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Making Urban Data Significant and Meaningful Through a Collaborative Workshop

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Abstract

This article explores the innovative deployment of the "Urban Data Mural" as a participatory design tool in urban sustainability research. Situated within the framework of open science, the project facilitates a dynamic interaction among urban data stakeholders—territorial managers, scientists, and citizens. The mural serves as a platform for these actors to engage directly with data production and utilization processes, thereby addressing common challenges such as data accessibility, comprehension, and origin awareness. Through workshops and collaborative activities, the mural integrates diverse data types—from open data provided by major platforms to sensitive data from research and government sources—into a cohesive system that supports urban planning and policy-making. This approach not only democratizes data access but also enhances stakeholder understanding and contribution to urban sustainability efforts.

Keywords : Participatory workshop; Urban sustainability; Data visualization cards; Stakeholder engagement; Collaborative design tools; Open science; Community mapping; Data democratization; Design thinking

Introduction and context elements

Measuring the Anthropocene's impact on its surroundings requires a growing abundance of data related to urban environments, sourced from open data portals, citizen collections, contributions to international databases, as well as various sensors (Edwards, 2017). The three main actors—territorial managers, scientists, and users—who both produce and consume this data, each have distinct needs from it. They may suffer from a lack of awareness regarding the data's origins, face limited access, or only partially understand the information available (Gonzalez-Zapata & Heeks, 2015; Negev, 2012). Within the framework of the France 2030 acceleration strategy, the PEPR (Priority Research Programmes and Equipments) for Sustainable Cities and Innovative Buildings aims to facilitate scientific exchanges among these three stakeholders on the topic of the future of our cities.

Moreover, the concepts of open data, big data, smart cities, and sustainable urban development are becoming increasingly pressing issues for local governments. While there is an eagerness to harness these resources to enhance city management and planning, there is also apprehension regarding the

implications of producing and sharing data (Falco & Kleinhans, 2018; Kassen, 2018; Martin & Begany, 2017). This trepidation stems from a misunderstanding among city managers about the processes and benefits of data production. Despite the necessity for local support, there exists a gap in feedback mechanisms, quality improvement efforts, and inputs from inhabitants. As researchers from Université Gustave Eiffel, specializing in the study of cities of tomorrow, we are dedicated to bridging this divide. Our mission is to facilitate communication among all stakeholders regardless of their expertise level : town halls, social housing providers, city management companies, network operators, and, crucially, citizens themselves. We thus sought an adaptable and versatile tool that could be tailored to various contexts and terrains. The card-based design facilitates active participation and encourages contributions from all, creating a dynamic space for shared understanding and collaborative problem-debate.

The creation of a participatory science tool using urban data cards addresses a gap in the current landscape of urban sustainability and innovative building research. There has been a lack of tools that combine a participatory approach with a critical reflection on the quality and availability of data needed to tackle these subjects. Existing methods do not simultaneously engage diverse stakeholders—territorial managers, scientists, and citizens— while also scrutinizing data reliability and accessibility.

By integrating a collaborative, card-based workshop model, we aim to bridge this gap. This tool facilitates a comprehensive examination of urban data, encouraging participants to contribute their insights and perspectives. It promotes an inclusive dialogue that enhances understanding and utilization of both open and sensitive data. Consequently, this approach not only democratizes data access but also fosters a collaborative environment where stakeholders can discuss solutions for sustainable urban development and innovative building practices.

Theoretical framework

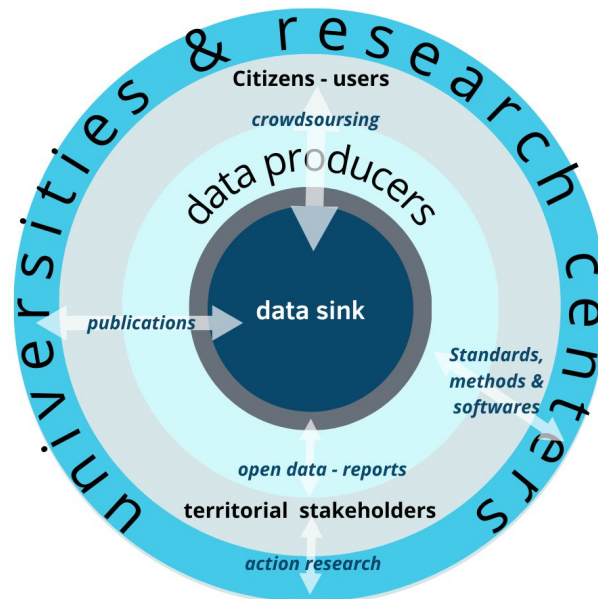
Data as an interface between researchers, locals and stakeholders

