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Collective Intelligence for Sustainable Development

Getting Smarter Together

Co-building the Accelerator Labs as a joint venture with:

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QATAR FUND FOR DEVELOPMENT
صندوق قطر للتنمية

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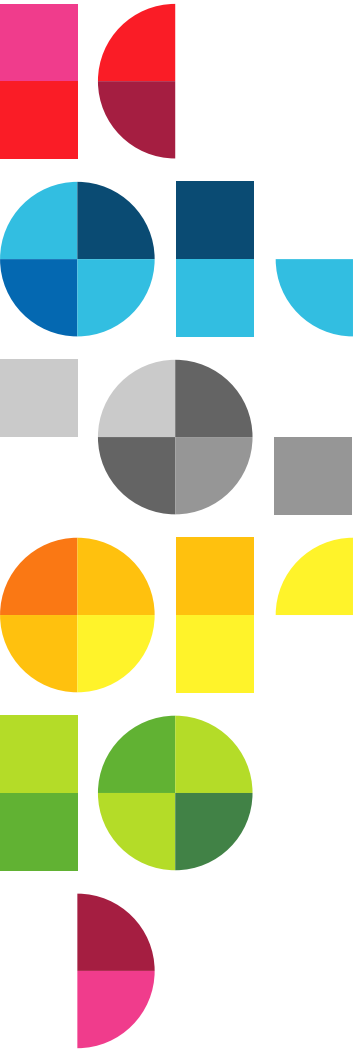

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About the UNDP Accelerator Labs
The United Nations Development Programme (UNDP) Accelerator Labs is the world's largest and fastest learning network on wicked sustainable development challenges. Co-built as a joint-venture with the Federal Ministry for Economic Cooperation and Development of Germany and the Qatar Fund for Development, the Network covers 115 countries, and taps into local innovations to create actionable insights and reimagine sustainable development for the 21st century.

Learn more at acceleratorlabs.undp.org or follow us at @UNDPAccLabs

About Nesta
Nesta's Centre for Collective Intelligence Design helps organizations and communities to tackle complex social problems in new ways. We do this by working with our partners to identify how they can make better use of diverse perspectives, new sources of data and digital technologies. Our work draws on a wide variety of different methods and disciplines, from crowdsourcing to AI. Our goal is to help groups of people to become smarter together – creating new collectively intelligent systems that are able to address 21st century challenges.

To learn more,
see nesta.org.uk/project/centre-collective-intelligence-design/ or email the team at collective.intelligence@nesta.org.uk

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Berditchevskaia, A., Peach, K., Lucarelli, G., Ebelshaeuser, M. (2021). *Collective Intelligence for Sustainable Development: 13 Stories from the UNDP Accelerator Labs.*

Contents

Foreword

The COVID-19 pandemic has triggered a once-in-a-generation global swell of home-grown ingenuity. Communities are adapting, improvising, and looking beyond this unparalleled socio-economic challenge. Their responses have included everything from a foot-operated handwashing machine invented by a nine-year old boy in Kenya, to using the power of crowdsourcing to rapidly produce 3D-printed Personal Protective Equipment, to tracking the spread of the virus via a mobile app in Cabo Verde. The challenge now is how to *sustain* and *scale-up* this unprecedented innovation surge to accelerate progress on the Sustainable Development Goals (SDGs). Part of the solution lies in harnessing the intelligence distributed across local communities and organisations. That will help us to better understand complex problems and unlock new solutions to immense global challenges – from tackling our climate emergency to boosting the protection and restoration of our planet's precious ecosystems and biodiversity.

This collective intelligence approach is founded upon the principle that an enhanced capacity to solve problems is created when people work together through the mobilization of a wider range of data, ideas, and insights. And advances in technology and data science hold the potential to tap into collective intelligence on a larger scale than ever before. In this rapidly evolving field, the United Nations Development Programme (UNDP) has teamed-up with Nesta's Centre for Collective Intelligence Design to generate a clearer vision of *how* collective intelligence approaches can speed up progress on the SDGs. To this end, this new publication series, *Collective Intelligence for Sustainable Development: Getting Smarter Together* analyses and compares the methods and tools employed by over 200 private and public sector organizations in this discipline. Collective intelligence is a core method employed by the UNDP Accelerator Labs Network – the world's largest and fastest *learning network* on sustainable development challenges, which now serves 115 countries. That includes, for instance, utilising real-time data sources and ethnography to gain new insights into the first-hand experiences of women and men who live on the frontlines of climate change. The accompanying report, *13 Stories from the UNDP Accelerator Labs* details more of these pioneering approaches deployed by the Labs – from using big data to improve waste management in Lao PDR, to combining multiple datasets to tackle gender-based violence in Mexico.

The hands-on experience of the United Nations in every corner of the world since the COVID-19 pandemic hit has acutely demonstrated how local communities possess the bright ideas and capacity to tackle both local and global, existential challenges. We now need to fully harness the knowledge of the almost eight billion people on the planet – and disseminate their often-surprising solutions and innovative approaches. The *Collective Intelligence for Sustainable Development* series is more than a mere signpost on our path to building the *future of development*. It serves both as an invitation and a practical guide for local, national, and international development practitioners to make increased use of real-time knowledge creation, collective action and evidence-driven decision making. And ultimately, collective intelligence will serve as a vital tool to help shape a greener, more inclusive, and more sustainable planet.

Achim Steiner
Administrator, United Nations Development Programme (UNDP)

Executive summary

This report sets out how governments and the many organizations involved in global development are increasingly mobilizing not just money, but also intelligence to speed up progress towards the Sustainable Development Goals (SDGs).

From citizen insights to innovative grassroots solutions, mobile phone companies' data to satellite imagery and AI – new resources of intelligence are being harnessed by organizations around the world to understand complex problems, make better decisions and find new solutions.

We bring together this diverse set of practices under the label of **collective intelligence**. At its simplest, collective intelligence can be understood as the enhanced capacity that is created when people work together, often with the help of technology, to mobilize a wider range of information, ideas and insights. Some of the methods employed are old. But many are new and require new skills and mindsets to make the most of them.

This analysis is the first attempt to map and understand how collective intelligence approaches are being used to address the Sustainable Development Goals. It documents many examples, and captures patterns in their application and impact.

From our research we find that there are six key clusters of 'use cases' – practical ways in which people are using collective intelligence approaches for development.

We discovered 15 methods that are being used most frequently, and often in combination. These range from crowdsourcing to web scraping and remote sensing (see p.16 for the full list), and we found that AI is also increasingly being used in parallel, mainly to increase the speed and efficiency of data processing at scale (see p.28).

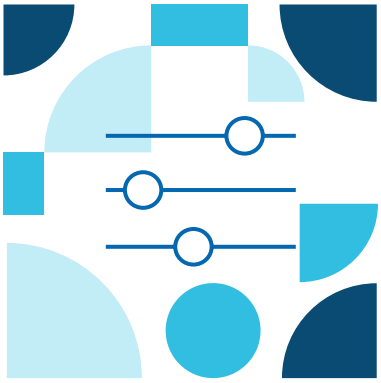
What these collective intelligence methods have in common is the use of technology to mobilize, make sense of, or augment the observations, insights and ideas of large numbers of people.

The majority of the case studies we analyzed align most closely with targets related to SDGs 10-16 towards equity, sustainable cities, climate action and responsible governance, but we found examples cutting across all aspects of Agenda 2030.

Collective intelligence and the SDGs: six 'use cases'

1. New forms of accountability and governance

In this use case methods such as eyewitness video and crowdmapping are being used to document violence or human rights abuses, with a view to holding perpetrators to account. This use case also sees how governments are crowdsourcing ideas and opinions from citizens during policy making, and how citizens are generating new forms of data to monitor policy implementation.
SDGs: 16



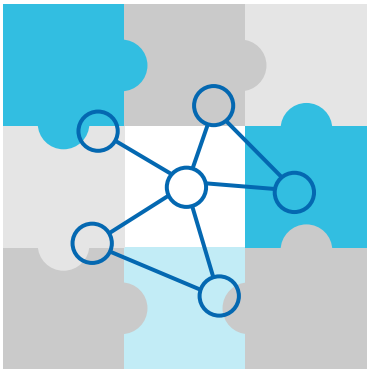
2. Anticipating, monitoring and adapting to systemic risks

A wide range of collective intelligence methods are helping organizations to improve their capacity for early warning and monitoring of, and response to, natural disasters, conflict and epidemics. These include working with on-the-ground volunteers to provide data about emerging issues, or with crowdmappers to capture location information for crisis preparedness. Others combine datasets, including web scraped social media data, for real-time public health surveillance, or ask large groups of people to forecast geopolitical events.
SDGs: 5, 13, 16

3. Real-time monitoring of the environment

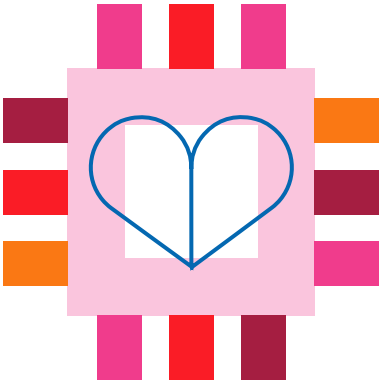
Collective intelligence methods like citizen science and in-situ or remote sensing methods (such as satellites) have been gaining traction as complements to existing ways of monitoring the state of environments – from air quality to deforestation.[1] Web scraping social media and citizen reporting tools are also being used to generate information on environmental hazards from people in affected areas. This use case has the potential to fill data gaps in environmental monitoring.
SDGs: 11, 14, 15

1 Quinlivan, L., Chapman, D.V., Sullivan, T. 2020. Applying citizen science to monitor for the Sustainable Development Goal Indicator 6.3.2: a review. Environmental Monitoring and Assessment 192(218). doi: 10.1007/s10661-020-8193-6



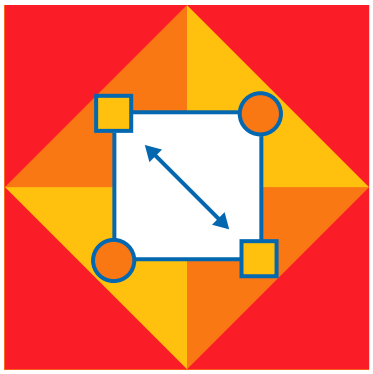
4. Understanding and working with complex systems

Collective intelligence approaches that combine multiple data sources are helping policy makers and development organizations to visualize the dynamics of complex systems and uncover insights that have previously been hidden. City leaders are also increasingly turning to crowdsourcing ideas and opinions of their constituents to understand the different needs or experiences of diverse or changing populations.
SDGs: 10, 11, 12



5. Inclusive development and technologies

The SDGs' promise to 'leave no one behind' brings with it an imperative to involve marginalized communities in development initiatives. Collective intelligence methods like crowdmapping, citizen reporting and mobile phone surveys can be used to engage people whose voices are often not counted. Crowdsourcing data from under-represented groups to train machine learning models is another growing trend that is important for developing fairer artificial intelligence (AI) systems.
SDGs: 5, 10



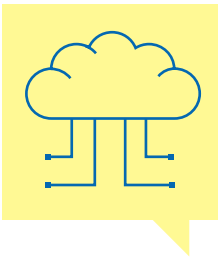
6. Distributed problem solving

To tap into people's problem solving capabilities, organizations are: crowdsourcing solutions; convening peer-to-peer crowdsourcing of knowledge and experience; using open source repositories to share solutions for others to adapt and use; and crowd labeling data to train machine learning models. These collective intelligence methods have broad application across the majority of the SDGs, but become especially relevant for targets such as climate action, where there might be a lack of established solutions and practices, or when new and locally-appropriate solutions are in high demand.
SDGs: 2, 3, 13

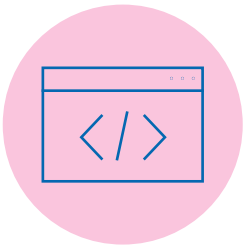
Orchestrating and scaling collective intelligence for the SDGs

As we embark on a 'decade of action' for Agenda 2030, most would agree that to achieve the global goals and avert climate catastrophe the world will need to mobilize power and money as never before.[2] But to use power and money well it will also be vital that governments, organizations, and communities become skilled in mobilizing intelligence of all kinds – data, information and ideas.

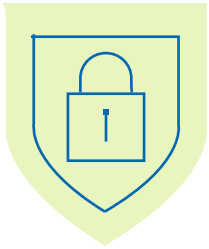
The big challenge for the next few years will be to orchestrate collective intelligence more strategically or at scale. We suggest the following priorities:



Help governments make better use of collective intelligence. Local communities are collecting and sharing data on an unprecedented scale, while civil society organizations and social movements are doing pioneering work. Yet many governments are unfamiliar with the new sources of data available.

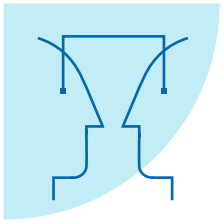


Make open source the default. Open source software and data such as OpenStreetMap, Ushahidi, Consul, Landsat and Sentinel have accelerated distributed experimentation with collective intelligence by a wide range of organizations. These open infrastructures are critical for collective intelligence and are increasingly underpinning effective action on the SDGs.



Considerations of ethics and personal privacy must be taken seriously in the design of collective intelligence projects. Collective intelligence depends on the trust and goodwill of participants. Organizations must prioritize people and purpose over technology – and ensure their projects promote data empowerment, not data extraction.

Funders should support AI and collective intelligence experimentation testbeds in real-world settings. Many have been slow to appreciate the vital importance of linking AI to collective human intelligence. But there is great scope to combine them together and in many fields AI risks being ineffective if it's not integrated with human intelligence. A related priority should be to build up centers of expertise, particularly in sub-Saharan Africa, to counter the concentration of data and AI expertise in mainly US firms.



Create a stronger evidence base around impact and support collaborative experimentation in a greater number of communities. The field will also develop faster with greater support for innovators to share information and knowledge.

2 Watts, J. 2018. We have 12 years to limit climate change catastrophe, warns UN. The Guardian, October 8, 2018. https://www.theguardian.com/environment/2018/oct/08/global-warming-must-not-exceed-15c-warns-landmark-un-report. Accessed January 19, 2021.

A call to action

Realizing the potential of collective intelligence for the SDGs will be a collective task, but will build on work that is already underway. This report sets out some key roles that existing institutions could play.

The Organisation for Economic Co-operation and Development (OECD) could help to establish the protocols and standards that will be needed to underpin the shared data and knowledge infrastructures that will allow collective intelligence to be orchestrated more strategically.

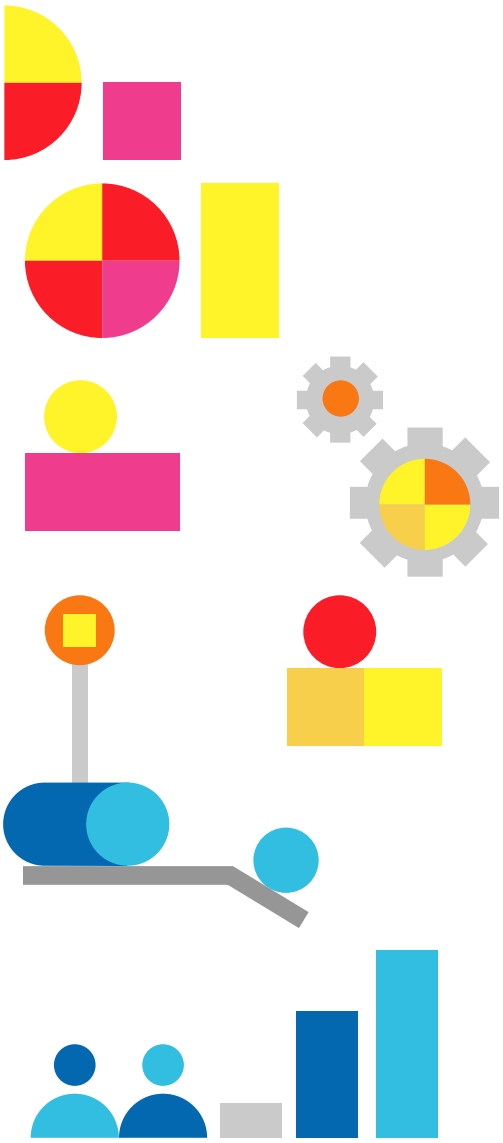
The development banks could make it standard for any investment plan to include a complementary strand on the organization of intelligence – including the orchestration of data, science and evidence, as well as grassroots insights and wisdom.

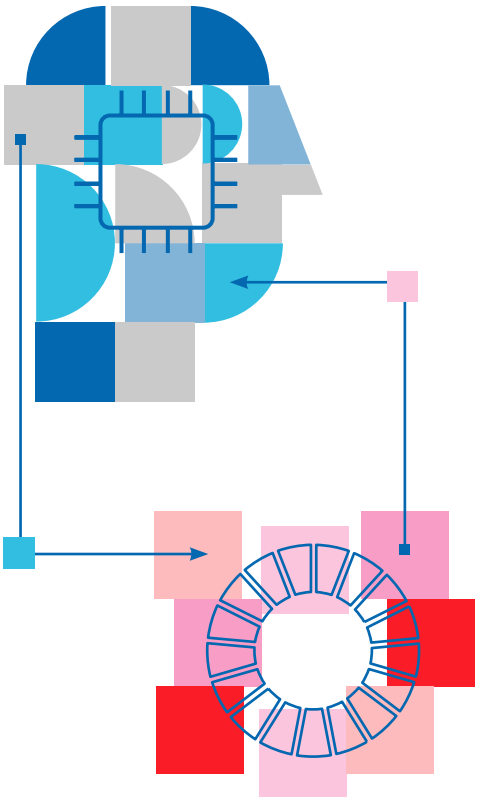
Universities could help build the skills and experience that graduates will need to work in a collectively intelligent way. Many are now using the 'challenge based' model where, alongside their degree, students work on practical problem solving in teams that draw on multiple disciplines as well as insights outside of higher education.

