

# Dynamic Collaborative Visualization of the United Nations Sustainable Development Goals (SDGs): Creating an SDG Dashboard for Reporting and Best Practice Sharing

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**Abstract:** Dynamic data visualization is a collaborative dashboarding methodology used to identify trends and insights in data while revealing changes in activity and work progress. This paper introduces a dashboard technique that collects, reports, and shares global business schools' fulfillment of the United Nations Sustainable Development Goals (SDGs)--the SDG Dashboard. With this tool, business schools can share experiences with the goal of promoting sustainable change and advancing the work (e.g. research papers, partnerships, and syllabi) being done internationally within schools. By revealing patterns and trends that may not be evident when reading individual school level accounts of SDG alignment, this dashboard was created to promote inter-school collaboration while highlighting best practices. Overall, it can be used as a high-level assessment tool to highlight areas of greatest impact on the SDGs as well as opportunities for growth. The SDG Dashboard allows users to drill down into the data, revealing patterns of global impact, while also highlighting the breadth of work that is being done. This dynamic dashboard is an agent for collaborations in all topics outlined in the United Nations Sustainable Development Goals, which are: sustainable economic growth, responsible consumption and production, availability for decent work, poverty eradication, cleaner energy, environmental conservation, and the foray of issues concerning overall inequality and quality education.

## 1 INTRODUCTION

This paper introduces a dynamic dashboard visualization technique with a primary focus on fostering collaboration. The dashboard itself is dynamic in two respects. First, the end goal of interacting with the data is to provide academics worldwide with information that stimulates change or advances progress as to how SDGS are taught, studied, and processed and second the drill down feature allows for a changing view of the data depending on the focus of the viewer. In this paper the term collaborative means working with a variety of schools and faculty, the dashboard represents the shared use of computer-supported, (interactive) visual representations of data by more than one person with the common goal of contribution to joint information processing activities (as defined by Isenberg et. al., 2011). To be truly collaborative, the goal is to concisely share best practices to promote change in the world. The use of a dashboard as the

method of sharing the data was chosen as the graphical interface allows at-a-glance key information while also providing drill down functionality allowing for both broad and narrow information retrieval. Before explicating the technique, it is important to establish some background on the context for its application. Our work is both an exploration of an innovative visualization technique, as well as a solution to the particular problem of usefully communicating and analyzing large amounts of data referencing social and environmental transformation promoted by the United Nations.

On the heels of the successful 2000 campaign to address Millennium Development Goals, the United Nations generated a new set of 17 Sustainable Development Goals (SDGs) to be realized by 2030. The SDGs include some of the same goals as the Millennium Goals, but their reach extends into an even wider range of transformative social and environmental objectives like promoting decent work

and economic growth; advancing sustainable industry, innovation, and infrastructure; stewarding life below water and on land; and collaborating to foster peace, justice, and strong institutions. Since their launch, the SDGs have become strategically adopted in many sectors: nation-states, corporations, non-governmental organizations, and higher education institutions.

All of these sectors share a common problem of performance reporting, how to thoughtfully “manage what they measure” in terms of fulfilling these goals; the SDG Dashboard was developed as a pilot for the global business school membership organization Principles for Responsible Management (PRME). The initial goal was to collect and share data about how schools are teaching, researching, and partnering with other institutions to influence change related to the SDGs. Participating business schools pledged to collect information on how they participated as teachers, researchers, and practitioners in understanding methods to address their goals. These reports aim to communicate each school’s effectiveness in addressing SDGs and provide best practices. Through an iterative and open discussion collaboration, the SDG Dashboard was created to expand the work being done globally, and collect and disseminate this data in one location with input from multiple institutions, academics, and students.