With the ongoing global digitalisation of society and its interactions, data has become the trading currency at the heart of a growing part of the world economy (Nuccio & Guerzoni, 2019). While such a transition comes with obvious caveats regarding privacy or sovereignty if left unregulated (Hummel, Braun, Tretter, & Dabrock, 2021), it also presents itself with the opportunity to empower citizens and foster collaboration (Thoneick, Degkwitz, & Lieven, 2017). By giving good-willing members of the society the means to understand data, the stakes at hand, and take control of it, socio-ecological transitions can be accelerated rather than hindered (Rosário & Dias, 2022).

Cities are well-suited ecosystems around which to build such initiatives, with a high population density, great diversity of actors operating on it, and over-abundance of data produced over a small area. Urban data has the potential to bring together citizens, researchers and administrations, bridging the information gap and opening the door to a form of collaborative planning addressing both local and global issues (Istrate, Popartan, Auerbach, Gaspari, & Tavangar, 2023).

We believe that data can be the common language through which the socio-ecological transition to smart and sustainable cities is done in an inclusive and respectful way. As researchers, our objective is to gather, create and disseminate knowledge to better society. Designing a collaborative research tool to

engage citizens in data science is one step towards achieving this goal (Binet, Gavin, Carroll, & Arcaya, 2019).



Urban Data Dynamics: Production and Utilization Flows in the Data Sink Framework

Figure 1 : Urban data dynamics and the data sink framework

This diagram represents a centralized "Data Sink" that consolidates data from various sources for urban analysis and planning. This includes open data from major providers like INSEE (Institut National de la Statistique et des Etudes Economiques), IGN (Institut Géographique National) , and platforms like OpenStreetMap, as well as sensitive data from governmental and research institutions. Local authorities and citizens also contribute, enhancing the repository's diversity and utility.

Access to this data sink is tiered, balancing the openness of certain datasets with the protection of sensitive information. This structured access necessitates ongoing scientific support to ensure effective use and contribution by all stakeholders.

A mediation tool to foster dialogue, exchange knowledge and initiate change built on design thinking

In fields of place-based applied research such as urban informatics and sustainability science, traditional scientific communication and academic processes may prove ineffective, failing to permeate the relevant spheres of civil society and poorly accounting for the researchers' situated knowledge (Horlings, Nieto-Romero, Pisters, & Soini, 2020). With those issues in mind, we decided to approach our research questions by engaging first and foremost with local communities of actors (local governments, companies, inhabitants and researchers) in a few select places, chosen for their diversity of situations and relevance to sustainability and data studies. The workshop format thus appeared the best option to put diverse communities on an equally as possible footing to participate in the co-creation of the research program, refining orientations and raising interrogations in the hope of achieving a common goal.

For the past few years, several French non-profit organisations have developed similar thematic workshops around socio-ecological issues (“Climate Fresk”; “The Digital Collage”; “Biodiversity Collage”), met with critical public acclaim. Considering their success and growing familiarity among the general public, we have drawn inspiration from these serious games to design the form of our workshop, while keeping a more research-grounded function.

The workshop was created with a design thinking framework (Carlgren, Rauth, & Elmquist, 2016; Chasanidou, Gasparini, & Lee, 2015) in mind as a way to minimise the unwanted effects of a top-down approach, providing us with a means to put ourselves on the level of the future users. This process was adapted to better fit our research-oriented goals, building upon similar experiences from other academics (De Vos, Xin, & Emmanouil, 2018; Schelle et al., 2015). Design Thinking involves several key stages: empathize, define, ideate, prototype, test, and implement (Cerejo & Barbosa, 2012). These stages ensure a comprehensive approach to understanding user needs, generating creative solutions, and refining those solutions through feedback and iteration.

