Developing metrics and instruments to evaluate citizen science impacts on the environment and society

EC Horizon-2020 Grant Agreement number 824711

Call: H2020-SwafS-2018-2020 (Science with and for Society)

Topic: SwafS-15-2018-2019

Type of action: RIA

Deliverable 3.4: Participatory adaptive, personalised information-delivery web platform, period - 1 prototype (P1P)

Delivery Year: 2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824711.

Document Information

Project Number	824711		**Acronym**	MICS
Full title	Developing metrics and instruments to evaluate citizen science impacts on the environment and society			
Project URL	**www.mics.tools**			
EU Project officer	Yiannis Vacondios			
Deliverable	**Number**	D3.4	**Title**	*Participatory adaptive, personalized information-delivery web platform, period – 1 prototype (P1P)*
Work package	**Number**	3	**Title**	*Toolboxes for methods application, information visualisation, and delivery to decision makers, citizens and researchers*
Date of delivery	**Contractual**	Month 18, June 2020	**Actual**	Month 18, June 2020
Dissemination Level	Public			
Authors (Partner)	James Sprinks (Earthwatch)			
Responsible Author	Albert Scrieciu		**Email**	albert.scrieciu@geoecomar.ro
	Partner	GeoEcoMar		
Abstract (for dissemination)	The MICS platform prototype for period 1 presents the first incarnation of the MICS system and its user interfaces. It is intended to be a demonstration of the technology required to produce a stable platform, and a first consideration of some of the usability issues and potential design solutions. It will form the basis for an iterative design process running up to D3.5 (the period 2 prototype), which will more fully involve the assessment methodologies derived in WP2, and respond to the validation activities of WP4.			
Keywords	Software, platform, design, interfaces, usability			

Version Log

Version as date	**Author**	**Partner**	**Change**
2020_06_08	James Sprinks	Earthwatch	Initial document creation and formatting
2020_06_16	James Sprinks	Earthwatch	First draft
2020_06_23	James Sprinks	Earthwatch	Second draft based on RRC feedback
2020_06_29	James Sprinks	Earthwatch	Third draft based on RRC feedback
2020_06_29	Albert Scrieciu	Earthwatch	Final draft

To cite this document:

Sprinks, J., Ceccaroni, L., Parkinson, S., Woods, S.M. & Scrieciu, A. (2020). D3.4: Participatory adaptive, personalised information-delivery web platform, period – 1 prototype (P1P). *Deliverable report of project H2020 MICS (grant agreement No 824711)*

Contents

1 Executive Summary

The MICS web platform prototype (P1P) describes the first iteration of the platform on which the MICS toolbox will run, and from which further incremental development and integration will originate. It establishes the initial functional specifications of the end-user MICS interface and utilises open-source solutions for both front and back-end development. To ensure semantic interoperability where possible the prototype follows terminology as defined by deliverable 2.5: The MICS ontology and other terms defined by the COST Action working group on data standardisation and interoperability (COST Action, 2020).

2 Introduction

2.1 The context within the MICS Project

The purpose of the MICS project is to investigate how citizen science adds value to research and innovation, and in doing so better understand the opportunities to improve this process. The project will develop several methods and procedures to measure citizen science impact, modified to be fit for purpose and will include original impact assessment indicators. To this end, the MICS project will collect a range of different data, both qualitative and quantitative, from several sources.

Deliverable 3.4 presents the initial prototype of the MICS platform. The platform represents the gateway through which end-users, be they citizen science practitioners, participants, reviewers, policy makers or other stakeholders, will be able to access the MICS toolbox, to better understand the strengths and weaknesses of their project in terms of impact. It will provide a space to review project attributes, understand the MICS process when assessing impact, and review outputs to help realise potential impact in the future. As such, this prototype represents a first attempt of an iterative process, with the platform being amended and approved **upon through a user-centred approach.**

2.2 Context within WP3

WP3 will identify, adapt and develop (as appropriate) impact assessment tools for MICS, based on input from WP2 with respect to relevant concepts and methodologies identified. This input will aid the implementation of the tools and their initial running. The WP will also be informed by the validation activities conducted in WP4.

To incorporate all this information, WP3 will work in short and focused iterations. As such, D3.4 represents the first prototype platform of this iterative process. It is informed by D3.1 (Report on the technical requirements) and follows terminology and ontologies derived through T3.1 (Collaborative synthesis), and involves a first attempt at integrating the initial impact assessment tools derived as part of T3.2 (Tools for measuring the impact of citizen science). As a first practical instance of the platform, this deliverable will also present a first look at the visualisation tools and user-interaction layer for impact measurement, developed as part of tasks 3.5 (Development of mapping and visualisation tools) and 3.6 (Development of the user-interaction layer) respectively in conjunction with partners GeoEcoMar, GEO and RRC.