## 2 LITERATURE REVIEW

Simple data visualizations have been used as a tool to monitor and report SDGs in many studies. Clements, Sarkar, & Wei (2014) considered satellite photos visualized in grid space to identify vegetation changes in South Africa to address food scarcity (SDG 2: Zero Hunger) and WattDepot (Brewer, Lee, and Johnson, 2011) provided enterprise-level collection, storage, analysis, and visualization of energy data (SDG 7: Affordable and Clean Energy) to effect behavior change and energy literacy. Individuals have done work to assess metrically and visually how they have been able to impact needs for a specific goal or a set of goals and prepare great interactive dashboards to display their efforts. There is value in these individual dashboards to inform users about SDG impact data as there is value in the papers being done by academic researchers, and in the partnerships being forged by institutions with in need communities. Our collaborative dashboard provides an opportunity to present all work being done from various sources in one location creating a resource that can provide computer supported

cooperative work (CSCW) as multiple schools share data and insights that enable the dashboard to grow while also being open to adapting the dashboard to the needs of the users. The term computer supported cooperative work, first coined by Greif and Cashman in 1984, considers the depth to which we use technology to support people in their work (Grudin 1994). As stated by Iseberg et al. (2011) traditional visualization and visual analytics tools are typically designed for a single user interacting with a visualization application on a standard desktop computer. However, extending these tools to include support for collaboration clearly goes a long way towards increasing the scope and applicability of visualization in the real world (Isenberg et al 2011). This dashboard can be used to allow the work being done by universities to grow collaboratively with the dashboard as a central focus.

Taking the time to incorporate multitudes of work that can be viewed when considering only an individual school (using the drop down list) or the culmination of all reporting schools provides end-users with control of scope. Meanwhile the display provides a broad view where one can consider all 17 SDGs by impact area to quickly identify areas where a plethora of work is being done and where more work is still needed. Moreover, if someone had a specific goal and impact area in mind (for example, planning to teach a course addressing one or more goals like ending poverty and hunger), a person could narrow down the dashboard focus to only the exact works available providing insights, information and feasible opportunities for collaboration. The SDGs as set forth by the United Nations are by design intended to be considered as an amalgamated and interdependent set of goals and this tool is meant to provide a platform that encourages school interaction, promotes cooperation, and gives access to work for future partnerships.

This collaborative visualization addresses the need for a tool that can share data and grow with the feedback of those who provide the source data as has been done iteratively since its inception. Ultimately it offers a robust and effective technique to enhance SDG impact performance. The goals have been adopted as strategically and operationally important objectives in higher education, where there is a need for collaborative SDG visualization similar to what is being done at the country level. Globally, efforts are being made to assess how well countries are meeting the SDGs and move forward with best practices. For example, island countries like Indonesia have sought to explore the benefits of data visualization in SDG monitoring (Pulse Lab, 2018) with a “mission to

accelerate the discovery and adoption of data innovation for sustainable development and humanitarian action.” The United Nations itself offers a variety of official platforms to assess human progress towards fulfilling these goals. A further example, Schmidt-Traub et al., (2017) present the SDG Index and Dashboards (released annually), which explore differences in countries’ performance, considers the empirical relationship to subjective wellbeing (SWB), and discusses how remaining gaps in data and analysis can be filled. This came in the wake of Bertelsmann Stiftung and the Sustainable Development Solutions Network (SDSN) jointly releasing their first SDG Index and Dashboards (SDG Index and Dashboards) in July 2016, with data covering 149 of 193 UN member states.

This Dashboard provides the type of visualization most aligned with information sharing through collaboration. Through many iterations, the current dashboard exists due to feedback and open conversation with schools who have shared their data, information and best practices while asking meaningful questions that have allowed for updates and adaptations as well as informative discussions at several presentations globally. Between its inception, continued collection with constant interaction with all participating schools, and final goal of helping to share out best sources or data and encouragement of future partnerships, the dashboard is at its core created to be a collaborative tool. It is dedicated to sharing and reporting best SDG practices in global higher education (not comparing and ranking) using a drill down visualization. There is a need to begin to characterize the increasingly diverse audience for visualization technology and map out the design space for new creative and collaborative tools to support these users (Heer et al., 2008). We propose this dynamic dashboard that can be used to connect professors, students, and institutions to collaborate on projects, research, and teaching to help a new generation of students prepare to be socially responsible citizens and corporate employees working for change in accord with the SDGs.

