TU Delft OPEN

REPORT

Citizen Science at TU Delft

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Research highlights

- We propose a definition of Citizen Science at TU Delft, developed together with researchers and inspired by the 10 principles of Citizen Science from the European Citizen Science Association (ECSA).

- We conclude that cooperating with citizens in scientific research projects, while using scientifically sound methods and using specialized skills, increases mutual understanding and can aid in collecting hard-to-access or long-term data, with benefits for both the university and citizens.

- We make recommendations for further developments based on the researchers' needs. We identify needs for sharing experience, for learning about possibilities of working with citizens, as well as needs for support and resources for activities and skills specific to Citizen Science.

Keywords

citizen science, open science, research support, soft skills

Delft University of Technology

Abstract

Within the context of national and international developments in Citizen Science and Open Science and with regard to TU Delft's development of several citizen science projects and the growing expertise in working with citizens, we explored the initiatives and organisations active in Citizen Science, its implications in research and education and its positioning within the Open Science framework.
In co-creation with researchers and stakeholders from Delft and inspired by the 10 principles of Citizen Science from European Citizen Science Association (ECSA), we propose a definition of citizen science and a vision for citizen science at TU Delft.

We conclude that the involvement of citizens in the scientific research process requires a specific approach and a specific set of skills. We argue that cooperating with citizens in scientific research projects, while using scientifically sound methods and using specialised skills, increases mutual understanding and can aid in collecting hard-to-access or long-term data, with benefits for both the university and citizens.

We identified researchers' needs of sharing experience, of learning how to work with citizens and a general need for the support and resources required for new types of activities and skills specific to Citizen Science.

Additionally, we brought out concerns related to trust and data reliability issues when working with citizens. It is crucial for the research with an active citizens' role to be designed in accordance to the principles of Open Science so that it meets the requirements of transparent high-quality scientific practice.

Based on all the findings, we determined that citizen science confers a new dimension to Open Science. We make recommendations for the next steps in supporting an emerging community of citizen scientists in our university.

Rationale

The need to strengthen the relationship between science and society is topical, both at the national and European levels. Involving citizens in research by giving them an active role is one way strengthening this relationship and it is something with which TU Delft researchers already have experience.

Central questions are:

What is citizen science?

How can citizen science contribute to the TU Delft Strategic Framework 2018-2024? (Haslinger, 2019)

What benefits does citizen science have for the Open Science Programme? (Figure 1)

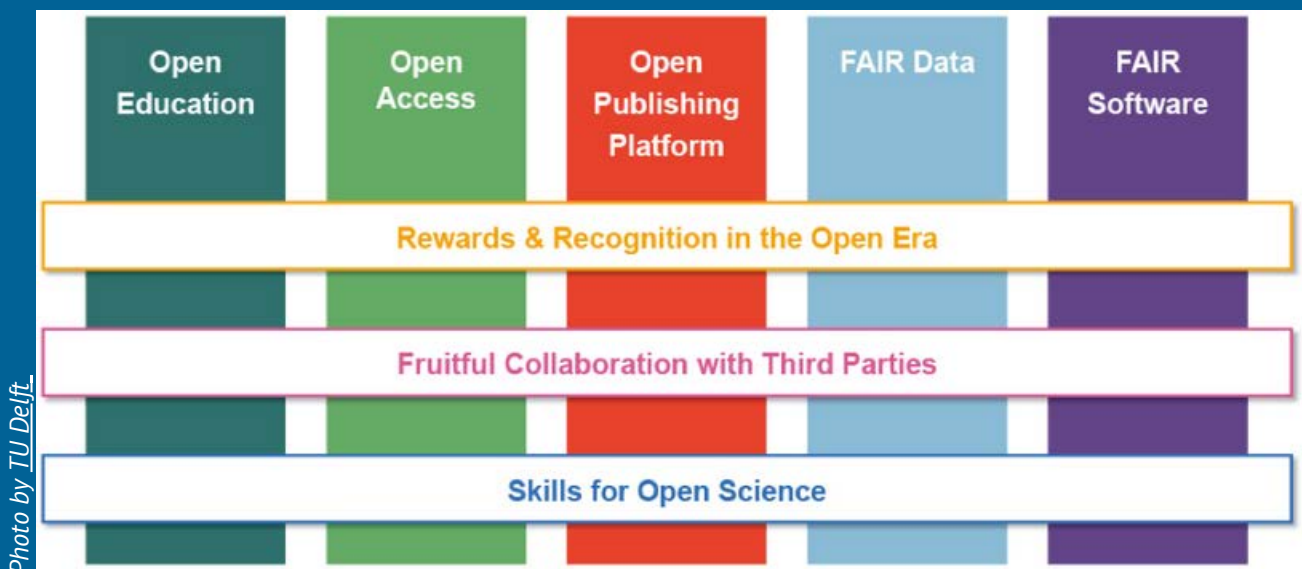What kind of outputs would a citizen science project deliver to the TU Delft organisation?

Figure 1. The structure of the TU Delft Open Science Programme 2020-2024 consists of five projects and three cross-cutting themes.

Approach

In 2020, we explored the topic of Citizen Science in the context of Open Science through context research, interviews and workshops.

We used the following premises:
- TU Delft has already experience with various forms of Citizen Science, but not all the researchers are aware that their project falls into this research approach;
- the projects are dispersed under different names on different websites.
- Researchers use no "citizen science" keywords, but "participatory science", "citizens engagement", "multi-actors systems", "crowdsourcing" and "co-creation";
- there is no clear definition of Citizen Science in the scientific literature and researchers are not aligned when talking about Citizen Science.

Starting with these premises, we took different approaches.

1. In order to understand the current stance of Citizen Science in general and specifically, as related to open science and to university libraries across the world, we **reviewed** the existing **literature** and we joined **webinars**, **workshops** and a **conference**. The aim was to identify common practices, big players in the (inter)national citizen science field and experiences of other practitioners.

2. In order to find a definition of Citizen Science, its positioning within Open Science, a vision for Citizen Science at TU Delft and a possible approach to its development, we initiated a **qualitative research** project: a. we took **interviews** with experts and researchers from TU Delft and other universities, and b. we organised **three working sessions** with experts and interested parties from TU Delft in order to determine the needs and possibilities for development of a citizen science support framework TU Delft.

3. In order to map the research landscape at TU Delft in two dimensions, to find out about the type of research (fundamental to applied research) vs where it is performed (lab to field research), we launched a **survey** across the university.

4. In order to get direct experience with Citizen Science projects, we participated in two **TU Delft projects**, Smartphones4water and 'Delft Meet Regen' with support services.

Introduction

State-of-the-art in Citizen Science

Citizen Science may not yet be an established concept within TU Delft. Nevertheless, the attention for and developments in Citizen Science around us, both nationally and internationally, are increasing enormously. There is a large number of ongoing Citizen Science projects, a growing number of funding opportunities, more and more universities recognise the importance of Citizen Science and embed research and support for it in their organisation.

At various levels, network organisations are active to facilitate the sharing of knowledge and experience through online platforms, conferences and working groups. They are also committed to bringing the value of Citizen Science to the attention of policymakers and subsidy providers. Thanks to these networks, Citizen Science has become an important item on the agenda of various organisations. Some of the most important international organisations are: The Citizen Science Global Partnership, The Citizen Science Association (CSA), The European Citizen Science Association (ECSA), EU-Citizen.Science, SciStarter and Scivil.

Why Citizen Science?