Development partners could help grow civil society's capacity to mobilize collective intelligence – supporting the skills needed, as well as speeding up the development of new methods and tools.

The private sector should make it easier for development organizations and innovators to access data and cloud services for SDG-related work.

The key strategic challenge for the UN is how to better orchestrate a broad range of intelligence relevant to the SDGs – from science and data, to public policy evidence and emerging findings from experiments – to help innovators on the ground work more effectively.





Who is this report for?

The report is aimed at senior officials within national governments, international agencies and development organizations who understand the urgency for action and want to tap into distributed collective intelligence as part of national strategies towards the SDGs. We also hope this report will provide a source of inspiration for innovators within broader development and research communities.

Methodology

This study was carried out from September 2020 to January 2021. Over 277 case studies covering a wide range of collective intelligence methods were mapped and categorized by most relevant SDG. Case studies were drawn from Nesta's existing repositories and publications of collective intelligence case studies, as well as a rapid review of the academic and grey literature on the SDGs and related fields, such as citizen science and digital democracy. Case studies from UNDP Accelerator Labs were identified using a combination of online search and semi-structured interviews carried out by a Nesta researcher.

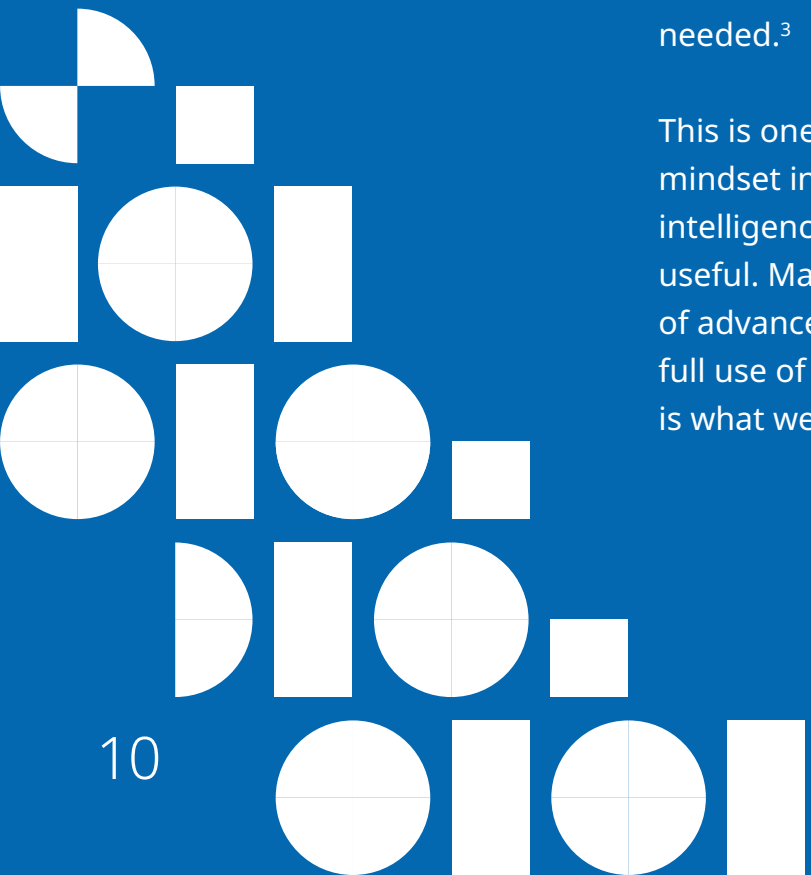
During our analysis we identified use cases, where we inferred a common purpose amongst case studies – particularly looking for use cases that were relevant to multiple SDGs. For each use case we assigned a number of SDG targets. These were identified by retrospective analysis of the focus of the case studies against the SDG targets.

Although few of the case studies explicitly documented links to a specific SDG target or goal, this retrospective analysis helps to illustrate how collective intelligence methods could be used more intentionally for the SDGs in the future. The limitations of our approach mean that the targets listed are unlikely to be the only ones that could benefit from the application of collective intelligence methods. They are, however, the ones where we found the clearest association – and may offer the quickest wins for funders, practitioners and governments.

Introduction

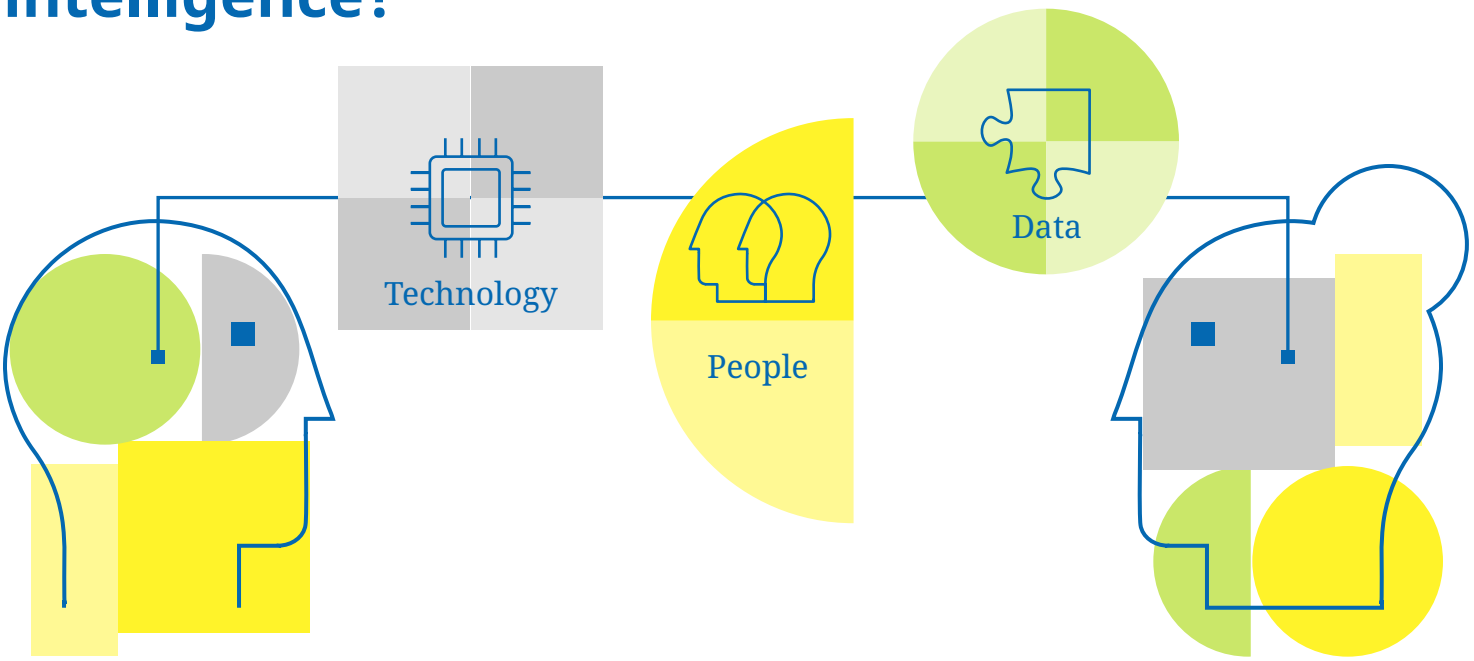
When the United Nations High Commissioner for Refugees (UNHCR) set out to develop a predictive model to anticipate the movements of displaced people into border refugee camps, they faced a difficult challenge. Understanding which data might be relevant for a complex issue like migration can be like looking for a needle in a haystack. It turned out that goats were the answer. This answer came not from abstract theory but rather from conversations with refugees. When Somali refugees prepare to leave the country, they sell their goats. Goats are delicate and struggle to make the long journeys characteristic of forced migration, and so refugees have no choice but to sell them. This simple insight inspired the UNHCR to include market fluctuations of goat prices as a parameter in their model, helping them to better anticipate future refugee crises and allocate humanitarian resources where most needed.[3]

This is one of hundreds of examples of a new mindset in development circles: seeking out intelligence of all kinds, and then making it useful. Many of these examples make full use of advanced technologies. But they also make full use of human experience and insight. This is what we mean by collective intelligence.



3 UNHCR Innovation Service. 2019. A goat story. May 8, 2019. https://medium.com/unhcr-innovation-service/a-goat-story-3ed6bdd2b237. Accessed January 19, 2021.

What is collective intelligence?



At its simplest, collective intelligence can be understood as the enhanced capacity that is created when people work together, often with the help of technology, to mobilize a wider range of information, ideas and insights. Collective intelligence emerges when these contributions are combined to become more than the sum of their parts.

Over centuries, every society has relied on collective intelligence – sharing knowledge, culture and tools to better manage crops, combat diseases, anticipate weather patterns and much more.

Since the start of the digital age, however, collective intelligence has really evolved. There are now thousands of digital tools helping us to pool ideas in entirely new ways, and connect people across huge distances. In the 19th century, it took almost 70 years to crowdsource the 400,000 words that made up the complete first edition of the Oxford English Dictionary. A modern-day equivalent, the English Wikipedia, receives more than 1.9 edits per second and sees about 200,000 new pages created per month.[4]

Digital technologies are also enabling us to generate new sources of data. We can use satellite imagery or mobile phone data, for example, to create new intelligence on our world and societies. Many of these new data sources are generated through the 'digital exhaust fumes' of human activity, or through the active contribution of volunteers. Most of this new data is made useful by the legions of women and men helping to label the datasets that are used to train machine models, and the efforts of people to interpret their meaning.

Figure 1

Building blocks of 21st century collective intelligence

By bringing together diverse groups of people, data and technology, we can create a collective intelligence that is greater than the individual parts in isolation.

4 Wikimedia Statistics (web page) https://stats.wikimedia.org/#/en.wikipedia.org. Accessed January 19, 2021

Increasingly, artificial intelligence (AI) is being applied in combination with collective intelligence methods – to augment and optimise the mobilisation of human intelligence. This is mainly through algorithms that increase the speed and efficiency of data processing at scale. But there are other emerging uses of AI, such as modelling and visualization, to push the boundaries of how groups work together to understand complex problems such as rapid urbanisation and the localised impacts of climate change.

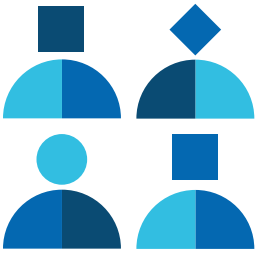
Combining the capabilities of people, data and digital technologies for solving problems is the next frontier of 21st century problem solving.

How this is done, however, matters as much as what is done. To use collective intelligence well means being informed by its fundamental key principles (see Figure 2).[5] This includes a recognition of the need to draw on diverse views and perspectives to come to better decisions, and the need to be mindful of biases and power relations. It also means acknowledging the importance of data empowerment – enabling people to use data to advocate for their rights, take collective action or hold governments to account. As a practice, collective intelligence is informed by many of the same values that have driven the use of participatory decision making and action research involving local communities in development since the Participatory Learning and Action approaches of the 1990s. It is critical to hold on to these foundations even as technology and new data sources change the way collective intelligence is deployed.

Collective intelligence employs a wide range of different methods. These range from deliberation to crowdsourcing and web scraping (see p.16). Although some of these methods remain relatively new to the world of development, their use has been slowly increasing alongside more traditional forms of intelligence (from official data to ethnographic research).

Figure 2

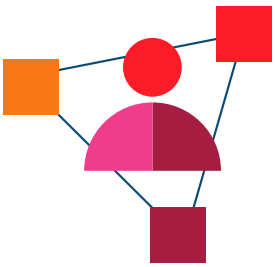
Collective intelligence design principles



Increase diversity of the people you involve and opinions you listen to

Enable people to contribute views and ideas independently and freely

Integrate different types of data to unlock fresh ideas



Be citizen-centred: data empowerment, not data extraction

5 Peach, K., Berditchevskaia, A., Bass, T. 2019. Collective Intelligence Design Playbook, p.40. https://www.nesta.org.uk/toolkit/collective-intelligence-design-playbook/

Why does Sustainable Development need collective intelligence?

Converging crises and increasing uncertainty

Today, the world faces converging crises and rising uncertainty.[6] The COVID-19 pandemic has sent shockwaves around the world, precipitating an economic crisis and potentially the worst global recession in eight decades.[7] Meanwhile, risks posed by the looming climate and environmental emergency continue to grow.[8]

Progress is too slow, and being reversed

Even before the COVID-19 pandemic, global progress towards the SDGs had stalled and, in some cases, reversed.[9] The most recent High-level Political Forum put it bluntly saying 'acceleration is needed in many areas.'[10] The UN now estimates that the pandemic will turn back the clock on decades of progress, pushing 71 million people into extreme poverty in 2020.[11]

Growing complexity of challenges

The impact of automation and rapid urbanization are just some of the complex issues development policy makers are grappling with for which no 'best practice' solutions exist and views are divided.[12]

Persistent data gaps

Development policy makers still struggle to access useful data to inform decision making. A 2018 UN survey, for example, found that in Africa and Asia, on average, data for only 20 per cent of SDG indicators was available. This gap is likely to widen as a result of COVID-19, with 97 per cent of national statistics offices in sub-Saharan Africa struggling to fulfil international reporting requirements during the pandemic.[13] Traditional data collection methods also often fail to keep up with change – for example, not capturing recent aspects of urban poverty.[14] And the continued lack of data disaggregated by gender means that many of the issues women face go uncounted, undermining the promise to 'leave no one behind'.[15]

Recognition of the need for new approaches to development

This combination of increasing complexity and lagging progress means that the approaches that have characterized much development practice (i.e. top-down and rigidly focused on narrowly-defined goals) may be particularly unsuitable.[16] The OECD also suggests that rather than following a singular paradigm or pathway, development strategies need to be more context-specific, and more participatory, place-based, multisectoral and multilateral – with more focus on experimentation and mutual learning. It also calls for a rethinking of international cooperation beyond financial aid to foster more effective exchanges of social and human capital.[17]

6 World Uncertainty Index (web page) https://worlduncertaintyindex.com/. Accessed January 19, 2021.

7 World Bank. 2021. Global Economics Prospects. https://www.worldbank.org/en/publication/global-economic-prospects

8 Larris, E. 2020. Climate crisis fills top five places of World Economic Forum's risks report. The Guardian, January 15, 2020. https://www.theguardian.com/business/2020/jan/15/climate-crisis-environment-top-five-places-world-economic-forum-risks-report. Accessed January 19, 2021.

9 United Nations. 2020. Report of the high-level political forum on sustainable development convened under the auspices of the Economic and Social Council at its 2020 session. August 10, 2020. https://undocs.org/E/HLPF/2020/6. Accessed January 19, 2021.

10 Ibid.

11 Lieberman, A. 2020. UN forum offers 'sobering' vision of SDGs progress and new virtual reality. Devex, July 21, 2020. https://www.devex.com/news/un-forum-offers-sobering-vision-of-sdgs-progress-and-new-virtual-reality-97713. Accessed January 19, 2021.

12 World Bank. 2020. Urban Development Overview. https://www.worldbank.org/en/topic/urbandevelopment/overview. Accessed January 19, 2021.

13 United Nations. 2020. The Sustainable Development Goals Report 2020. https://unstats.un.org/sdgs/report/2020/The-Sustainable-Development-Goals-Report-2020.pdf

14 Murali, M., Cummings, C., et al. 2018. 10 things to know about the impacts of urbanization. ODI (web page) https://odi.org/en/publications/10-things-to-know-about-the-impacts-of-urbanisation/. Accessed March 28, 2021

15 Badiee, S., Melamed, C. Making the data revolution a gender data revolution. Data Revolution Group, December 15, 2014. https://www.undatarevolution.org/2014/12/15/gender-data-revolution/. Accessed January 19, 2021.

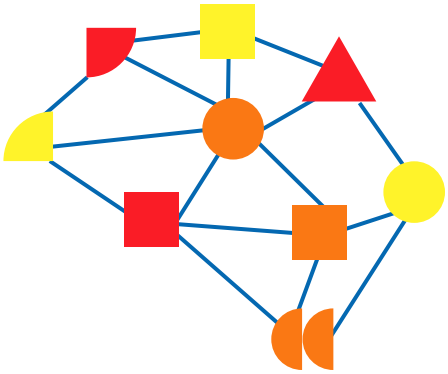
16 Leach, M., MacGregor, H., Scoones, I., Wilkinson, A. 2021. Post-pandemic transformations: How and why COVID-19 requires us to rethink development, World Development 138. doi: 10.1016/j.worlddev.2020.105233

17 OECD. 2018. Perspectives on Global Development 2019. Rethinking Development Strategies. https://www.oecd.org/dev/Overview_EN_web.pdf

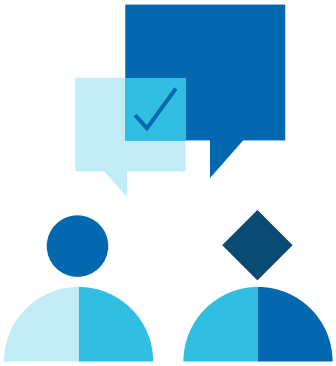
Collective intelligence can help

The starting point for collective intelligence for the SDGs is simple: what are the resources of intelligence that can be brought together and shared? These resources will range from localized insights and inventions from people on the ground, to data of all kinds (whether gathered by satellites or mobile phone companies), to scientific knowledge and evidence.

