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## Interface for visualization of team analytics with the CoSo platform

Camille Masselot, Marc Santolini

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# Crowd4SDG

## Citizen Science for the Sustainable Development Goals

### Deliverable 4.6

## Interface for visualization of team analytics from the platform and from the in situ collected data

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#### **Abstract:**

The ability to visualize interaction and engagement data is important to monitor the participation processes of citizen science projects. In this report, we introduce two web-based dashboards for monitoring and evaluation of citizen science projects. We show how these tools provide insights into the network structure and summary statistics of the collaborations that happened during the innovation cycles of the Crowd4SDG project, and how they can be leveraged for future studies beyond this program.

For more information on Crowd4SDG, please check: <http://www.crowd4sdg.eu/>





## Document history

	Name	Partner	Date
<b>Authored by</b>	Camille Masselot, Marc Santolini	UPC	09/12/22
<b>Revised by</b>	Jesus Cerquides	CSIC	16/12/22
<b>Edited by</b>	Marc Santolini	UPC	16/01/23
<b>Reviewed by</b>	Jose-Luis Fernandez-Marquez	UNIGE	08/02/23
<b>Edited by</b>	Marc Santolini	UPC	08/02/23
<b>Approved by</b>	Jose-Luis Fernandez-Marquez	UNIGE	09/02/23

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## Project Partners

	Partner name	Acronym	Country
1 (COO)	Université de Genève	UNIGE	CH
2	European Organization for Nuclear Research	CERN	CH
3	Agencia Estatal Consejo Superior de Investigaciones Científicas	CSIC	ES
4	Politecnico di Milano	POLIMI	IT
5	United Nations Institute for Training and Research	UNITAR	CH
6	Université Paris Cité	UPC	FR



## Crowd4SDG in brief

The 17 Sustainable Development Goals (SDGs), launched by the UN in 2015, are underpinned by 169 concrete targets and 232 measurable indicators. Some of these indicators have no established measurement methodology. For others, many countries do not have the data collection capacity. Measuring progress towards the SDGs is thus a challenge for most national statistical offices.

The goal of the Crowd4SDG project is to research the extent to which Citizen Science (CS) can provide an essential source of non-traditional data for tracking progress towards the SDGs, as well as the ability of CS to generate social innovations that enable such progress. Based on shared expertise in crowdsourcing for disaster response, the transdisciplinary Crowd4SDG consortium of six partners will focus on SDG 13, Climate Action, to explore new ways of applying CS for monitoring the impacts of extreme climate events and strengthening the resilience of communities to climate related disasters.

To achieve this goal, Crowd4SDG will initiate research on the applications of artificial intelligence and machine learning to enhance CS and explore the use of social media and other non-traditional data sources for more effective monitoring of SDGs by citizens. Crowd4SDG will use direct channels through consortium partner UNITAR to provide National Statistical Offices (NSOs) with recommendations on best practices for generating and exploiting CS data for tracking the SDGs.

To this end, Crowd4SDG will rigorously assess the quality of the scientific knowledge and usefulness of practical innovations occurring when teams develop new CS projects focusing on climate action. This will occur through three annual challenge based innovation events, involving online and in-person coaching. A wide range of stakeholders, from the UN, governments, the private sector, NGOs, academia, innovation incubators and maker spaces will be involved in advising the project and exploiting the scientific knowledge and technical innovations that it generates.

Crowd4SDG has six work packages. Besides Project Management (UNIGE) and Dissemination & Outreach (CERN), the project features work packages on: Enhancing CS Tools (CSIC, POLIMI) with AI and social media analysis features, to improve data quality and deliberation processes in CS; New Metrics for CS (UPC), to track and improve innovation in CS project coaching events; Impact Assessment of CS (UNITAR) with a focus on the requirements of NSOs as end-users of CS data for SDG monitoring. At the core of the project is Project Deployment (UNIGE) based on a novel innovation cycle called GEAR (Gather, Evaluate, Accelerate, Refine), which runs once a year.

The GEAR cycles involve online selection and coaching of citizen-generated ideas for climate action, using the UNIGE Open Seventeen Challenge (O17). The most promising projects are accelerated during a two-week in-person Challenge-Based Innovation (CBI) course. Top projects receive further support at annual SDG conferences hosted at partner sites. GEAR cycles focus on specific aspects of Climate Action connected with other SDGs like Gender Equality.