3 Technical structure

Core to the principles of the MICS project is accessibility and the sharing of resources. The structure of the MICS platform is no exception, with open-source repositories, servers and development frameworks being utilised for both the front and back-end of the system. The following technologies have been used for the prototype MICS platform:

- **Apache:** free and open-source cross-platform web server software, released under the terms of Apache License 2.0. Apache is developed and maintained by an open community of developers.
- **MariaDB:** a community-developed, commercially supported fork of the MySQL relational database management system, intended to remain free and open-source software under the GNU General Public License.
- **Laravel:** a free, open-source PHP web framework, intended for the development of web applications following the model–view–controller architectural pattern.
- **Vue:** an open-source model–view–viewmodel (MVVM) JavaScript framework for building user interfaces and single-page applications.
- **D3:** a JavaScript library for producing dynamic, interactive data visualizations in web browsers. It makes use of Scalable Vector Graphics, HTML5, and Cascading Style Sheets standards.
- **Greensock:** an industry standard JavaScript animation library that lets you craft high-performance animations that work in every major browser.

The prototype MICS platform can be found by following this development domain link.

4 Platform design

The prototype MICS platform has been separated into 3 distinct user-interfaces for design purposes:

1. The project space, where users can sign-up, create a space for their project, add general details and access the MICS tools;

2. The impact assessment interface, where users can input data regarding their projects' impact associated with the five domains of environment, economy, society, science and governance; and
3. The impact assessment output, where users can access a report of their projects' impact, strengths, weaknesses and suggested actions.

In order to ensure that these interfaces are accessible, intuitive and easy-to-use, Nielsen's 10 general principles for interaction design have been followed, which provide a broad rule of thumb of how interfaces should function (Nielsen, 1995). They are as follows:

1. **Visibility of system status:** The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
2. **Match between system and the real world:** The system should speak the users' language with words, phrases and concepts familiar to the user, rather than system-oriented terms.
3. **User control and freedom:** Users often choose functions by mistake and will need clearly marked 'emergency exits' to leave the unwanted state; support undo and redo.
4. **Consistency and standards:** Users should not have to decipher whether different words, situations, or actions mean the same thing.
5. **Error prevention:** Better than good error reporting is a careful design that prevents a problem occurring in the first place.
6. **Recognition rather than recall:** Minimise the user's memory load by making artefacts, actions and options visible.
7. **Flexibility and efficiency of use:** Allow users to tailor frequent actions to their behaviour, whether they are inexperienced or experienced.
8. **Aesthetic and minimalist design:** Dialogues should not contain irrelevant or rarely needed information. Every unit of information competes with each other, diminishing their visibility.
9. **Help users recognise, diagnose, and recover from errors:** Error messages should be expressed in plain language, precisely indicate the problem, and constructively suggest a solution.
10. **Help and documentation:** Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

4.1 The project space

The project space interface is effectively the landing page of the MICS platform. It is where users can sign-up to the platform and create a space for their project by entering general details about it. In order to adhere to the heuristics mentioned earlier, a social media feel in terms of design and visualisation has been taken, as this provides an intuitive user experience, especially when creating a personalised page. If the user is visiting the platform for the first time, they are presented with a sign-in dialogue, as seen in Figure 1. It utilises a single sign in approach, which provides access to multiple applications by passing an authentication token seamlessly to configured applications (Google authentication is shown in the figure). By doing this, the MICS database does not need to collect unused password and username data that could potentially be identifiable and therefore a privacy risk.