Collective intelligence approaches can help us tap into new sources of data and insight to fill SDG data gaps and understand emerging problems more quickly. Being able to mobilize granular data rapidly (from sensors to citizen-generated data) can help generate more comprehensive and up-to-date insights. Bringing together different types of insight can also help reveal new dynamics in complex systems. This is the starting point for developing more effective responses. And by involving marginalized communities in generating, analyzing and using data, collective intelligence offers opportunities to stop replicating existing prejudices and inequalities.



Collective intelligence can accelerate progress by tapping into the collective brainpower of citizens, drawing on a wider network of innovators, or seeking and sharing tested solutions from elsewhere. By opening up timely and relevant information for citizens to use, collective intelligence approaches can also increase people's ability to make decisions and power to act – enabling citizens to participate in tackling social problems.



Collective intelligence approaches can help in complex or uncertain situations where there is disagreement about how to proceed, where the way forward is unclear, or when the nature of the problem is contested. Collective intelligence methods can bring together many diverse views and perspectives, not just those of the vocal minority or the usual experts who may be too narrowly focused. They can help stakeholders, experts and affected communities come to greater agreement on priorities for action and make more inclusive decisions.

How is collective intelligence being used for the SDGs?

Collective intelligence is already being mobilized by organizations around the world to address the SDGs. In our rapid review of the academic literature and case studies, we found practical examples of collective intelligence relating to all 17 SDGs.

Six use cases for collective intelligence for the SDGs

From the analysis of case studies, we see a clustering of current practice around six key use cases relating to just under half of the SDGs – with particular emphasis on goals 10-16.

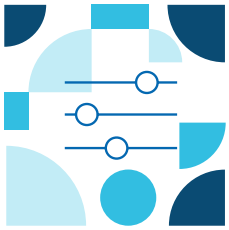
These use cases describe the different ways in which people use collective intelligence methods to try to achieve a particular result or create new value for a community or organization. Informing each of these use cases is a diverse range of practical case studies from around the world, which share either explicitly-stated or implicitly-inferred goals.

Figure 3

Six use cases for collective intelligence for the SDGs

New forms of accountability and governance

SDGs: 16

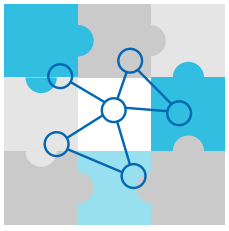


Anticipating, monitoring and adapting to systemic risks

SDGs: 3, 13, 16

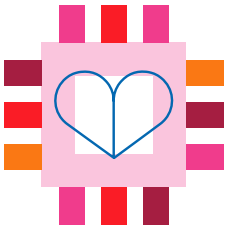
Real-time monitoring of the environment

SDGs: 11, 14, 15



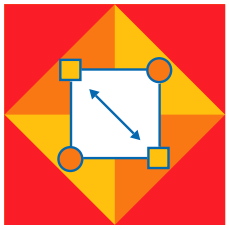
Understanding and working with complex systems

SDGs: 10, 11, 12



Inclusive development and technologies

SDGs: 5,10



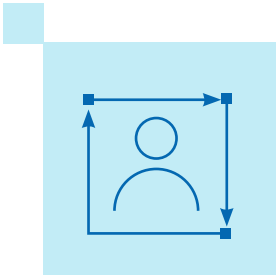
Distributed problem solving

SDGs: 2, 3, 13

15 collective intelligence methods commonly used for the SDGs

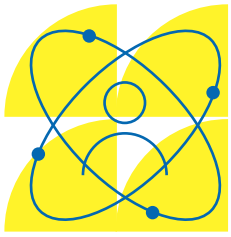
Each use case illustrates how different collective intelligence methods, sometimes used in combination, are deployed to achieve a particular goal. A striking finding of this analysis is the flexibility that this toolbox offers to achieve different ends.

Our analysis found these 15 methods are currently being used most frequently for SDG-related activity, which we which we describe below.[18]



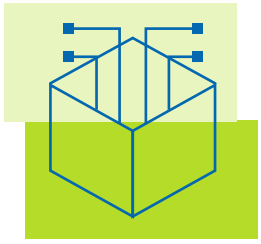
Citizen-generated data

Citizen-generated data is a broad category that includes any information that can be collected from people either by active involvement (e.g. videos, reports, ideas – usually using digital platforms) or passively (e.g. transactions data, call detail records, wearables).



Citizen science

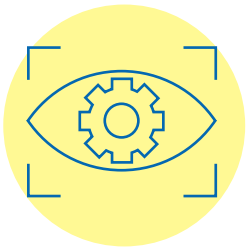
Citizen science is any process where scientists and (usually unpaid) volunteers work together to collect or process scientific data or observations. Citizen science unlocks new resources for research, experimentation and analysis by opening the process to anyone.



Combining data sources

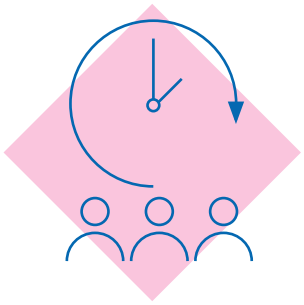
Collective intelligence depends on the trust and goodwill of participants. Organizations must prioritize people and purpose over technology – and ensure their projects promote data empowerment, not data extraction.

18 For a more comprehensive list of collective intelligence methods see: Peach, K., Berditchevskaia, A., Bass, T. 2019. Collective Intelligence Design Playbook. https://www.nesta.org.uk/toolkit/collective-intelligence-design-playbook/



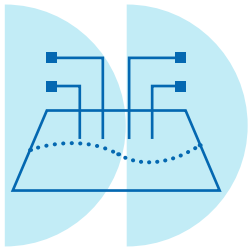
Computer vision

The ability of a computer to understand, analyze or generate images and/or videos. Frequently used to help classify drone or satellite images or user-generated images.



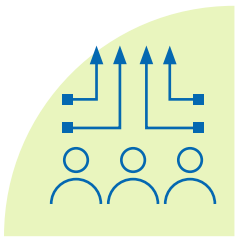
Crowd forecasting

Crowd forecasting is a method that asks small or large groups to make predictions about the future. Individual predictions are aggregated using statistics into a consensus crowd forecast. It's inspired by research which showed that small crowds of non-experts can often forecast political events more successfully than individual experts.



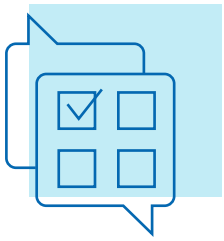
Crowdmapping

Crowdmapping is a type of crowdsourcing which gathers data from different sources (including social media, text messages or geographic data) to provide real-time, interactive information about issues on the ground. Crowdmapping can create detailed almost real-time data in a way that a top-down, centrally-curated map may struggle to replicate.



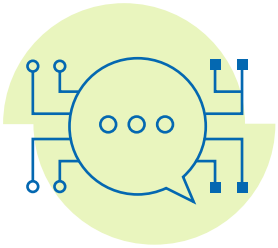
Crowdsourcing

Crowdsourcing is an umbrella term for a variety of approaches that source data, information, opinions or ideas from large crowds of people, often by issuing open calls for contribution. It can help bring new ideas to light that hadn't previously been considered, or to gather expertise from people who have specialized knowledge or understanding of an issue.



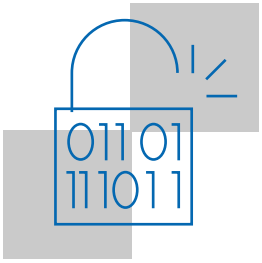
Microsurveys

Microsurveys are a short, abbreviated form of surveying which typically take the respondent only a few minutes to complete. Microsurveys are often delivered by mobile phone, text message or a digital platform. Benefits include a much faster turnaround, and higher frequency of results, compared to traditional surveys.



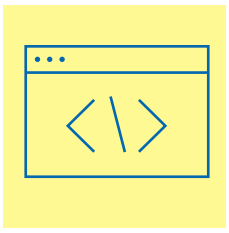
Natural Language Processing (NLP)

NLP allows computers to understand, interpret and extract key information from human language. NLP techniques can be used to carry out automated analysis of user-generated text from sources like social media, to better understand what issues matter to people, translate languages or simulate language.



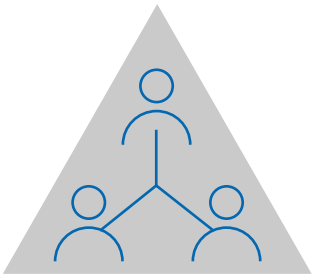
Open data

Open data is the raw data that is gathered by people or organizations and published in an electronic format that machines can read. It's then shared online and allowed to be re-used by others instead of keeping it private.



Open source repository

An open source repository is a digital repository where content (e.g. code, text or DIY designs) can be stored and freely downloaded with few restrictions on use. Many open source repositories aid collaboration by providing a space for uploading documentation, monitoring and version control.

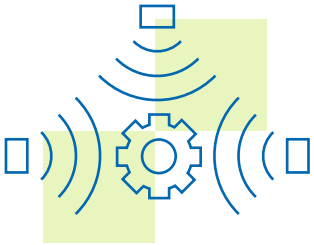


Peer-to-peer exchange

Peer-to-peer exchange refers to the process of sharing information horizontally to build and maintain a community, to collect data, connect people or send alerts. Platforms for this vary, ranging from messaging platforms to online forums or collaborative platforms. Some rely on the internet but others do not (e.g. SMS or mesh networks).

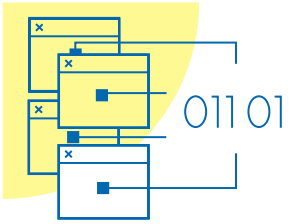
Predictive analytics

Predictive analytics encompasses a variety of statistical techniques that enable a computer to analyze structured data using numeric and machine-readable data. It typically relies on algorithms from classical machine learning. It can be used to make predictions about the future or otherwise unknown events.



Remote or in-situ sensing

Collecting information from satellites or physical sensors recording actions and physical changes (e.g. traffic cameras, weather sensors, ambient sensors, wearables or drones). This data can provide cheap, real-time measurements of anything from pollution to crop yields.

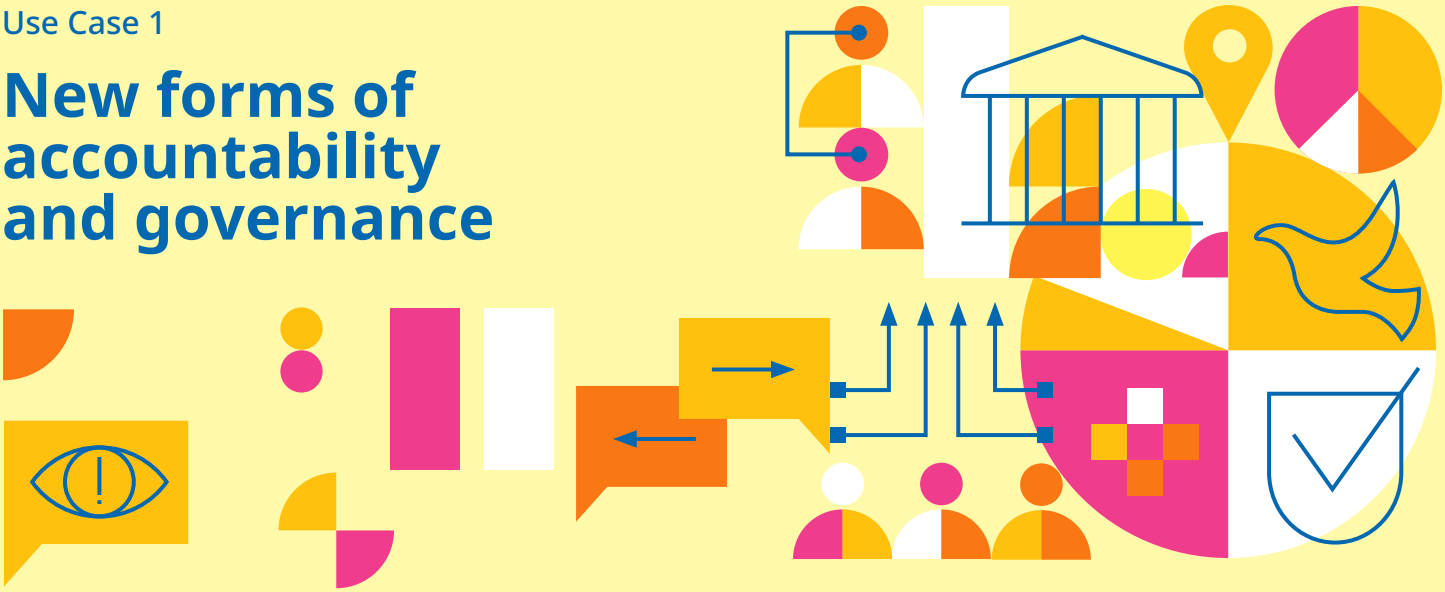


Web scraping

Web scraping is a method for extracting unstructured data from across the web, such as company websites or social media. Where official datasets are costly to gather and infrequently updated, web scraping can provide more timely insights into social or economic trends.

Use Case 1

New forms of accountability and governance



In the last few years, the development community has increasingly acknowledged the need to enable marginalized or discriminated communities to hold powerful people and institutions to account.[19]

Facilitated by the growing adoption of digital technologies and mobile phones in low- and middle-income countries, collective intelligence methods are supporting new forms of accountability and participation. There are four key collective intelligence methods being used to do this.

How collective intelligence methods are deployed

- Eyewitness video for collective witnessing of violence and human rights abuses
- Crowdmapping and/or citizen reporting of incidents of violence by citizens
- Crowdsourcing ideas and opinions from citizens during policy making
- Citizen-generated data for monitoring the implementation of policy and programmes

Relevant SDG targets

- Reducing violence and related deaths (16.1)
- Responsive, inclusive, participatory decision-making at all levels (16.7)
- Reducing violence and related deaths (16.1)

19 Institute of Development Studies. Participatory Methods (web page) https://www.participatorymethods.org/method/citizen-participation-and-accountability/. Accessed January 19, 2021.

Eyewitness video for collective witnessing of violence and human rights abuses

Collective witnessing of human rights abuses on social media using mobile phone footage is helping to galvanize and empower social movements around the world. From the Black Lives Matter movement in the US, to the residents of Brazil's favelas[20] and the #EndSARS campaign in Nigeria,[21] 2020 has seen citizens using video evidence to expose police brutality and force political leaders into action. Taken together, this footage is helping researchers and lawyers to identify patterns of violence, or create a fuller picture of an incident based on multiple perspectives. The development of apps like Tella,[22] databases like the Digital Evidence Vault,[23] and the work of organizations like Witness[24] are now helping activists around the world create timestamped, verifiable footage with more concrete value for exposure in the media and, ultimately, as evidence for legal accountability.

Crowdmapping and/or citizen reporting of incidents of violence by citizens

Citizen reporting of violence is continuously being harnessed through geographic information system (GIS) mapping tools, which capture, store and display data linked to a physical location. The resulting maps help organizations and people to more easily see, analyze, and understand patterns and relationships.[25]

Ushahidi[26] is one of the earliest and most prominent examples of crowdsourcing geographic data to create maps – a method known as 'crowdmapping'. It has had more than 150,000 deployments, capturing data via text, email, Twitter, phone app, RSS feed and custom surveys from millions of volunteers in 160 countries.[27] One of the organizations using the Ushahidi platform is the Ceasefire Centre for Civilian Rights,[28] which mobilizes communities to map human rights violations across Iran, Iraq and Syria – providing an up-to-date and alternative picture of the current situation from those on the ground.

Crowdsourcing ideas and opinions from citizens during policy making

Around the world there are a growing number of municipal authorities and national governments harnessing collective intelligence tools to promote more inclusive and participatory decision making. The most effective approaches combine offline public engagement with digital platforms

20 Shaer, M. 2015. 'The Media Doesn't Care What Happens Here'. The New York Times Magazine, February 18, 2015. https://www.nytimes.com/2015/02/22/magazine/the-media-doesnt-care-what-happens-here.html. Accessed January 19, 2021.

21 Okeowo, A. 2020. The role of video evidence in Nigeria's #EndSARS movement. October 20, 2020. https://blog.witness.org/2020/10/role-video-evidence-nigerias-endsars-movement/. Accessed January 19, 2021.

22 Tella App (web page) https://tella-app.org/. Accessed January 19, 2021.

23 Center for Human Rights Science. Digital Evidence Vault: An evidence vault for Open Source Investigations (web page) https://www.cmu.edu/chrs/technology_program/dev.html. Accessed January 19, 2021.

24 Witness. About video as evidence (web page) https://vae.witness.org/about-video-as-evidence/. Accessed January 19, 2021.

25 National Geographic. GIS (Geographic Information System). https://www.nationalgeographic.org/encyclopedia/geographic-information-system-gis/. Accessed January 19, 2021.

26 Ushahidi (web page) https://www.ushahidi.com/. Accessed January 19, 2021.

27 Ryan, M., Gambrell, D., Noveck, B.S. 2020. Using Collective Intelligence to Solve Public Problems, pp.60-65. https://media.nesta.org.uk/documents/Using_Collective_intelligence_to_Solve_Public_Problems.pdf

28 Ceasefire Centre for Civilian Rights (web page) https://www.ceasefire.org/#. Accessed January 19, 2021.

to crowdsource information about problems, generate ideas for new solutions (often with a prize as an incentive), or provide opinions on new proposals.[29, 30]

A well-known example is vTaiwan – a four stage online and offline process in which the Taiwanese government and citizens work together to collaborate on new legislation. It uses a tool called Polis to help map opinions and find areas of consensus. It has been used for 26 pieces of legislation so far.