There are several reasons why scientists involve citizens in their research. An important reason is that it allows them to collect (large amounts of) data/knowledge that they would not be able to collect without the participation of these citizens. In addition, citizens are involved in unravelling complex structures by means of games, thus contributing to molecular design. Citizen Science is a way of empowering citizens, by bringing science to people while increasing trust in science. Citizen Science is also seen as a good way of involving students in higher education in scientific research, giving them insight into the research process and access to datasets, thus making a valuable contribution to higher education. The initiative for Citizen Science is also regularly taken by citizens themselves to tackle (social) issues in their environment (see here examples of projects: EteRNA, Drinkable Rivers and Stall catchers).

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Photo by cottonbro from Pexels

Defining Citizen Science

Citizen Science has been a form of research for some decades. As a result, a large body of literature, initiatives and projects have been created globally. Projects with different goals, participants and modes of participation. They all involve people, typically not professional scientists, who participate in and make use of scientific processes, data and knowledge. There is no common definition of Citizen Science. The European Citizen Science Association has formulated the following 10 principles of Citizen Science (ECSA, 2015):

1. Citizen Science projects actively involve citizens in scientific endeavours that generate new knowledge or understanding. Citizens may act as contributors, collaborators, or as project leader and have a meaningful role in the project.
2. Citizen Science projects have a genuine science outcome. For example, this may include a research question or informing conservation action, management decisions, or environmental policies.
3. Both the professional scientists and the citizen scientists benefit from taking part. Benefits may include the publication of research outputs, learning opportunities, personal enjoyment, social benefits, satisfaction through contributing to scientific evidence e.g. to address local, national and international issues and through that, the potential to influence policy.
4. Citizen scientists may, if they wish, participate in multiple stages of the scientific process.
5. This may include developing the research question, designing the method, gathering and analysing data and communicating the results.
6. Citizen scientists receive feedback from the project, like how their data is being used and what the research, policy or societal outcomes are.
7. Citizen Science is considered a research approach like any other, with limitations and biases that should be considered and controlled for. However, unlike traditional research approaches, Citizen Science provides opportunities for greater public engagement and democratisation of science.
8. Citizen Science project data and meta-data are made publicly available and where possible, results are published in an open access format. Data sharing may occur during or after the project, unless there are security or privacy concerns that prevent this.
9. Citizen scientists are acknowledged in project results and publications.
10. Citizen Science programmes are evaluated for their scientific output, data quality, participant experience and wider societal or policy impact.

A commonly used classification model for the degree of citizen involvement in research is the Typology of participation (Haklay, 2013).
Level 1. **Crowdsourcing** - Citizens as sensors
Level 2. **Distributed Intelligence** - Citizens as basic interpreters
Level 3. **Participatory science** - Participation in problem definition and data collection
Level 4. **Extreme** - Collaborative science - problem definition, data collection and analysis

Citizen Science and Open Science

Citizen Science offers an extra dimension to Open Science: involving citizens in the scientific research process makes science accessible for non-scientists in an comprehensible way. It is important for the research in which citizens play an active role, to be designed in accordance with the principles of Open Science, with high-quality science practices. Citizen Science projects require a well-considered approach and time, especially in the field of communication, data management and ethics.

From various initiatives, the potential synergies between Citizen Science and Open Science are being investigated and detailed. A report on Citizen Science in the Netherlands was recently published by the Dutch national Open Science programme (NPOS, 2020).
In this report, Citizen Science is seen as a research method that by 2030 will become a self-evident and often indispensable part of scientific research, that is embedded in the curriculum of higher and scientific education and included in the system of rewarding and recognition. According to this report, the two most important pillars for taking the next step in the development of Citizen Science are building a network structure and working on quality promotion.

Similar project reports or white papers from multiple organisations emphasize the importance of the Citizen Science approach in the roadmap to Open Science.

- A report (from the European-wide project Doing It Together Science - DITOs) highlights how Citizen Science empowers citizens to address grand challenges, how it responds to diminishing societal trust in science through transparency (DITOs, 2017);
- The Global Citizen Science community has been invited to contribute to this process and its first contribution is a short paper on 'Global Citizen Science perspectives on Open Science' where the views of 63 Citizen Science practitioners from 24 countries were put together into the paper responding to UNESCO's key themes (Wehn, 2020);
- CESAER is the European association of leading specialised and comprehensive universities of science and technology that champion excellence in higher education, training, research and innovation. They have a Task Force Open Science;
- LIBER (Ligue des Bibliothèques Européennes de Recherche – Association of European Research Libraries) is the voice of Europe's research library community. One of the seven focus areas in the LIBER Roadmap to Open Science is Citizen Science (Ayris, 2018).

# Supporting Citizen Science in universities abroad

At various universities, Citizen Science is supported from a specific department, research centre, or in a special program of the Academic Library. There are also collaborations between universities with regard to the support of Citizen Science. For example:

- The Citizen Science Center Zurich is run jointly by the University of Zurich and the ETH Zurich and aims at supporting next generation Citizen Science;
- ExCiteS is an interdisciplinary research group at UCL. It brings together scholars from diverse fields to develop and contribute to the guiding theories, tools and methodologies that will enable any community to start a Citizen Science project to deal with issues that concern them;
- One of the special programs of Arizona State University Library is a Citizen Science knowledge hub from which support is provided to university researchers, as well as to other academic libraries and public libraries;
- The Public Science Lab is not so much a single lab as it is a window into the collaborations between a vast network of scholars across many disciplines and institutions.

Interesting initiatives in the Netherlands

In the Netherlands, more and more attention is being paid by universities to Citizen Science or citizen engagement. For these universities, it might be interesting to collaborate with organisations involved in Citizen Science initiated by citizens, like Waag and Amersfoort University. A digital dossier with news, backgrounds and research results from citizen science projects of Wageningen University & Research.

The Leiden University's Citizen Science Lab brings scientists, citizens and social parties together to arrive at new insights for science and society through Citizen Science. The Lab supports the various parties in jointly setting up these projects. As the centre for Citizen Science within the University of Twente, DesignLab is involved in several initiatives to promote Citizen Science and involve communities outside of campus.

Photo by Colby Ray on Unsplash
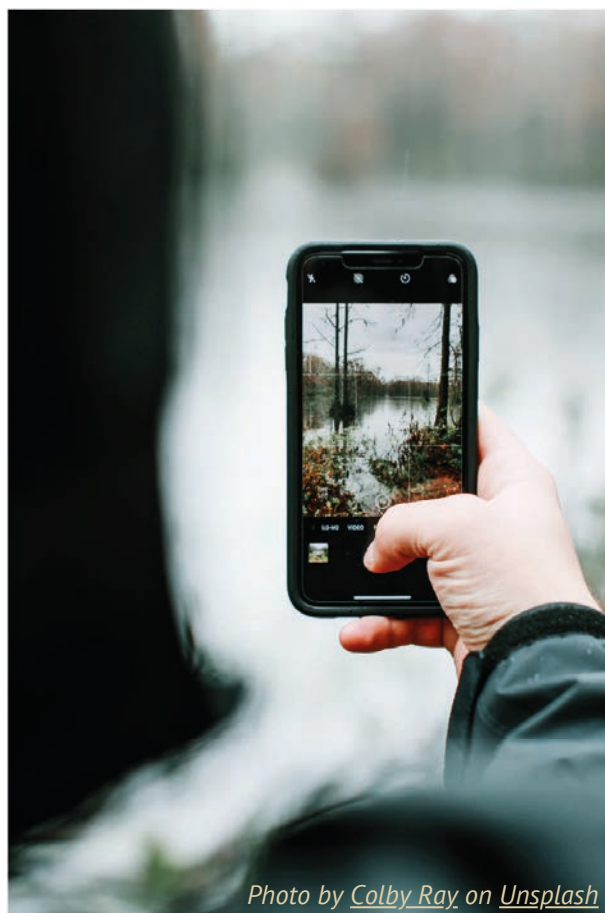
The TOPFIT Citizenlab is working on a citizen science methodology developed for and by citizens that can actually be applied in practice in the healthcare sector.