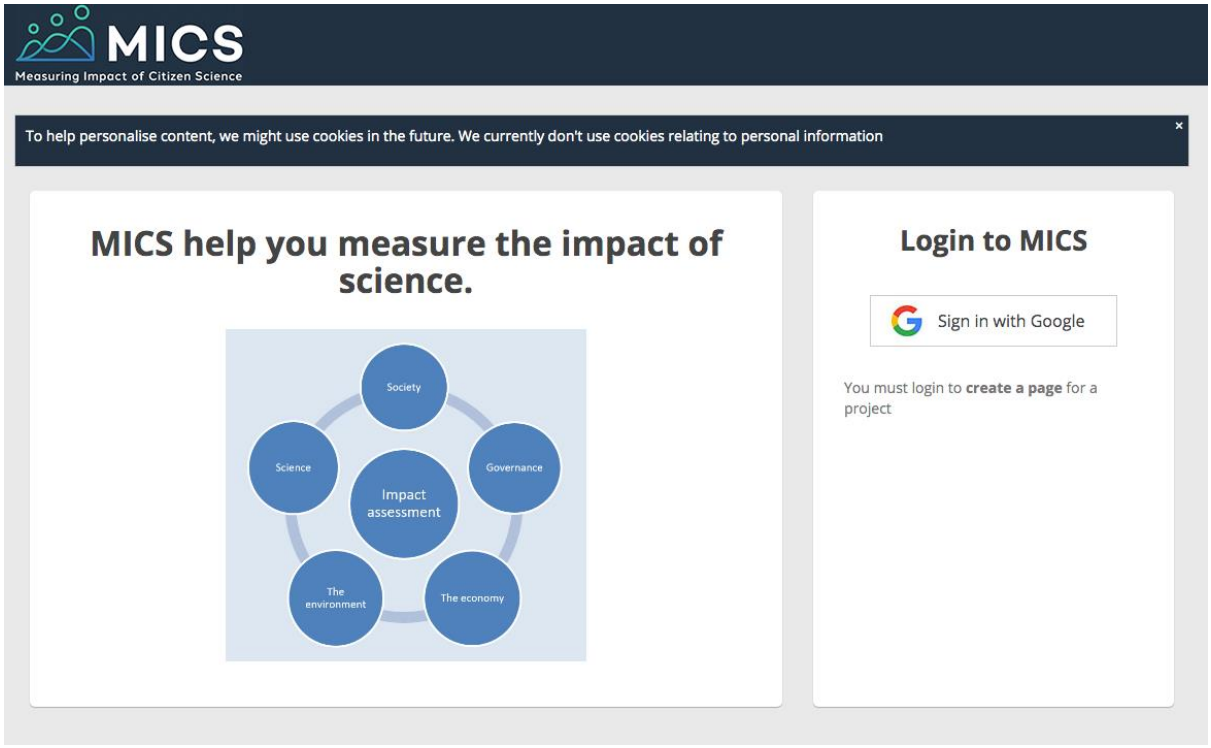

Figure 1: Prototype MICS platform sign-in page

Once the user has signed, in they can create a page for their project. Here general project details can be added such as its name, URL, location, logo and contact point. Figure 2 shows a project page for the MarsCAPE project (www.marscape.wordpress.com).

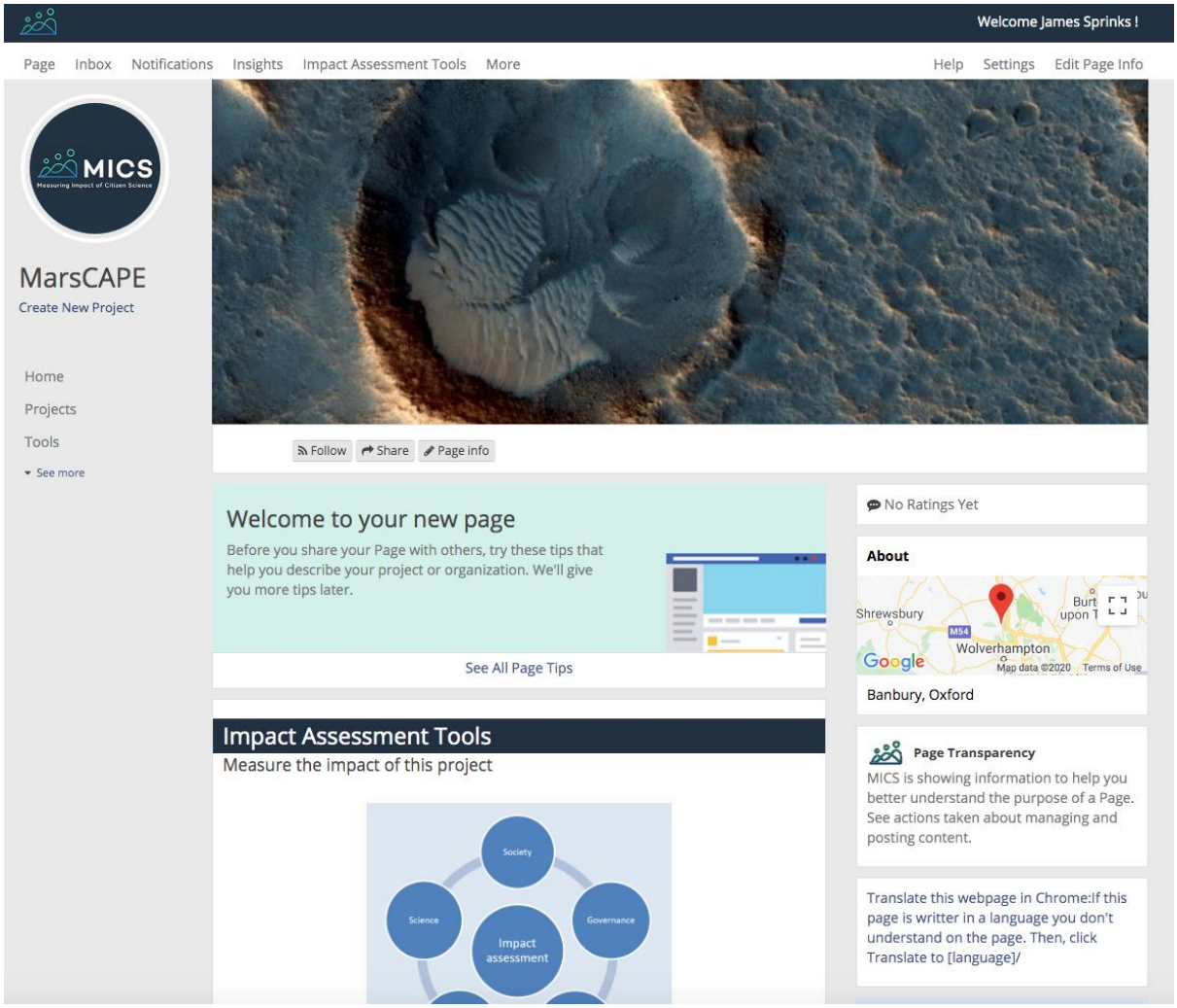

Figure 2: Prototype MICS platform example project page (MarsCAPE)

In addition to the general project details, the design also includes general, standardised navigation tabs (Home, Tools, Help, Settings etc.), and also provides an access point to the second user interface of the MICS platform, the impact assessment interface.