Brazil's e-Democracia portal,[31] is another well-established digital democracy platform, set up in 2009 by the lower house in Brazil's National Congress. It has been used to encourage public participation on a wide number of draft bills. Its greatest successes to date include the Youth Statute Bill, which crowdsourced 30 per cent of its final text from young people across the country, and the Internet Civil Rights Bill which received 374 individual contributions on the Wikilegis platform – many of which were adopted into the final bill.[32]

In the last decade, there has also been more experimentation by government policy makers with deliberative democracy methods, most notably the citizen's jury/panel. This is where a small but representative sample of the population meets, usually face-to-face, to provide its opinions or recommendations on specific policy questions. To date, these initiatives have been largely confined to OECD countries.[33]

Citizen-generated data for monitoring the implementation of policy and programs

Involving citizens in monitoring the implementation and outcomes of policy or legislation is relatively rare, but there are notable examples.[34] Citizen-generated data (often using GIS systems) to provide 'ground truthed' evidence is key to these initiatives.

The ¿Qué pasa, Riachuelo? is an online platform supported by Datashift, that includes an interactive georeferenced map of all public information about the clean-up process run by the Matanza-Riachuelo River Basin Authority. It's a social monitoring tool, allowing citizens and NGOs to follow the execution of the legally mandated clean-up plan and report breaches or problems. Although the project succeeded in encouraging the authority to publish its data in a more timely and open way, it has been largely defunct since funding ended.[35]

A significant limitation for many monitoring projects is the lack of connection to legislative authorities or those with the power to use that knowledge to adapt or course-correct if needed.

A collaboration between Ground Truth Initiative, the World Bank and Map Kibera Trust is a rare example that does. They developed a digital platform to enable citizens to map and gather feedback on projects funded through participatory budgeting processes. Projects included everything from new hospital wings to small dams and classrooms. The mapping process made it easier to track progress on the projects and to know where they were located so that funding could be allocated most effectively the following year.[36]

29 Ryan, M., Gambrell, D., Noveck, B.S. 2020. Using Collective Intelligence to Solve Public Problems, pp.18-25. https://media.nesta.org.uk/documents/Using_Collective_intelligence_to_Solve_Public_Problems.pdf

30 Noveck, B.S. 2018. Crowdlaw: Collective Intelligence and Lawmaking. Analyse & Kritik, Vol. 40(2). doi: 10.1515/auk-2018-0020

31 e-Democracia (web page) http://www.edemocracia.leg.br/. Accessed January 19, 2021.

32 Simon, J., Bass, T., et al. 2017. Digital Democracy, pp.19-20. https://media.nesta.org.uk/documents/digital_democracy.pdf

33 OECD. 2020. Innovative Citizen Participation and New Democratic Institutions: Catching the Deliberative Wave. OECD Publishing, Paris. doi: 10.1787/339306da-en

34 Simon, J., Bass, T., et al. 2016. Digital Democracy, p.13. https://media.nesta.org.uk/documents/digital_democracy.pdf

35 Fressoli, M., Arza, V., Castillo, M. 2016. Entina Argentina. The impact of citizen-generated data initiatives in Argentina. https://civicus.org/thedatashift/wp-content/uploads/2016/05/CGD-impact-report-Argentina.pdf

36 Hagen, E. 2020. Mapping Participatory Budgeting in Kenya's Counties. GroundTruth, March 13, 2020. http://groundtruth.in/2020/03/13/mapping-participatory-budgeting-in-kenyas-counties/. Accessed January 19, 2021.

Use Case 2

Anticipating, monitoring and adapting to systemic risks

A wide range of collective intelligence methods are helping governments and international agencies improve their capacity for early warning and monitoring of, and response to, natural disasters, conflict and epidemics. Collective intelligence is also steadily being harnessed by communities themselves for better preparedness and response. From citizen science, to web scraped data, crowd forecasting, sensor data and crowdmapping – there are five common applications of collective intelligence methods to help organizations anticipate and respond to systemic risk.

How collective intelligence methods are deployed

- Citizen science to gather new data for early detection or monitoring of public health threats
- Combining web scraped and/or existing datasets for real-time surveillance of public health threats
- Combining web scraped and/or citizen-generated data to inform crisis response
- Crowd forecasting of epidemics, conflict and geopolitical events
- Crowdmapping (sometimes combined with satellite/sensor data) for community preparedness and response

Relevant SDG targets

- Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks (3.d)
- Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries (13.1)
- Reduce violence and related deaths (16.1)

Citizen science to gather new data for early detection or monitoring of public health threats

One benefit of working with distributed networks of citizens to gather data through methods like citizen science, is that they can help to create much needed data about new and emerging issues. Citizen science can also be good for encouraging mass participation and building awareness of an issue.

MetaSUB is a global project to build microbial portraits of urban transit systems. A network of volunteers and scientists takes swabs from trains and escalators. They identify the pathogens they find and any markers of antibiotic resistance.[37] The microbial surveillance carried out by the MetaSUB community in over 100 cities helped add to research which found that the longer COVID-19 was on a surface the less likely it was to make someone sick. Increasingly AI is being used to find patterns amongst the mountains of data generated by this project. In the future, it may even help make predictions, or spot future pandemics much earlier.[38]

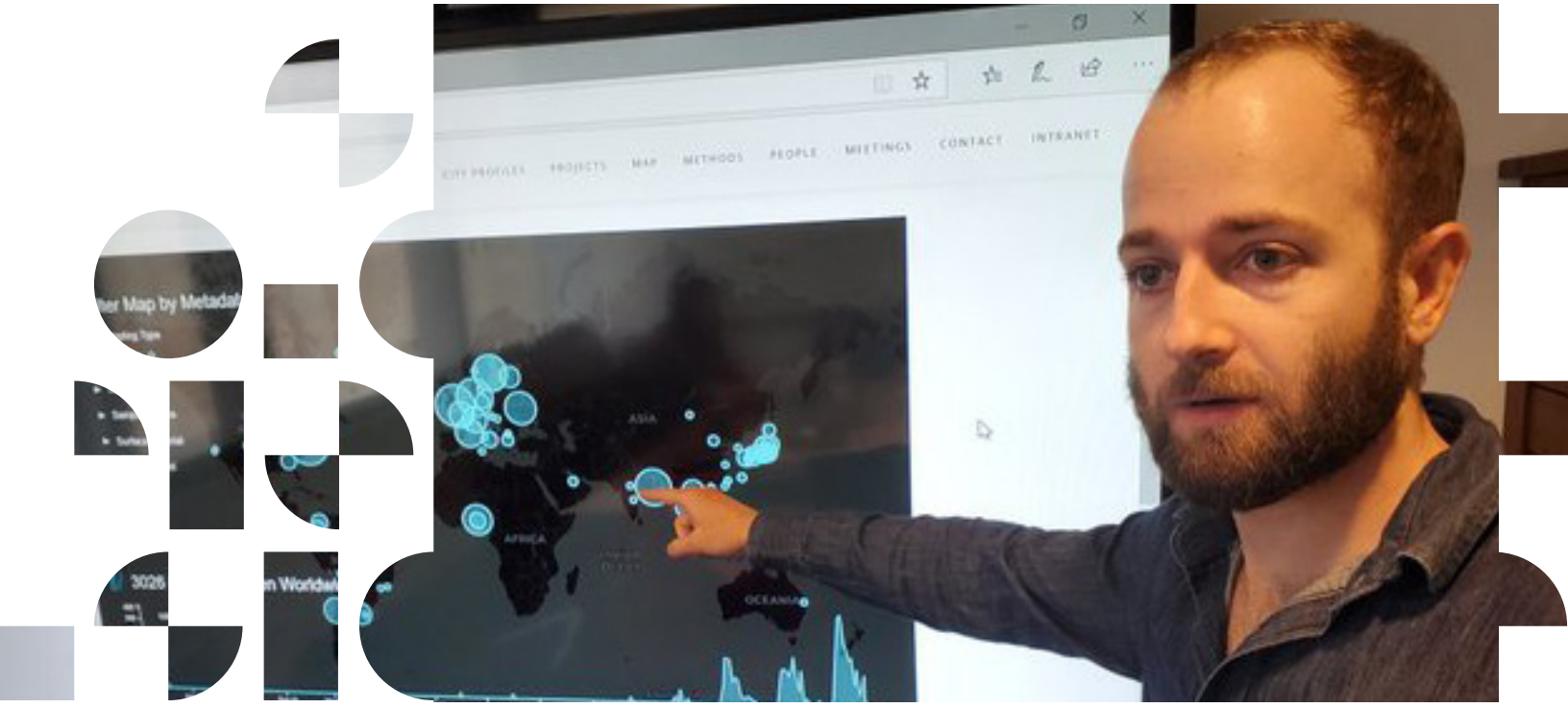
Another project that harnesses citizen scientists for disease surveillance is Mosquito Alert –an app where volunteers notify scientists of the presence of mosquitoes, or their breeding sites, by uploading photos and location information. Data is validated by scientists and then published on a publicly-available map. As well as helping scientists, the data is used by public health managers from a variety of Spanish cities to monitor and control mosquito populations. As of December 2020, the app had over 96,000 registered citizen scientists taking part in the project.[39] And over 13 per cent of the one billion observations contained in the Global Biodiversity Information Facility are from citizen science data generated through Mosquito Alert's app.[40]

37 MetaSUB (web page) http://metasub.org/. Accessed January 19, 2021.

38 Strong, J. 2020. Down and Dirty with Covid Genes. MIT Technology Review (podcast) https://cms.megaphone.fm/channel/inmachineswetrust?selected=MIT5515197777. Accessed January 19, 2021.

39 Mosquito Alert (web page) http://www.mosquitoalert.com/. Accessed December

40 Torres, M., Oltra, A., Bartumeus, F., Eritja, R. 2018. Mosquito Alert Annual Report 2018. Citizen science project results, p.20. http://www.mosquitoalert.com/wp-content/uploads/2018/11/Informe-anual-Mosquito-Alert_2018_en.pdf



Combining web scraped and/or existing datasets for real-time surveillance of public health threats

Collective intelligence methods like web scraping and combining different data sources are making it easier to monitor public health threats in real-time. The COVID-19 crisis has seen these methods applied to the creation of a number of dashboards, interactive maps and visuals that track the virus' spread and its impact.[41] The tracker developed by John Hopkins University has become the primary source of information for journalists and people around the world to monitor the spread of the virus.[42]

An example predating the COVID-19 pandemic is HealthMap, established in 2008, which utilizes online information for disease outbreak monitoring and real-time surveillance of emerging public health threats. An automated process brings together disparate data including online news, eyewitness reports and official reports to monitor, visualize and disseminate online information about emerging diseases in nine languages. Its data is used by the World Health Organization, the US' Centers for Disease Control and Prevention, and the European Centre for Disease Prevention and Control, among others. But unlike other systems that target only public health officials, it also has an app that is geared towards citizens, allowing them to see outbreaks in their neighborhood.[43]

Increasingly, however, collective intelligence initiatives are moving beyond monitoring epidemics to trying to predict them using machine learning models. AIME (Artificial Intelligence in Medical Epidemiology) is an AI platform to predict mosquito-borne disease outbreaks. During tests of its dengue prediction system, it was successful in predicting the next outbreak of dengue fever up to three months in advance. To do this, the platform combines real-time data generated by doctors, who send in notifications of dengue cases, with existing datasets of variables that influence the spread of dengue — from local terrain and elevation to roofing types and thunderstorms. From these, the system then predicts where the next outbreaks will be within a 400-metre radius, and with 81 per cent accuracy.[44] The platform is now used in Malaysia, Brazil and the Philippines to help healthcare providers manage and curb outbreaks.[45]

Combining web scraped and/or citizen-generated data to inform crisis response

The same web scraping methods used for disease surveillance are also being used to provide humanitarian agencies and emergency responders with faster and more relevant information in the immediate aftermath of a crisis. Combining existing datasets with locally-generated contextual information from citizens helps those planning emergency responses.

MIND (Managing Information for Natural Disasters) is a tool developed by UN Global Pulse to better inform humanitarian response planning and logistics after natural disasters.[46] It's built on an automated data pipeline that analyzes several non-traditional datasets all in one place. The tool combines information from Twitter and Google searches in the affected areas, as well as information from Wikipedia and OpenStreetMap about the location, casualty reports from news sources, and data from the International Aid Transparency Initiative, showing details about projects and organizations in the affected areas.[47] MIND is still a research prototype that is openly available for user testing.

41 Patel, N.V. 2020. The best, and the worst, of the coronavirus dashboards. MIT Technology Review, March 6, 2020. https://www.technologyreview.com/2020/03/06/905436/best-worst-coronavirus-dashboards/. Accessed January 19, 2021.

42 COVID-19 Global Map. John Hopkins University. https://coronavirus.jhu.edu/map.html. Accessed January 19, 2021.

43 HealthMap (web page) https://healthmap.org/en/. Accessed January 19, 2021.

44 Aime (web page) http://aime.life/. Accessed January 19, 2021.

45 Allen, D. 2020. Coronavirus: Using AI to Predict Disease Outbreaks. Medical Expo e-magazine, January 5, 2020. http://emag.medicalexpo.com/qa-using-ai-to-predict-disease-outbreaks/. Accessed January 19, 2021.

46 UN Global Pulse. MIND (web page) https://www.unglobalpulse.org/microsite/mind/. Accessed January 19, 2021.

47 Pulse Lab Jakarta. 2019. Managing Relevant Information in the Aftermath of Natural Disasters: Launching PLJ's Latest Data Analytics Platform. Medium May 29, 2019. https://medium.com/pulse-lab-jakarta/managing-relevant-information-in-the-aftermath-of-natural-disasters-launching-pljs-latest-data-de3b4cbae07b. Accessed January 19, 2021.

eBayanihan – a mobile and web-based participatory disaster management system which was developed and piloted in the Philippines during 2014-15 – represents a different approach. Unlike MIND, it did not scrape data from social media feeds of affected citizens, but allowed them to post reports of damage directly. They could also provide an initial needs assessment following incidents and request skills, resources or volunteers for the response. Machine learning algorithms helped model and validate these crowdsourced reports – categorizing and visualizing them. It provided real-time notifications to people managing response clusters. Unfortunately, it's unclear to what extent the system is still in use or how it's integrated into government disaster management.[48]

Crowd forecasting of epidemics, conflict and geopolitical events

Triggers for some crises are difficult to predict in advance due to their rare occurrence. With new pandemics or conflict, the lack of historical data can make statistical predictions or machine learning models unreliable. To address gaps in these methods, some organizations are employing another collective intelligence method called 'crowd prediction polling' or crowd forecasting. These 'wisdom of the crowd' forecasts are calculated by aggregating many individual judgments about the likelihood of events. Past research has even suggested that a non-specialist crowd can predict geopolitical events more accurately than individual analysts.[49]

For example, the Early Warning Project produces a ranked list of more than 160 countries, based on their likelihood of experiencing a mass killing, in order to better target preventative action by governments and charities. It does this using a combination of crowd forecasting, expert ranking and a machine learning model. During the first phase, experts in the field take part in an annual comparison survey where they rank pairs of countries according to which is more likely to

47 Pulse Lab Jakarta. 2019. Managing Relevant Information in the Aftermath of Natural Disasters: Launching PLJ's Latest Data Analytics Platform. Medium May 29, 2019. https://medium.com/pulse-lab-jakarta/managing-relevant-information-in-the-aftermath-of-natural-disasters-launching-pljs-latest-data-de3b4cbae07b. Accessed January 19, 2021.

48 eBayanihan (web page) http://ebayanihan.ateneo.edu/#. Accessed January 19, 2019.

49 Mellers, B. A., Baker, J.D., Chen, E., Mandel, D.R, Tetlock, P.E. 2017. How generalizable is good judgement? A multi-task, multi-benchmark study. Judgement and Decision-Making, 12(4), pp.369-381. http://journal.sjdm.org/17/17408/jdm17408.pdf

experience a mass killing. A machine learning model also generates estimates based on more than 30 variables from historic datasets. Seventeen 'higher-risk' countries are then tracked using crowd forecasting, producing quarterly forecasts over the course of a year. As forecasters can regularly update their estimates with new information, they're able to pick up and reflect 'weak signals' or sudden changes in the context missed by the other methods.

The Flu Forecasting Center at Carnegie Mellon University also taps into a group of volunteers (both experts and non-experts) for their annual flu tracking system. Each week volunteers log into an online system to review a chart showing the trajectory of past and current flu seasons. They're then asked to complete the current season's curve, projecting how many more flu cases there will be over time. The crowd's aggregate forecast is often just as accurate as the machine learning prediction, trained on over 20 years of data. Over the last few years, the center has fine-tuned this combination of human and machine predictions to forecast the trajectory of the flu with a high degree of accuracy, beating the attempts of many other researchers.[50]

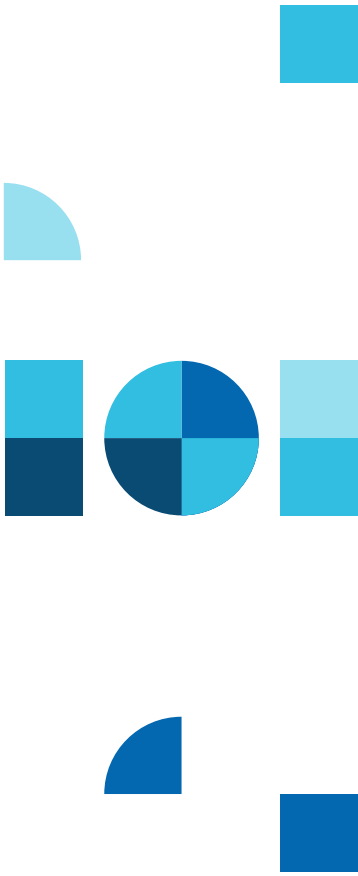
Crowdmapping (sometimes combined with satellite/ sensor data) for community preparedness and response

The best collective intelligence initiatives open up data for use by members of the public as well as decision makers – increasing people's ability to make decisions and power to act. Crowdmapping and GIS are the most commonly applied collective intelligence methods for gathering and sharing information in this way. Some initiatives combine this citizen-generated data with sensor or satellite data for a fuller picture of a situation and how it's changing.