Erasmus SYNC Lab is a research group at the department of Developmental Neuroscience in Society at Erasmus University Rotterdam. SYNC stands for Society, Youth and Neuroscience Connected. Their mission is to bridge multiple levels of measurement to understand how young people develop into contributing members of society.

The Centre for Science and Culture of Utrecht University is the central meeting place for science, culture and society. With activities and expertise in the field of wide-ranged education, science communication & education and culture, the Centre for Science and Culture contributes to the profile and ambitions of Utrecht University for education, research and social impact. The focal points are the engagement of a large audience to science (public engagement) and wide-ranged education of students.

Photo by Artem Beliaikin from Pexels

Citizen Science at TU Delft

At TU Delft, the Science Centre's Waterlab has been active with Citizen Science in the field of water research for several years now. Researcher Jeff Davids holds a PhD in Citizen Science research in Nepal (Davids, 2019).

At the faculty Technology, Policy and Management is a great deal of experience in civic participation and co-creation. Recently Javed Hassan Sabu finished his Msc thesis research 'What motivates researchers to participate in Citizen Science projects?' (Sabu, 2020).

Within research projects of Delft Global Initiatives, Citizen Science is regularly used as a research methodology, because citizens are needed to obtain sufficient data. In the Green Village, as well, involving citizens in projects is a standard practice. We have gratefully used all their valuable expertise and experience in Citizen Science in order to produce the requested advice.

Citizen Science think tank

We invited people from several TU Delft faculties and institutes to discuss and to collect different opinions and expertise on citizen science (Figure 2).

With the mission from the TU Delft Executive Board (College van Bestuur - CvB) to position Citizen Science with respect to Open Science, we planned three sessions with the goals:

- to find a common ground and establish the definition of Citizen Science,
- to get a vision of Citizen Science at TU Delft and
- to develop a roadmap for the next years.

Figure 2. Partners of discussion at TU Delft, active or interested in Citizen Science project developments.

Methodology

DESCRIPTION OF WORK		PARTICIPANTS
SESSION 1	Citizen Science - alignment and vision	CS think tank (8 people)
SESSION 2	Citizen Science - vision and strategy	CS think tank (8 people)
SURVEY	Research landscape at TU Delft	TU Delft researchers
SESSION 3	Thematic session Open Science	OS community
PROJECT	Smartphones4Water*	TU Delft community
PROJECT	Delft Measures Rain**	Delft citizens

 * project initiated by the S4W organisation
** project initiated by the WaterLab

GOALS

SESSION 1   **Citizen Science - alignment and vision**

1. What is Citizen Science? Definition, components and model
2. How prepared are we to start Citizen Science at TU Delft?

SESSION 2   **Citizen Science - vision and strategy**

1. What is Citizen Science? Definition review
2. Positioning Citizen Science in relation to Open Science
3. Vision of Citizen Science at TU Delft

SURVEY   **Research landscape at TU Delft**

Vizualise the research landscape in relation to two dimensions, namely:
x axis - Lab to Field
y axis - Fundamental to Applied

SESSION 3   **Thematic session Open Science**

1. To map the existing and possible support for Citizen Science at TU Delft within the Open Science framework
2. To invite people to think about possibilities of Citizen Science support development within the Open Science programme
3. To check our assumption that Citizen Science reinforces Open Science and intersects with all the actual streams of development (whether FAIR Data, Open Publishing, Open Hardware, or themes Skills for Open Science or Reward & Recognition.)

PROJECT   **Smartphones4Water**

Collect smart phones to be reused for water measurements.

PROJECT   **Delft Meet Regen**

Identify whether rain patterns differed between different parts of Delft, depending on the environment, amount and type of buildings.

Photo by Nicoleta Nastase

Results

GOALS

1. What is Citizen Science? Definition, components and model
2. How prepared are we to start Citizen Science at TU Delft?

The first session created a first encounter between some of the stakeholders and researchers, from TU Delft and other institutions.

There were many points of view and clearly different experiences with CS projects. The subject sparked heated debates and long discussions that gave us extra, unexpected but valuable insights.

1. What is Citizen Science? Definition, components and model

In order to get our (TU Delft) understanding of Citizen Science, we used as a starting point a discussion on the 10 principles of Citizen Science defined by ECSA. The variety of visions, coming from such different angles, lead us to the decision to let the discussion evolve freely.
The result was a complex view translated into our own definition of Citizen Science, derived from the combination of our insights with the 10 principles. This definition was submitted for scrutiny during a second brainstorming session.

Photo by Nicoleta Nastase

Results

Citizen Science model and components

By asking participants to draw Citizen Science as a pie with components and their importance, we could derive the following two models. We asked as well what Citizen Science is not.
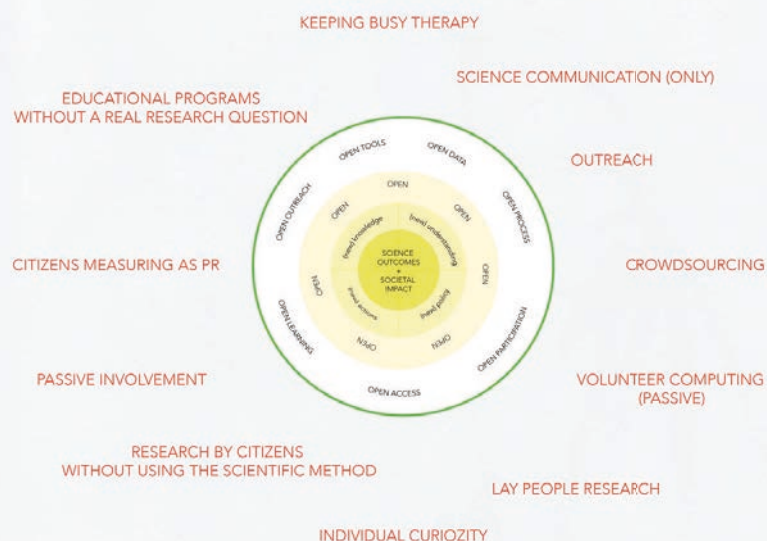

Figure 3. Models and components of what Citizen Science is (a and b) and what it is not (c) - results of the a brainstorming session on the alignment and vision of Citizen Science at TU Delft

Results

2. How prepared are we to start Citizen Science at TU Delft?
- SWOT analysis - Strengths and Weaknesses

Photo by Nicoleta Nastase

SWOT Analysis: STRENGTHS

Open Science:
- a long history of Open Science, that CS would fit in with easily

Research in CS is not new in TU Delft:
- research with high societal relevance & impact would be very suitable for CS;
- (there are) research topics with CS potential;
- (there are) a few examples of CS projects

Good touchpoints:
- good relationship with the municipality;
- Science Centre as access point for citizens

A lot of potential in research:
- many fields of knowledge & research;
- high quality research;
- built on innovation & flexibility/ "new wings"

Infrastructure:
- (strong) scientific infrastructure (labs, repository, paper subscription);
- involvement in practical research is strong;
- support from the Library, the Science Centre and from TU Delft Executive Board for more engagement with society

People:
- TU Delft - much goodwill;
- scientist available;
- students who want to learn

Funding opportunities

SWOT Analysis: WEAKNESSES

No clear definition Citizen Science:
- a lack of clarity about what citizen science is and a reluctance to try it as a potential effect;
- little recognition for combination hard/soft skills and societal impact

