



CITIZEN SCIENCE

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# Citizen Science and Participation for Inclusive Smart Cities



| Citizen scientists documenting wildlife activity, plant phenology and trail use in the Greater Snow King Area, at the Bridger-Teton National Forest.  
*Image: Bridger Teton NF / Wikimedia Commons*

**Professor Vanessa Evers advocates for citizen science and participation to enhance policymaking processes and support the advancement of inclusive smart cities.**

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### **Skepticism in a Rapidly Changing Society**

Digital transformation is rapidly changing society and having a profound impact on people. The launch of ChatGPT, for instance, has left many wondering how their job prospects and education will be impacted. Other generative artificial intelligence (AI) systems that can manifest "on-the-spot" videos, photographs and music raise important questions about distinguishing real content from fake.

While most people acknowledge that technological innovations—such as AI and big data—can offer solutions for tackling complex global challenges, including climate change, increasing inequality, ageing populations and health crises, many struggle to weigh the potential benefits of adoption against negative consequences on job security, personal privacy and cyber safety, among others.

This uncertainty extends to scientific advancements. For example, during the COVID-19 pandemic, the development of effective vaccines at speed was a

scientific breakthrough. However, widespread disinformation—the phenomena that would trap people in filter bubbles on social media—led to mistrust and vaccine hesitancy, which greatly impacted the effectiveness of immunisation programmes worldwide. Bringing people on board only at the end of the innovation process proved very challenging.

A key factor contributing to resistance to new innovative solutions may be the lack of citizen participation in and ownership of the scientific research, technological development, and policy translation processes that resulted in the innovation.

It is against this backdrop that this essay argues for strong citizen participation in research and development (R&D)—or what we call *Citizen Science*—and policy translation processes. This may be essential to bridge the gaps in understanding and acceptance of technological and scientific innovations that can benefit people and society.

## Strong citizen participation in the early policy design process increases the chance of successful translation of R&D into policy.

### "Traditional" Research

In most societies, finding solutions for societal challenges has traditionally started with academic research, in fields such as engineering, humanities, social sciences, arts and business. Such research would typically be commissioned by major users, such as governments, and conducted within specialised institutions or laboratories.

Governments depend on research data to inform policies, such as climate change regulations for mitigating greenhouse gas emissions.

Hence, they also decide on what research to prioritise. This may range from "blue sky research" – which is curiosity-driven and not applied to address specific problems, thus has unclear immediate-medium term impact – to research on government agenda issues that impact people's health and wellbeing.

Translating the completed research into solutions may involve communication of the findings, and collaboration among various government bodies to formulate new policies.

As citizens are usually involved late in this process, this may have implications on the success of new policies.

### What is Citizen Science?

Unlike the "traditional" scientific research for developing government policy, citizen science involves citizens and civil society organisations as active participants in the R&D process to share their views, needs and concerns, as well as to seek their buy-in. For example, citizen participation can range from general crowdsourcing of information (e.g., uploading pictures of birds spotted in nearby parks to monitor biodiversity) to extensive involvement, where citizens partner with academic experts or research scientists to define problems, determine the research agenda, and collect and analyse data.

The diversity and impact of research themes—such as health, sustainable energy, and a safe and accessible digital world—offer motivation for the public to participate.

Guided by academic researchers who play a key role in ensuring rigorous methodologies, objective peer reviews and expert data interpretations, citizen science can greatly enhance data collection and deliver highly reliable and accurate findings. Thus, citizen science can complement academic research to advance scientific knowledge and address complex challenges to improve the lives of individual citizens and society as a whole.

Citizen participation is also key in the policy translation process. While democratic instruments, such as opinion polls, allow for feedback from the population, they are very much removed from specific government interventions, such as public health measures or environmental regulations. Strong citizen participation early in the policy design process increases the chance of successful translation of R&D into policy, thus ensuring that innovation can be applied to solve societal challenges.

## The Benefits of Citizen Participation

Leveraging citizen science as a powerful new way of engaging in R&D brings a number of benefits:

1. **More Data:** As citizen science involves more people in collecting data, information can be gathered from more places and over an extended time. Policymakers can make better decisions based on more extensive data.
2. **Learning and Engaging:** Citizen science projects help people understand and take part in scientific work. By taking an active role in collecting and analysing data, people gain better understanding of the R&D process, which enables them to contribute meaningfully to discussions and decisions about policies.
3. **Local Knowledge:** Citizen scientists often have important knowledge about their local areas and communities. They know things that scientists might miss. Policymakers can tap into this local knowledge to design policies that address specific needs and contexts.
4. **Collaboration:** Citizen science projects bring together scientists, policymakers, and community members to solve problems by sharing ideas and expertise. By collaborating, scientists, citizens and policymakers can design research projects, analyse data, and create policies that are based on both scientific evidence and local knowledge.
5. **Trust and Openness:** Involving the public in data collection and analysis demonstrates that everyone's opinions and actions are valued, which helps promote trust among scientists, policymakers, and the public. This also makes the policymaking process more transparent and accountable.
6. **Awareness and Action:** Citizen science raises awareness about important issues and encourages people to join in research efforts. Active participation often results in stronger connections to issues, which in turn drive public support and advocacy for policymakers to address the concerns raised by citizen science projects.



