








Review

Unlocking the Power of Digital Commons: Data Cooperatives as a Pathway for Data Sovereign, Innovative and Equitable Digital Communities

Michael Max Bühler ^{1,*}, Igor Calzada ^{2,3,4}, Isabel Cane ⁵, Thorsten Jelinek ⁶, Astha Kapoor ⁷, Morshed Mannan ⁸, Sameer Mehta ⁹, Vijay Mookerje ¹⁰, Konrad Nübel ¹¹, Alex Pentland ¹², Trebor Scholz ¹³, Divya Siddarth ¹⁴, Julian Tait ¹⁵, Babu Vaitla ¹⁶ and Jianguo Zhu ¹⁷

- ¹ Faculty of Civil Engineering, Konstanz University of Applied Sciences (HTWG), 78462 Konstanz, Germany
 - ² School of Social Sciences, WISERD, Cardiff University, Cardiff CF10 3AT, UK; calzadai@cardiff.ac.uk
 - ³ Ikerbasque, Basque Foundation for Science, 48009 Bilbao, Spain
 - ⁴ Faculty of Social Sciences and Communication, University of the Basque Country, 48940 Leioa, Spain
 - ⁵ Public Governance Directorate, Organization for Economic Co-Operation and Development (OECD), 75016 Paris, France; isabel.cane@oecd.org
 - ⁶ Center for Digital Governance, Hertie School of Governance, 10117 Berlin, Germany; t.jelinek@hertieschool.org
 - ⁷ Aapti Institute, Bengaluru 560042, Karnataka, India; astha@aapti.in
 - ⁸ Robert Schuman Centre, European University Institute, Piazza S. Domenico, 50014 Firenze, Italy; morshed.mannan@eui.eu
 - ⁹ Rotterdam School of Management (RSM), Erasmus University Rotterdam, 3062 PA Rotterdam, The Netherlands; mehta@rsm.nl
 - ¹⁰ Naveen Jindal School of Management, University of Texas at Dallas, Richardson, TX 75080, USA; vijaym@utdallas.edu
 - ¹¹ Construction Process Management, Technical University Munich, 80333 Munich, Germany; konrad.nuebel@tum.de
 - ¹² Connection Science, MIT Media Lab, Cambridge, MA 02139, USA; sandy@media.mit.edu
 - ¹³ Platform Cooperativism Consortium, The New School, New York, NY 10003, USA; scholzt@newschool.edu
 - ¹⁴ Collective Intelligence Project, Stanford, CA 94305, USA; divya@cip.org
 - ¹⁵ Open Data Manchester, Manchester M60 0AS, UK; julian@opendatamanchester.org.uk
 - ¹⁶ Data2X, Washington, DC 20006, USA; bvaitla@data2x.org
 - ¹⁷ Centre for Future Energy Networks, University of Sydney, Sydney, NSW 2006, Australia; jianguo.zhu@sydney.edu.au
- * Correspondence: mbuehler@htwg-konstanz.de; Tel.: +49-151-143-144-99



Citation: Bühler, M.M.; Calzada, I.; Cane, I.; Jelinek, T.; Kapoor, A.; Mannan, M.; Mehta, S.; Mookerje, V.; Nübel, K.; Pentland, A.; et al. Unlocking the Power of Digital Commons: Data Cooperatives as a Pathway for Data Sovereign, Innovative and Equitable Digital Communities. *Digital* **2023**, *3*, 146–171. <https://doi.org/10.3390/digital3030011>