Complexity of the system of stakeholders:
- struggles with multi-actor situations (and thus with different/divergent interests of stakeholders);
- stakes of multiple large companies;
- we are not equipped to work in a multi-stakeholder environment

Communication:
- lack of communication/sharing experiences among scientists;
- seems not open/inviting to citizens;
- common knowledge is not/little available to citizens

Infrastructure:
- no citizen science help/infrastructure for researchers who want to try;
- little support, e.g. platforms;
- no easy point of access for Citizen Science ideas;
- no support mechanism for scientists with a Citizen Science question

Funding:
- money flow based on quantifiable output;
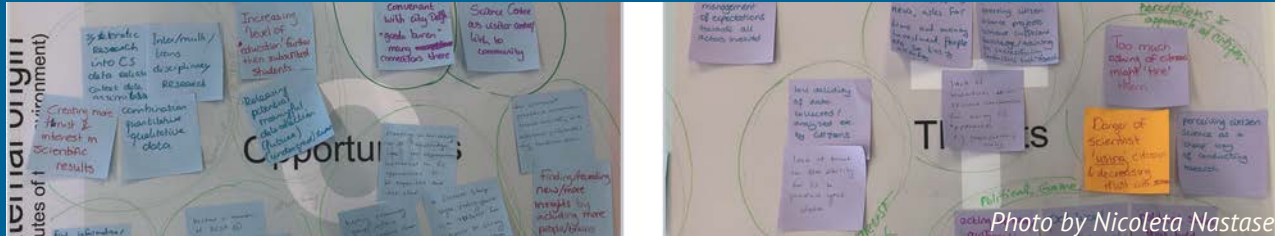- no or little funding for CS

Attitude:
- large institution/bureaucracy;
- acting top-down, with authority, as TU Delft

Results

2. How prepared are we to start Citizen Science at TU Delft?
- SWOT analysis: Opportunities and Threats

Photo by Nicoleta Nastase

SWOT Analysis: OPPORTUNITIES

Research:
- combination of quantitative + qualitative data;
- creating more trust and interest in scientific results;
- systematic research into CS data reliability - context data assimilation;
- finding/revealing new, more insights by including more people/brains
- inter-/multi-/trans-disciplinary research

Education
- increasing further the level of education further than subscribed students;
- releasing potentially meaningful data collection (future) (undergraduate) students

Community:
- hosting community groups with a shared concern, by co-creating a research question or by initiating a CS project;
- to connect, practice research more actively with citizens e.g. medical area

Bigger picture:
- become a member of ECSA;
- collaborate with EU Citizen Science

New services:
- creating a university-wide "knowledge hub" for researchers interested in CS + approaches to be supported and assisted;
- a science shop style entry-point into TU Delft for citizens to bring a research question for collaboration

Using existing assets:
- covenant with city Delft - good neighbours with many connections;
- Science Centre as a visitor center, link to the community

SWOT Analysis: THREATS

Researchers: skills, resources and incentives:
- citizen science is new, it asks for money investment;
- people are so busy already;
- TU Delft scientists starting CS projects without sufficient knowledge/training for successfully conducting such research;
- tools on monodisciplinary research and papers, especially for tenure trackers.

Political games:
- political involvement/position taking;
- political stakes that hold back/block CS questions

Trust:
- lack of trust in the ability of CS to produce good data;
- low validity of data collected, analysed, etc. by citizens
- perceived CS as a "cheap" way of conducting research;
- danger of scientists "using" citizens and decreasing trust in science

General:
- unclear management of expectations towards all actors involved;
- finding legal infrastructure/data (GDPR);

Analysis

Needs for development

For the University:
- Adopt a clear definition of Citizen Science (CS);
- Create a funding mechanism for CS, based on quantifiable output;
- Empower the researchers to help them embrace co-creation with citizens (bottom up) approach;
- Investigate factors that could increase the trust in the data produced within CS projects;
- Create a code of conduct, an ethics & integrity guideline for a rigorously scientific CS project (one benefit could be avoiding the misuse of citizens that could lead to less trust in science);
- Put in place a legal infrastructure (GDPR compliance);
- Management of expectations for all the actors involved in a CS project.

For Researchers:
- Emphasise the need of a combination of "hard" & "soft" skills for a CS researcher;
- Create an environment for the interaction of a multi-stakeholder system, with divergent interest;
- Ease the communication between scientists, to share their experiences;
- Create training for the researchers intending to start a CS project to form the necessary skills;
- Create a support mechanism, an infrastructure that can offload the (already busy) researchers starting a CS project. Streamline some of the activities;
- Create incentives/a reward mechanism for researchers to start a CS project.

For Citizens:
- Create an inviting environment for citizens, an easy point of access, where they can address questions and ideas for possible projects;
- Science communication and translation into laypeople language should become a priority;

Insights

1. Citizen Science is two-way:
   - opening science to citizens
   - inviting citizens to collaborate

2. Citizen Science covers all aspects of open science. It's not a separate pillar.

3. TU Delft can have two roles in a CS project:
   - as principal investigator (TU Delft can take the lead in a research project and invite citizens to collaborate with them)
   - as advisor (TU Delft can give advice or guidance to citizens who want to do their own research and answer their own questions, but lack the knowledge or skill to do this in a scientifically robust way)

GOALS
1. What is Citizen Science? Definition review
2. Positioning Citizen Science in relation to Open Science
3. Vision of Citizen Science at TU Delft

The proposition 'The CvB wants all research and education projects to be carried out in cooperation with citizens in 2025.' has provided a lot of input with regard to the needs for support to get started with Citizen Science or to further professionalize it.
The researchers' ideas on Citizen Science are still very divergent at this stage.

1. What is Citizen Science? Definition review

At TU Delft, we define Citizen Science at its core as scientific research and education in collaboration with citizens (Figure 4). Nevertheless, this definition is accompanied by a set of requirements, a simplified form of the 10 principles of ECSA, for it to become the right framework for all participants. This definition will enable people to act and collaborate within Citizen Science projects and will guide us in our enterprise in developing the right support services for our citizen scientists.

Definition

Citizen science is scientific research and education in collaboration with citizens, with the following requirements:

- The problem definition can come from both citizens and researchers.
- CS projects generate new knowledge or understanding like any other research project, by using the scientific method.
- In every research phase there must be a clear attribution of roles between the participants.
- All participants in CS projects benefit from participation and are acknowledged for it.
- All participants benefit from the results of a CS project (Open Science).
- Communication and tools interfaces have to be made tailor-made.
- CS projects are evaluated for
    - their scientific output and data quality like any other research project,
    - the participant experience and
    - wider societal or policy impact.