### **3 METHODOLOGY AND DEVELOPMENT OF COLLABORATIVE VISUALIZATION IN THE SDG DASHBOARD**

Our team set out to determine a creative method of reporting and sharing data across institutions in an accessible reporting tool that considered SDG by impact area. The reporting tool was developed with an ability to discern activity quickly, which led to a tool that drills down into the reported data revealing usable information at the broad SDG level through a heatmap and key performance indicators (KPI). Drilling down (as seen in Figure 1), the dashboard can portray just the data reported by a single SDG (column view), or it can highlight only work being done in one specific impact area like teaching (row view), or it can be narrowed down in scope to only consider one SDG across one impact area. In all cases, the drilled down data can be viewed and interacted with at the finite level promulgating titles, abstracts and links connecting the user to the data source shared within the dashboard. The creation of the final product requires data collection, cleaning, organization, and visualization of the aggregated sustainability data.

#### **3.1 Survey Tool Created in Order to Perform Data Collection**

In order to collect the data for aggregation, an initial compilation tool using SurveyMonkey.com was introduced, which asked hundreds of questions in order to ascertain SDG detailed data at the impact area and target levels. According to PRME partners, this collection was bulky and cumbersome, which led to immediate modifications. To reduce time and effort for the user, the collection, Qualtrics.com replaced SurveyMonkey.com because of the powerful survey flow logic option and was then tested and updated with several pilot schools across the globe participating and providing insights.

The Qualtrics survey was developed to aggregate information and control flow components were placed within each question level to allow for a more concise, targeted collection tool. The current tool considers data down to the SDG and impact levels. It allows respondents from schools to upload portions of data at varying times. This puts the power of data selection, control, and evaluation into the users’ hands.

Built-in logic allows respondents to view only questions that pertain to their current data. The set-up is as follows:

- Each school using the survey chooses which of the 17 SDGs they are interested in uploading data (See Appendix Figure A1).
- Once SDGs are chosen, the survey asks users which impact areas they would like to report (see Appendix Figure A2).
- Finally, the survey requests data within the SDG where the user reports the number of activities being uploaded (see Appendix Figure A3).

The collected data generates a report that allows for aggregation and reporting within the dashboard. The report consists of a list of items describing the data type under that SDG (e.g., a course, a research paper, or a project).

### 3.2 Data Cleaning and Organization for Dissemination

It took multiple iterations of collection and cleaning, as well as discussions with pilot schools, and feedback from PRME presentations before the final product, this collaborative dynamic dashboard, was produced. From a data design perspective, it is important that a clear and whole picture is available displaying the SDGs met and the areas of impact. To learn more about any specific activity within an SDG, the tool will concisely report the most important findings, actions, or partnerships. The Dashboard uses live web links to provide users with current information (e.g., research papers or partnership documents), providing future collaboration at a finite level.

The current process of collection and cleaning has expedited the time between data upload and dashboard integration using consistent variables. Each school can upload data that is then exported into an excel document, formatted for visualization, and then forwarded to the initial stakeholder to assure accuracy. Fields that are required for best use are:

- Year of impact
- SDG and Impact Area an activity meets
- Title of the activity
- Short description (e.g. abstract, course description for classes)
- City and country impacted
- Link to related information (e.g. doi for papers, a website for partnerships)

## 4 SDG DASHBOARD

The final product is the SDG Dashboard, an interactive tool created to allow end users opportunities for collaboration and best practices within the academic realm of SDG teaching, research, partnerships, dialogue, and organizational practices. Figure 1 represents the broad design, which provides a pictorial view of which school is being considered if it is one individual school under consideration. The top row of data provides the key performance indicators (KPIs), specifically, how many SDGs have been reported on (out of the 17), how many distinct activities are available to view, and how many countries have been impacted by these activities. Below the KPIs is a broad view heatmap portraying all 17 goals and what was reported by a school within the SDG and impact area level using color where more shade indicates increased activity. The right, side and bottom contain bar charts which provide total counts of all activities by SDG as well as by impact area. The bottom-left area shows a world map and again uses color to denote which global areas are being impacted by the activities provided. On the bottom right, a drop-down chart provides a detailed list of all activities reported. A user can click on a specific SDG to dig deeper into the data which can be viewed in figure 2. Here, SDG 16 (Peace, Justice, and Strong Institutions) is highlighted which updates the KPIs, map and list on the bottom right. In this case, a specific title for a research paper is being hovered over to reveal the abstract that is available in order to get a better understanding of the paper. If openly available, the paper itself is simple a click away, as the titles have embedded links. This can also be done within a singular impact and are considered across one or more SDGs. Users hover over each activity for detailed descriptions and a simple click links the user directly to the pertinent research, partnerships, or syllabi (see Figure 2).