Academic Editors: Mirjana Ivanović, Richard Chbeir and Yannis Manolopoulos

Received: 6 April 2023
Revised: 13 June 2023
Accepted: 27 June 2023
Published: 29 June 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: Network effects, economies of scale, and lock-in-effects increasingly lead to a concentration of digital resources and capabilities, hindering the free and equitable development of digital entrepreneurship, new skills, and jobs, especially in small communities and their small and medium-sized enterprises (“SMEs”). To ensure the affordability and accessibility of technologies, promote digital entrepreneurship and community well-being, and protect digital rights, we propose data cooperatives as a vehicle for secure, trusted, and sovereign data exchange. In post-pandemic times, community/SME-led cooperatives can play a vital role by ensuring that supply chains to support digital commons are uninterrupted, resilient, and decentralized. Digital commons and data sovereignty provide communities with affordable and easy access to information and the ability to collectively negotiate data-related decisions. Moreover, cooperative commons (a) provide access to the infrastructure that underpins the modern economy, (b) preserve property rights, and (c) ensure that privatization and monopolization do not further erode self-determination, especially in a world increasingly mediated by AI. Thus, governance plays a significant role in accelerating communities’/SMEs’ digital transformation and addressing their challenges. Cooperatives thrive on digital governance and standards such as open trusted application programming interfaces (“APIs”) that increase the efficiency, technological capabilities, and capacities of participants and, most importantly, integrate, enable, and accelerate the digital transformation of SMEs in the overall process. This review article analyses an array of transformative use cases that underline the potential of cooperative data

governance. These case studies exemplify how data and platform cooperatives, through their innovative value creation mechanisms, can elevate digital commons and value chains to a new dimension of collaboration, thereby addressing pressing societal issues. Guided by our research aim, we propose a policy framework that supports the practical implementation of digital federation platforms and data cooperatives. This policy blueprint intends to facilitate sustainable development in both the Global South and North, fostering equitable and inclusive data governance strategies.

Keywords: data; cooperatives; open data; data stewardship; data governance; digital commons; data sovereignty; open digital federation platform

1. Introduction

Understanding the urgent need to democratize the digital landscape requires a clear acknowledgment of the problems we are facing today. As the digital world continues to evolve, we witness an alarming concentration of power within a small number of “cloud empires” [1]. This dominance not only undermines market competition but also poses significant threats to data privacy, autonomy, and equitable access to digital resources. These cloud empires exercise overwhelming control over markets and consumer data, creating an environment that often lacks transparency and accountability. They also dictate the terms of data usage, commodification, and sharing, often side-lining individual and community rights over their own data. These trends are fundamentally problematic as they exacerbate digital inequality and stifle the potential for innovation and participatory digital engagement.

Responding to this state of affairs, our research argues for the transformative potential of data cooperatives as a viable solution. Data cooperatives, rooted in principles of democratic governance, collective ownership, and equitable data practices, offer a promising alternative. They empower individuals and communities by enabling them to assert control over their data, thus challenging the dominance of cloud empires. Through the detailed case studies and policy recommendations presented in our paper, we seek to not only contribute to the ongoing discussions around digital commons but also to provide actionable strategies for achieving a more equitable, inclusive, and democratic digital world.

Our research aim is to integrate the digital commons [2] discourse with the practical execution of data cooperatives [3,4] and digital federation platforms. Through a comprehensive analysis of various case studies, we strive to develop a robust policy framework designed to facilitate the adoption and effective operation of these digital structures. We contend that such structures offer a potential solution to the prevailing issue of digital resources and capabilities being disproportionately concentrated in the hands of a few entities. Our objective, therefore, is to articulate a roadmap towards more equitable and inclusive digital data governance, underpinned by cooperative principles and communal benefits.

1.1. Challenges That Must Be Overcome

The primary challenges addressed by this review article are the concentration of digital resources and capabilities in the hands of a few dominant players, the subsequent erosion of digital entrepreneurship and job opportunities, and the negative impacts on small communities and SMEs. These issues hinder the achievement of Sustainable Development Goals (SDGs) 8, 9, and 11, which emphasize inclusive and sustainable economic growth, innovation, and resilient communities. Key challenges that can be addressed by data and platform cooperatives are summarized in Table 1 and Figure 1.

Table 1. Key challenges to be addressed by data and platform cooperatives.