Figure 4. TU Delft definition of Citizen Science, derived from the 10 principles of Citizen Science proposed by ECSA

2. Positioning Citizen Science in relation to Open Science

While Open Science is all about transparency of science and reuse of its results, Citizen Science is inclusive open science, involving actors from outside the academic environment, for a mutual benefit.
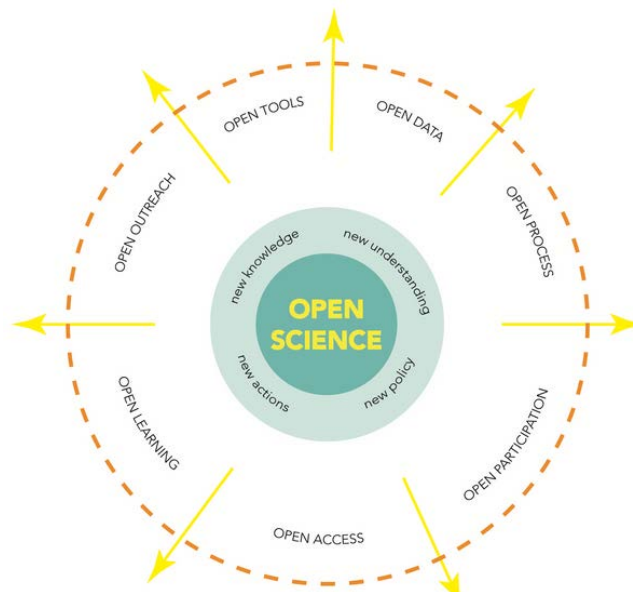

Figure 5. Open Science - giving access to information; being transparent with regard to the research process, data and tools; extending teaching, increasing the outreach beyond the academic environment; opening the doors for participation in the scientific research
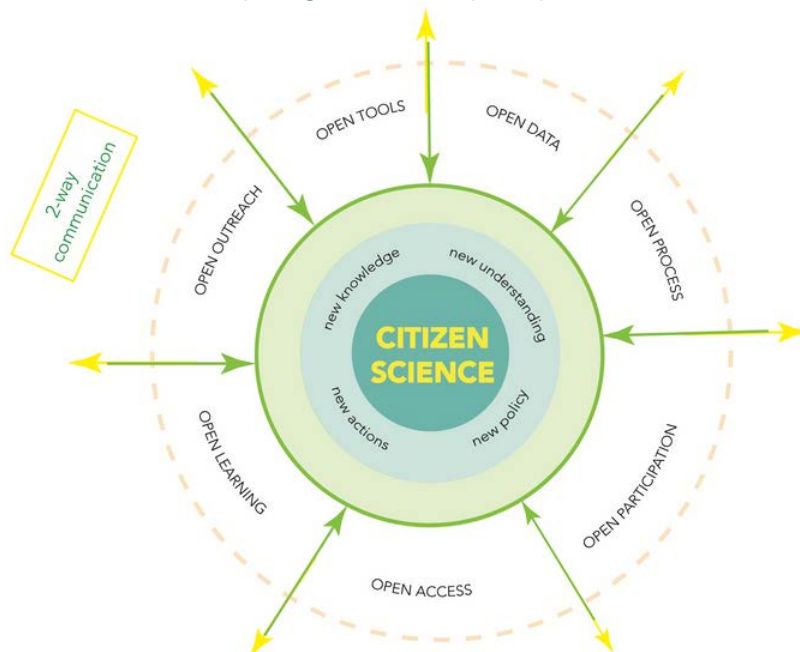
Figure 6. Citizen Science - proactive Open Science, inviting citizens in to collaborate, to bring in research questions and participate to scientific research, with different degrees of engagement and under academic supervision

Citizen Science is considered particularly suitable for applied research in a field situation. For more fundamental research one does not seem to see direct application possibilities (Figure 7).

Figure 7.
Assumption on the positioning of TU Delft, in comparison with other institutions active in working with citizens (Higher Vocational Education institutions - HBOs or Dutch Organisations for Applied Scientific Research - TNOs). Data is needed to validate the assumption (See Survey)

As a result of this session, we realised that a CS project consists always of three components: a research, a societal and an educational component (Figure 8). They can vary in proportion as communicating vessels.
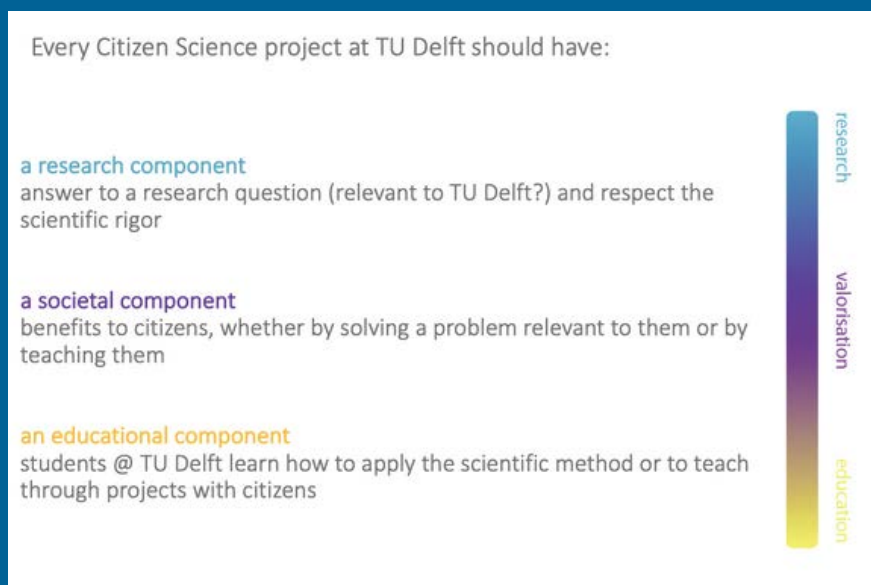

Figure 8.
We discovered that every project in Citizen Science has to have all these components, and not necessarily in equal proportions.

Results

3. Vision of Citizen Science at TU Delft

We had two exercises:
1. Imagine "Citizen Science only" at TU Delft: We asked our participants to imagine a situation where all the research and educational projects at TU Delft can be solved only with the involvement of citizens.
We had asked then two questions:
   a. if it's true, how can we make it happen?
   b. If it's not true, why not?
2. "If Citizen Science were a car…"

Photo by Nicoleta Nastase,

At TU Delft, Citizen Science only! True: how can we make it happen?

Skills
- Extra curriculum, soft skills development with staff/students
- create a "middle man" - a department that facilitates the extra activities and the knowledge/skills

Infrastructures, support structure and methodology
- Capacity building for CS scientists (on the practical side)
- Outreach (protocols)
- Smart outreach to citizens to open up possibilities for research
- Citizen communication (protocols):
- Make IP (intellectual property) clear
- Data ethics and others should be clear for citizens
- TU Delft public lectures, "popular" articles. In short: science communication to laymen
- Capacity building, to appoint specialists for "translation" towards citizens
- Data (protocols):
- Data collection
- Creating awareness about the data that has been collected
- Data visualisation - tools should be built (online environments)

Showcases
- Front runners: scientists who proved that it can be done and act as ambassadors for other scientists
- How and why did someone else does it!

Funding
- Funding for sustainability - long term!

Incentives
- Giving incentives to volunteers
- New incentives: recognising the effort, high impact publication

General
- TU Delft "can do" mentality: No excuses! We will help you do it!
- Science of Citizen Science
- Obligatory citizens users Committee
- Which research questions are well-suited to Citizen Science

At TU Delft, Citizen Science only! Not true: why not?

Academic side
- Lack of knowledge on how to do among TU scientists
- When there is no collaborative network concerning their research
- Lack of funding for extra tasks that come with the CS

- CS is time-consuming

- Lack of trust in "amateurs"
- Data collection - trustworthy by citizens

- Lot of research cannot be done in collaboration with citizens - like "fundamental research"
- CS is not suitable for many types of research (majority)
- Not possible - R&D is highly expensive and protection of intellectual ownership is necessary

- Too dangerous - our values/responsibility
- Dangerous/technical expensive for laymen to be involved in some parts of the research
- Safety issues/hazardous materials
- In a laboratory becomes often very hard

- Distracts attention from Science communication
- Not wanted/not part of the ecosystem
- Not needed
- No help in exceeding one's fundamental research-oriented brain (translation needed)
- Hinders "soloists" to be fully creative
- In case of controversy, one should be able to do scientific research in complete freedom without "social" pressure
- Don't have a dual mindset: Tech/Society

Citizens side
- Incentives for citizens to collaborate with scientists. Show/open data that has been collected
- Need to train citizens
  - When citizens feel forced
  - Too many cases where it is not beneficial to participants

Results

If Citizen Science were a car...

