policy on software and data that result from (publicly funded) research. The eScience Center makes all their research output (e.g. software, data and publications) available online. All their own source code repositories are publicly accessible on the software development platform GitHub. All software, data and documentation include permissive open-source licenses.

**Diversity**

The institute is highly multi-national, with a staff from 16 nationalities according to the self-evaluation report. With regards to gender, the eScience Center is aiming for at least 1 female member in the Directors team and at least 30% women in the organization. At the moment one of the four members in the Directors team is a woman and 25% of the total number of employees are women. It is evident that the directors' team is striving to reduce the gender gap by e.g. encouraging women to apply for jobs and by putting the director operations in place as the diversity officer of the eScience Center.

# 4 Conclusions and recommendations

## 4.2 Conclusions

The Committee very much appreciated the quality of the information, which was provided prior to the review, the presentations and the open and constructive dialogue with all during the site visit. Based on the self-evaluation report written by the eScience Center, the additional information provided, and the extensive site visit that took place on February 7 and 8, 2019, the Committee concluded in summary as follows:

- The research conducted by the eScience Center in collaboration with the academic researchers is of excellent quality. The eScience Center has a clear national leadership in their core research areas addressing broadly the needs in the academic community in the Netherlands.

- The eScience Center is seen as a unique centre, different from the setup of eScience in other countries in its way of working. The split of working hours of the engineers (outside/inside) is considered to be an asset.

- The scientific impact of the centre is clearly recognized. Almost all of the related targets described in the strategy 2015-2020 are already reached or on schedule. The decreased acceptance rates due to the success of the calls forces the eScience Center to come forward with a new strategy and a different setup of the open calls, which could result in an increased, more focussed impact.

- A large part of the eScience Center output consists of research software, workflows and digital methodologies. The centre is promoting the practice of open science, for example, by establishing their online Research Software Directory to make all the developed software public. This is scientifically relevant and a significant contribution to the societal impact. Actively enhancing the reuse of software would even further increase the impact. The centre may take a leading role in stimulating Open Science, e.g. by teaming up with the Nationaal Platform Open Science (NPOS).

- The eScience Center is currently investing little in public-private partnerships. Increasing impact can be reached by engaging more in public-private collaborations (PPS).

- The viability of the centre in the longer run requires more attention to the governance and the strategic development. In particular the fast dynamics in the field in terms of competences and new academic initiatives, deserves an in-depth discussion about the future positioning of the centre.

## 4.3    Recommendations

The recommendations are listed in no preferred order.

*Quality of eScience*
The committee supports the statement that the centre focuses on 'scientific excellence' as its core business, rather than a 'supporting role', and recommends to investigate how to continue advancement of the eScience Center's core competences. Closer connections with eScience initiatives within universities and international eScience centres should be made in order to increase its impact.

*Scientific Impact*
The committee recommends the eScience Center to revise the call strategy as well as the selection procedure for projects. The development of the core competences of the eScience Center has to be aligned with the call strategy. Changes may involve 1) procedure within calls 2) selection procedure 3) thematic focus within project calls 4) project size.
Concerning the reuse of software/dissemination, the committee advises to develop and apply appropriate performance metrics and monitoring tools.

*Societal and Academic Relevance*
The committee recommends that the eScience Center puts even more attention to the reuse of software. For any project, much more attention should be paid in advance to the sustainability of the developed software beyond the lifetime of the project.
The committee strongly recommends the eScience Center to engage more in public-private collaborations (PPS).
The eScience Center is encouraged to take a leading role in stimulating Open Science, e.g. in cooperation with the Nationaal Platform Open Science (NPOS).

*Viability*
The committee strongly advises to review and renew the eScience Center's (long-term) strategy to ensure the viability in the longer run. In-depth discussions among board, advisory committee and directors are pivotal in this respect.
It is advised that the eScience Center makes choices in future ownership and operation of established software (e.g. of the entire software directory). The (early) transition of software to a production-oriented company can be a viable solution.