For the Urban Data Workshop, we focused on the first three stages of Design Thinking—empathize, define, and ideate—to facilitate the workshop activities. This approach allowed us to deeply understand the participants' perspectives and urban data challenges. The empathize stage involved engaging with participants to understand their needs and experiences with urban data. The define stage focused on identifying and articulating the key problems and objectives related to urban sustainability and innovative building data. Finally, the ideate stage encouraged collaborative brainstorming to generate creative solutions and strategies for managing and utilizing urban data effectively.

Beyond the workshop itself, the development of the data cards for the Urban Data Mural extended through the remaining stages of Design Thinking—prototype, test, and implement. We created and iteratively refined a set of 50 data cards detailing various data typologies, their specificities, qualities, collection methods, and scales. This iterative process included prototyping the cards, testing them in workshop settings, and implementing feedback from participants to continuously improve the tool.

After each iteration, we revised the workshop to try and overcome the challenges met: as such, it is an ever-evolving process of iterative co-creation, with the input of each participant being taken into account for potential modifications before the next session. The main themes and structure of the workshop are also adapted according to the participants' profile and locally relevant issues.

Designing the workshop

Designing Interactions: Bridging Data and Dialogue in Urban Sustainability

We initially acquired *MethodKits* as a pedagogical tool for a previous project, recognizing their potential for rich and multifaceted exploitation (Borneo, Bruun, & Stage, 2016; Möller, 2018). Prompted by the establishment of a research support project focusing on sustainable urban and innovative building data, we sought to re-purpose this dynamic, rooted in Design Thinking, towards two foundational objectives: to catalogue the necessary data for constructing an information system for urban research and to foster interactive connections between civil society and researchers.

However, the *MethodKit* alone proved insufficient as it did not encapsulate the concept of data and their characteristics (Roy & Warren, 2019; Wölfel & Merritt, 2013). To address this gap, we created a set of 50 cards detailing data typologies, their specificities, qualities, collection methods, and scales. For example,

urban noise data could be derived from computational models or collected through individual sensors, offering lesser quality but encouraging participatory engagement.

This set of cards on heterogeneous data typologies is dynamic, evolving through workshops as participants highlight gaps, facilitating discussions not only about the data used in their research or arguments but also about how these data might be better processed, projected at different scales, or integrated into a big data system with algorithms or automation. The discussion also extends to unavailable data, prompting considerations on how such datasets could be constituted or opened up.

Once participants have selected and detailed their thematic focus using the *MethodKit* or other means, facilitators of the "data mural" engage them in exploring which data could be used to support, objectify, or challenge their statements. Questions are raised about the type of data relevant to their topic, its format, accessibility, reliability, etc. The primary goal is to expand awareness of the possibilities available, both for the information system team and for the participants themselves.

Data Licensing and Access: Open Access Data License Proprietary Data License Paid Access Data License Owner Private License	Data Geographical Scope: Data Area World Data Area France Data Area Europe	Data Scale and Structure: Data Scale IRIS (French district) Data Scale Grid Pattern
Data Type: Data Plain Text Data Table Data Vector Data Raster Data 3D Model Data Audiovisual	Data Set: Unstructured Structured	Data Quality: Data Satisfying Data Bad Data Fine
Metadata: Well Described None	Update Frequency : Daily Real Time Yearly Frozen in Time	Security Concerns: Confidential Restricted Access Concerns None
Data Sources: Survey Model Measurement Calculation Sensor/Indicator Pure Creation	Data Producers: State Agency Citizen Science Lone Researcher Research Team	Data Availability: Communicated About Published in Full Unavailable

Table 1 : summary of the set of cards on data typologies

Results

Unravelling the urban data mural

The "Urban Data Mural" was experimented with during a study day in La Chapelle Nord in Paris in March 2024, gathering a diverse audience ranging from researchers to citizens, as well as associations, entrepreneurs, and students from various disciplines.