What kind of vehicle is it?
Who or what does the steering?
Who or what are the passengers?
Who or what is the chassis?
Who or what is the motor?
Who or what is the fuel? What makes it move?
Who or what are the wheels?
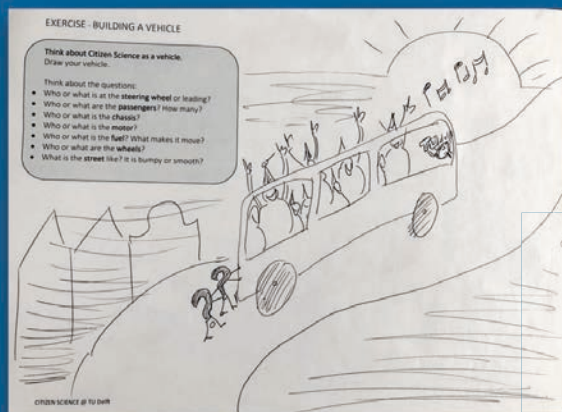*What is the street like? It is bumpy or smooth?*

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Figure 9. Citizen Science is a bus, with everyone interested on board. The road is large, people are driven by questions or problems. Emotions are important, people are engaged, going together in the same direction towards a bright future.
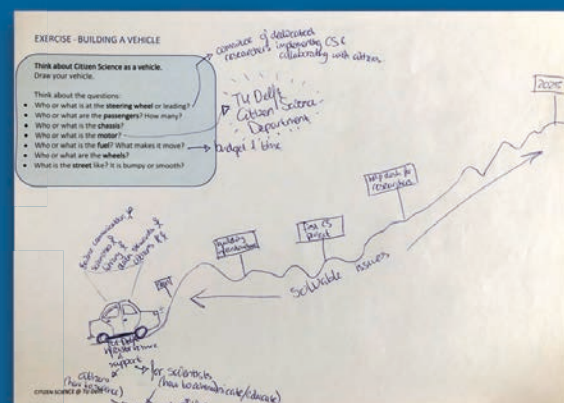
Figure 10. Citizen Science is a car on a bumpy road of solvable issues, driven by a committee of dedicated researchers, with scientists and citizens as passengers but also with science communicators and library on board. It works on budget (fuel) and its framework is made by TU Delft infrastructure and support services. The motor is a Citizen Science Department.

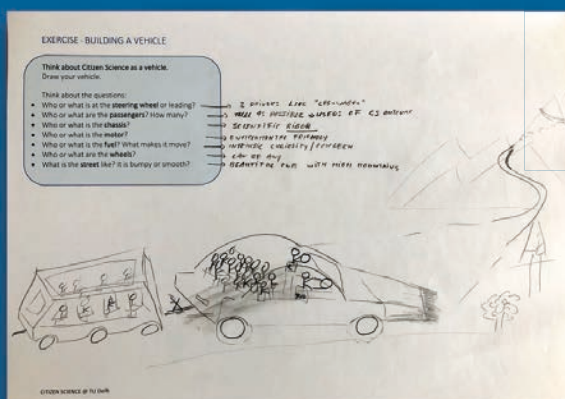*Photo published by TU Delft Library with author's permission*

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Figure 11. Citizen Science is a car with an extra carriage. There are two drivers, a teacher (scientist) who supervises and a student (the citizen) who drives. The car takes on board as many passengers as possible, people taking the benefit from the Citizen Science project. The framework of this entrepreneurship is the scientific rigor. The motor is environmentally friendly and the car works on intrinsic curiosity or concerns. The wheels can be anything and the road ahead is beautiful but with high mountains.

Results

SESSION 2
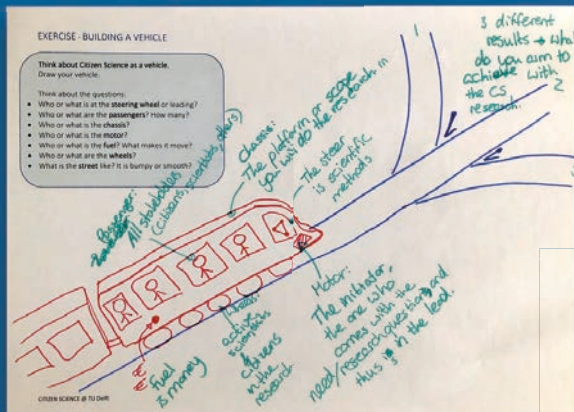### Citizen Science - vision and strategy

Photo published by TU Delft Library with author's permission

Figure 12. Citizen Science is a tram or train, going up with power and can choose to go on more possible directions, depending on what one wants to achieve with the research. It's steered by the scientific method and has as passengers all stakeholders (citizens, scientists and others). It works with money and its structure (chassis) is the platform or the scope one will do the research. The wheels are the active scientists and citizens within the research and the motor is the one who has a question to solve.

Figure 13. Citizen Science is a network, with no steering - or everyone is in charge, responsible - with a suitable number of participants The chassis, the structure is a support mechanism or service. The fuel is the compassion or shame, the wheels are multiple social phenomena (trends, tech, politics or people behavior) and the road is bumpy forever.
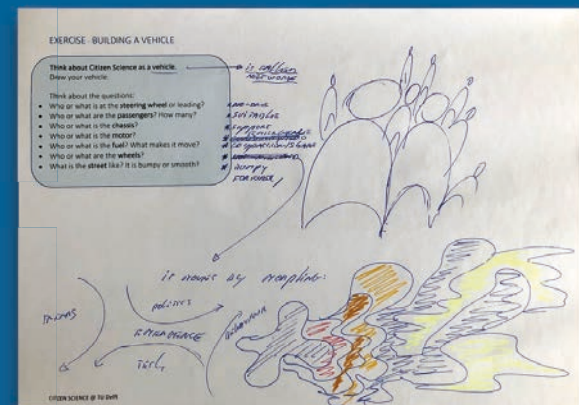

Photo published by TU Delft Library with author's permission

Figure 14. Citizen Science is a van driven by selected citizens, as long as the aim is clear. They can contribute the the research agenda by providing additional directions and give their opinions about content. The street is not bumpy if the fundamental science can still be practiced without the citizens involvement and the intellectual property remains protected and if citizen science uses the scientific method.

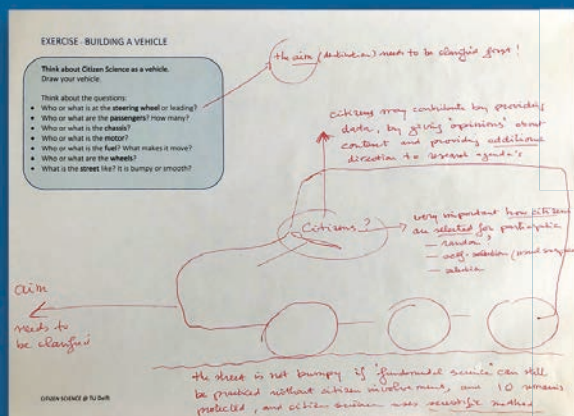*Photo published by TU Delft Library with author's permission*