# 5 Annex 1 - Curricula Vitae of Evaluation Committee Members

*Prof. dr. E.M. (Emmo) Meijer (Chair)*
Emmo Meijer studied Chemistry at VU University Amsterdam and received his doctorate there in 1979. He took a position with DSM that same year, where he worked in various research and business management positions and played a key role in shifting the company's main focus to the life sciences. Finally, professor Meijer was appointed President of DSM Research and became DSM's first Chief Technology Officer in 2001. In 2005 he continued his career at Unilever, where he was responsible as Senior Vice-President for Global Foods R&D and later for company-wide product development. Emmo Meijer was a part-time professor of Biochemistry at Eindhoven University of Technology. Amongst others he was in the chair of NWO Chemical Sciences, chairman of the Top Institute Food and Nutrition, president of the Netherlands Academy of Technology and Innovation (AcTI) and vice-chairman of the Dutch Polymer Institute (DPI). Currently he is in the chair of the supervisory board of the University Utrecht, member of the managing board of the KU Leuven, member of the council advising the Dutch government on science, technology and innovation matters (AWTI) and chairman of the top sector Chemistry. Moreover, he is engaged as adviser and board member in a number of venture capital funds. He is an honorary member of the Royal Netherlands Chemical Society and recipient of the Academy Medal of the Royal Society of Sciences and Arts.

*Prof. dr. D.I. (Dorret) Boomsma*
Dorret Boomsma is a Dutch biological psychologist specializing in genetics and twin studies. After receiving her Ph.D., Boomsma received an appointment as an assistant professor at the Vrije Universiteit Amsterdam in the Department of Psychonomics. In 1994 she became associate and in 1998 full professor and head of the Department of Biological Psychology. Boomsma has built a database of over 100,000 twins and an equal number of family members in The Netherlands, which has been used for hundreds of twin studies.  She is a member of the Royal Netherlands Academy of Sciences and Arts (KNAW) as well as a recipient of the Netherlands Spinoza prize.

*Prof. dr. ir. M.R. (Maarten) van Steen*
Maarten van Steen works in the field of networked computer systems, with an emphasis on wireless systems as well as more traditional distributed systems. He is an alumnus of the University of Twente where he graduated in 1983 in Applied Mathematics. After completing his PhD at the Computer Science department in Leiden, Van Steen worked at TNO Delft, where he carried out research on parallel computing and gained his first experience in research management. He continued his academic career at Erasmus University Rotterdam and later at VU University Amsterdam, where he was appointed full professor in 2002.
Since January 2015 he is Scientific Director of the digitalization research institute of the University of Twente: The Digital Society Institute. He chairs the ICT Research Platform Netherlands, representing all Dutch academic departments and institutes. He is also chair of NWO Informatics advisory committee.

*Prof. dr. S. (Sverker) Holmgren*
Sverker Holmgren is a Professor in Scientific Computing at Uppsala University, Sweden, where he is also the head of the Computational Science research program and the Director of the Swedish e-Science strategic research area consortium eSSENCE, led by Uppsala University and funded by the Swedish Ministry of Education and Research. He also has a part-time position at NordForsk as the Director of the Nordic eScience Globalisation Initiative (NeGI).
During 2011-2017, Holmgren was the Dean of Mathematics and Computer Science at the Faculty of Science and Technology at Uppsala University. During 2013-2016 was also the chair of the European e-Infrastructure Reflection Group (e-IRG), formed to give advice to the EU member and associated states on ICT infrastructure (networking, computing and data) for research. Earlier assignments include being Director for the Uppsala University computing centre UPPMAX and later being the Director for the Swedish National Infrastructure for Computing (SNIC) during six years.

*Prof. dr. D. (David) De Roure*

David De Roure is Professor of e-Research at University of Oxford. Focused on advancing digital scholarship, professor De Roure works closely with multiple disciplines including social sciences (studying social machines), humanities (computational musicology and experimental humanities), engineering (Internet of Things), and computer science (large scale distributed systems and social computing). He has extensive experience in hypertext, Web Science, Linked Data, and Internet of Things. Drawing on this broad interdisciplinary background he is a frequent speaker and writer on the future of digital scholarship and scholarly communications.