Key Challenge	Description
Market Concentration	The network effects, economies of scale, and lock-in effects experienced by large technology companies have led to an increasing concentration of digital resources and capabilities. This creates a barrier for new entrants, particularly SMEs and small communities, stifling competition, and innovation.
Digital Exclusion	Due to the monopolistic nature of the digital landscape, small communities and SMEs often lack affordable and accessible digital infrastructure and resources, leading to digital exclusion and perpetuating inequality.
Insufficient Data Governance	Many small communities and SMEs lack robust data governance structures and open standards, making it difficult for them to harness the full potential of data-driven insights and decision-making.
Underdeveloped Skills and Capacity	The existing concentration of resources and capabilities in the digital landscape contributes to a skills gap in small communities and SMEs, limiting their ability to participate in the digital economy and adapt to technological advancements.
Eroding Self-Determination and Data Sovereignty	The increasing influence of AI-driven decision-making and the dominance of a few major players in the digital landscape undermine the self-determination of small communities and SMEs, restricting their ability to shape their digital futures through data sovereignty [5].

This review article aims to address these challenges by proposing the establishment of open digital federation platforms and data cooperatives, which can foster a more equitable and inclusive digital ecosystem, empower small communities and SMEs, and support the achievement of SDGs 8, 9, and 11. Data and platform cooperatives represent a novel approach to digital governance, emphasizing democratic decision-making, equitable benefit distribution, and user rights protection. However, several challenges must be addressed to ensure the viability and success of these models. These challenges span legal and regulatory frameworks, funding acquisition and financial sustainability, scalability and growth, technological infrastructure development, and effective governance implementation.

Additionally, cooperatives must tackle issues related to awareness and adoption among users, interoperability and data portability, data privacy and security, competitive pressures from established businesses, and advocacy for supportive regulatory and policy frameworks. A comprehensive examination of these challenges can provide valuable insights into the factors influencing the development and adoption of data and platform cooperatives, paving the way for future research and practical applications in the digital landscape.