4.2 Impact assessment interface

The impact assessment interface of the prototype MICS platform represents the most complex procedure of the user journey. Whilst the creation of sign-in credentials and a personalised space is a widely known mechanism used on several platforms, the capture of impact and its assessment is much more unique. As such, it presents a design challenge for the MICS consortium, with few previous examples to influence the prototype approach. It is likely that in order to fully assess the impact of a particular citizen science project, a wide range of inputs will need to be collected, through many questions (perhaps into the hundreds) presented to the user. This will take time and commitment, and therefore the impact assessment interface needs to be easy-to-use, engaging and informative – reassuring the user that the information they are supplying is of benefit to both the MICS platform and themselves (i.e. worth their time to complete).

In order to achieve this, the concept of user trajectories has been used to inform the design. Trajectories explain the user experience as a journey through structures, punctuated by transitions,

and in which interactivity and collaboration are orchestrated (Benford et al., 2009). They identify not only the intended, canonical user trajectory as envisaged by the designer of the system, but also possible divergences that can occur, and mechanisms that can be used to orchestrate the user back to the intended path. Figure 3 visualises the user paths, and possible divergences and convergences that can occur.

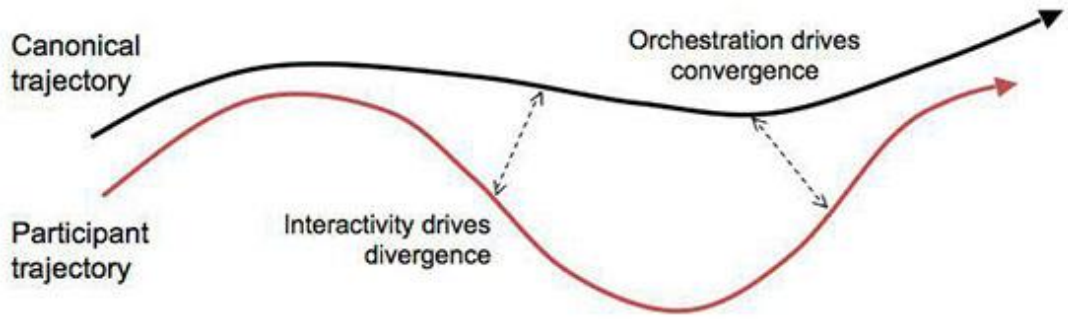

Figure 3: User trajectories, divergences and convergences - the canonical trajectory represents the user path as intended by the developer of the system, the participant trajectory represents their actual path, with divergences and convergences taking them away from and back towards intended behaviour.

It is important that possible divergences, and the solutions to them are identified as early as possible in the MICS platform design process, to mitigate future issues they could cause. As part of the prototype design process, possible divergences that have been considered are:

- **Fatigue:** A lot of questions need to be answered, causing disengagement through fatigue and loss of interest.
- **Lack of knowledge:** The user cannot answer a question, or does not have the information to hand to complete it.
- **Lack of purpose:** The user not connecting with a reason for completing the task, not informed of how they will benefit.

Taking these possible divergences into account, and following Nielsen's design heuristics, Figure 4 shows the initial design of the impact assessment interface for the MICS platform prototype. It concentrates on the Environment domain, but can be seen as a blueprint that the other domains will follow.

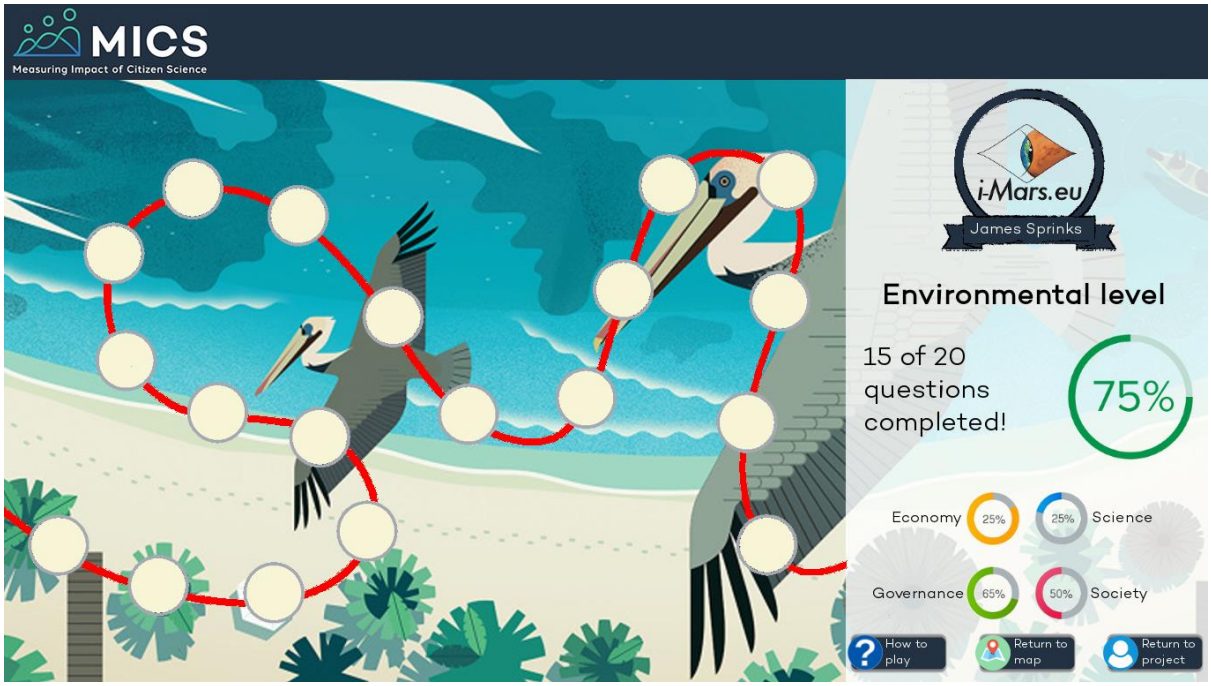

Figure 4: Prototype MICS platform impact assessment interface (environment)