De Roure has strategic responsibility for Digital Humanities at Oxford within The Oxford Research Centre in the Humanities (TORCH). He is a member of Cyber Security Oxford, an Oxford Martin Senior Fellow, and collaborates with the Oxford Internet Institute in Web Science. He was Director of the Oxford e-Research Centre 2012-17. Prior to moving to Oxford in 2010 he was Professor of Computer Science at University of Southampton, where he was Director of the Centre for Pervasive Computing in the Environment. He was closely involved in the UK e-Science programme and from 2009-2013 was the UK National Strategic Director for Digital Social Research for the UK Economic and Social Research Council, and subsequently Strategic Advisor for new and emerging forms of data and real time analytics.

He is a Fellow of the British Computer Society and the Institute of Mathematics and its Applications, a visiting professor at Goldsmiths, University of London, and a Supernumerary Fellow of Wolfson College where he chairs the Digital Research Cluster.

*Prof. dr. Simone Hochgreb*

Simone Hochgreb is a professor in Engineering at the University of Cambridge, specialising in combustion and turbulent reacting flows. Her current work is in the application of laser diagnostics to reacting flows using real and model flames, both under steady and unsteady conditions, particularly regarding stratified flames. She has previously held positions at MIT, Sandia National Labs. She is a Fellow of the Royal Aeronautics Society and the Combustion Institute, and has received the Royal Society Wolfson Merit Award and the Society of Automotive Engineers Ralph R. Teetor Award. She holds a BSc from the University of São Paulo, and a PhD from Princeton University.

# 6 Annex 2 - Program of the Site Visit 7-8 February 2019

# Program site visit external assessment eScience Center

The site visit takes place at the eScience Center on Amsterdam Science Park. Besides eScience Center staff and board, the committee will meet project partners who work on collaborative projects with the eScience Center.

**Thursday, February 7**
- 13.30-14.15 – NWO (prof. dr. Stan Gielen) and SURF (prof. dr. Erik Fledderus) present the context and goal of the evaluation ('late lunch' included)
- 14.15-14.45 – Private kick-off meeting assessment committee
- 14.45-15.00 – Break
- 15.00-16.15 – Presentation eScience Center by director eScience Center and interview with Directors Team
- 16.15-17.00 – Presentation (+ interview) of Flagship Project eWaterCycle II, by prof. dr. Nick van de Giesen (TU Delft) and Dr. Niels Drost (eScience Center)
- 17.00-17.15 – Break
- 17.15-18.00 – Interview with Jan de Jeu (chair eScience Center Board) and prof. dr. Franciska de Jong (board member)
- 18.00-19.00 – Break (to hotel)
- 19.00-21.00 – Dinner at (committee, secretaries, director eScience Center and board members De Jeu and De Jong)


**Friday, February 8**
- 08.45-09.00 – Private interim meeting
- 09.00-09.40 – Presentation (+ interview) Googling the Cancer Genome project, by prof. dr. Jeroen de Ridder (University Medical Center Utrecht) and Dr. Arnold Kuzniar (eScience Center)
- 09.40-09.50 – Break
- 09.50-10.30 – Presentation (+ interview) Bridging the Gap project, by prof. dr. Christian Lange (Utrecht University) and Dr. Janneke van der Zwaan (eScience Center)
- 10.30-10.45 – Break
- 10.45-12.15
    - Interviews on the eScience Center's technological expertise areas, with Prof. dr. Rob van Nieuwpoort (Technology director eScience Center), Dr. Jason Maassen (Technology lead eScience Center, expertise Efficient computing) and Dr. Romulo Gonçalves (Technology Lead, expertise Data analytics and optimized data handling)
- 12.15-13.30 – Walking lunch + project & software demos
    - Via Appia, by Dr. Maurice de Kleijn (VU Amsterdam) and Maarten van Meersbergen/Dr. Romulo Gonçalves (eScience Center)
    - 3D-e-Chem, by Dr. Lars de Ridder and Stefan Verhoeven (eScience Center)
    - Case Law Analytics, by prof. dr. Gijs van Dijck (Maastricht University) and Dafne van Kuppevelt (eScience Center)
- 13.30-14.00 – Interview Prof. dr. Sally Wyatt (Maastricht University), chair eScience Advisory Committee
- 14.00-14.30 – Presentation (+ interview) SecConNet project, by Prof. dr. Paola Grosso (University of Amsterdam) and Lourens Veen (eScience Center)
- 14.30-15.30 – Private final meeting
- 15.30-16.15 – Break (time for preparation provisional findings)
- 16.15-17.00 – Presentation provisional findings to director eScience Center, chair eScience Center Foundation and SURF and NWO representatives
- 17.00-19.00 – Drinks and buffet at the eScience Center, with assessment committee, Directors Team, Board and SURF and NWO representatives (sharing thoughts on provisional findings)