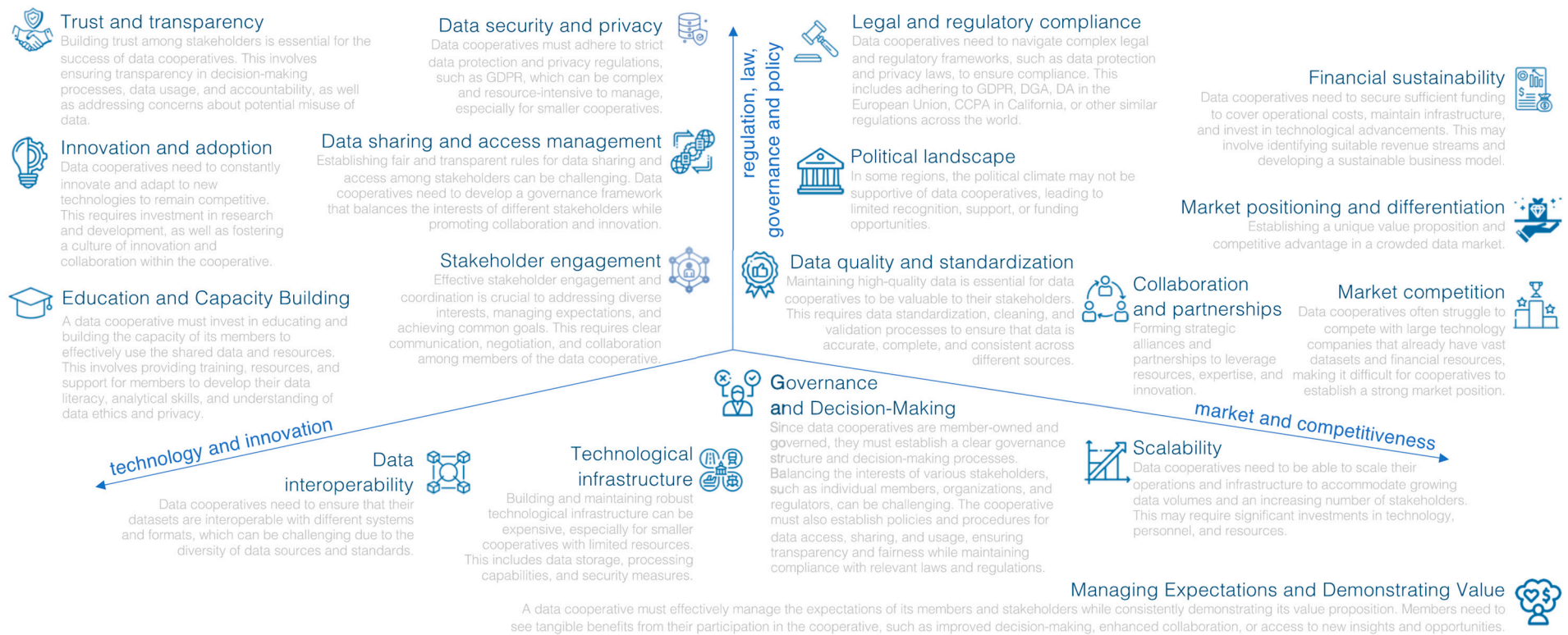


Figure 1. Challenges that might arise for data and platform cooperatives in the areas of regulation, law, governance, and policy; technology and innovation as well as market and competitiveness (own depiction).

1.2. Definitions of Key Concepts

Data sovereignty [5,6], open digital federation platforms, data cooperatives, and platform cooperatives are interrelated concepts central to our research. Our study's central argument lies in their intersection and the cooperative and democratic principles they embody. Data sovereignty pertains to the legal assertion that digital information conforms to the laws and governance structures of the jurisdiction where it is collected, processed, or stored [7,8]. This principle requires that organizations and individuals exercise control, management, and protection of their data in accordance with the relevant legal and regulatory framework [9]. In the context of data privacy, cross-border data transfer, and cloud computing, data sovereignty has become a critical factor that underscores the need to adhere to local privacy, security, and compliance requirements when handling and transferring data across international borders [7,8,10–14]. Data sovereignty extends beyond formal institutional structures and involves various modes of governance, including informal mechanisms that prioritize specific cultural contexts and rights. An essential dimension of this broader understanding of data sovereignty is Indigenous Data Sovereignty, a concept that goes beyond the traditional jurisdictional laws and governance structures. The CARE Principles for Indigenous Data Governance, as articulated by Carroll et al., 2020 [15], are an enlightening example of such an informal yet vital governance model. The principles emphasize the right of Indigenous peoples to govern the collection, ownership, and application of data about their communities. The acronym "CARE" stands for Collective Benefit, Authority to Control, Responsibility, and Ethics. Collective Benefit means that data activities should align with Indigenous values and deliver discernible benefits to the Indigenous communities from which the data originates. Authority to Control reaffirms the Indigenous peoples' right to control information about their people, traditions, and territories. Responsibility refers to the duty to consult with and include Indigenous communities in data processes and uses. Ethics necessitates respect for Indigenous peoples' values and rights in all data practices. In acknowledging these principles, we recognize the pluralistic nature of data sovereignty, emphasizing that it must always be rooted in the local context and respect local rights and traditions. Such an understanding of data sovereignty illuminates our exploration of data cooperatives and emphasizes the importance of cultural sensitivity, inclusivity, and ethical responsibility in data governance practices. Open digital federation platforms, or federated platforms, represent collaborative online ecosystems that encourage data sharing, interoperability, and cooperation among various stakeholders through a federated structure. In such a setting, the term "federation" denotes a group of entities united under a central system or governance structure, maintaining autonomy and control over their resources. The platform's openness promotes transparency, innovation, and collaboration, thus fostering a more inclusive and interconnected digital environment. A data cooperative (Figure 2) is also known as a data co-op (whereas data trusts are a different data stewardship model to a data cooperative. The trust model is based on a board of trustees who have a fiduciary duty towards data subjects and are not necessarily controlled directly by them, whereas data cooperatives have stronger democratic governance and data decisions are made either by the cooperative members themselves or officers that are employed by the members to act on their behalf [16]). Refs. [3,4,17–21], is a member-owned and governed organization that facilitates the design, collection, processing, pooling, management, analysis, and/or sharing of data among its members in a collective, democratic, and transparent manner. This collaborative structure allows members to retain control over their data while benefiting from the collective resources, knowledge, and expertise within the cooperative. As noted by the European Union's Data Governance Act, data cooperatives can also be used by individuals and micro-entrepreneurs through data donation/altruism to negotiate and informedly choose terms and conditions for data processing prior to consent and allow for mechanisms to exchange views on data processing purposes and conditions that would best represent their interests. As such, data cooperatives aim to promote data sovereignty and overcome the data divide. In the context of data cooperatives, "democratic" governance emphasizes the representational power of