## 1. Purpose and scope of the deliverable

The focus of Work Package 4 (WP4), led by Université Paris Cité, is to conduct research on Citizen Science. This encompasses the establishment of methods and the collection of data to inform the development of effective, high-quality citizen science projects. To that aim, this work package develops metrics and statistical models in order to assess the many-faceted outcomes of the citizen science projects developed within the Crowd4SDG consortium.

By leveraging the digital traces from online tools that document project progress and citizen engagement, it is possible to quantitatively monitor and analyse: i) the activity of teams working within the GEAR collaborative framework, and ii) the activity and engagement patterns of citizen science participants. As such, we propose to frame the participants' behaviour, their interactions and engagement with tools used during the GEAR cycles.

In this deliverable, we describe the interface for visualising the team analytics we collected.

We highlight in bold what this deliverable addresses among the tasks of WP4.

### T4.3: In-situ assessment of citizen local interactions and self-reporting (UPC, UNIGE)

In this Task a self-report smartphone application will be developed in order to be able to establish deeper insights into collaboration dynamics. The app will be able to assess social proximity through smartphone sensors (Bluetooth, Wi-Fi and GPS) and trigger context-based notifications. We intend to use this app to provide fine-grained measurements of citizen collaborative dynamics, both in terms of social network dynamics and in terms of learning experience through the self-reporting contextualisation it offers. The application will be based on an open-source platform developed by researchers at the Child Mind Institute in New York in the context of a large-scale mental health study. Their platform, Mindlogger, is a general-purpose open source data collection platform that can be used by anyone to administer surveys, quizzes or different types of tasks. Proximity-based notifications will be implemented to trigger "Ecological Momentary Assessments" asking individuals to document the type of interaction they are currently part of, so that we obtain an augmented understanding of the social context. **Lastly, we will provide reports that provide insights into network structure and summary statistics. The reports will be in the form of a dashboard tool based on open source software MITeams.** The results of this task will be used for assessing participant interactions during the different phases of the GEAR methodology cycle and thus feed back into WP3. The self-reporting phone app will be used for the in-person events to be carried out in the Accelerate Phase carried out (see Task 3.2).

#### Deviation from the original task description

We originally intended to leverage the MITeams software when we wrote the application in 2017. Since then, the MITeams software has been relabeled OpenTeams, and an open source version has been deposited on GitHub<sup>1</sup>. However, it has not been maintained, and we encountered difficulties in implementing a version to suit our needs. Given the fact that we have been developing a web-based app CoSo<sup>2</sup> for collecting the data that we wished to monitor and visualize, we decided to leverage javascript visualization libraries built on the

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<sup>1</sup> <https://github.com/CenterForCollectiveLearning/OpenTeams>

<sup>2</sup> <https://coso-wl-frontend.herokuapp.com/> with credentials user: [coso@crowd4sdg.eu](mailto:coso@crowd4sdg.eu), password: democoso2023!



current *de facto* standard (D3.js) to develop the monitoring dashboard directly within CoSo, rather than attempt a difficult integration of a deprecated tool. In addition to the live monitoring capabilities within CoSo, we also decided to develop an independent static html dashboard page for the evaluation of the 3 GEAR cycles as a whole, that could serve as a basis for evaluating the program.



## 2. Demonstrator

In this section, we introduce the monitoring and evaluation dashboards that were developed, and provide visual insights into their functionalities.

### 2.1. Use cases

When developing the dashboards, our target persona was a program coordinator, such as a member of the Crowd4SDG organization team, who wishes to monitor and evaluate the engagement and interactions between participants of the program. This consists in our case of data from each of the GEAR cycles, and the possibility to compare them. Other examples would include general participatory / collaborative innovation programs where participants can form teams and interact with other teams, or with the coordinators, in order to advance their projects (see for example open research programs [1,2]). Other examples would be citizen science projects that would want to monitor the participation of their target community. The need from this persona is that communities can get large (few hundreds of participants), and it can become intractable to know for example whether participants are well integrated into the ecosystem, or whether they are siloed and would need to get help to connect to other relevant participants. As such, having access to the architecture of participation is important, i.e. an overall picture of the interaction network.

To answer this need, we worked on two different use cases, focused more specifically on the monitoring and evaluation parts.

For monitoring, we developed a live dashboard that allows a program coordinator to register participants in a database, design and send surveys to participants, asking in particular about their interactions, and visualize both the results of the surveys as well as the analytics on engagement in a visualization dashboard. We also integrated a link to the Slack API in order to allow administrators to visualize the interactions of the community on Slack in the dashboard along with the survey results. We finally focused on an interface where the coordinator can (i) manage the participants database (ii) design and send surveys and (iii) visualize data in a dashboard. Using this tool, a coordinator can therefore monitor more effectively the program, and take informed actions based on the provided visualizations.