# 7 Annex 3 - Terms of Reference and Explanation of the categories

# Proposal Terms of Reference

## *External assessment of the Netherlands eScience Center 2014-mid 2018*

NWO and SURF hereby issue the following Terms of Reference to the assessment committee of the Netherlands eScience Center (hereafter eScience Center), chaired by Prof. dr. Emmo Meijer.

## 1.    Background

The Netherlands eScience Center was launched in 2011 as a unique collaboration between NWO, the principle Dutch scientific funding body and SURF, the Dutch higher education and research partnership for ICT. The overall mission is: Enabling digitally enhanced research through efficient utilization of data, software and e-infrastructure. The objective of eScience is to promote innovation in collaborative data-intensive and computationally demanding research across all disciplines. It deals primarily with the application, development and advancement of re-usable research software in collaboration with domain scientists and computer and data scientists. Background information about the eScience Center and its upstart period can be found in the document *Strategy 2015-2020 & Beyond*, which will be provided prior to the site visit. The first external evaluation of the eScience Center took place in October 2013, covering the period 2011-2013. The strategy of the eScience Center is summarized in the arrow figure below. The eScience Center works problem-driven, with questions and technical challenges from all Research Disciplines (top) guiding the development and application of eScience Instruments (right side). To develop its core technological competences (center), it collaborates with Computer and Data scientists (left) and e-Infrastructure provides (bottom).
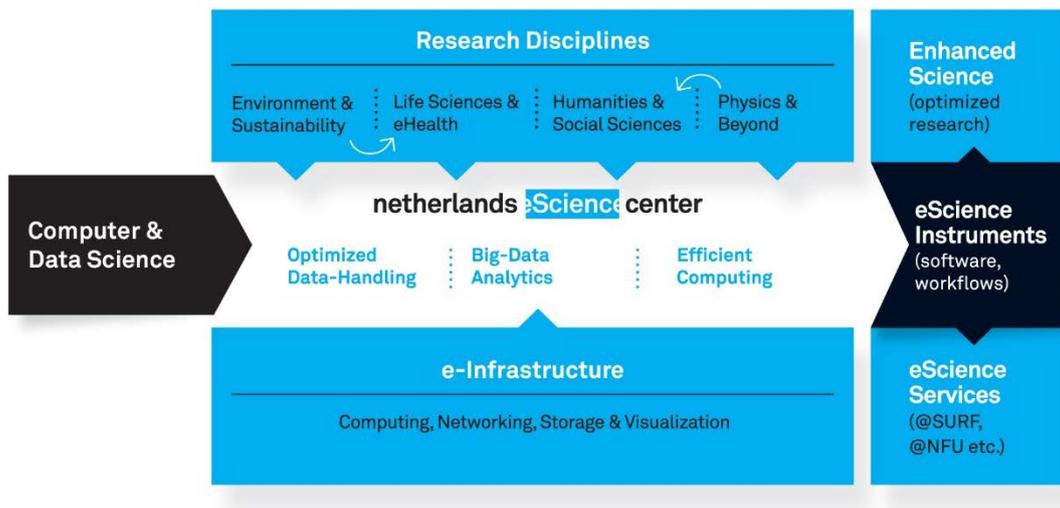


## 2.    Assessment

You are being asked to assess the quality of the implementation of the strategy of the eScience Center over the period January 2014-June 2018. Please focus on the quality and impact of the eScience Center's main activities, as laid out in the document *Strategy 2015-2020 & Beyond*, and the extent to which the eScience Center is equipped to achieve its strategic goals now and in the future. You should do so by judging the organization's performance on the four assessment criteria (1. to 4.) below. Be sure to take into account current international trends and developments in academic research, and eScience in particular, in your analysis.