Figure 15. Citizen Science is a community-driven truck, with residents and policy makers at the steering wheel, with scientists as wheels and on a framework given by the university. It's fueled by money and time and with motivations, concern and curiosity as the engine. The road is smooth if given by the scientific method but can be bumpy because of the communications.
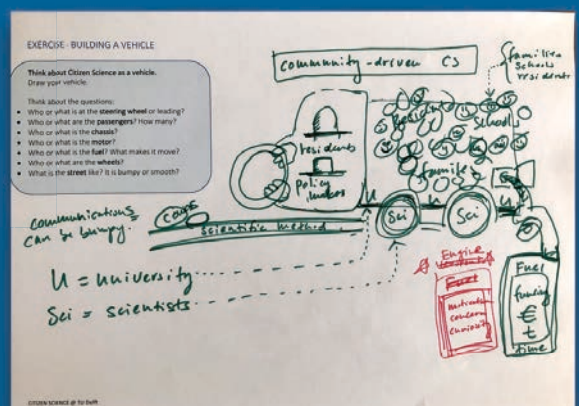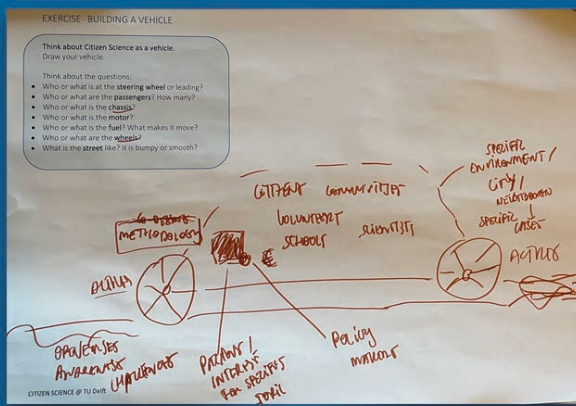

Photo published by TU Delft Library with author's permission

Figure 16. Citizen Science is a car with everyone on board: citizens, scientists, schools, volunteers. The structure is given by the scientific methodology.

Photo published by TU Delft Library with author's permission

Insights

While there is a lot that can be done towards the development of Citizen Science at TU Delft, there is also concern about it being used as a solution for every research project, with clear arguments on why not work with citizens in some cases. All this session input adds to the needs for development discovered in the SWOT analysis. We got specific solutions on skills development, infrastructure and support development for citizen science projects. We retrieved ideas like showcasing of the success stories, funding, creating incentives or taking care of the selection processes and feedback from citizens.

There are also legitimate concerns about the lack of knowledge, training or funding for researchers. We recollect the trust issue about working with citizens, a question appears about the subject suitability or necessity of involving citizens, the safety issues in some projects but also the possible "social pressure" interference with the research or just the fact that citizens are not part of the project ecosystem.

From the last exercise, "If Citizen Science were a car...", we got the impression on how similar the researchers look at approaching Citizen Science: everyone has the vision of "together" - scientists and citizens - in a bus, tram, car, truck, and even as a network.

When it comes to the responsibility, there are different views and therefore, expectancies: one envisions distributed responsibility, another one the researchers taking the lead, and yet another one a supervision system where the student leads under the observation and support from the researcher.

Citizen science can be driven by the problem to be solved but also by the one (researcher or citizen) who asks the question to be solved. In this last case, the researchers and citizens together are the wheels that make the project move forward. This makes us understand that there is no unique way to approach the projects with citizens and it could be a personal choice as well as dictated by the nature of the project and people involved.

In all the cases, people do not expect to be easy but they are full of optimism that together - with funding as fuel - and with enthusiasm, it will work. The university, with its frameworks and overview is present to support the progress while in general, science, with its rigorous practice, will ensure the quality required when working with citizens.

Results

An important outcome of the second session was that one type of research lends itself more to involving citizens than another. Fundamental research and research conducted mainly in a lab setting are considered less suitable for Citizen Science than applied research and research in the practice/field. This raised the question of which current research projects at TU Delft would be potentially interesting to involve citizens: can we visualise the research landscape in relation to two dimensions - namely:

1. (x axis) Lab to Field
2. (y axis) Fundamental to Applied.

It was not possible to make such an overview based only on desk research.

Therefore, we developed a short survey, that we intended to distribute it among researchers at TU Delft. The survey was tested at a meeting of the Data Champions in early March 2020, where the Citizen Science theme was on the agenda. In that meeting, the survey was enthusiastically received and the opportunity was offered to launch the survey broader, online, and announced via the data champions newsletter.

The response rate was lower than expected. It is possible that the pandemic, which had just begun, played an important role in this. The response rate has increased a little by specifically approaching the Delft Research Initiatives, as well as the Field Labs of TU Delft.

Figure 17. Projects distribution at TU Delft, on a graph Lab to Field (x axis) and Fundamental to Applied (y axis)

We received 46 reactions to the survey from the researchers. All faculties were represented, with most of the respondents coming from the faculties of Technology, Policy and Management; Applied Sciences; Mechanical, Maritime and Materials Engineering and Aerospace Engineering. These respondents indicated the positioning of 73 research projects within the research landscape defined by the above-mentioned dimensions (Figure 17).

Insights

These results show that 60% of this small sample of 73 projects are taking place in the Lab environment. At the same time, the rest of 40% of the projects complete our initial assumptions - see Figure 7 - with a set of 9 projects having a theoretical character and another set of 19 research projects with applied character, all distributed in the "field" side of the graph. We interpret the existence of these field projects as opportunities to work with citizens, and this result goes along with our perception of a growing interest among the researchers for Citizen Science at TU Delft.

In addition to this chart, through this survey we found a number of new researchers with experience in Citizen Science, as well as people interested in what Citizen Science could mean for their projects.

The projects of the respondents with experience, almost all of them have an applied-field character (the top right quadrant of the graph), while the projects of the interested researchers are distributed in all the other quadrants of the graph.

Both groups of researchers are valuable to us for gaining insights into their practices and mainly their needs in Citizen Science projects, so that we can develop the right support services.

Results

PROJECT
Smartphones4Water

During the winter of 2019/2020, we collaborated with Smartphones4Water (S4W) organisation.

S4W "mobilises young researchers, citizen scientists, and mobile technology to improve lives by strengthening our understanding and management of water." They have been active in Nepal, Ghana and the Netherlands, as they collaborated with WaterLab in the project Delft Measures Rain.
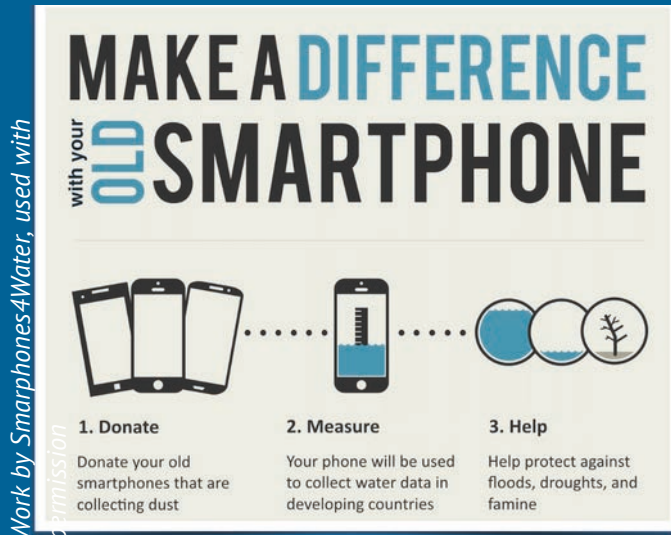

S4W uses smartphones to do measurements with local citizens, measurements of surface water, ground water, rain, weather and land use. The smartphones are mostly used devices that are donated by citizens. In order to help S4W collect more smartphones for their project in Ghana, we set up collection bins for used smartphones at the TU Library and Science Centre Delft. After a collection period of two months, 77 cellphones were collected and transferred to S4W.