For evaluation purposes, we developed a software that takes as input survey results and Slack data from different phases of a program to create an interactive dashboard comparing these phases. The use case here is when, at the end of a program, a coordinator would want to evaluate different phases or different implementations of the programs in different settings. Here, our goal was to develop a code in R that can be easily modified and adapted to custom purposes, providing essential visualizations of geographical, network, qualitative and quantitative data. We implemented this dashboard for the Crowd4SDG project<sup>3</sup>.

### 2.2. Data of interest

The type of data that we wish to monitor are coming from surveys and from a Slack workspace. We focused particularly on network data to assess collaboration and communication within the community of participants. Examples of such network visualizations to monitor participants' interactions can be found in [3,4].

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<sup>3</sup> <https://co-so.app/crowd4sdg-dashboard/>

The interaction networks and task allocation structures linked to the participation processes during the GEAR cycles were probed by specific questions delivered through regular surveys using the CoSo app:

- Which task did you perform last week?
- Who did you collaborate with last week?
- Who did you seek advice from last week?

Moreover, communication activity networks were obtained by using mention and activity data from the public channels of a Slack workspace that was used by the teams during the different phases of the GEAR cycle as a means to communicate with other participants and with the organizing team.

Finally, in addition to the interaction and engagement data, we collected general information about participants and teams through surveys, such as demographic information or the use of tools provided by the consortium. This information was used to feed the custom dashboard for program evaluation.

### 2.3. Program monitoring dashboard

The CoSo app [3], that we introduced in the D4.3 report<sup>4</sup>, has been used as a central platform to collect data on task allocation and collaborations through surveys. CoSo is composed of three main applications. In CoSo, a backend gathers all user data into a structured database and provides an API, allowing for a simplified management and data extraction from the database of GEAR participants. Second, a mobile application allows users to journal tasks, receive notifications, fill surveys and gather immediate insights about their logged data. Finally, a frontend web application allows for data visualization, team management, survey and communication creation by the research team as well as survey filling by users. This is this last interface that we focus on in this section. The platform is currently accessible in its demonstrator version on <https://coso-wl-frontend.herokuapp.com/> with the following credentials:

**user:** [coso@crowd4sdg.eu](mailto:coso@crowd4sdg.eu)  
**password:** democoso2023!

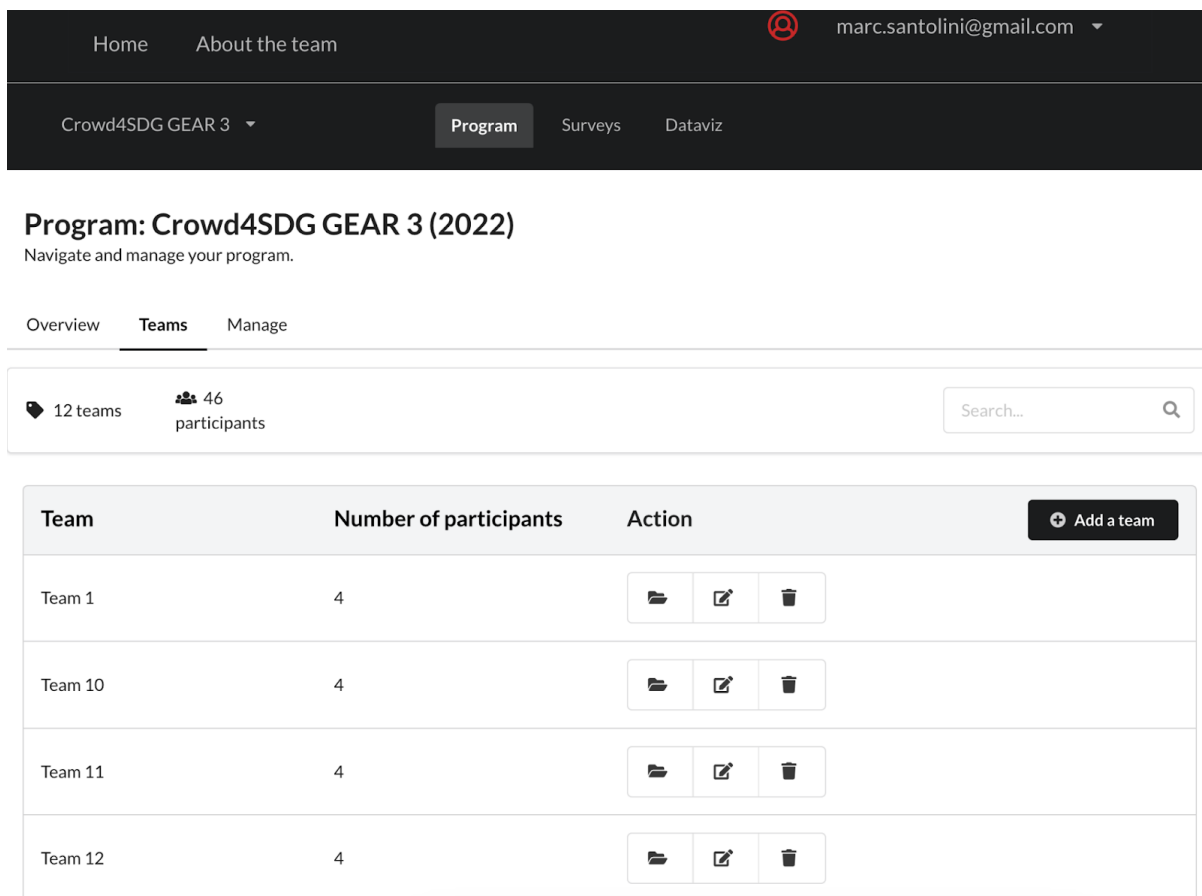
CoSo allows coordinators to register participants in a database, design and send surveys to participants, asking in particular about their interactions, and visualize both the results of the surveys as well as the analytics on engagement in a visualization dashboard. In addition, CoSo integrates APIs to third services to collect further data, such as Slack communication data. As such, CoSo has the ability to provide live monitoring of the participation processes happening during the GEAR cycles. To do so, the CoSo app has been built using a React framework, making it easy to integrate a visualization dashboard with d3.js based visualizations. In our case, we leveraged the Nivo library (<https://nivo.rocks/>) for the visualizations. Moreover, a Web API built with Ruby on Rails underlies all communications between the dashboard and the database. It offers a secure way to query the database for a specific set of data with different layers of protection, in particular sensible data that should only be accessed by the coordinators. For that, a hierarchy of permissions is implemented on top of the API, allowing the accessibility of contents according to the rights given to the user.

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<sup>4</sup>

<https://crowd4sdg.eu/wp-content/uploads/2021/10/D4.3-In-situ-assessment-report-of-citizen-local-interactions-min.pdf>

In order to help coordinators monitor the program, we focused on an interface where the coordinator can (i) manage the participants database (Figure 1) (ii) design and send surveys (Figures 2-3) and (iii) visualize data in a dashboard (Figures 4-5). These have been implemented as “tabs” in the interface, where the coordinator can switch between these functionalities. As such, a typical user journey is first to add participants to the database in the program management section (Figure 1). Then, surveys can be designed and sent in the survey section (Figures 2-3). Some visuals are proposed for each survey to show engagement levels. Finally, interactive visualizations are automatically produced in the visualization section to provide insights on the interactions between participants (Figures 4-5). This last section is designed in a modular fashion in the code base, so that any type of visualization can be added with a simple .js file in the dataviz folder in the codebase.



**Figure 1:** screenshot from the CoSo website dashboard showing the program management section, where coordinators can register users to which surveys are to be sent.

We show in Figure 1 the program management interface for the GEAR 3. Coordinators can register participants and define teams. Figures 2-4 focus on survey design (Fig 2), management (Fig 3) and insights (Fig 4). The survey design allows to create questions focusing on who a participant interacted with across other teams, allowing to feed network visualizations shown in Figure 5. It also allows to create dependencies between questions: e.g., if an interaction was reported with a certain participant, a follow-up question can ask to describe more about that interaction with free text. The visualizations from insights are updated live as participants fill in surveys.

Use the navigator below if you want to restrict the surveys to a subset of teams. If LEFT BLANK, the survey will be sent to all participants.

▼

Survey title \*

GEAR Cycle: Weekly 1

Survey description \*

Share with us about what you did, with whom you worked and your satisfaction!

**GEAR Cycle: Weekly 1**

Share with us about what you did, with whom you worked and your satisfaction!

↑ Question 1 - Checkbox ✕

Question title \*

Which task(s) did you perform last week?

Description

A great question description.