One of the best known examples is Peta Bencana, which is applying collective intelligence methods to disaster response in the Indonesian capital of Jakarta. It creates real-time flood maps by combining reports from citizens on Twitter with official data on flooding and sensors from around the city. It's used by the local government to prioritize its flood response and by residents to make informed decisions about how to navigate around the city.[51]

In Tanzania, Ramani Huria helps communities in informal settlements to map residential areas, roads, streams, floodplains and other relevant features – aiming to bring disaster prevention and response to areas that were previously off the map. In 2015, it helped public authorities respond to an unexpected outbreak of cholera, providing detailed information on water points and sanitation data.[52] During the COVID-19 pandemic, the Taiwanese government made data on the nationwide stock of masks publicly available using an open API. This allowed civic-minded developers to create interactive maps showing the real-time distribution and supply of masks. These were used by citizens queuing for masks and enabled the government to address distributional problems.[53]

There are many other successful deployments of crowdmapping globally, even stretching to the Arctic. The SIKU platform combines satellite imagery with reports from indigenous communities in their own languages of weather conditions, ice hazards and wildlife. It helps document the impact of climate change, and is used to share dangerous and changing ice conditions within Inuit communities.[54]



50 Hao, K. 2020. This is how the CDC is trying to forecast coronavirus's spread. MIT Technology Review, March 13, 2020.https://www.technologyreview.com/2020/03/13/905313/cdc-cmu-forecasts-coronavirus-spread/. Accessed January 19, 2021.

51 Peta Bencana (web page) https://petabencana.id/. Accessed January 19, 2021.

52 Dar Ramani Huria (web page) http://ramanihuria.org/. Accessed January 19, 2021.

53 Leonard, A. 2020. How Taiwan's Unlikely Digital Minister Hacked the Pandemic. Wired, July 23, 2020.https://www.wired.com/story/how-taiwans-unlikely-digital-minister-hacked-the-pandemic/. Accessed January 19, 2021.

54 SIKU. The Indigenous Knowledge Social Network (web page) https://siku.org/. Accessed January 19, 2021.

Box 1

How is AI augmenting collective intelligence for the SDGs?

Most uses of AI in development today are based on machine learning algorithms, which improve their performance based on extracting patterns from very large training datasets. This approach is a great fit for collective intelligence projects, many of which gather or interpret large amounts of human-generated content like images and videos, crowdsourced through smartphone apps and online platforms.

These are the three main ways AI and collective intelligence are currently being used together for the SDGs:

1. Efficiency and scale of data processing

AI is being effectively incorporated into collective intelligence projects where timing is paramount and a key insight is buried deep within large volumes of unstructured data. This combination of AI and collective intelligence is most useful when decision makers require an early warning to help them manage risks and distribute public resources more effectively. For example, Dataminr's First Alert system uses pre-trained machine learning models to sift through text and images scraped from the internet, as well as other data streams, such as audio broadcasts, to isolate early signals that anticipate emergency events.[55]

2. Organizing human knowledge

To make the most of collective intelligence, it's important to draw on a diversity of views. But it's difficult to synthesize hundreds of inputs to extract common themes and priorities, especially when working with non-traditional citizen-generated data. This is often the limiting factor in large scale deliberative or consultation exercises, and here, AI can help. AI methods like natural language processing (NLP) can be used to identify prominent topics and help to cluster the data by meaning. Popular citizen participation platforms like CitizenLab and Decidim are already experimenting with these AI methods[56] and NLP has also been used to identify SDG priorities in the context of a social listening project by Pulse Lab Kampala.[57]

3. Optimizing and prioritizing workflows

Finally, we see examples of AI being deployed alongside volunteers to help them complete microtasks with more consistency and accuracy. For this combination of AI and collective intelligence, the performance gains may need to be carefully balanced with how comfortable volunteers feel about working with AI tools. For example, in 2018 the Humanitarian OpenStreetMap Team (HOT) launched the RapiD tool that uses computer vision to detect roads and terrain features, to help their volunteers complete crowdmapping tasks more quickly during crisis response. The RapiD tool was first used to support mapping in Kerala, India during a flooding event but has since been fully integrated into the HOT platform. Importantly, HOT offered volunteers the opportunity to opt out if they preferred working without AI.[58]

55 Jaimes, A. 2019. Multi-Modal Understanding and Summarization of Critical Events for Emergency Response. Dataminr, October 25, 2019. https://www.dataminr.com/blog/multi-modal-understanding-and-summarization-of-critical-events-for-emergency-response. Accessed January 19, 2021.

56 Grobbink, E., Peach, K. 2020. Combining Crowds and Machines: Experiments in collective intelligence design 1.0, pp.24-26. https://media.nesta.org.uk/documents/Combining_Crowds_and_Machines_PeWIhhR.pdf

57 Centre for Collective Intelligence Design, Nesta. 2019. Pulse Lab Kampala. Radio content analysis to understand community concerns. AI and Collective Intelligence: case studies. https://www.nesta.org.uk/feature/ai-and-collective-intelligence-case-studies/pulse-lab-kampala/. Accessed January 19, 2021.

58 Centre for Collective Intelligence Design, Nesta. 2019. MapwithAI. Computer vision based on supervised deep learning to support community mapping. AI and Collective Intelligence: case studies. https://www.nesta.org.uk/feature/ai-and-collective-intelligence-case-studies/mapwithai/. Accessed January 19, 2021

Use Case 3

Real-time monitoring of environmental conditions

As the scale of environmental issues surpasses available monitoring resources, 59 collective intelligence methods like citizen science and in-situ or remote sensing methods have been gaining traction. Groups of volunteers working with scientists, sometimes using satellite or sensor data, can extend the capacity of the government to gather and share important data. There are three key collective intelligence methods that are helping to build a more granular understanding of on-the-ground conditions needed for responsive policy making, interventions and services:

How collective intelligence methods are deployed

- Citizen science to monitor biodiversity and environmental conditions
- Remote and/or in situ sensing (and open data) to monitor changes in the environment
- Combining web scraped and/or citizen-generated data to monitor environmental hazards

Relevant SDG targets

- By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management (11.6)
- By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution (14.1)
- By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements (15.2)
- By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally (15.3)
- By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world (15.4)
- Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species (15.5)

Citizen science to monitor biodiversity and environmental conditions

Citizen science relies on the enthusiasm and willingness of ordinary people to help with tasks ranging from measuring air or water quality to cataloging flora and fauna or analyzing satellite photographs and making maps online after a natural disaster. This breadth of options means that individuals can choose how to contribute based on the time they have available and their personal interests.

The eBird platform, which was first developed in the US and is now a global movement, allows a dispersed volunteer community of bird watchers to collect vast amounts of data – with more than 100 million bird sightings contributed annually.[60] This is used by researchers and conservation groups to track population trends, identify important sites for protection and better design plans to help protect endangered species. eBird data contributes to hundreds of conservation decisions and scientific articles, as well as helping to inform bird research around the world.[61] For example, eBird Argentina[62] is being used to track local populations of the Torrent Duck, a species predominantly found in South America whose global numbers are declining.

Citizen science has broad application across the SDGs, but particularly so in helping to monitor air quality and environmental degradation. In recent years, the number of initiatives has proliferated. The Marine Debris Tracker, enables citizens to document and geolocate marine plastic pollution using an app.[63] OpenLitterMap does the same for all forms of waste.[64] AppEAR brings together communities in Argentina, Ecuador and Peru to study freshwater aquatic environments.[65] sensors.Africa is a pan-African community that uses low cost sensors to monitor air quality in places

61 Fressoli, M., Arza, V., Castillo, M. 2016. Entina Argentina. The impact of citizen-generated data initiatives in Argentina. https://civicus.org/thedatashift/wp-content/uploads/2016/05/CGD-impact-report-Argentina.pdf

62 eBird Argentina (web page) https://ebird.org/argentina/home. Accessed January 19, 2021.

63 Debris Tracker (web page) https://debristracker.org/. Accessed January 19, 2021.

64 OpenLitterMap (web page) https://openlittermap.com/. Accessed January 19, 2021.

65 sensors.AFRICA. Measuring Nairobi's air quality using locally assembled low-cost sensors. Medium. April 16, 2019. https://medium.com/sensorsafrica/measuring-nairobis-air-quality-using-locally-assembled-low-cost-sensors-f31bc54551f2. Accessed January 19, 2021.

like Nairobi and makes that data available to journalists, civic watchdogs, citizens and governments to help push for tighter regulations.[66]

In 2020, UNDP Argentina, set out to monitor the street-level fluctuations in air quality in Buenos Aires through its Accelerator Lab. The goal was to understand the typical exposures to pollutants for urban residents, that official monitors fail to capture. The team partnered with open-seneca, a worldwide network of citizen science projects that measures air quality using low cost sensors.[67] They built the sensors with 80 local university students and used an open call to identify 20 local cyclists who could measure pollutants during their routes over a seven-week period. The project has inspired multiple pilots in other Argentinian cities, and the team is working with local and national policy makers to increase the functionality of the sensors allowing measurements of noise and temperature to inform urban planning decisions.

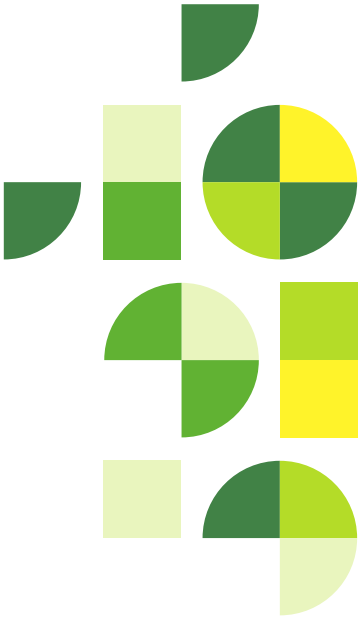
Remote and/or in situ sensing (and open data) to monitor changes in the environment

Collective intelligence projects also frequently draw on Earth Observation (EO) data from satellites, data from in-situ sensors or mobile phones to measure changes in environmental conditions. This data is sometimes combined with citizen-generated observation data, or volunteers are recruited to help analyze or validate them to make them more usable for research or policy.

Regen Network is a technology start-up. It uses satellite, sensors and on-the-ground observation data to understand current ecological conditions. Farmers are incentivized to experiment with new approaches to improving the ecosystem – like carbon sequestration, cleaning waterways or increasing biodiversity. The sensor and observation data helps farmers to monitor the progress of their experiments in real-time, and learn what works best. At present Regen is being deployed in Ecuador to help cacao farmers adopt regenerative agriculture practices in place of monoculture, and in Barbados to help a former sand quarry which has been reforested to quantify conservation and land regeneration outcomes.[68]

Global Forest Watch and Global Fishing Watch are two other initiatives that provide real-time monitoring for the environment. Global Forest Watch helps conservation groups and policy makers monitor deforestation using satellite data and data from people on the ground. It has been used by companies like Mars to evaluate its palm oil suppliers and make decisions about where to source from. The Amazon Conservation Association uses it to provide governments with timely information on illegal gold mining or logging, enabling them to take action within 24-48 hours of receiving an alert.[69] A new study has found that active monitoring of forests in Central Africa using satellite data reduced deforestation by 18 per cent.[70] Global Fishing Watch helps to identify illegal fishing by combining government data on commercial fishing fleets with data from automatic identification systems (AIS) that large ships use to broadcast their position.[71] In 2020, the platform was being used by the US Navy and Ghana Navy to assist with fishing patrols, and by researchers to identify illegal 'dark' fishing fleets off the North Korean and Somali coasts. Both platforms make their data free and available for researchers, journalists, campaigners and governments.[72]

Other examples of this application of collective intelligence include Rainforest Connection,[73] which uses acoustic monitoring to detect the sound of



66 open-seneca (web page) https://open-seneca.org/about-us/. Accessed January 19, 2021.

67 open-seneca (web page) https://open-seneca.org/about-us/. Accessed January 19, 2021.

68 Regen Network (web page) https://www.regen.network/. Accessed January 19, 2021.

69 Global Forest Watch (web page) https://www.globalforestwatch.org/about/. Accessed January 19, 2021.

70 Shea, K. 2021. Use of GLAD Alerts Led to 18% Reduction in Deforestation in African Forests. Global Forest Watch, January 4, 2021. https://blog.globalforestwatch.org/data-and-research/glad-alerts-reduce-deforestation-africa/. Accessed January 19, 2021.

71 Global Fishing Watch (web page) https://globalfishingwatch.org/. Accessed January 19, 2021.

72 Long, T. 2020. 2020 Hindsight: How a New Wave of Transparency Can Lead to Better Ocean Governance. Global Fishing Watch, December 21, 2020.https://globalfishingwatch.org/data/2020-how-transparency-can-lead-to-better-ocean-governance/. Accessed January 19, 2021.

73 Rainforest Connection (web page) https://www.rfcx.org/home. Accessed January 19, 2021.

chainsaws, logging trucks and gunshots that could indicate illegal logging activity. Old mobile phones with an extra microphone are attached to trees and hidden in the jungle. They stay charged and listen 24 hours a day, powered by solar cells. The phones record all sounds in the forest, process the data and send it to the cloud, where it's analyzed in real time. Machine learning and data analytics help distinguish sounds like a chainsaw from background forest noise and identify other patterns that might otherwise go undetected – including the presence of endangered species. Text alerts are automatically sent to authorities who can determine if the activity is illegal and then stop it. So far, the Rainforest Connection has been used in Cameroon, Ecuador, Peru and Brazil.[74]

Combining web scraped and/or citizen-generated data to monitor environmental hazards

The people in affected areas are often the best source of information about environmental hazards. Their collective intelligence is increasingly being activated through bespoke citizen reporting tools, or by web scraping social media data where people are already sharing information, to enable more agile responses.

MOPA (Monitoria Participativa Maputo) is a World Bank and Make All Voices Count supported initiative in Maputo, Mozambique. Citizens report waste-related issues to the municipal government using mobile phones. Data visualizations, SMS alerts and statistics allow city officials to monitor waste collection service quality and help waste collection companies locate problems such as waste dumping and overflowing bins as they arise.[75] MOPA helped improve waste removal response time from five days to 14 hours.[76]

In Ukraine the open burning of waste is a widespread practice, with deep roots in its culture and agricultural economy. To understand the scale and locations of open burning across the country, the Accelerator Lab of UNDP Ukraine created a near real-time map of open burning across the country. They used novel data sources including satellite images, GIS, and citizen-generated reports of fires to produce an interactive dashboard. They then worked together with community groups from across the country and local policy makers to interpret and discuss the data over a series of ten online meetings. They also mapped over 367 individuals and organizations who were already composting waste as an alternative to open burning – demonstrating that local solutions already existed.[77]

Haze Gazer, is a crisis analysis and visualization tool created by UN Global Pulse Lab Jakarta to provide up-to-date information on fire and haze hazards in Indonesia.[78] It uses advanced data analytics and data science to mine open data, such as fire hotspot information from satellites (from Global Forest Watch), as well as citizen-generated data from Twitter, Instagram and YouTube to understand how the affected communities are responding.[79] The Haze Gazer system is now installed in the Executive Office of the President of Indonesia.

74 Nunez, C. 2017. Your Old Cell Phone Can Help Save the Rain Forest. National Geographic, June 15, 2017. https://www.nationalgeographic.com/news/2017/06/topher-white-engineer-rainforests-explorer-festival/. Accessed January 19, 2021.

75 MOPA (web page) https://www.mopa.co.mz/en/. Accessed January 19, 2021.

76 MOPA. 2017. How an app generates data that help clean-up Maputo. Making All Voices Count, November 16, 2017. https://www.makingallvoicescount.org/news/mopa-how-an-app-generates-data-that-help-clean-up-maputo/. Accessed January 19, 2021.

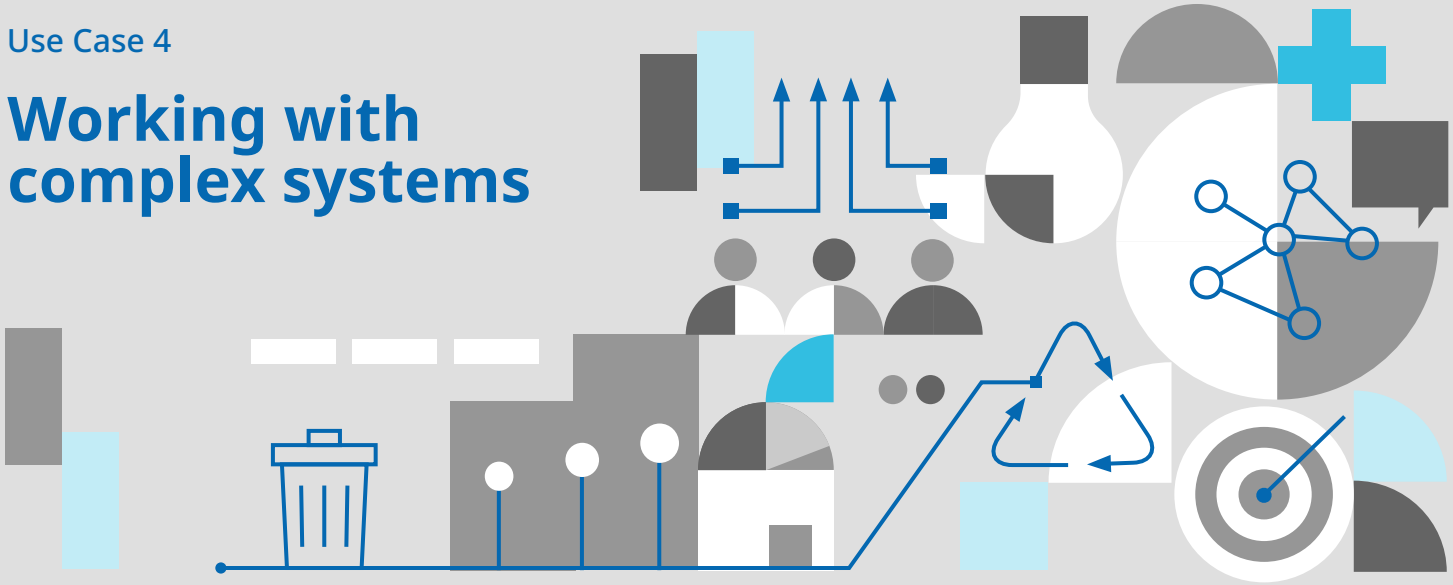
77 Kylymnyk, I. Confronting the country's burning crisis collectively. UNDP, September 29, 2020. https://www.ua.undp.org/content/ukraine/en/home/blog/2020/confronting-the-countrys-burning-crisis-collectively.html. Accessed January 19, 2021.