Designed as an evolving tool, it has been intentionally developed within an open design framework, allowing for adaptability and inclusiveness. To enhance participation and ensure inclusiveness, we opted to produce a set of cards in French, moving away from the original *MethodKit* cards.

These 200 cards, each detailing a specific topic and additional information, not only capture the urban challenges pertinent to the terrain but also reflect the unique characteristics of the neighbourhood undergoing significant transformation due to three major development projects.

The goal was to ensure individual resonance through varied formulations of the cards, addressing the different perspectives of the participants. The workshop facilitated a rich dialogue, with participants actively contributing their insights on their sections of the mural towards the session's end. However, we identified two areas for improvement: the need to create bridges between participants for a more enriched collective reflection, and the provision of accessible data sources. It became apparent that participants were largely unaware of the landscape of major data producers in France and had limited knowledge of potential data sources. Consequently, we are iterating our approach to introduce a set of cards dedicated to leading open data providers such as INSEE, IGN, or Data.gouv, to support the arguments presented in response to urban challenges.



Figure 2 : Example of a portion of the urban data mural realised at La Chapelle Nord (Paris)

For instance, when a participant wished to discuss diversity in local schools, we could direct them to the national education open data portal, highlighting data types like the "Social Position Indices (IPS) of students." This mediation tool exemplifies the potential of Design Thinking in shaping urban dialogues and co-constructing knowledge, paving the way for more inclusive and informed urban interventions, all while embodying the ethos of open design in its ongoing development.

Documentation and Archiving

During the session, various means are employed to document the event: photographs, note-taking, and audio recordings. All these activities are carried out with the prior consent of the participants to respect their rights to image and speech. The mural, which can extend over several meters, is systematically photographed for our archives, thereby ensuring the preservation of the ephemeral discussions and creations of the day.

Creation of a Fanzine

As a token of appreciation to the participants and hosts, we produce a summarising fanzine of about ten pages. Created with a Design Thinking spirit and a particular focus on accessibility, this document aims to be both easy to read, visually appealing, and aesthetically pleasing. It compiles the themes discussed during the workshop, the explored locations, and the addressed issues, enriched with links to the used resources or visited places, as well as excerpts from the mural's feedback sessions.

This fanzine aims to be an alternative publication, diverging from traditional academic formats to embrace a more handmade and accessible approach for everyone. It reflects the collaborative and inclusive dynamics of the workshop while providing a tangible platform to share the accumulated knowledge and experiences. Through this initiative, we aspire not only to value everyone's participation but also to disseminate the session's reflections and discoveries to a broader audience, thereby contributing to a better understanding of the challenges of sustainable urban development and urban data.

This effort of feedback, combining documentary rigour and creativity, underlines our commitment to promoting a culture of exchange and open dialogue.

Discussion

Internal Impacts

The "Urban Data Mural" participatory tool offers several internal benefits that directly enhance the processes and culture of the team involved in the Sustainable City and Innovative Building Information System. Firstly, it enables a better understanding of the complexity and heterogeneity of urban data. By manipulating and discussing various data typologies through methodological cards, team members can refine their data management and analysis approach. This tool also aids in better understanding the target audience of the information system by integrating direct feedback from users during sessions. This interaction enriches the database by listing and cataloguing data providers as well as the specific characteristics of the data sets.

Moreover, the mediation game created for this tool facilitates exchanges among team members about future data management, promoting a cohesive and coordinated approach. The creation of a complete, replicable, and distributable tool instills a culture of design thinking and an iterative, inclusive process within the team, thus strengthening continuous innovation and adaptability. The "Urban Data Mural" serves as a dynamic platform for continuous training within our team. Through internal training sessions, we use the feedback and methodologies developed during the mural activities to continuously enhance our skills and knowledge. This approach ensures that our team remains adept and responsive to emerging urban data challenges. In line with our commitment to accessibility and community engagement, we actively distribute the card supports of the tool as open source materials.