This dynamic dashboard allows for views of school efforts being made on specific SDGs while also allowing for a drill-down view and immediate access to the most recent activities and papers for best practices and collaboration.

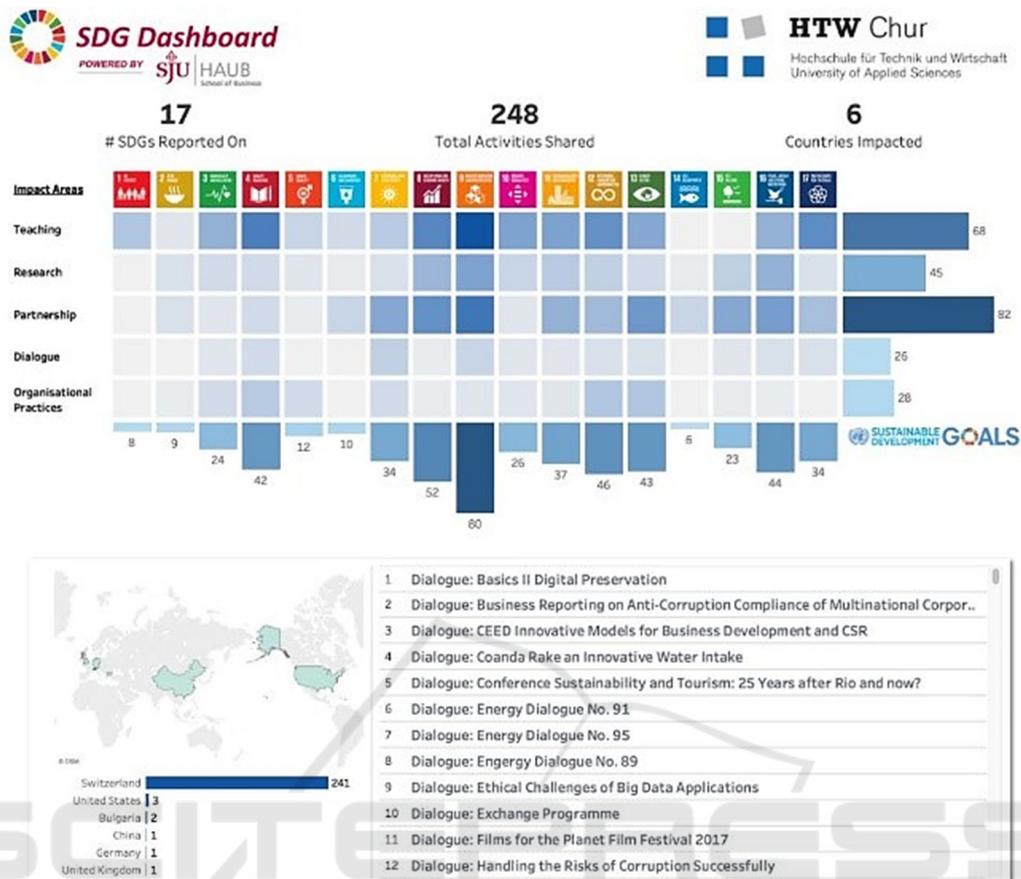


Figure 1: View of a singular school data, where KPI represent overall performance, top visual represents activities shared across all SDGs and impact areas, the map Bottom left shows coordinates of where work is being done, and the text box on right allows for list of individual activities.