78 Haze Gazer (web page) http://hazegazer.org/. Accessed January 19, 2021.

79 Lee, J.G., Amin, I. 2017. Scaling up Haze Gazer: an analysis and visualization tool for haze crisis management. UN Global Pulse, January 26, 2017. https://www.unglobalpulse.org/2017/01/scaling-up-haze-gazer-an-analysis-and-visualization-tool-for-haze-crisis-management/. Accessed January 19, 2021.

Use Case 4

Working with complex systems



Our economies, the climate, migration and urban infrastructures are all examples of complex systems. What these complex systems have in common is their nonlinear, adaptive, networked, and emergent behavior. As many development policy makers increasingly recognize, single interventions in one part of a complex system may not produce the intended effects – and may precipitate unintended ones.

Collective intelligence approaches that combine multiple data sources can help local governments and development organizations better understand the complexity and changing dynamics of systems like cities, as well as the different needs or experiences of the people within them. There are three common applications of collective intelligence methods to make complex systems intelligible for better decision making:

How collective intelligence methods are deployed

- Combining sensor data and/or citizen-generated data for 'intelligent' networked actions
- Combining datasets (and creating open data) to 'see' a complex system
- Crowdsourcing ideas and opinions from citizens to inform decision making

Relevant SDG targets

- Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks (3.d)
- Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries (13.1)
- Reduce violence and related deaths (16.1)

Combining sensor data and/or citizen-generated data for 'intelligent' networked actions

By integrating different types of available data, collective intelligence can help to coordinate and influence the activities of people and organizations in a complex system in new ways, forming a central nervous system for cities and communities – and helping them to operate more effectively.

Breadline is a collective intelligence platform that enables local food rescue volunteers from NGOs in Hong Kong to see quantities of leftover bread at different bakeries across the city in real time. It allows the volunteers to choose their own collection routes, removing bakeries from the list when volunteers indicate that they intend to pick up from a particular store. The increased transparency enables volunteers to act in a decentralized way that also lets them draw on their tacit knowledge of the fastest way to get round the city. It has led to a fourfold increase in bread collected.[80]

Waze is a community-driven navigation app. It combines GPS location data from mobile phones of drivers with crowdsourced information on accidents, hazards or speed traps from its 50 million members. From this it creates real-time traffic maps and helps people find the fastest route for their journey.[81,82] Many of its features have been incorporated into Google Maps, but its game-like features have enabled it to retain a strong community user base.

One of the largest scale examples is China's City Brain project. It consolidates data feeds from more than 700 IT systems from different government agencies. It's used to optimize traffic lights, help ambulance and fire response, and improve waste collection, parking lot management and health monitoring. It has now been implemented in 23 cities across Asia, sometimes as part of the digital component of the Belt and Road Initiative.[83]

Combining datasets (and creating open data) to 'see' a complex system

In the last decade, an explosion of initiatives has made data more accessible or open – including new models for partnerships like data trusts and data collaboratives. These are helping to break down traditional silos and unlock potential new uses of data to generate meaningful insights into complex systems. Being able to see things that were previously hidden, or only partially visible, is a core requirement of the kind of systems transformation called for by the SDGs.

For urban planning and management challenges, understanding the impacts, drivers and dynamics of the complex city system is critical. Bringing together novel and existing datasets can enable policy makers and planners to see both long-term trends at the macroscale and microtrends at the local level. The Africapolis platform brings together multiple data sources to build understanding of long-term urban dynamics across Africa. Its data is based on a large inventory of housing and population censuses, electoral registers and other official population sources. Satellite and aerial images are also used to identify the built-up areas and the precise location of settlements. Official administrative boundaries data is used to link population data to the observed information on the built-up areas.[84]

New, and often citizen-generated, data can help city planners better understand different needs across the city and provide a more flexible alternative to cumbersome traditional master planning processes. In India, the Bhuvan project creates maps that help cities with effective land-use management and responsive planning.[85]

80 Grobbink, E., Peach, K. 2020. Combining Crowds and Machines: Experiments in collective intelligence design 1.0, pp.24-26. https://media.nesta.org.uk/documents/Combining_Crowds_and_Machines_PeWIhhR.pdf

81 Waze (web page) https://www.waze.com/en-GB/ccp. Accessed January 19, 2021.

82 Page, V. 2019. Waze: The Pros and Cons. Investopedia, May 18, 2020. https://www.investopedia.com/articles/investing/060415/pros-cons-waze.asp#:~:text=Waze%20uses%20data%20from%20app,that%20could%20slow%20down%20drivers. Accessed January 19, 2021.

83 Alibaba Cloud Intelligence Brain (web page) https://www.alibabacloud.com/et/city. Accessed January 19, 2021.

84 Africapolis (web page) https://www.africapolis.org/home. Accessed January 19, 2021.

85 Bhuvan (web page) https://bhuvan.nrsc.gov.in/bhuvan_links.php. Accessed January 19, 2021.

It uses data taken from satellite imagery on transport infrastructure, natural features and land-use, alongside utility data and information crowdsourced from locals through the Point of Interest app. These maps are used to draft master plans which are published online for review and feedback by local residents. Today, 121 city master plans have been published using Bhuvan and work is underway on 143 more.[86]

Another example of a complex system is food production and distribution. This system becomes even more complex when a large part of that system is driven by the informal sector as it is in Zimbabwe.[87] During the COVID-19 pandemic, with the country experiencing food shortages, the UNDP Accelerator Lab in Zimbabwe established a partnership with three major trade associations to tap into data on day-to-day transactions and volume of trade across the country. They also collected qualitative data about the experiences of these informal workers who were so important to the system. Combining these novel data sources helped to reveal previously unmapped vulnerabilities in the system – such as a regular January fluctuation in market prices. Their methods are now informing the Zimbabwe Resilience Building Fund, a long-term development initiative that aims to improve the resilience of communities in the face of recurrent shocks and stresses.[88]

86 Centre for Collective Intelligence Design, Nesta. 2020. Supporting democratic, responsive urban planning and design. https://www.nesta.org.uk/feature/collective-intelligence-and-smart-city/supporting-more-democratic-responsive-urban-planning-and-design/. Accessed January 19, 2021.

87 An estimated 90 per cent of the economy is informal in Zimbabwe. https://www.ids.ac.uk/opinions/the-impact-of-the-covid-19-lockdown-on-zimbabwes-informal-economy/. Accessed January 19, 2021.

88 The Zimbabwe Resilience Building Fund (web page) http://www.zrbf.co.zw/. Accessed March 29 2021.

Crowdsourcing ideas and opinions from citizens to inform decision making

Experience has shown that imposing large-scale urban projects on citizens without their input or involvement is frequently an invitation to vicious backlash. Cities around the world are turning to digital platforms to crowdsource problems and potential solutions from their residents.

One well-known example is Block by Block. It uses the Minecraft platform (an easy-to-learn 3D digital modeling game) as a community participation tool for visualization and collaboration to actively engage neighborhood residents who do not typically have a voice in influencing spatial planning and design of cities. Once project ideas are completed in Minecraft, stakeholders from local government, planners and architects listen to presentations by people who were part of the design process. In the Gaza Strip, the program allowed the incorporation of women's and girls' ideas in reconstructing key public spaces that have since benefited around 100,000 people.[89] So far, Block by Block has helped the renewal of urban neighborhoods in more than 30 countries.[90]

As the COVID-19 crisis continues to send shockwaves around the world, precipitating potentially the worst global recession in eight decades,[91] the risks caused by the looming climate and environmental crises continue to grow.[92] To tackle these complex systemic issues, today's leaders will need to decide on actions now that may only deliver benefits in the long-term, and possibly even deliver some pain in the short-term. Not only will this require new ideas and new ways of managing public investment, it will also require new ways to bring people along with tough choices. This means having conversations with the public about desired future destinations, the route maps to get there and the trade-offs they're willing to accept. A range of collective intelligence methods known as participatory futures approaches are increasingly being used to widen the range of people thinking about the future, and to connect their views into policy making.[93]

In 2016, the Mayor of Mexico City decided to crowdsource a city-wide constitution from local residents. He appointed a 28-person drafting committee made up of Mexico City residents, supported by technical staff. Local people's visions for the city were gathered through a survey called Imagina tu Ciudad (Imagine Your City) and student volunteers, armed with tablets, were deployed to gather responses from citizens in public spaces. People could also set up online petitions for specific articles to be included in the constitution. The constitution was formally approved in February 2017 with crowdsourced components providing an important influence on policy, including on LGBTQI rights and the right to mobility – the first time such a right was ever enshrined in a city constitution.[94]

Another practical illustration comes from Aruba. In 2008, the government initiated a deliberative exercise to chart a 2025 vision for the island that would also deal with the existential challenges it faced – such as fragile ecosystems and vulnerability to volatile global energy markets.[95] It used a structured process of appreciative inquiry to generate positive visions for the future, and scenario building to create stories about different futures. More than half the island's 100,000 residents were involved. The exercise led to the creation of a national strategy, which outlasted a change of government due to the popular support it garnered.

89 Harrouk, C. UN-Habitat Promotes Inclusive Planning and Gender Equitable Cities Using Technology. ArchDaily, January 2, 2020.https://www.archdaily.com/931217/un-habitat-promotes-inclusive-planning-and-gender-equitable-cities-using-technology. Accessed January 19, 2021.

90 Block by Block (web page) https://www.blockbyblock.org/. Accessed January 19, 2021.

91 World Bank. 2021. Global Economics Prospects. https://www.worldbank.org/en/publication/global-economic-prospects

92 Larris, E. 2020. Climate crisis fills top five places of World Economic Forum's risks report. The Guardian, January 15, 2020. https://www.theguardian.com/business/2020/jan/15/climate-crisis-environment-top-five-places-world-economic-forum-risks-report. Accessed January 19, 2021.

93 Ramos, J., Sweeney, J., Peach, K., Smith L. 2019. Our Futures: By the people, for the people. https://www.nesta.org.uk/report/our-futures-people-people/

94 Cities of Service (web page) https://citiesofservice.jhu.edu/resource/crowdsourcing-a-constitution-mexico-city/. Accessed January 19, 2021.

95 Nos Aruba (web page) http://www.nosaruba2025.aw/nosaruba.html. Accessed January 19, 2021.

Box 2

How might AI and collective intelligence help us get even better at working with complex systems?

One significant future opportunity lies in using AI to augment collective intelligence to model scale and complexity. For complex challenges, it can be hard to connect local issues to global problems, or make the case for short-term sacrifices that bring long-term benefits.[96] Methods based on distributed AI[97] are emerging to help us overcome these limits of perception. For example, agent-based modeling and multi-agent systems are being used by decision makers to explore different scenarios and understand the impacts of interventions they plan to make,[98] while generative AI models are helping to visualize long-term impacts[99] of systemic problems like climate change. These emerging AI methods can be used to explore the complexity at the heart of the SDGs.

CityMatrix is a good example of what this looks like in practice. It helps decision makers test out the impact of urban planning decisions.[100] Using many different sources of urban data, CityMatrix creates an interactive simulation of a city environment, powered by agent-based modeling. The tool's visual interface allows participants to set policy priorities and choose between different options recommended by an optimization algorithm. Variants of the tool have been piloted with a number of cities, including Paris, Boston and Riyadh, but it will take time for these types of models to become a mainstay of collective decision making. Ultimately, tools like CityMatrix may be used to bring together different stakeholder groups across cultural and social divides to collaboratively explore complex issues while engaging in deliberation about competing values, trade-offs and priorities. There are promising signs of progress from the development sector. In 2020, the UN announced that it was planning to test out a simulation tool for policy prioritization with governments in Latin America.[101]

96 Weber, E.U. 2015. Climate Change Demands Behavioral Change: What Are the Challenges? https://spia.princeton.edu/system/files/research/documents/Climate%20Change%20Demands%20Behavioral%20Change_Social%20Research.pdf

97 Distributed Artificial Intelligence (DAI) is a class of methods and technologies that concerns the development of distributed solutions to solving complex learning, planning and decision making problems. For an overview of DAI methods and technologies see: Corea, F. 2019. Distributed Artificial Intelligence. https://francesco-ai.medium.com/distributed-artificial-intelligence-3e3491e0771c. Accessed January 20, 2021.

98 Berditchevskaia A., Stathoulopoulos K., Wilcock, R. 2020. The research frontier: where next for AI and collective intelligence? Nesta, Feburary 21, 2020. https://www.nesta.org.uk/blog/research-frontier-where-next-ai-and-collective-intelligence/. Accessed January 19, 2021.

99 For example, see the Mila project that visualizes the impacts of climate change: https://mila.quebec/en/ai-society/visualizing-climate-change/. Accessed January 19, 2021.

100 Yan, Z. 2017. CityMatrix: An Urban Decision Support System Augmented by Artificial Intelligence. MIT Media Lab, September 1, 2017. https://www.media.mit.edu/publications/citymatrix/. Accessed January 19, 2021.

101 Heaven, W.G. 2020. The UN says a new computer simulation tool could boost global development. MIT Technology Review, May 29, 2020. https://www.technologyreview.com/2020/05/29/1002404/united-nations-computer-agents-simulation-boost-global-sustainable-development-goals/. Accessed January 19, 2021.

Use Case 5

Inclusive development and technologies

The SDGs' promise to 'leave no one behind' brings with it an imperative to involve marginalized individuals and communities in development initiatives. Collective intelligence methods like crowdmapping, citizen reporting and mobile phone surveys are some of the methods used to engage and reach people whose voices are often not counted, or who may face barriers to accessing public consultations. As well as creating a rich harvest of insights, these three key collective intelligence methods can play an important role in growing the capacity of citizens and distributing power:

How collective intelligence methods are deployed

- Crowdmapping and/or citizen reporting to document the issues affecting particular groups
- Crowdsourcing views and experiences using phone polling/text-based microsurveys
- Crowdsourcing data from under-represented groups to build more inclusive AI systems

Relevant SDG targets

- End all forms of discrimination against all women and girls everywhere (5.1)
- By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status (10.2)
- Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard (10.3)

Crowdmapping and/or citizen reporting to document the issues affecting particular groups

Citizen reporting and crowdmapping are being used to expose the scale of problems like sexual violence that affect large numbers of women globally,[102] but often go undocumented. It's well known that a persistent lack of gender disaggregated data makes women invisible in national statistics, and means that many of the issues they face go uncounted and therefore unaddressed in policy agendas.[103] But this is also true for people living with disabilities, indigenous communities and LGBTQI populations. As more development decision making becomes data-driven, it's important that efforts are accelerated to involve diverse communities in generating and using data to make decisions and hold others to account.

HarassMap is a non-profit initiative that crowdsources reports from women in Egypt about sexual harassment and abuse using the Ushahidi platform. They use the data to challenge stereotypes that blame the victims of harassment, build campaigns to convince people to take action and help create zero-tolerance of sexual harassment in schools, universities and workplaces.[104] Safecity does the same in India and Kenya, digging into trends related to the types of violence or location to design appropriate interventions.[105]

Citizen reporting methods are also being used by young people living with disabilities in Kenya, Zambia and the Philippines as part of a partnership between On Our Radar and Leonard Cheshire. They monitor progress towards the SDGs by documenting their experiences on their mobile phones. The stories are uploaded onto an online reporting hub. This evidence is then used by disabled people's organizations and youth with disabilities to inform their advocacy for more inclusive policies.[106]

The Geochicas' Las Calles De Las Mujeres[107] uses crowdmapping to discover and visualize the absence of female figures in street names in Latin American and Spanish cities, as well as highlighting the historic contributions of women. By bringing together a common technical and social infrastructure for addressing gender data gaps, Geochicas has created a global peer-led community of activists. As of 2019, the movement had more than 190 crowdmappers from 22 different countries.[108]

Crowdsourcing views and experiences using phone polling/microsurveys

The high penetration of basic mobile phones and technologies like radio are also being used to crowdsource views and experiences from traditionally overlooked groups, such as those in conflict zones or communities affected by poverty and illiteracy.

To overcome this, UNICEF launched U-Report, a mobile messaging program, in 2011. It gathers opinions and information from young people using polls and allows them to report issues. It operates on numerous social media, messaging and SMS channels, and is now active in 68 countries with 11 million users. The data and insights are shared back with communities and communicated to policy makers who make decisions that affect young people.[109]
To better understand the perspectives of people in remote and hard-to-reach communities, Africa's Voices, UNICEF Somalia, and Media INK designed five interactive radio shows on gender and child protection issues. The themes included female genital cutting and child marriage. Over 40,000 text messages were received

102 UN Women states that one in three women face some kind of sexual assault at least once in their lifetime: https://news.un.org/en/story/2019/11/1052041. Accessed January 19, 2021.