By writing and publishing these resources, we detail the methodologies, discoveries, and best practices gained from the tool, making them widely available to both the academic community and the public. This open source distribution fosters a broader understanding and adoption of our innovative approaches. Additionally, the interactions and needs identified during the mural sessions inspire ongoing technological innovation. We are committed to developing new technologies and digital platforms that stem directly from these insights. This not only enhances our internal capabilities but also ensures that our interventions remain cutting-edge and highly relevant to the evolving landscape of urban sustainability and data management.

External Impacts

Externally, the "Urban Data Mural" serves as a strategic dialogue tool for researchers, municipalities, and other territorial actors, facilitating the exchange of knowledge and strengthening partnerships. By positioning itself as a mediator in an open approach, the tool promotes the dissemination of scientific culture to the public, helping to demystify complex urban data and promote a more nuanced understanding of urban challenges. The tool's ability to highlight urban data research projects and to value the research work or data collection tools created by fellow researchers also contributes to enhancing the visibility and impact of the conducted research. This, in turn, fosters deeper appreciation and increased recognition of research efforts in the field of urban sustainability and construction innovation.

The "Urban Data Mural" tool not only facilitates dialogue within diverse urban sectors but also actively expands our network. By regularly inviting experts and practitioners to participate in our sessions, we foster a collaborative environment that bridges academic and professional communities. This strategy enhances our partnerships and integrates a wide range of insights into our projects, ensuring that our approaches are comprehensive and well-informed. To continuously improve our processes and outputs, we are committed to establishing robust monitoring and evaluation mechanisms. These will assess the tool's effectiveness in enhancing data management practices and in cultivating a data-driven culture within and beyond our organization. This ongoing evaluation is crucial for identifying areas for improvement and for ensuring that our initiatives effectively address the needs of the communities we serve.

Some participants expressed frustration over the non-implementation of their proposals. However, this sentiment opens up opportunities to explore democratic tools such as participatory budgeting and citizen assemblies, which fall outside the university's purview. By incorporating these democratic mechanisms, stakeholders can still see their contributions materialize in meaningful ways, fostering a sense of ownership and engagement in the urban planning process. This shift towards broader civic

participation underscores the potential for collaborative governance in achieving sustainable urban development, an aspect often lacking in participatory urban planning initiatives (Geekiyana, Fernando, & Keraminiyage, 2021). As such, this workshop provides a much-needed deliberative space for diverse communities, as highlighted in similar experiments (Sharp et al., 2022).

What's next

After implementing the Urban Data Mural in various contexts and across diverse territories, we are now planning to integrate this work into the Big Data Information System that is currently being developed for our research teams. The outcomes of the murals, the challenge cards, data and suppliers, as well as the feedback obtained, will be incorporated as data sources into the system, setting the stage for a new field of experimentation. This approach of engaging with various stakeholders will not only enrich the design of our information system for sustainable cities and innovative buildings but will also prompt us to think about creating bridges between a physical environment, represented by the cards and murals, and a virtual environment, materialised by a web interface. This interface could generate statistical reports and cartographies based on the insights drawn from the murals.

By integrating tools like Jupyter notebooks, pre-configured to interact with our data sink, we plan to enable users to generate customized reports based on their selections of location, issues at hand and data providers. This open field of experimentation promises to offer each participant of the mural the opportunity to quickly produce scientific contributions, such as analysis reports with their chosen data. Our ultimate goal remains to promote participatory science that is interactive, well-documented, and meticulously designed, serving everyone.

The integration of the Urban Data Mural into our Big Data Information System thus exemplifies our commitment to harnessing collaborative and innovative approaches to data management and research. By bridging the gap between physical and digital realms, we not only enhance the utility of urban data but also foster a culture of inclusiveness and scientific advancement. This initiative is set to transform the landscape of urban research, making it more accessible, responsive, and significant for all stakeholders involved.

Conclusion

In conclusion, the "Urban Data Mural" workshop has offered a practical example of how design thinking can be applied within urban sustainability research. It employs a participatory approach that seeks to include various stakeholders—from local governments to citizens—in the dialogue about urban data use. This approach has encouraged an exchange of knowledge and perspectives, aiming to involve each participant in the creation of solutions to urban challenges. The experience has shown the value of open science in making data access more transparent and fostering cooperation, which is essential for thoughtful urban planning and policy development. As we continue to refine our methods and widen our interactions, we hope to support the ongoing adoption of participatory science as a useful tool in our efforts towards sustainable, data-driven urban development.