The left of the interface comprises of the question interaction, with each of the circles representing a question to be completed, which will change colour to indicate that an answer has been supplied. The right of the interface shows the information screen. In addition to the general information regarding the project (i-Mars.eu), the user (James Sprinks) and other navigation buttons (How to play, etc.), it contains triggers to help address some of the possible divergences previously described:

- **Fatigue:** Dials are displayed showing the users' progress through each domain. Also, in conjunction with the sign-in and project space process, it is envisaged that the user can leave the system and return at any time, with previous contributions being saved.
- **Lack of knowledge:** The questions can be answered in any order, so the user can prioritise those that can be more easily addressed at the time. Also, the questions can be ignored if it is felt they are not applicable to the project. Finally, the user can navigate to other domains, if the information is more readily to hand.
- **Lack of purpose:** It is hoped that the progress dials can provide a gamification aspect to the interface, with users encouraged by their progress. Whilst not fully developed for the prototype platform, consideration has been given to interrupting the process. By punctuating the questions with displaying information regarding impact, their answers, and other topical subjects, it will be possible to lengthen the users' engagement (Diner et al., 2018; Herrmann & Nierhoff, 2017). The information displayed can demonstrate why assessing impact is important with examples, increasing the user's connection with the task and its benefits.

At any point that the impact assessment interface is in use, the user can return to a central map, where other domains can be accessed. This allows for easy navigation, with the user able to drop in and out of domains as they wish, and as they have the relevant information available. Figure 5 shows a prototype visualisation of the map screen, with the domains signposted.

Figure 5: Prototype MICS platform impact assessment domain map

As with Figure 4, dials display the users progress in answering the questions of each domain, whilst the areas of desert around each signpost will become more developed as more questions are completed – providing an extra gamification element.

4.3 Impact assessment output

The final user interface of the prototype is the MICS assessment output. Again, this is a very important part, representing the reward to the user of all the contributions made during the assessment process. The assessment output interface presents the output of the MICS algorithm and assessment tools, which are still being developed and refined (Task 3.2 Tools for measuring the impact of citizen science; Task 3.3 Production of a citizen-science toolbox, and WP2: Task 2.7 Recommendations on impact evaluation of citizen science) as a major part of the remainder of the project duration. As such, the visualisations shown in this deliverable should be seen as design examples, rather than any definitive final measure of impact for the projects shown or the marks awarded. Figures 6-9 shows the prototype MICS impact assessment output.