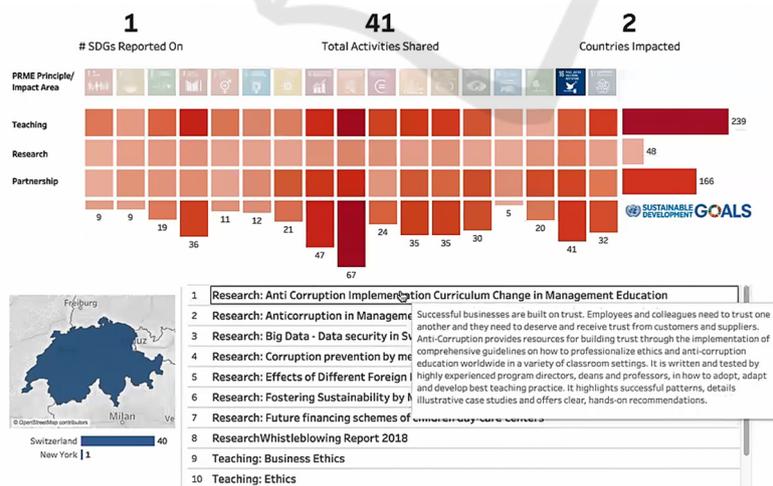


Figure 2: View of a singular school data, where KPI represent overall performance, top visual represents activities shared across all SDGs and impact areas but with drill down on SDG 16. The map (bottom left) shows coordinates of where work is being done, and the text box on right shows top 10 activities. First research paper title is hovered over revealing the abstract and a double click would lead to access to paper if publicly available.

## 5 CONCLUSION: THE FUTURE OF DYNAMIC COLLABORATIVE VISUALIZATION

This project aims to achieve two objectives. First, it proposes a framework for this dynamic dashboard visualization. Much of the theory, models, and application of dashboard visualizations in the literature are limited in their power to communicate with a variety of stakeholders and persuade people to take action using the data (basic goals of data visualization). The sustainable issues faced globally as reflected in the sustainable development goals are being addressed by ever-changing and integrated techniques that require nimble data collection and reporting. Collaboration from diverse sources over time is a critical factor in successfully providing current, shareable, and actionable data to advance the fulfillment of sustainability. Dynamic Collaborative Visualization addresses these limitations by offering access to multiple scale data generated by the actual users who share their data and are partners in the changes made to both the data collection and final visualization. The second objective is the application of this dashboard in one particular domain, a case study, of the United Nations 17 Sustainable Development Goals (SDGs) in higher education institutions. The SDGs outline an inspiring, implementable, and measurable plan for humanity to manifest a more prosperous, equitable, and sustainable future. This SDG Dashboard provides opportunities for growth and expansion of current SDG practices within business schools and universities across the globe. This visualization technique provides a solution to a particular problem, that of usefully communicating large amounts of data about social and environmental transformation promoted by the United Nations.

By revealing useful information, assessing areas of high impact, as well as areas where there are opportunities for growth, the Dashboard features reveal patterns of global impact (breadth) and activity title and description (depth) while also providing direct links to the overall activity where viable. The application in the form of the SDG Dashboard, advances data-driven best practices while enhancing global business schools' performance on the SDGs and techniques to continue visualization collaboration. Goals moving forward include the ability to provide analytical insights as far as growth for individual schools and address areas where more

needs to be done (example Life Below Water, SDG 14, has very little activity).

Future work will require further theoretical development and differentiation from the existing literature. This project provides a platform to showcase the dashboards communicative power in a novel context, reinforcing its value as a powerful tool for data visualization, analysis, and application. Overall, the dashboard provides quick access and opportunities for organizations and institutions working together to solve complex problems and address challenges. At the center of the shared data is easy access, which in this case is done through visualization.