References

- Binet, A., Gavin, V., Carroll, L., & Arcaya, M. (2019). Designing and Facilitating Collaborative Research Design and Data Analysis Workshops: Lessons Learned in the Healthy Neighborhoods Study. *International Journal of Environmental Research and Public Health*, 16(3), p. 324. Retrieved February 8, 2024, from <https://www.mdpi.com/1660-4601/16/3/324>
- Bornoe, N., Bruun, A., & Stage, J. (2016). Facilitating redesign with design cards: experiences with novice designers, in: *Proceedings of the 28th Australian Conference on Computer-Human Interaction*, pp. 452–461. OzCHI '16. New York, NY, USA: Association for Computing Machinery. Retrieved February 8, 2024, from <https://dl.acm.org/doi/10.1145/3010915.3010921>
- Carlgren, L., Rauth, I., & Elmquist, M. (2016). Framing Design Thinking: The Concept in Idea and Enactment. *Creativity and Innovation Management*, 25(1), pp. 38–57. Retrieved February 8, 2024, from <https://onlinelibrary.wiley.com/doi/abs/10.1111/caim.12153>
- Cerejo, J., & Barbosa, Á. (2012). The Application of Design Thinking Methodology on Research Practices: A Mind-map of Tools and Methods, in: *Proceedings of the 62nd Annual Conference of the International Council for Educational Media on Design Thinking in Education, Media, and Society*; Nicosia, Cyprus.
- Chasanidou, D., Gasparini, A. A., & Lee, E. (2015). Design Thinking Methods and Tools for Innovation in Multidisciplinary Teams.
- Climate Fresk. Climate Fresk. Retrieved April 11, 2024, from <https://climatefresk.org/world/>
- De Vos, E., Xin, X., & Emmanouil, M. (2018). Expanding Design Thinking with Methods from Futures Studies. Reflections on a Workshop with Chinese User Experience Students, in: A. Marcus & W. Wang (Eds.), *Design, User Experience, and Usability: Designing Interactions*, pp. 3–18. Lecture Notes in Computer Science. Cham: Springer International Publishing.
- Edwards, P. N. (2017). Knowledge infrastructures for the Anthropocene. *The Anthropocene Review*, 4(1), pp. 34–43. Retrieved April 25, 2024, from <https://doi.org/10.1177/2053019616679854>
- Falco, E., & Kleinhans, R. (2018). Beyond technology: Identifying local government challenges for using digital platforms for citizen engagement. *International Journal of Information Management*, 40, pp. 17–20. Retrieved April 25, 2024, from <https://www.sciencedirect.com/science/article/pii/S0268401217308320>
- Geekyanage, D., Fernando, T., & Keraminiyage, K. (2021). Mapping Participatory Methods in the Urban Development Process: A Systematic Review and Case-Based Evidence Analysis. *Sustainability*, 13(16), p. 8992. Retrieved June 5, 2024, from <https://www.mdpi.com/2071-1050/13/16/8992>
- Gonzalez-Zapata, F., & Heeks, R. (2015). The multiple meanings of open government data: Understanding different stakeholders and their perspectives. *Government Information Quarterly*, 32(4), pp. 441–452. Retrieved April 25, 2024, from <https://www.sciencedirect.com/science/article/pii/S0740624X1530006X>

Horlings, L. G., Nieto-Romero, M., Pisters, S., & Soini, K. (2020). Operationalising transformative sustainability science through place-based research: the role of researchers. *Sustainability Science*, 15(2), pp. 467–484. Retrieved April 11, 2024, from <https://doi.org/10.1007/s11625-019-00757-x>

Hummel, P., Braun, M., Tretter, M., & Dabrock, P. (2021). Data sovereignty: A review. *Big Data & Society*, 8(1), p. 2053951720982012. Retrieved April 22, 2024, from <https://doi.org/10.1177/2053951720982012>