Citizen scientists sorting microplastic samples from the Yarra river to quantify plastic pollution, as part of the Port Phillip EcoCentre's Clear Bay Blueprint project in Melbourne, Australia.

*Image: Australian Citizen Science Association*

## Enabling Citizen Science for Inclusive Smart Cities

Governments looking to address issues that are important to their citizens, inform their policies based on science and innovations co-designed with citizens, and foster public trust in their development of inclusive smart cities, can consider implementing four strategies to increase citizen participation:

1. Establish an inventory and agenda of research topics that is aligned to what citizens consider to be top priority and important to investigate;
2. Assist the transition of researchers and scientists from being research owners to becoming effective facilitators of citizen science research;
3. Support the development of new frameworks, methods, facilitation tools and other technologies for problem definition, data collection, analysis and fact-checking to be managed in an inclusive, safe, accountable, academically sound and ethical manner. As citizen science requires different research methodologies and facilitation, this will ensure that resulting citizen-led research will be sound and of high academic quality whilst guaranteeing the privacy and safety of citizen's data; and,
4. Support the communication of research findings beyond scientific publications to include other public outreach channels, as this will enhance citizen science related education, social media awareness and life-long learning opportunities.

### Level 4 'Extreme Citizen Science'

- Collaborative Science - problem definition, data collection and analysis

### Level 3 'Participatory Science'

- Participation in problem definition and data collection

### Level 2 'Distributed Intelligence'

- Citizens as basic interpreters
- Volunteered thinking

### Level 1 'Crowdsourcing'

- Citizens as sensors
- Volunteered computing

There are four levels of participation in citizen science, from general crowdsourcing to extreme citizen science.

*Image: Buckingham Shum et al., "Towards a Global Participatory Platform: Democratising Open Data, Complexity Science and Collective Intelligence", The European Physical Journal Special Topics 214(1) (2012): 109–152.*

To illustrate, a government agency responsible for the city's economic policies may start a citizen science project to understand the potential consequences of generative AI for jobs in different industry sectors. This may be developed on an online portal, where citizens can collect interviews with friends and families using research instruments and tools facilitated by researchers. The data can then be analysed, visualised and statistically evaluated to draw out main themes and findings, and the results automatically generated to a text that can be peer reviewed and published in academic and public media channels.

Finally, as citizen science is achieved through collaborations involving citizens, academics and government officials, more time and resources may be required to accelerate its implementation in

an increasingly fast-moving world. Recommendations to encourage more government officials to adopt citizen science approaches include:

1. **Raising awareness:** Workshops and public events can be organised to showcase how citizen science projects can provide valuable data, engage communities and foster public trust, which are essential to address real-world challenges, such as environmental monitoring, public health, disaster response, urban planning and natural resource management. Policies that incentivise the use of citizen science in government decision-making processes and the integration of citizen science principles in relevant policy frameworks can be promoted during such events.



Mount Rainier National Park's Cascades Butterfly project citizen science team members collecting data on subalpine butterflies and plant phenology to inform and adapt land management practices for national parks and forests.

Image: Park Ranger / Wikimedia Commons

## 2. Capacity and capability

**building:** Training programmes, webinars and content to drive understanding and effective implementation of citizen science practices can build capacity for adoption of citizen science approaches. Guidelines, toolkits, platforms and resources can be tailored for government officials to navigate the process of integrating citizen science into research that informs policymaking to further enhance capabilities.

## 3. Fostering collaborations:

Opportunities to participate in citizen science initiatives or advisory boards may provide policy makers with first-hand insights into the process and its benefits. Collaborations between citizen science practitioners,

researchers and government officials may be facilitated through joint initiatives, funding opportunities and collaborative research projects.

4. **Success sharing:** Success stories and best practices of citizen science initiatives that have contributed to evidence-based policy decisions, community empowerment and positive societal impact should be recognised and celebrated. Inclusivity and transparency may be highlighted by demonstrating how underrepresented communities have been engaged through citizen science, where the data collection and analysed has led to greater governance transparency.

## Conclusion

Innovations from science and technology and reliable research findings are key to solving urban and societal challenges. A two-pronged strategy—comprising efforts by researchers to facilitate sound citizen science programmes and by governments to integrate citizen participation to enhance their policymaking processes—will enhance their ability to successfully leverage citizen science to support the advancement of inclusive smart cities. 🗨️