Please provide a written assessment on each of the four criteria and assign the eScience Center to a category (1=Excellent; 2=Very good; 3=Good; 4=Unsatisfactory) in each case. Please also provide recommendations for improvement for the eScience Center on each criterion, based on developments in the field of eScience. You are asked also to reflect on research integrity and diversity in your report.

*Assessment criteria*

The first three assessment criteria (see below) are derived from the main activities of the eScience Center, which are: Developing Versatile Cross-Disciplinary eScience Tools; Enabling Scientific Breakthroughs; Coordinating eScience Activities. The eScience Center performs these activities primarily in collaborative problem-driven projects with academic partners, which are granted after calls for proposals (see page 11 of the document *Strategy 2015-2020 & Beyond*). While the research in these projects is conducted under the responsibility of the project leaders, eScience should lead to enabling and acceleration of the research and therefore have scientific impact. Viability is added as the final criterion, referring to the extent to which the eScience Center is equipped for the future, based on the performance of our internal organization and the strategy to deal with external developments. The assessment criteria, including indicators for these criteria, are listed below. Information on the performance of the indicators can be found in the report *Summary eScience Center and self-assessment 2014-mid-2018*, which will be made available to the committee prior to its visit. The assessment criteria and associated indicators are:

1. *Quality of eScience*
   - Indicators include: Re-use, generalization and sustainability of eScience tools; Adoption of eScience tools in scientific community; Recognition of eScience expertise, and Quality and scope of eScience tools and publications (manuscripts, workflows, data, software)
2. *Scientific impact*
   - Indicators include: Enabling and acceleration of scientific and scholarly research; Contribution to high quality science and scientific breakthroughs; Quality and scope of publications; Marks of scientific recognition
3. *Societal and academic relevance*
   - Indicators include: Breadth and diversity of involved stakeholders; Impact on national and international programs; Impact of outreach activities; Leadership on digitization (academic relevance); NLeSC seen as an innovation partner; Collaboration with industry/public-private collaboration; Societal relevance during the past period
4. *Viability*
   - Indicators include: Performance of internal organization; Demand for eScience from the academic community; Relevance of the eScience Center in the academic landscape; Strategy for the years ahead including governance and leadership skills and adoption of the advice resulting from the 2013 evaluation; Vision for the future of eScience and NLeSC; Transfer of knowledge about eScience to the institutions in relation to the scalability limits of the NLeSC.

## 5.    Documentation

The necessary documentation will be made available on a secure and password protected online location no less than 8 weeks prior to the site visit. The documentation includes at least the following:
1. Strategy 2015-2020 & Beyond
2. eScience Center Summary and self-assessment 2014-mid-2018
3. A selection of publications
4. A document with short descriptions and hyperlinks to the 2017 Advisory Report National Digital Infrastructure, the corporate website, the Research Software Directory, the Software Development Guide

A folder with additional background information will be made available that includes:
1. Annual Reports 2013-2017
2. External mid-term assessment 2011-2013

3. Relevant organizational documents (e.g., Statutes and founding documents, Communication strategy, Staff Policy, 2016 Employee satisfaction survey)

## 6.    Site visit

The site visit at the eScience Center will take place in Q4 of 2018 (probably late November, first weeks of December). The provisional program for the site visit is enclosed with this letter. We will contact you about the final program and practical information approximately three months prior to the site visit.

## 7.    Statement of impartiality

Before embarking on your assessment work, you will be asked to sign a statement of impartiality. In this statement, you declare that you have no direct relationship or connection with the eScience Center.

## 8.  Assessment report

We ask you to report your findings in an assessment report drawn up in accordance with a format that will be provided to you prior to the assessment. You must send the draft report to the eScience Center Management Team (info@esciencecenter.nl) no more than 8 weeks after the site visit. The eScience Center will be given the opportunity to check the report for factual inaccuracies. The committee decides whether the suggestions/corrections are accepted. The assessment report will be presented by the committee to the board of SURF and the executive board of NWO.