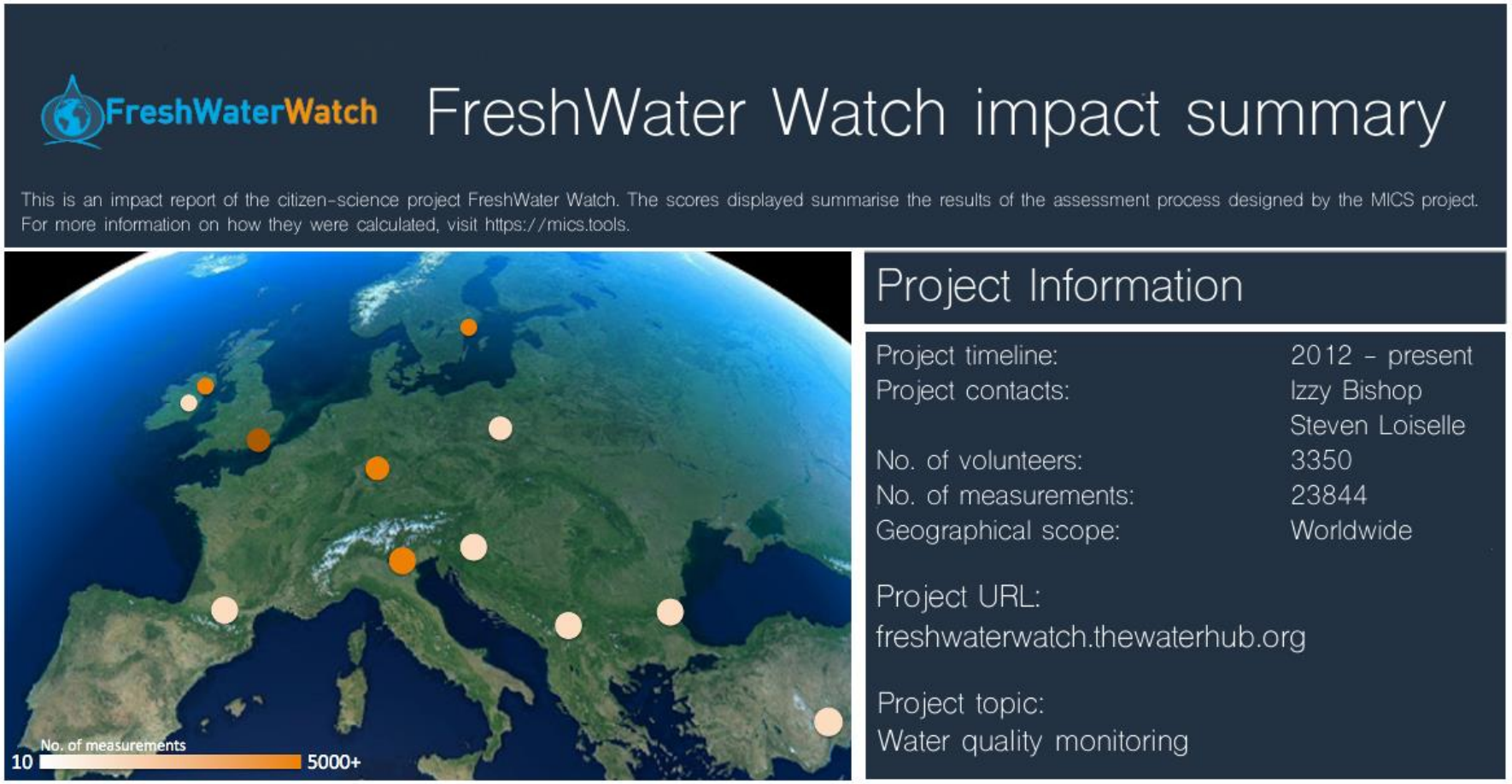

Figure 6: Impact assessment output project overview

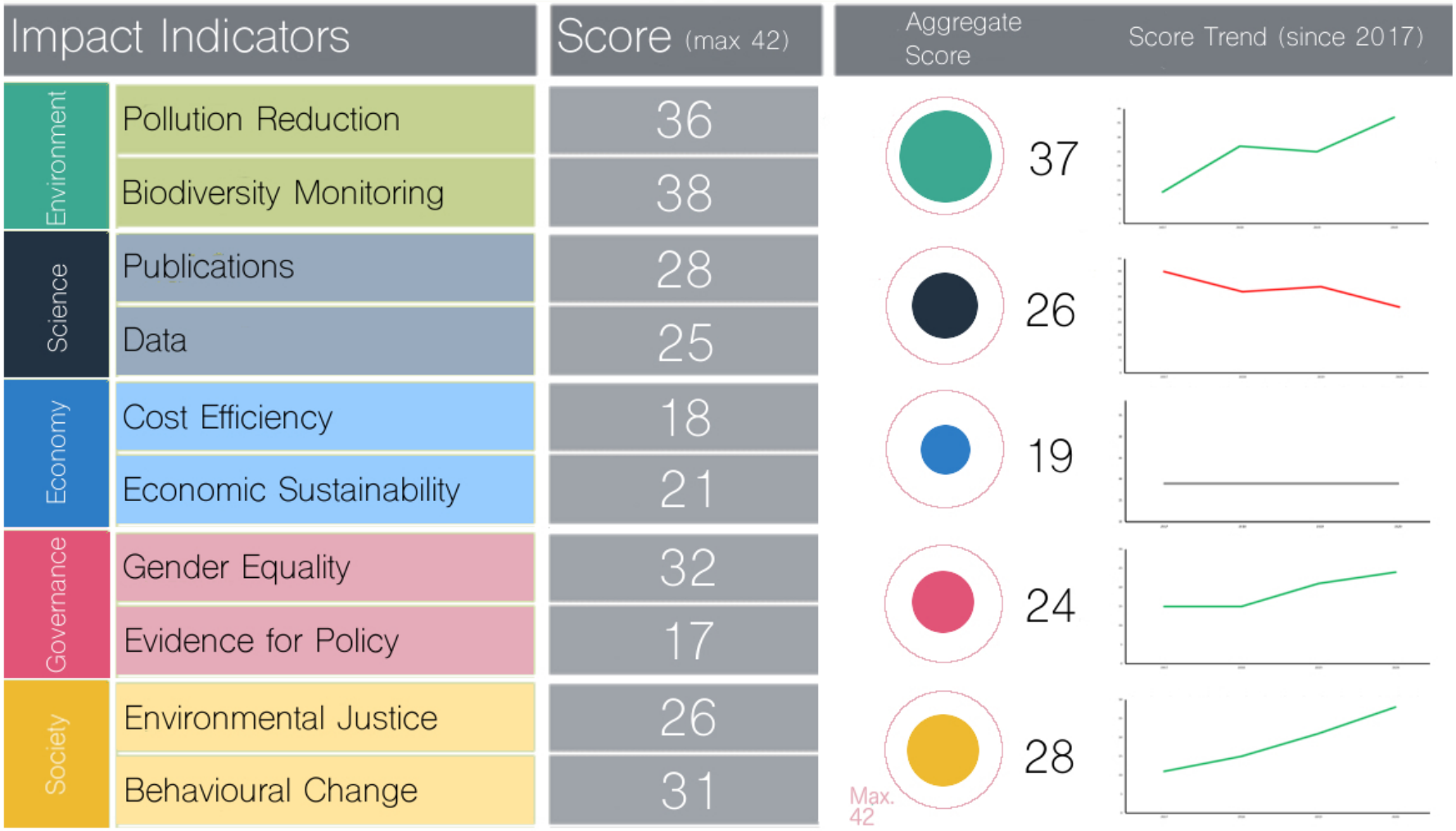

Figure 7: Impact assessment output domain scores

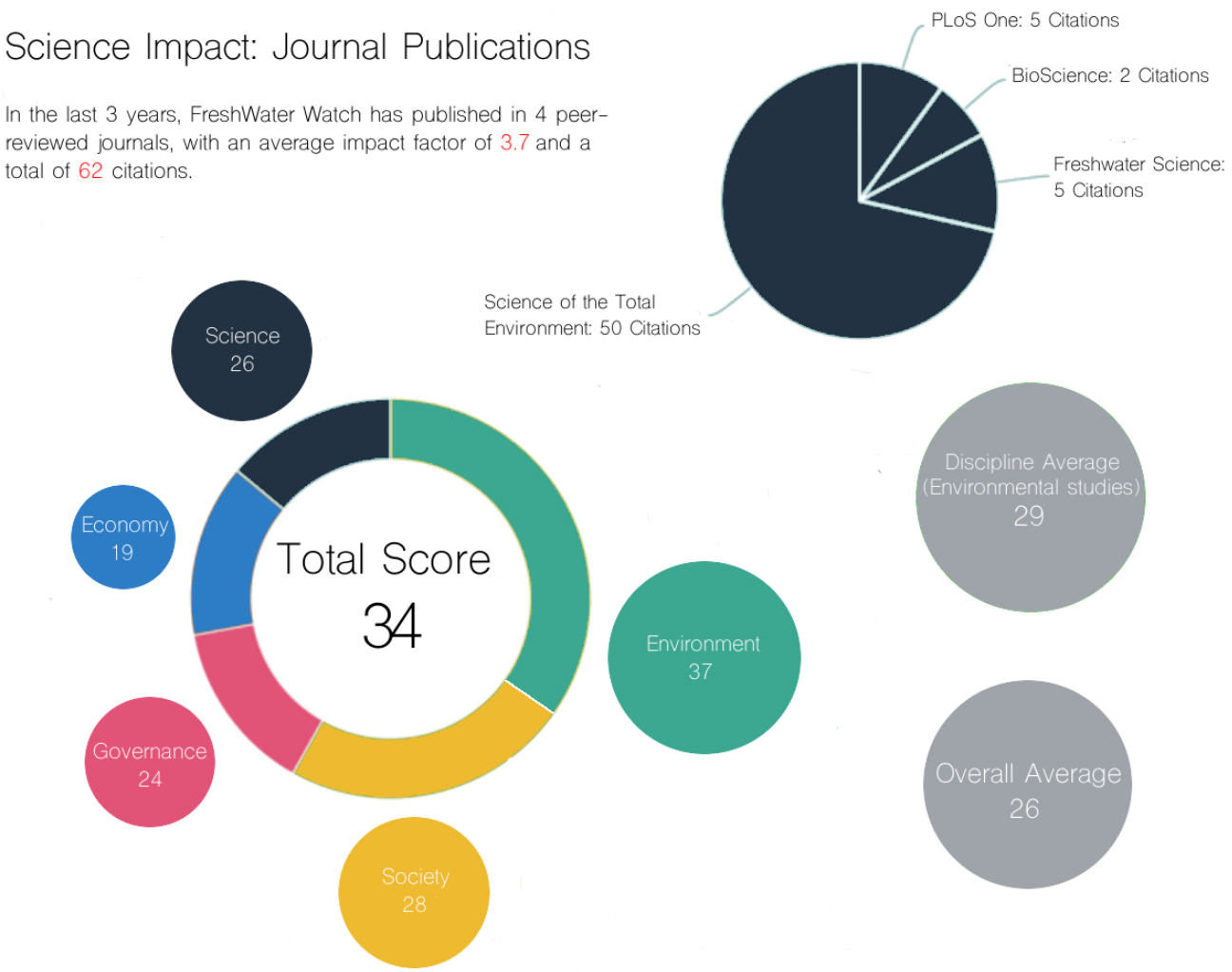

Figure 8: Impact assessment output domain detail

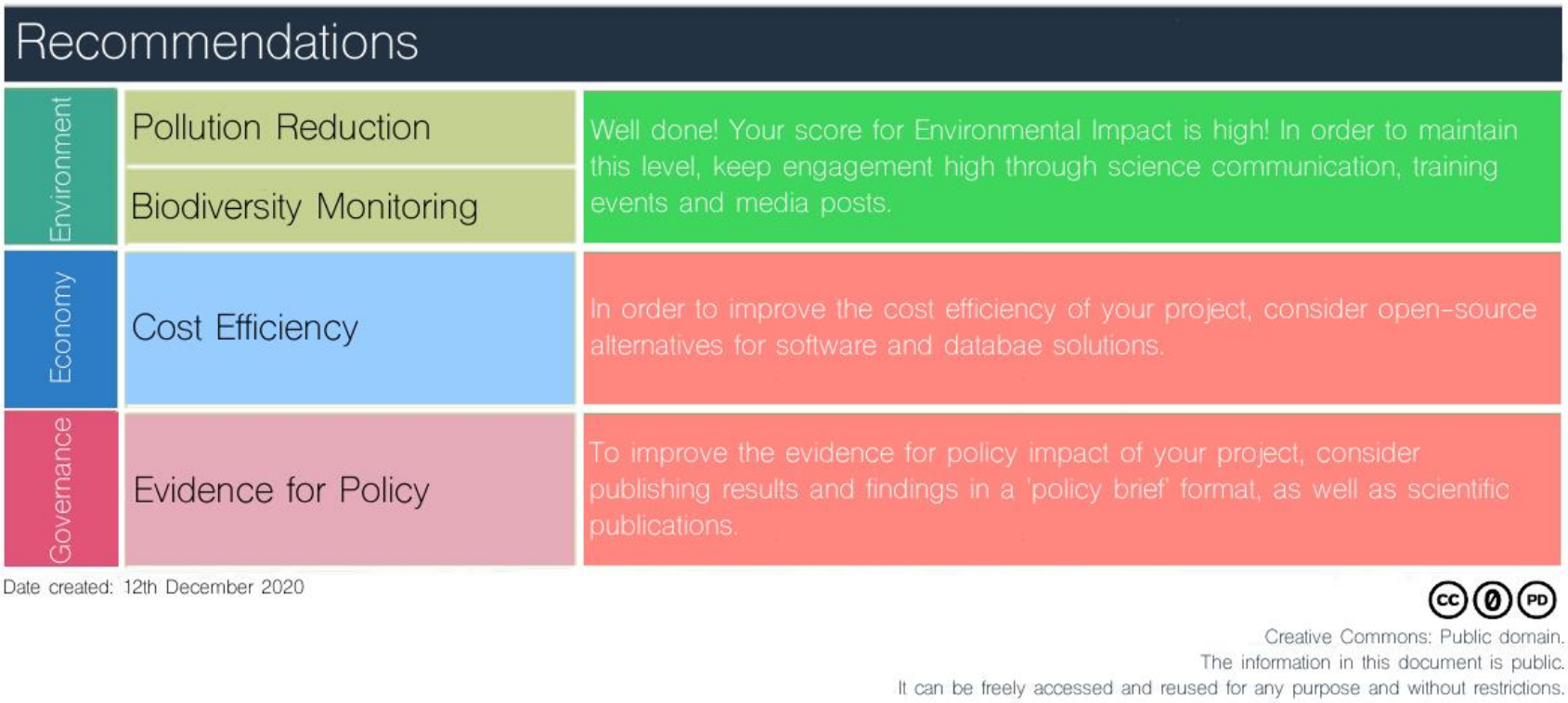

Figure 9: Impact assessment output recommendations

As can be seen the impact assessment output comprise of four sections:

- **Project overview:** Displaying general project details regarding contacts, size, duration and location to give context to the impact report.
- **Domain scores:** A breakdown of the projects' impact score split by domain, and also by indicator. It also shows an aggregated score for each domain, and a trend graph showing how the score has evolved through the project duration.
- **Domain detail:** A drilled-down visualisation of each domain, selectable by the user. In this example (science), it displays the journals that the project has published in, and compares the projects' score with both the discipline (in this case environmental studies) and the overall average of every project on the MICS platform.