CONTENT

Label Brainstorming / ideation ✖

Label Planning tasks ✖

Label Developing protocols / n ✖

**Which task(s) did you perform last week?**

- Brainstorming / ideation
- Planning tasks
- Developing protocols / methods
- Reading papers / documents
- Collaborating with other teams
- Interpreting results
- Preparing other documents/materials to share outside the team
- Preparing graphics / videos
- Writing / preparing a pitch
- Project administration
- Software development
- Hardware development

Figure 2: survey design interface: on the left, the administrator can add questions, and on the right they can see an interactive preview on the resulting survey.

Crowd4SDG GEAR 3 ▼ Program Surveys Dataviz

**Program: Crowd4SDG GEAR 3 (2022)**  
Create and diffuse your surveys.

List **New Survey**

**GEAR Cycle: Weekly 1**

Share with us about what you did, with whom you worked and your satisfaction!

---

Number of questions: 8

✖
✎
i
🔄
🗑️

**GEAR Cycle: Weekly 2**

Share with us about what you did, with whom you worked and your satisfaction!

---

Number of questions: 8

✖
✎
i
🔄
🗑️

**GEAR Cycle: Weekly 3**

Share with us about what you did, with whom you worked and your satisfaction!

---

Number of questions: 7

✖
✎
i
🔄
🗑️

**GEAR Cycle: Weekly 4**

Share with us about what you did, with whom you worked and your satisfaction!

---

Number of questions: 7

✖
✎
i
🔄
🗑️

Figure 3: dashboard summarizing the different surveys designed.

### GEAR Cycle: Weekly 1

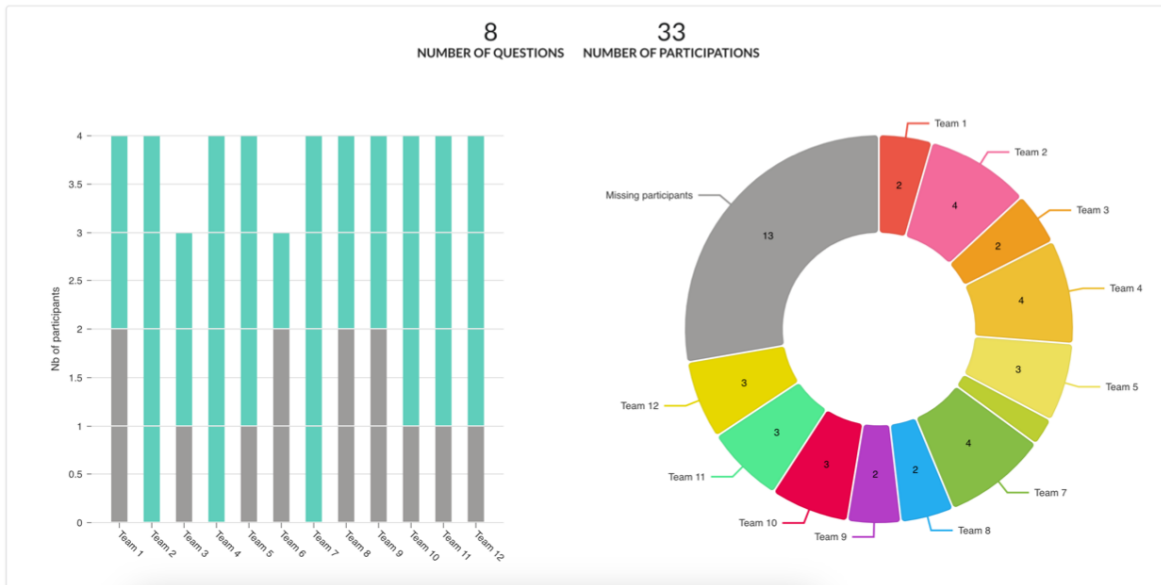


Figure 4: insights on survey results, showing engagement across teams.

Finally, Figure 5 shows the interaction network derived from answers to the surveys about social interactions in GEAR 3. Interactions reported within each survey can be shown separately, or together. Colors denote teams, and node size the number of interactions. These interactive visualizations allow users to select nodes when hovering to see the corresponding participants. Note the high density of interactions within teams, and the existence of interactions between teams (e.g. advice seeking).

### Program: Crowd4SDG GEAR 3 (2022)

Explore and download data visualizations based on survey responses from your program participants.