## REFERENCES

- Brewer, R. S., Lee, G. E.M & Johnson, P. M. (2011). The Kukui Cup: a dorm energy competition focused on sustainable behaviour change and energy literacy. 44th *Hawaii International Conference of System Sciences*. (HICSS, 2011),1-10.
- Clements, N, Sarkar, S., Wei, W. (2014). Multiplicative Spatio-Temporal Models for Remotely Sensed Normalized Difference Vegetation Index Data. *Journal of International Energy Policy*, 3(1), 1 – 14.
- Grudin, J. (1994). Computer-supported cooperative work: history and focus. *Computer*. 27(5), 19-26.
- Heer J., van Ham F., Carpendale S., Weaver C., Isenberg P. (2008). Creation and Collaboration: Engaging New Audiences for Information Visualization. In: *Kerren A., Stasko J.T., Fekete J.D., North C.* (eds) *Information Visualization-Human Centered Issues and Perspectives*, 4950, 92-133. Springer Verlag: Heidelberg, Berlin, 2008
- Isenberg, P., Elmqvist, N., Scholtz, J., Cernea, D., Ma, K., & Hagen, H. (2011). Collaborative visualization: definition, challenges, and research agenda. *Information Visualization*. 10(4), 310-326.
- Pulse Lab Jakarta (2018). *Indonesian Government Develops a Monitoring Dashboard for the SDGs*. Published April 1, 2018. Retrieved from: <https://medium.com/pulse-lab-jakarta/indonesian-government-develops-a-monitoring-dashboard-for-the-sdgs-fb17ebf59d05>
- Schmidt-Traub, G., Kroll, C., Teksoz, K., Durand-Delacré, D. & Sachs, J. (2017) National baselines for the Sustainable Development Goals assessed in the SDG Index and Dashboards. *Nature Geoscience*, 10, 547-555.

## APPENDIX

### PRME Data Collection

- [SDG 1 "No Poverty"](#)
- [SDG 2 "Zero Hunger"](#)
- [SDG 3 "Good Health and Well-Being"](#)
- [SDG 4 "Quality Education"](#)
- [SDG 5 "Gender Equality"](#)
- [SDG 6 "Clean Water and Sanitation"](#)
- [SDG 7 "Affordable and Clean Energy"](#)
- [SDG 8 "Decent Work and Economic Growth"](#)
- [SDG 9 "Industry, Innovation and Infrastructure"](#)
- [SDG 10 "Reduce Inequalities"](#)
- [SDG 11 "Sustainable Cities and Communities"](#)
- [SDG 12 "Responsible Consumption and Production"](#)
- [SDG 13 "Climate Action"](#)
- [SDG 14 "Life Below Water"](#)
- [SDG 15 "Life on Land"](#)
- [SDG 16 "Peace, Justice and Strong Institutions"](#)
- [SDG 17 "Partnerships for the Goals"](#)

Figure A1: First page of Qualtrics survey allows user to check each SDG that they would like to report on.



Figure A2: Screen shot of next survey level for SDG 13, specifically, which impact areas will be reported on.

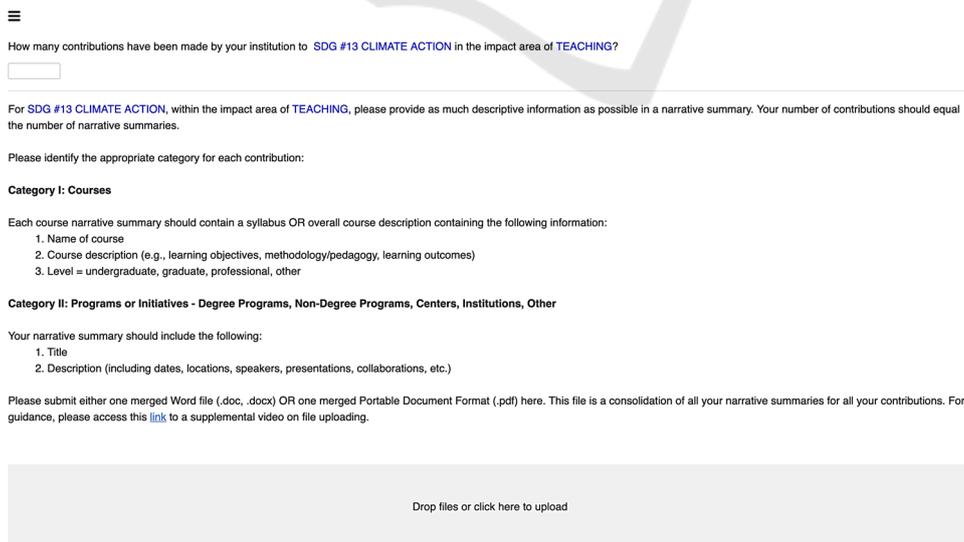


Figure A3: Screen shot of detail level reporting page for SDG 13, impact area teaching. Respondent is asked to tell how many items will be reported on and then upload a link of the combined sheets representing these actions.