103 Badiee, S., Melamed, C. 2014. Making the data revolution a gender data revolution. Data Revolution Group, December 15, 2014. https://www.undatarevolution.org/2014/12/15/gender-data-revolution/. Accessed January 19, 2021.

104 HarassMap (web page) https://harassmap.org/en/. Accessed January 19, 2021.

105 Safecity (web page) https://safecity.in/. Accessed January 19, 2021.

106 Leonard Cheshire (web page) 2030 and Counting. https://www.leonardcheshire.org/our-impact/our-international-work/youth/2030-and-counting. Accessed January 19, 2021.

107 Geochicas. Las Calles De Las Mujeres map (wep page) https://geochicas.org/index.php/2018/03/17/las-calles-de-las-mujeres/. Accessed March 29, 2021.

108 Yang, S. 2019. The Streets of Women. Geoawesomeness, July 9, 2019. https://www.geoawesomeness.com/the-streets-of-women-geochicas/. Accessed January 19, 2021.

109 UNICEF Office of Innovation. U-Report. Empowering and connecting young people around the world to engage with and speak out on issues that matter to them. https://www.unicef.org/innovation/U-Report. Accessed January 20, 2021.

in response to questions posed during the shows, with over 45 per cent of these coming from women and girls. The insights from the responses are now informing UNICEF's social norms work and its messaging around social change.[110]

Also making use of radio's wide reach, in 2015 UN Global Pulse Lab Kampala designed a prototype AI tool that analyzed data from call-in shows on Ugandan local public radio stations. The team developed three NLP models to convert speech to text through speech recognition and translation between English and the regional languages Luganda and Acholi. The tool automatically tracked trends in the use of terms relevant to the SDGs, delivering key insights on health service issues, the arrival of refugees and local crises. The project provided a valuable proof of concept that citizen-generated audio contains unique information that is of use to governments and development organizations. It is now being scaled to other countries.

Phone polling has also provided important evidence for journalists investigating land grabs in South Sudan. To uncover the truth, journalists Carloyn Thompson and Lagu Joseph Jackson designed a mobile phone survey which was distributed through random dialing on a national network, and pre-recorded in six local languages. Respondents could answer by pressing numbers on their phone, and in some cases recording a message. The result of the investigation was published on Al Jazeera in 2019, and led to discussions in the South Sudanese community around land rights as part of the peace agreement.[111]

Crowdsourcing data from under-represented groups to build more inclusive AI systems

As AI becomes more pervasive, it's important to ensure that the technology does not exacerbate existing inequalities. Collective intelligence methods are also

being used to create an alternative and more inclusive AI-enabled future.[112] Developing training datasets for machine learning models (see Box 2) that are more representative of the diversity of real-world experience is a vital first step.

Mozilla's Common Voice project, for example, uses an accessible online platform to crowdsource the world's largest open dataset of diverse voice recordings, spanning different languages, demographic backgrounds and accents. Common Voice aims to open up the AI market and stimulate the development of AI voice assistants that are able to serve the needs of more diverse communities.[113] Other projects focus on a smaller subset of languages; for example, Siminchikkunarayku and Masakhane[114] focus on Peruvian and regional African languages respectively. These projects recognize that developing AI systems based on under-represented languages and voices helps to preserve and increase the reach of cultural heritage. The resulting AI systems are also better able to serve the needs of these groups, who would otherwise be excluded.

110 Africa's Voices, MediaINK and UNICEF. Child protection & gender equality in Somalia (UNICEF). https://www.africasvoices.org/case-studies/child-protection-gender-equality-in-somalia-unicef/. Accessed January 20, 2021.

111 Thompson, C., van Schie, K., Jackson, L.J. 2019. Forced OUT: Measuring the scale of the conflict in South Sudan. Al-jazeera (web page) https://interactive.aljazeera.com/aje/2019/south-sudan-forced-out/index.html. Accessed January 20, 2021.

112 Berditchevskaia, A., Baeck, P. 2019. The Future of Minds and Machines: How artificial intelligence can enhance collective intelligence, p.39. https://www.nesta.org.uk/report/future-minds-and-machines/. Accessed January 19, 2021.

113 Common Voice (web page) https://commonvoice.mozilla.org/en. Accessed October 27, 2020.

114 Masakhane (web page) https://www.masakhane.io/. Accessed January 19, 2021.

Use Case 6

Distributed problem solving

The sixth use case is distributed problem solving, which overlaps in many ways with the five other use cases. These collective intelligence methods have broad application across the majority of the SDGs, but become especially relevant for targets where there might be a lack of access to established solutions and practices, or when new or locally-appropriate solutions are needed. This is often the case where the issue or environment is new or evolving, or where there have not been strong enough incentives for others to find solutions. It's perhaps not surprising then, that our analysis found examples of collective intelligence being frequently applied to help improve climate adaptation and food security (targets 2.3 and 13.1), as well as tackle infectious and neglected or rare diseases (targets 3.3 and 3.4).

How collective intelligence methods are deployed

- Crowdsourcing solutions/open innovation
- Peer-to-peer crowdsourcing of knowledge or ideas
- Open source repositories/project wikis to share solutions
- Crowd labeling of data to train 'AI for good' models

Relevant SDG targets

- By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment (2.3)
- By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases (3.3)
- By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being (3.4)
- Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries (13.1)

Crowdsourcing solutions/ open innovation

The use of open innovation methods such as challenge prizes, like XPRIZE or The Grand Challenges, are now well-established in the panoply of collective intelligence approaches. Usually run by an institution, they work by specifying problems to be solved and then encouraging, incentivizing and supporting a much broader range of innovators to help solve them. They have been used for a wide range of issues, from tackling antibiotic resistance to climate change – and work best with careful orchestration and problem solvers who understand the realities on the ground.[115]

Nesta Challenges' Data Driven Farming Prize, sponsored by USAID and Feed the Future, challenged innovators to use technology to improve agricultural productivity and the livelihoods of smallholders in Nepal. Thirteen finalists, including six from Nepal, were selected from 143 entries from 27 countries. Winning entries included Nepal's Db2Map[116] for their GeoKrishi program which integrated satellite, government and crowdsourced data into actionable advice for farmers and agricultural entrepreneurs. Another winner was Spero Analytics[117] from Canada, for their wireless solar mesh network to communicate soil moisture data to agricultural extension services. Six months after the prize ended, finalists had formed at least 22 new partnerships, including links with government ministries, and eight new technology products had entered the market.[118]

In Colombia, the UNDP's Accelerator Lab also turned to crowdsourcing solutions when the COVID-19 pandemic exposed the

115 Nesta Challenges. 2019. Challenges Prizes: A Practice Guide. https://www.nesta.org.uk/toolkit/challenge-prizes-a-practice-guide/

116 Database to Map (webpage) http://www.db2map.com/Default.aspx. Accessed February 12, 2021.

117 Spero Analytics (webpage) http://spero.ag/. Accessed February 12, 2021.

118 McRae, F. 2019. Modernising the farming industry. Nesta Challenges, August 15, 2019. https://challenges.org/case-study/data-driven-farming. Accessed February 12, 2021.

country's shortage of face masks and other forms of personal protective equipment (PPE). The Life Helmets challenge called for designs for closed full-face shields to allow citizens to safely return to work while avoiding infection. The five winning designs were submitted by a doctor, a student, a DIY maker and a taxi driver – demonstrating how collective intelligence approaches can bring in a diverse and sometimes unusual range of problem solvers. Following the completion of the challenge, the Life Helmets platform was turned into a marketplace for the winning designs, where members of the public and companies can buy face shields for personal use. UNDP Colombia has since purchased and distributed more than 27,000 of these winning Life Helmets across the country, including in remote locations where communities have struggled to access PPE.

Peer-to-peer crowdsourcing of knowledge or solutions

'Lead-user innovation' is a term coined by MIT's Eric von Hippel in the eighties. It refers to people who are the creators of novel solutions to particular problems or challenges they face.[119] The advance of the internet has led to more and more collaborations of lead users – who can now find each other and work together even though they may be separated geographically.

Wefarm is a free peer-to-peer service for small scale farmers in East Africa. It enables them to ask each other questions on anything related to agriculture via SMS and then receive crowdsourced bespoke content and ideas from other farmers within minutes. Wefarm's machine learning algorithms match each question to the best suited responders in the community. Its NLP models can identify three regional African languages – Kiswahili, Luganda and Runyankore – in addition to English. More than one million farmers are currently using it, sharing more than 40,000 questions and answers daily.[120]

In Ethiopia and Nigeria, researchers from Bioversity International have been working with subsistence farmers who test different varieties of seeds for climate resilience and pool their knowledge about which varieties fare best. This peer-to-peer crowdsourcing approach has been proven to find seeds that are much better at surviving extreme weather conditions than those recommended on official lists, a critical part of mitigating the impact of climate change on food systems.[121]

PatientsLikeMe is a patient network and real-time research platform with over 600,000 members. Patients connect with others who have the same disease or condition. Together they monitor their conditions, and share data on their diseases and treatment strategies. Data from the platform also forms the basis of more than 100 publicly accessible peer-reviewed scientific studies.[122]

Open source repositories/ project wikis to share solutions

Many networks are facilitating distributed problem solving by using open source repositories or project wikis – which enable anybody to use, study, modify or distribute an existing project or solution for free.

Public Lab is a non-profit organization that facilitates collaborative, open source environmental research. Its volunteer community develops open source hardware, software, and other open methodologies to democratize environmental monitoring. The community publishes plans and guides for 'Do It Yourself' monitoring tools that can be made at home, making it easier for others to apply or adapt the methods to their own situation.[123] Field Ready's designs for

119 Lead user. Wikipedia definition (web page) https://en.wikipedia.org/wiki/Lead_user#cite_ref-1. Accessed January 19, 2021.

120 Wefarm (web page) https://wefarm.co/. Accessed January 19, 2021.

121 Bioversity International's Seeds for Needs Initiative (web page) https://www.bioversityinternational.org/seeds-for-needs/. Accessed January 19, 2021.

122 PatientsLikeMe (web page) https://www.patientslikeme.com/. Accessed January 19, 2021.

123 Public Lab (web page) https://publiclab.org/. Accessed January 19, 2021.

3D-printed humanitarian supplies,[124] or Just One Giant Lab's low-cost and open source COVID-19 test kit[125] are other examples where resources are continuously iterated by a global community.

Crowd labeling of data to train 'AI for good' models

Collective intelligence is often fundamental to the latest advances in AI, especially machine learning approaches that rely on humans to label the large datasets they use as their training material.

An example of this is the organization SpotLab. Their online games include images of different parasites in digitized blood samples. By identifying different parasites in the blood samples, crowds are contributing to a dataset of labeled images that will train accurate AI models for the diagnosis of tropical diseases such as malaria and leishmania.[126]

Many of the larger citizen science platforms have started to engage volunteers in labeling data to help train AI models for a variety of tasks. These range from labeling pictures of placenta samples to help scientists understand why some placentas fail during pregnancy complications,[127] to labeling plant and animal species from the data collected by iNaturalist's citizen science community.

Cochrane Crowd is another long-running platform that relies on a network of 37,000 volunteers to help classify and label medical research on a wide range of issues. At a time when research output is expanding exponentially, citizen science can help to manage the information overload. Contributors complete a range of microtasks, for example noting whether the research is from a randomized trial, or classifying an article abstract. This enables the identification and description of health research as it's published or produced. It makes the production of expert synthesis and systematic reviews much quicker, turning information from multiple studies into knowledge about treatment effects.[128] In one study, the crowd was found to have an accuracy of 99 per cent on the tasks it performed.[129]

124 Field Ready (web page) https://www.fieldready.org/. Accessed January 19, 2021.

125 Just One Giant Lab. Low-cost & Open-source Covid19 Detection Kits (web page) https://app.jogl.io/project/118. Accessed January 19, 2021.

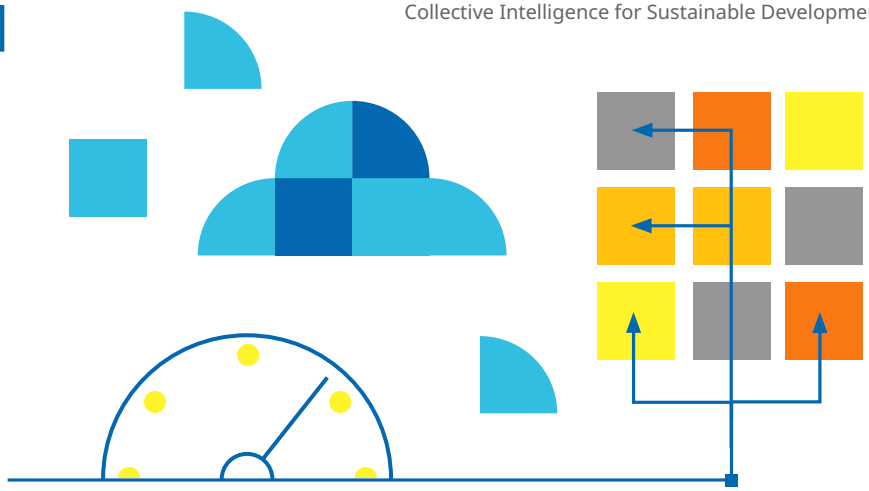
126 SpotLab (web page) https://www.spotlab.org/. Accessed January 19, 2021.

127 Science Scribbler: Placenta Profiles. Zooniverse (web page) https://www.zooniverse.org/projects/msbrhonclif/science-scribbler-placenta-profiles Accessed January 19, 2021.

128 Cochrane Crowd (web page) https://crowd.cochrane.org/. Accessed January 19, 2021.

129 Noel-Storr, A. 2019. Working with a new kind of team: harnessing the wisdom of the crowd in trial identification. EFSA Journal 2019;17(S1):e170715, 8 doi: 10.2903/j.efsa.2019.e170715

Orchestrating and Scaling Collective Intelligence for the SDGs



As the use cases in this report show, collective intelligence approaches can work well in addressing some of the big 21st-century challenges.

Use cases 1, 5 and 6 illustrate how collective intelligence can help make development more context specific, more participatory and more inclusive by harnessing the intelligence and capacity that exists in all communities. Use cases 2 and 4 highlight the value collective intelligence brings to dealing with uncertainty and complexity by bringing together new types of insight to reveal hidden dynamics or understand emerging problems more quickly. Use cases 2 and 3 point to the vital role collective intelligence can play in filling data gaps on the SDGs – enabling more accurate and detailed knowledge on progress and more rapid response. And use case 6 demonstrates how progress towards sustainable development can be accelerated by harnessing distributed problem solving and collaboration.

Most would already agree that to achieve the SDGs and avert climate catastrophe the world will need to mobilize power and money as never before.[130] But to use power and money well, it will also be vital that governments, organizations and communities become skilled in mobilizing intelligence of all kinds – data, information and ideas – from, and with, many more people. That will mean making collective intelligence methods much more mainstream than they are now.

In January 2019, UNDP launched a global Accelerator Lab Network – aiming to do just that. Starting with 60 teams across 78 countries, the Labs were envisaged as 'the world's largest and fastest learning network' with a mission to rethink development for the 21st century. Collective intelligence was adopted as one of three key approaches to make progress on the SDGs.[131] Through these Labs, UNDP has already jump-started the work of using collective intelligence methods across many of the SDGs, some examples of which can be found in this report.[132]

The next step is to orchestrate collective intelligence more strategically and at scale. The many excellent initiatives referenced in this report are often fragmented, hard to find and usually ad hoc. We will need many more initiatives that help connect local, small-scale projects into more of a global knowledge commons; creating usable and useful open data, open science and open innovations that are available to everyone.

A good example of the scale of ambition needed is the new UNEP-UN-Habitat partnership to create the 'world's largest air quality platform' covering 7,000 cities worldwide. For the first time, it will bring together air quality data collected by governments, NGOs, companies and local community groups and individuals that was previously either restricted to individually-run websites or apps, or not shared publicly.[133]

130 Watts, J. We have 12 years to limit climate change catastrophe, warns UN. The Guardian, October 8, 2018. https://www.theguardian.com/environment/2018/oct/08/global-warming-must-not-exceed-15c-warns-landmark-un-report. Accessed January 19, 2021.

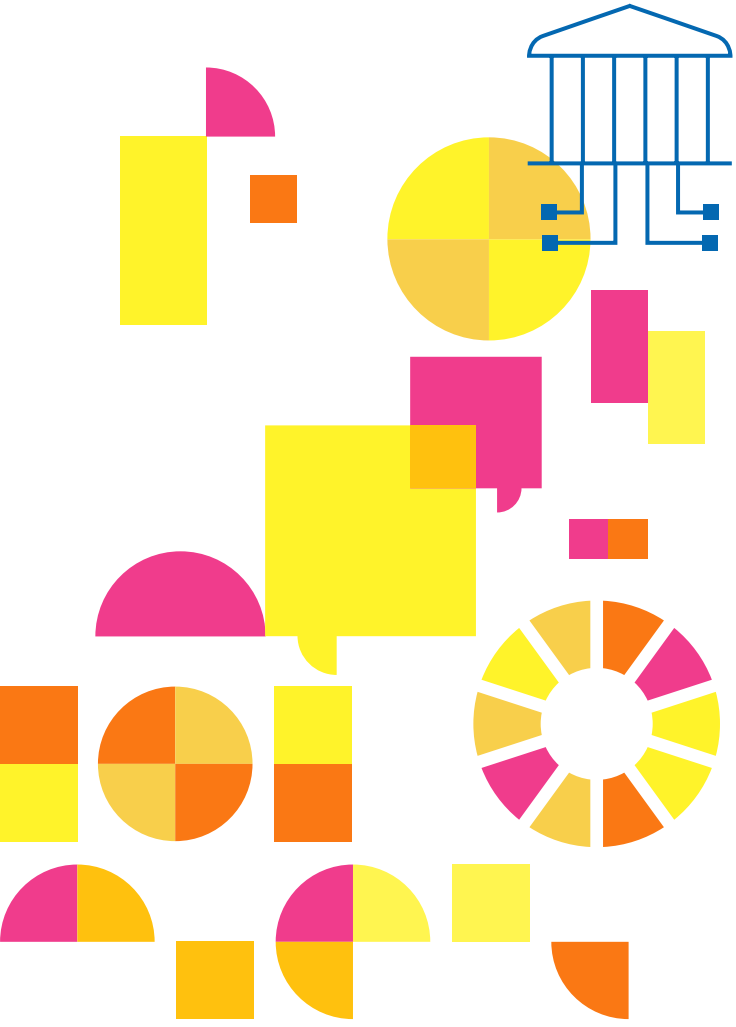
131 The three core methods are collective intelligence design, solutions mapping and portfolio of experiments.