Interactions Surveys Program Custom

Use the navigator below to select the questions you want to visualize:

- GEAR Cycle: Weekly 1: Who did you work with last week? ✕
- GEAR Cycle: Weekly 1: Who did you seek advice from last week? ✕
- GEAR Cycle: Weekly 1: Which of these people did you know personally before? ✕
- GEAR Cycle: Weekly 2: Who did you work with last week? ✕
- GEAR Cycle: Weekly 2: Who did you seek advice from last week? ✕
- GEAR Cycle: Weekly 2: Which members outside of your team did you know personally before? ✕
- GEAR Cycle: Weekly 3: Who did you work with last week? ✕
- GEAR Cycle: Weekly 3: Who did you seek advice from last week? ✕
- GEAR Cycle: Weekly 4: Who did you work with last week? ✕
- GEAR Cycle: Weekly 4: Who did you seek advice from last week? ✕

#### Network of interactions between participants



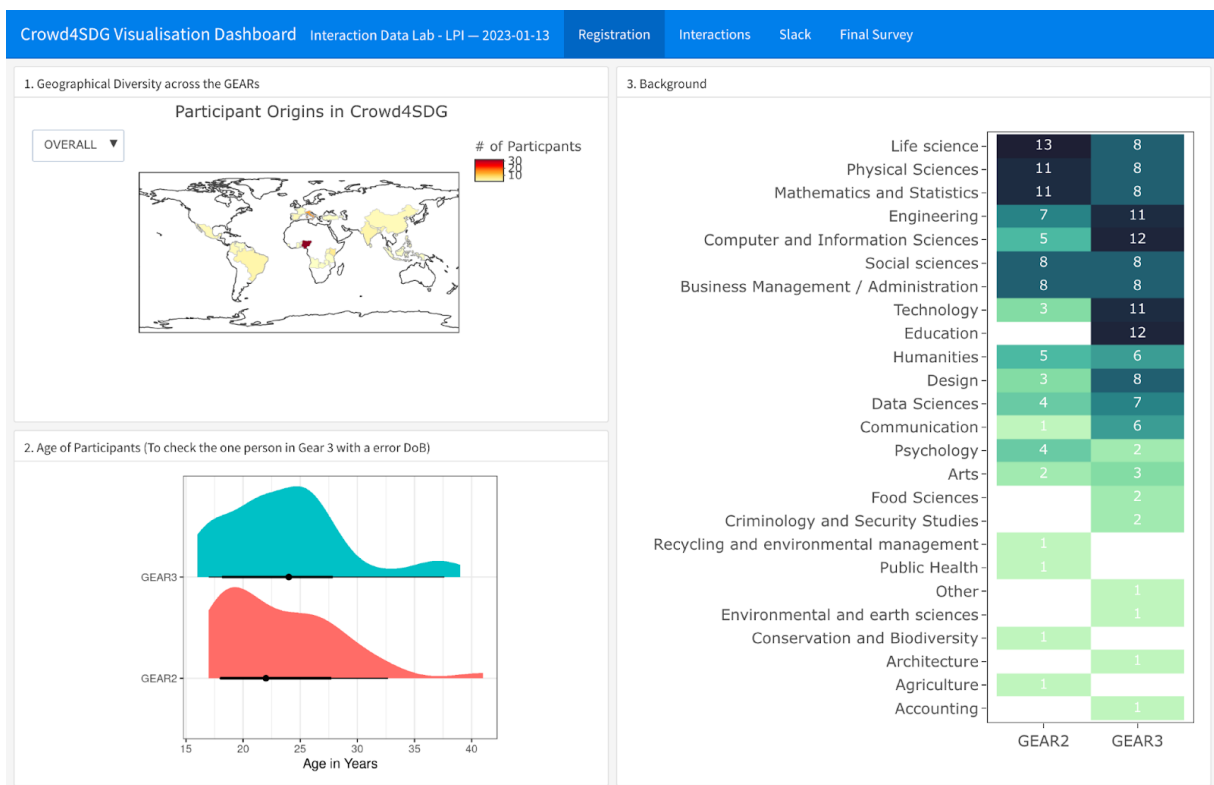
The network is reconstructed using the interaction data from the surveys, including questions about who participants worked with, sought advice from, and knew before.

**Figure 5:** network visualization showing reported interactions between participants across the four weekly surveys (reporting prior ties, advice seeking, and collaboration). Colors represent the different participating teams.

## 2.4. Program evaluation dashboard

In addition to the CoSo dashboard, which is a live dashboard updated continuously as novel data is collected during a GEAR cycle, we developed a static interactive dashboard in order to gain a bird’s eye view of the different GEAR cycles from the entire Crowd4SDG project. The dashboard is public and can be accessed at <https://co-so.app/crowd4sdg-dashboard>. The code has been made available open-source on Github<sup>5</sup>.