Work by Smartphones4Water, used with permission

Figure 18. Advertising the collection of smartphones in the project Smartphones4Water

Results

PROJECT
Delft Measures Rain

Delft Measures Rain ("Delft Meet Regen") is one of the citizen science projects of WaterLab.
It was set up in the spring of 2020 and the measurements were collected between July and September 2020 (Figure 19). The aim of the research was to identify whether rain patterns differed between different parts of Delft, depending on the environment, rain amount and type of buildings

Work by Marit Bogert

Figure 19. Delft Measures Rain ("Delft Meet Regen") is one of the Citizen Science projects of WaterLab.

Delft Measures Rain mobilised 95 citizens of Delft to participate in doing rain measurements and aid the research of Marie-Claire ten Veldhuis, researcher at CEG.
In total, almost 2000 measurements were received over a 2-month period. Participants received materials to construct a rain gauge beforehand and during the project received information and educational materials on rain in Delft, the Delft water system, flooding and droughts via two-weekly, multimedia newsletters. The team that constructed this report were closely involved with the projects to observe and learn from this 'pilot' in which the TU Library was practically involved in Citizen Science for the first time.

TU Delft OPEN

Collaborations

- Municipality Delft
- Science Centre Delft
- Smartphones4Water
- Water Board of Delfland
- Library TU Delft
- University Services Delft
- TU Delft Communications (including the city-convenant)

Additionally, we worked together with TU Delft PhD-student Monica Estebanez Camarena, who is doing similar research in Ghana, and Annie Breeuwsma from Duurzaamheidscentrum de Papaver, who provided content on green/blue adaptations for the newsletters.

Outcomes

- Data-wise
- Education-wise
- Collaboration/network-wise

Results

SESSION 3
Thematic session Open Science

GOALS

1. To map the existing and possible support for Citizen Science at TU Delft within the Open Science framework
2. To invite people to think about possibilities of Citizen Science support development within the Open Science programme
3. To check our assumption that Citizen Science reinforces Open Science and intersects with all the actual streams of development (whether FAIR Data, Open Publishing, Open Hardware or themes Skills for Open Science or Reward & Recognition.)

METHOD   Interactive online session with Open Science representatives with two parts:
1. Presentation Citizen Science
2. Ideation session: how can we contribute to Citizen Science @ TU Delft?

With the insights from the first two branstorming sessions, we distributed the needs of researchers on the projects and cross-cutting themes of TU Delft Open Science programme (Figure 20). We divided people into three groups and asked them to give input by rotation on the following themes, so that everyone could have a contribution, whether expert or not in the field:

- FAIR data - FAIR software - Reward & Recognition
- Open Access - Open Publishing - Fruitful collaboration with 3rd parties
- Open Education - Open Hardware - Skills for Open Science

Another important aspect in approaching the citizens, that came back several times during our Citizen Science sessions, was communication. While communciation is essential in all projects and cross-cutting themes of Open Science, we decided to ask, in a separate last round, to everyone to think with us about it, putting citizen science into perspective.

- Communication

Figure 20. Example of sessions insights matched to the Open Science projects and cross-cutting themes

The results of this session, as part of future work, will be reviewed by the leaders of the Open Science projects and cross-cutting themes. The outcome will be used for the development of the support structures and services within the Citizen Science project at TU Delft.

Conclusions

Citizen Science is not yet a well-known concept at TU Delft. Nevertheless, there are several researchers who have experience with one form or another of Citizen Science or Citizen Engagement known as participatory science or multi-actor systems. There are also several researchers who are interested in this form of research.
The value of involving citizens in science is recognised, although there are also concerns about the reliability of data and the time-consuming nature of this research approach. Knowledge and experience of Citizen Science is fragmented across the university. Outside the university, a large (inter)national network in the field of Citizen Science has been identified. For further development and professionalization of Citizen Science at TU Delft, there is a clear need for support and information.

Within the mission, four central questions were asked, which are briefly answered below based on the knowledge and information gathered in this exploration.

What is citizen science?
From the desk research, it has become clear that all kinds of different definitions of Citizen Science are used. In the two working sessions we came to a definition of Citizen Science, which fits well within the context of TU Delft and is strongly related to the ten principles of Citizen Science of ECSA.

How can citizen science contribute to the TU Delft Strategic Framework 2018-2024?
 Both desk research and discussions with various experts and stakeholders made clear that involving citizens in science contributes to the dialogue between university and society, increasing mutual knowledge and understanding. Citizen Science offers both researchers and students a valuable opportunity to collaborate substantively with citizens, who bring in their own perspective and expertise, thus increasing the connection with society and awareness of what is going on outside the academia. At the same time, it offers citizens the opportunity to gain more insight into science and to make their voices heard. Looking at the four principles from the strategic framework, the further development of Citizen Science within TU Delft supports the principles: impact, commitment, and openness.

What benefits does citizen science have for the Open Science Program?
 Both the EU and UNESCO are working on implementing Citizen Science as part of Open Science. To put it briefly: Citizen Science enables Open Science and requires Open Science. The further development and professionalisation of Citizen Science calls upon all projects and cross-cutting themes from the Open Science program. At the same time, it provides added value to the Open Science program, namely the interaction with society described above. For the visualisation of the Open Science program, this means that Citizen Science should be added as a project embracing the existing picture of vertical projects and horizontal cross-cutting themes (Figure 21).

What kind of outputs would a citizen science project deliver to the TU Delft organization?
The model of the three components of a citizen science project shows that three types of output can be delivered: research, societal and educational output.

Figure 21. Our view of the Citizen Science positioning into the Open Science framework

Recommendations

This exploration provided clear insights into the current state of Citizen Science at TU Delft, nationally, as well as internationally.

We have a definition of Citizen Sience at TU Delft, from co-creation sessions with researchers, inspired by the 10 principles of Citizen Science from the European Citizen Science Association (ECSA).

Our general conclusion is that Citizen Science offers significant added value to Open Science: involving citizens in the scientific research process, with a smart approach and a specific set of skills, makes otherwise laborious and long-term science possible in the short term, where everybody, scientist or citizen, benefits. Science has to be made accessible to non-scientists in a comprehensible way. It is crucial for the research in which citizens play an active role, to be designed in accordance to the principles of Open Science and therefore, meet the requirements of transparent high-quality scientific practice.

The vision of Citizen Science still varies from one researcher to the other but, overall, it is one nice but structured, possibly bumpy-road, journey for everyone on board. From our study, several TU Delft researchers are experienced with this research approach, while some others are interested in it. We identified the researchers' needs of sharing experience, of learning about possibilities of working with citizens, as well as the need for support and resources required for new types of activities and skills specific to Citizen Science.

Much of the knowledge and experience required for the support, although fragmented, can already be found in various parts of the university. A first crucial step is to trace this knowledge and experience and make it available to support researchers who want to involve citizens in their research. In order to do that, we need to find most of the researchers experienced in Citizen Science across the university.

Therefore, our recommendations are:

1. To include Citizen Science as a project in the Open Science Strategic Program. Citizen Science is an indispensable part of the Open Science debate.

2. To enable and encourage the formation of a Citizen Science community at TU Delft

3. To create support structures and infrastructure for both citizens and researchers that are interested in citizen science (front-runners). This can be supported by the developments of the other Open Science-program components.

4. To make showcases of already existing Citizen Science projects at TU Delft.

5. To make a limited budget available to sponsor new Citizen Science projects to gain further experience.

Team

To explore Citizen Science at TUDelft, we formed a team that brought together existing initiatives and experiences around Citizen Science from:

- the Waterlab the practical knowledge and experience with science education and Citizen Science projects related to water research;

- the Library the connection to the activities around Open Science and the findings of an earlier study into Citizen Science by the R&D team.
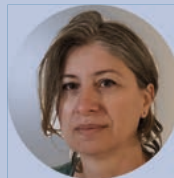
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Further reading

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