132 Berditchevskaia, A., Peach, K., Lucarelli, G., Ebelshaeuser, M., Collective Intelligence for Sustainable Development: 13 Stories from the UNDP Accelerator Labs. https://www.nesta.org.uk/report/collective-intelligence-sustainable-development-13-stories-undp-accelerator-labs/

133 UNEP. 2020. World's largest platform for air quality data launched at Tenth World Urban Forum. (press release) https://www.unenvironment.org/news-and-stories/press-release/worlds-largest-platform-air-quality-data-launched-tenth-world-urban. Accessed January 19, 2021.

Priorities for funders and development organizations to scale collective intelligence for the SDGs

The business world has learned to invest heavily in data and knowledge – and the most valuable companies in the world are largely ones based on sophisticated data, knowledge and software. A comparable commitment is needed now for the SDGs, so that development is much better supported by shared data, knowledge and software infrastructures. Here we suggest some of the roles that key institutions could play in making that happen.

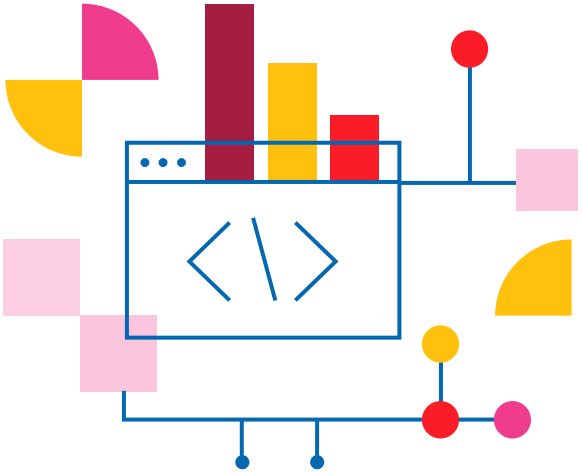


1. Help governments to make better use of collective intelligence

People are collecting, creating and sharing data on an unprecedented scale – but governments and some development organizations have been slow to make the most of new methods. Most of the projects in this report are being developed and implemented by social movements, civil society organizations and researchers. Many governments are unfamiliar with the many new sources of data now available – from satellite data to mobile data and citizen-generated data. The opportunities are immense, but greatly underutilized. A recent systematic review of the contribution of citizen science to the SDGs, for example, found that citizen science methods have the potential to contribute to the monitoring of all 17 SDGs (at least one indicator per goal). But it also found that at present citizen science is only being used by governments to monitor five indicators.[134]

The biggest leverage will come through helping governments make the most of the new tools and collective intelligence methods that are available and already being harnessed.

134 Fraisl, D., Campbell, J., See, L. et al. 2020. Mapping citizen science contributions to the UN sustainable development goals. Sustainability Science 15, pp.1735–1751. doi: 10.1007/s11625-020-00833-7



2. Open data and open software have enabled widespread experimentation – but now need to become the default for sustainable development

Open source software and data such as OpenStreetMap, Ushahidi and Consul have greatly accelerated distributed experimentation with collective intelligence methods by a wide range of organizations, from city municipalities to community-based organizations. The free availability of NASA's Landsat and, likewise, the European Space Agency's Sentinel satellite data has resulted in an explosion of collective intelligence projects in the last few years – including the Global Forest Watch platform.

Collective intelligence thrives best when underpinned by strong infrastructures. The most important of these is the internet itself. But other infrastructures built on top of it are also becoming increasingly vital. Open source collective intelligence platforms such as OpenStreetMap and Consul receive relatively little core funding but are used by many projects. Often these depend both on open standards and open access technology, as well as the work of many volunteers – a very valuable set of public goods that are rarely well-supported by traditional global, national or philanthropic funders.

Open data standards and open access technology are critical infrastructures for collective intelligence, enabling faster experimentation and adoption by disparate communities, scaling across geographies and more rapid learning about what works. However, these are still not the default for global development, and many platforms are still being created that are not open in these ways or reinvent the wheel, rather than improving and building on what's already available.

3. Trust and values matter in collective intelligence systems – and need to be cultivated

All collective intelligence projects depend on trust and goodwill. When they work well they also contribute to trust. As they start to underpin even more of the civic infrastructure it will also become more vital that considerations of ethics and personal privacy are taken seriously, and seen to be taken seriously. The recently abandoned Google Sidewalk Labs project in Toronto[135] came under fierce criticism for taking a top-down 'technology push' approach that prioritized technology and data over people and purpose.[136] Governments like Taiwan, however, are demonstrating an alternative: creating collective intelligence systems that enable citizens to collaborate in solving problems, allowing them to access and use data.[137] Barcelona's sensor network also gives citizens control over how their data is used.[138] These new models of distributed governance and responsibility are paving the way towards a social contract that uses collective intelligence to empower all stakeholders to take action, from governments and organizations to individuals. As development organizations and governments seek to make use of collective intelligence it's important that the values and principles that underpin these new approaches and technologies are paid sufficient attention, and that benefits outweigh risks.[139] A commitment to data empowerment, not data extraction, must remain central.

135 Cecco, L. 2020. Google affiliate Sidewalk Labs abruptly abandons Toronto smart city project. The Guardian, May 7, 2020.https://www.theguardian.com/technology/2020/may/07/google-sidewalk-labs-toronto-smart-city-abandoned. Accessed January 19, 2021.

136 Centre for Collective Intelligence Design, Nesta. 2019. Smart enough? How smart cities are (and are not) evolving. https://www.nesta.org.uk/feature/collective-intelligence-and-smart-city/smart-enough-how-smart-cities-are-and-arent-evolving-/. Accessed January 19, 2021.

137 O'Flaherty, K. 2020. How Taiwan beat Covid-19. Wired UK, November 14, 2020. https://www.wired.co.uk/article/taiwan-coronavirus-covid-response/. Accessed January 19, 2021.

138 Graham, T. 2020. Barcelona is leading the fightback against smart city surveillance. Wired UK, May 18, 2018. https://www.wired.co.uk/article/barcelona-decidim-ada-colau-francesca-bria-decode. Accessed January 19, 2021.

139 Addo, P.M., Baumann, D. et al. 2021. Emerging Uses of Technology for Development: A New Intelligence Paradigm. https://www.afd.fr/en/technology-development-new-intelligence-paradigm-addo-baumann-mcmurren-verhulst-young-zahuranec. Accessed February 10, 2021.

4. Novel combinations of AI and collective intelligence could help deliver insight on the SDGs

The world has seen extraordinary investment in AI over the last few years, both from government and business. The big investments in 'AI for good' are welcome, after many decades when far more was spent on military and commercial applications than in relation to global goals. Some research suggests that AI could act as an enabler on 134 targets (79 per cent) across all SDGs.[140]

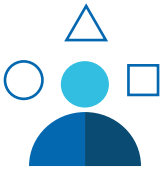
But in many fields the full value of AI depends on linking it to human collective intelligence – and AI funders have been slow to appreciate this. Most current uses of AI-enabled collective intelligence for the SDGs focus on optimizing for speed or making sense of vast quantities of citizen-generated data. Yet, even these 'lowest hanging fruits' are not always used when they could be. There is significant scope for experimentation in more creative uses of AI that help to enhance the reach, creativity and impact of collective intelligence.

Investing in a dedicated program of innovation, perhaps through regional or sectoral testbeds (for example focused on one use case, SDG or region) would allow for experimentation in real-world settings. A particular priority is to build up more centers of expertise, particularly in sub-Saharan Africa, to counter the concentration and overdependence on mainly US firms for AI and data proficiency.

5. Build the field, and develop the methods further for the SDGs

The field remains relatively young and, as has happened with other fields (such as the use of big data or new performance management tools), there is a need to develop the methods and adapt them to multiple uses. This can be done through:

Growing evidence
Tools such as crowdmapping and citizen science have been used for SDG-related projects for over a decade. Their uptake could be further aided by creating a stronger evidence base around impact, as well as supporting collaborative experimentation with these tools in a greater number of communities. This could be achieved by bolstering civil society organizations, who are already at the forefront of trying many of these methods, and leveraging universities to support in generating more systematic learning about what works best and why.[141]



Skills
Training in collective intelligence methods needs to become part of the default for anyone involved in development, including government officials and NGOs.

Connections
The field will also develop faster if innovators themselves become more of a collective intelligence, sharing observations, ideas, experiments, findings and results. At present, this kind of orchestration is very ad hoc. Whereas the leading edges of science and medicine are supported by strong and well-funded institutions to maximize the flow of information and knowledge, there is very limited comparable support for innovators working around the SDGs, which means that a lot of work is less effective than it could be.

140 Vinuesa, R., Azizpour, H., Leite, I. et al. 2020. The role of artificial intelligence in achieving the Sustainable Development Goals. Nature Communications 11, 233. doi: 10.1038/s41467-019-14108-y

141 Berditchevskaia, A., Stathoulopoulos, K. 2018. Using machine learning to map the field of collective intelligence research. Nesta, November 22, 2018. https://www.nesta.org.uk/blog/mapping-collective-intelligence-research/. Accessed January 19, 2021.

Who can make this happen?

The mainstreaming of collective intelligence methods into sustainable development practice will be a collective task and all major institutions have a part to play. It can build on much that is already underway – moving towards a greater acknowledgement of the role of data and digital, and how they can be targeted towards greater empowerment of citizens.

OECD

The OECD has played an important role by helping to set standards and principles for development cooperation, and monitoring spending by key partner countries. We suggest it could play a related role in establishing the protocols and standards that will be needed to underpin the shared data and knowledge infrastructures that would allow collective intelligence to be orchestrated more strategically. It could also help to build the evidence base for collective intelligence methods, and encourage their uptake by governments.

Regional development banks

The regional development banks are also set to have a vital role to play. The task for them is to make it normal for any investment plan to include a complementary strand on the organization of intelligence, including the orchestration of data, evidence and science, and feedback from grassroots insights and wisdom. This will always involve some cost, but a well-organized and shared set of resources can ensure that finance achieves greater impact. A related priority is building up capability in data and AI. These abilities are still highly concentrated in a few areas with overdependence on mainly US firms. We hope that funders can work together to build up centers of expertise, particularly in sub-Saharan Africa.

World Bank

The World Bank has for many years been directly involved in better ways of organizing intelligence, making use of open data and helping to synthesize knowledge. Here too we would welcome further engagement with collective intelligence methods of all kinds so that they become part of the default, or DNA, of development work, rather than being seen as separate. Finance, intelligence and impact should be thought of as a reinforcing triangle. The

World Bank could also expand its support to governments to build the technical capacities and infrastructures needed to engage with new types of data.

Universities

Another important set of players are the universities, who are well placed to help curate and grow knowledge relevant to the SDGs. The bigger task is to ensure a closer alignment of academic research to SDG national priorities. In addition, universities can help students to learn to work in more collectively intelligent ways. Many universities are now using 'challenge based' models for tens of millions of students, helping them to earn their degrees while also working on practical problem solving in teams that draw on multiple disciplines and insights outside of academia. This educational model is being used across the EU and in other countries including China, Mexico and South Africa.

Development Assistance Committee donors and development funders

Funders have an important role to play in enabling civil society capacity to mobilize collective intelligence. They can help support the skills needed, accelerate the development of new methods and tools, and invest in strengthening open collective intelligence infrastructures as 21st-century public goods. Funders interested in accelerating the use of collective intelligence could seek short- to medium-term wins through focusing on the use cases identified in this research with more established practice and capacity (SDGs 2,3,5 and 10-16) before taking the approach to less mature areas.

Private sector

As indicated many times in this report, the private sector has a significant role to play in contributing to collective intelligence, often holding data that is more comprehensive and up to date than the public sector. The Global System for Mobile Communications Association (GSMA) and mobile companies could be doing more to make it easier for development organizations and innovators to get data (and cloud services) for SDG work. So far progress has been disappointing in opening up mobile phone data, given how valuable this can be for understanding everything from economic activity and mobility to public health.

Parliaments

Many others have vital roles to play in advancing and influencing this agenda. The Inter-Parliamentary Union is an important influencer, particularly in relation to strengthening national statistics agencies and convincing governments to make better use of citizen-generated, and other novel, data.

United Nations

Finally, the growing attention being paid to intelligence of all kinds has implications for the future organization of the UN. The strategic challenge for the UN is how to better orchestrate multiple forms of intelligence relevant to the SDGs – from science and data, to public policy evidence and emerging findings from experiments. Much is already happening, from the Humanitarian Data Exchange to the UNEP-UN-Habitat air quality monitoring platform. The key is to strike the right balance between bottom-up, country-led initiatives and ensuring better provision of some pooled common resources (knowledge, software and databases) at global and regional levels. This combination can make work on the ground easier for everyone.

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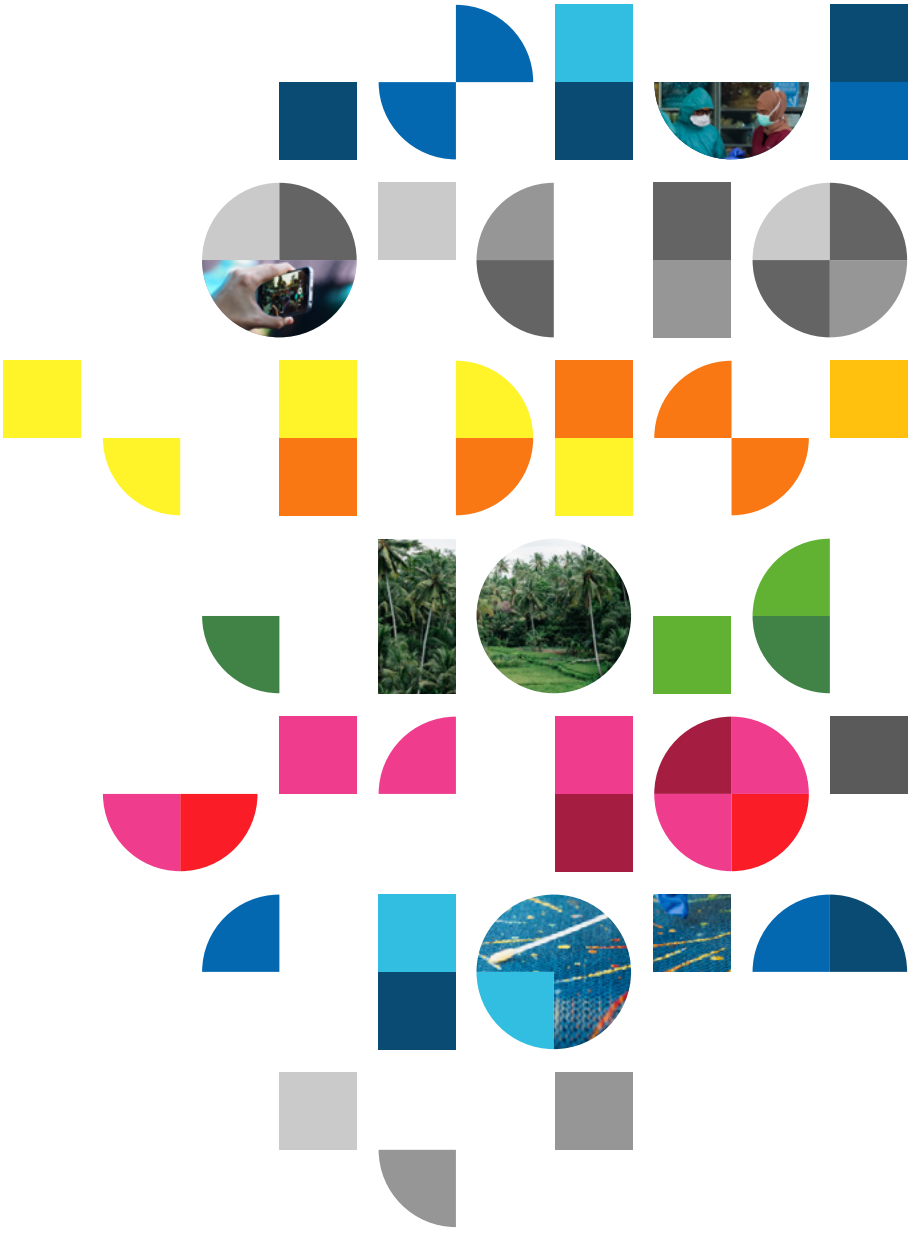

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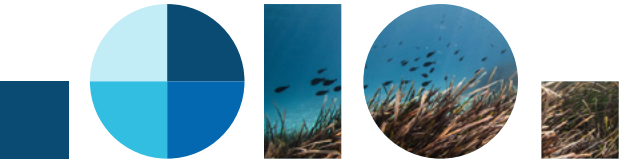

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