We show in Figures 6-9 an overview of the visualizations provided, encompassing demographic data, survey on tool usage, collaboration and communication networks. The visualizations allow coordinators to quickly compare several phases of the project, in this case GEAR 2 and GEAR 3, to gain insights on how changes in coordination method might have affected the program.

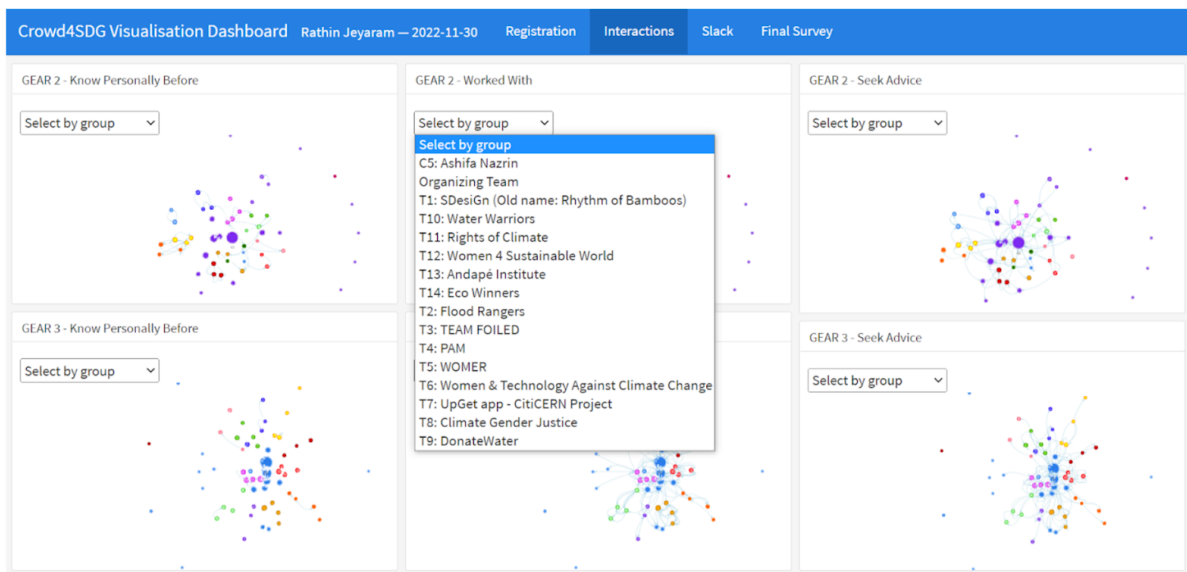


**Figure 6:** demographic information about participants across GEAR cycles 2 and 3.

<sup>5</sup> <https://github.com/InteractionDataLab/crowd4sdg-dashboard>



**Figure 7:** comparison of usage of different tools provided by the consortium across GEAR cycles.



**Figure 8:** interaction networks derived from survey data. Selectors allow the user to filter by team to facilitate investigations.