Istrate, A.-L., Popartan, L.-A., Auerbach, J., Gaspari, J., & Tavangar, M. R. (2023). Collaborative research for transitioning to Climate-Neutral Cities – contouring a prospective framework for integrated planning. *Planning Theory*, p. 14730952231183304. Retrieved February 8, 2024, from <https://doi.org/10.1177/14730952231183303>

Kassen, M. (2018). Adopting and managing open data: Stakeholder perspectives, challenges and policy recommendations. *Aslib Journal of Information Management*, 70(5), pp. 518–537. Retrieved April 25, 2024, from <https://doi.org/10.1108/AJIM-11-2017-0250>

Martin, E. G., & Begany, G. M. (2017). Opening government health data to the public: benefits, challenges, and lessons learned from early innovators. *Journal of the American Medical Informatics Association*, 24(2), pp. 345–351. Retrieved April 25, 2024, from <https://doi.org/10.1093/jamia/ocw076>

Möller, O. (2018). Concept - MethodKit. MethodKit. Retrieved February 26, 2024, from <https://methodkit.com/concept/>

Negev, M. (2012). Knowledge, data and interests: Challenges in participation of diverse stakeholders in HIA. *Environmental Impact Assessment Review*, 33(1), pp. 48–54. Retrieved April 25, 2024, from <https://www.sciencedirect.com/science/article/pii/S0195925511001065>

Nuccio, M., & Guerzoni, M. (2019). Big data: Hell or heaven? Digital platforms and market power in the data-driven economy. *Competition & Change*, 23(3), pp. 312–328. Retrieved April 22, 2024, from <https://doi.org/10.1177/1024529418816525>

Rosário, A. T., & Dias, J. C. (2022). Sustainability and the Digital Transition: A Literature Review. *Sustainability*, 14(7), p. 4072. Retrieved April 22, 2024, from <https://www.mdpi.com/2071-1050/14/7/4072>

Roy, R., & Warren, J. P. (2019). Card-based design tools: a review and analysis of 155 card decks for designers and designing. *Design Studies*, 63, pp. 125–154. Retrieved February 8, 2024, from <https://www.sciencedirect.com/science/article/pii/S0142694X19300171>

Schelle, K. J., Gubenko, E., Kreymer, R., Naranjo, C. G., Tetteroo, D., & Soute, I. A. C. (2015). Increasing Engagement in Workshops: Designing a Toolkit Using Lean Design Thinking, in: *Proceedings of the Multimedia, Interaction, Design and Innovation*, pp. 1–8. MIDI '15. New York, NY, USA: Association for Computing Machinery. Retrieved February 8, 2024, from <https://dl.acm.org/doi/10.1145/2814464.2814481>

Sharp, D., Anwar, M., Goodwin, S., Raven, R., Bartram, L., & Kamruzzaman, L. (2022). A participatory approach for empowering community engagement in data governance: The Monash Net Zero Precinct. *Data & Policy*, 4, p. e5. Retrieved June 5, 2024, from <https://www.cambridge.org/core/journals/data-and-policy/article/participatory-approach-for->

empowering-community-engagement-in-data-governance-the-monash-net-zero-precinct/90FD8575292C641BFE642572EE26E2E4

Thoneick, R., Degkwitz, T., & Lieven, C. (2017). Advancing Participatory: Democracy through Collaborative Data Platforms, in: Science and the City: Hamburg's Path to a Built Environment Education, pp. 93–103. Perspectives in Metropolitan Research.

Wölfel, C., & Merritt, T. (2013). Method Card Design Dimensions: A Survey of Card-Based Design Tools, in: P. Kotzé, G. Marsden, G. Lindgaard, J. Wesson, & M. Winckler (Eds.), Human-Computer Interaction – INTERACT 2013, pp. 479–486. Berlin, Heidelberg: Springer Berlin Heidelberg. Retrieved February 8, 2024, from http://link.springer.com/10.1007/978-3-642-40483-2_34

The Digital Collage. Retrieved April 11, 2024, from <https://digitalcollage.org/>

Biodiversity Collage. Retrieved April 11, 2024, from <https://www.fresquedelabiodiversite.org/en.html>