- **Output recommendations:** Guidance presented to the user, on how to improve scores that are lower than others, and how to maintain impact scores that are already high.

The output presented in the prototype MICS platform is intended to be an easy-to-absorb snapshot of a projects' impact. As the platform and its associated tools are further developed, taking into full account the outputs of WP2, it is envisaged that users will additionally have the option to download a more complete report of their impact, describing the MICS assessment process.

5 Future development

This deliverable describes the very first incarnation of the MICS platform. Between the time of writing and the final MICS prototype for period 2 (D3.5, due month 33), platform development will continue. Whilst the prototype acts as a basis for the technologies required to create a stable platform, it will also provide the starting point for an iterative design process. During this time, several design steps will take place, each further integrating the assessment methodologies developed as part of WP2, and taking into account user feedback regarding functionality and design issues, including from the validation activities of WP4 and other consortium partners.

6 References

- Benford, S., Giannachi, G., Koleva, B., & Rodden, T. (2009). From interaction to trajectories: Designing coherent journeys through user experiences. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 709–718. https://doi.org/10.1145/1518701.1518812
- Diner, D., Nakayama, S., Nov, O., & Porfiri, M. (2018). Social signals as design interventions for enhancing citizen science contributions. *Information, Communication & Society*, *21*(4), 594–611. https://doi.org/10.1080/1369118X.2017.1299779
- Herrmann, T., & Nierhoff, J. (2017). Prompting – A Feature of General Relevance in HCI-Supported Task Workflows. In C. Stephanidis (Ed.), *HCI International 2017 – Posters' Extended Abstracts* (pp. 123–129). Springer International Publishing. https://doi.org/10.1007/978-3-319-58750-9_17
- Nielsen, J. (1995). *10 Heuristics for User Interface Design: Article by Jakob Nielsen*. Nielsen Norman Group. https://www.nngroup.com/articles/ten-usability-heuristics/