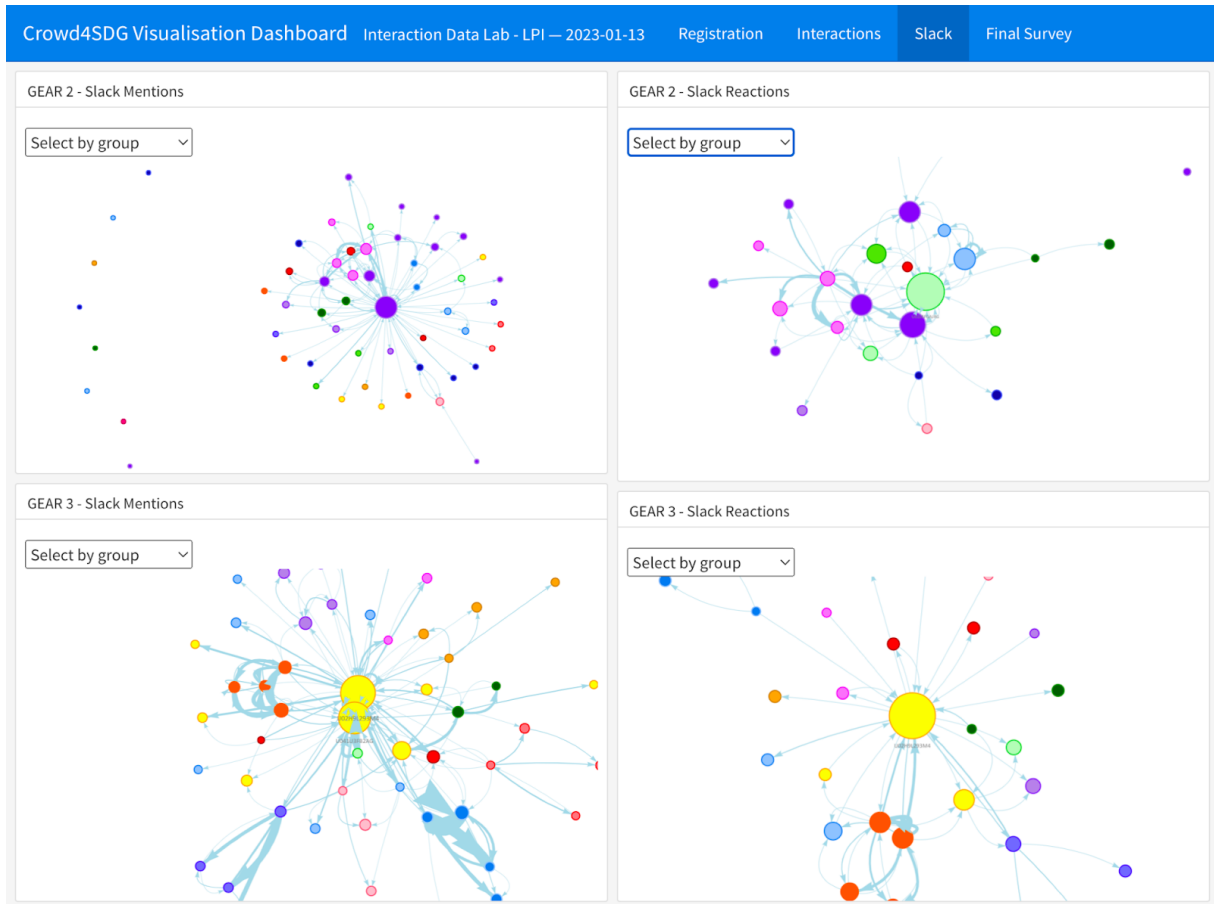


Figure 9: same as Fig 8, for Slack data.

### 3. Summary

In this demonstrator, we present two visualization dashboards for the monitoring and evaluation of participation processes in the GEAR cycles.

First, we developed an Insights section in the CoSo platform, allowing program coordinators to visualize the data continuously collected through surveys. The dashboard has been developed in a modular manner, with a standard javascript library, so that additional visualizations are easy to implement. Moreover, the CoSo platform and this dashboard can be used beyond Crowd4SDG to allow coordinators to monitor participatory processes within their community.

In addition, we developed an overall static interactive dashboard to evaluate the different phases of a program, in our case comparing the different GEAR cycles. This dashboard has been developed as an R code using standard libraries, and showcases both data from surveys as well as from the Slack workspace. The code has been made available open-source on Github<sup>6</sup>. As such it can be easily re-implemented for similar programs.

Overall, these dashboards serve as a basis for facilitating monitoring and evaluation of participatory processes within citizen science programs, and more generally for the coordination of teams and communities.

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<sup>6</sup> <https://github.com/InteractionDataLab/crowd4sdg-dashboard>

## 4. References

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- [3] Tackx, R., Blondel, L., & Santolini, M. (2021). Quantified Us: A group-in-the-loop approach to team network reconstruction. *Adjunct Proceedings of the 2021 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2021 ACM International Symposium on Wearable Computers*, 502–507. <https://doi.org/10.1145/3460418.3479363>
- [4] Masselot, C., Jeyaram, R., Tackx, R., Fernandez-Marquez, J. L., Grey, F., & Santolini, M. (2022). *Collaboration and Performance of Citizen Science Projects Addressing the SDGs*. <https://hal.archives-ouvertes.fr/hal-03808080>

## Annex 1: list of abbreviations

Abbreviation	Description
AI	Artificial Intelligence
CBI	Challenge-based Innovation (in-person coaching)
CoSo	Collaborative Sonar
CS	Citizen Science
GEAR	Gather, Evaluate, Accelerate, Refine
NSO	National Statistical Office
O17	Open Seventeen Challenge (online coaching)
SDG	Sustainable Development Goal
WP	Work Package