the cooperative, empowering traditionally underrepresented or misrepresented individuals in the digital space by providing them with a self-determined voice and equitable participation in decision-making processes [22], equitable data access, and data-driven innovation by fostering an environment of trust and cooperation. By enabling the sharing and repurposing of data, data cooperatives can generate significant economic, social, and environmental benefits for their members and the wider community [3,17–20,23–28]. A platform cooperative, or platform co-op, also referred to as a co-operative platform in some instances, is a type of digital platform that is owned and governed by its members, who are often the platform's users, workers, or other stakeholders [29]. It is an alternative to the traditional model of digital platforms, which are typically owned and controlled by private corporations seeking to maximize profits for shareholders. Platform cooperatives emphasize democratic governance, fair distribution of profits, and the well-being of their members. They often operate based on cooperative principles, which include voluntary and open membership, democratic member control, member economic participation, autonomy, and independence, education and training, cooperation among cooperatives, and concern for the community based on the International Co-operative Alliance's seven principles of the cooperative identity. These platforms can be found in various sectors, such as ride-sharing, e-commerce, social networking, online marketplaces, and even agriculture [30,31]. By shifting the ownership and control to the users and workers themselves, platform cooperatives aim to create more equitable, sustainable, and socially responsible alternatives to traditional digital platforms [32–37]. Platform co-operatives include sub-category data co-operatives, not vice versa [32–38]. Digital commons, a shared virtual realm where digital knowledge, information, and assets are managed collectively by a community, serve as a foundation for our research. This concept encompasses open-source software, research data, creative works, educational materials, and various digital content. With principles of collaboration, openness, and participatory governance, digital commons offer users the freedom to access, create, modify, and disseminate resources within a defined set of guidelines or rules. Digital commons present an alternative to traditional models of intellectual property by fostering open access, collaborative innovation, and knowledge sharing. In doing so, they alleviate barriers to information, encourage community ownership, and contribute to knowledge democratization, fostering more inclusive, sustainable digital ecosystems.

Our study builds upon the concept of digital commons, harnessing its ethos to propose the implementation of data cooperatives and digital federation platforms. We argue that these structures have the potential to address the issues of concentrated digital resources and capabilities while bolstering the democratic ethos of the digital commons. To this end, the essential role of digital commons in our research question is highlighted. We aim to enhance the reader's understanding of the unique contributions of our study to the existing literature by contextualizing our arguments within the broader digital commons framework [39–45].

Digital rights encompass the human rights and legal protections that individuals and organizations possess in the context of digital technology, the internet, and the online environment. These rights extend traditional human rights, such as privacy, freedom of expression, and access to information, to the digital realm. Key aspects of digital rights include the right to protect personal information, share and access information and opinions online, seek and receive information through digital channels, protect one's creations and innovations, and use digital technology without fear of surveillance, cyberattacks, or harassment. Digital rights advocacy aims to promote and defend these rights against challenges such as government surveillance, corporate data collection, and online censorship, ensuring a more open, inclusive, and democratic digital environment for all [7,23,46–52]. Barcelona, NYC, and Amsterdam established the Cities Coalition for Digital Rights advocated by the UN, and now encompasses more than 50 global cities in the protection of citizens' digital rights [47–49].

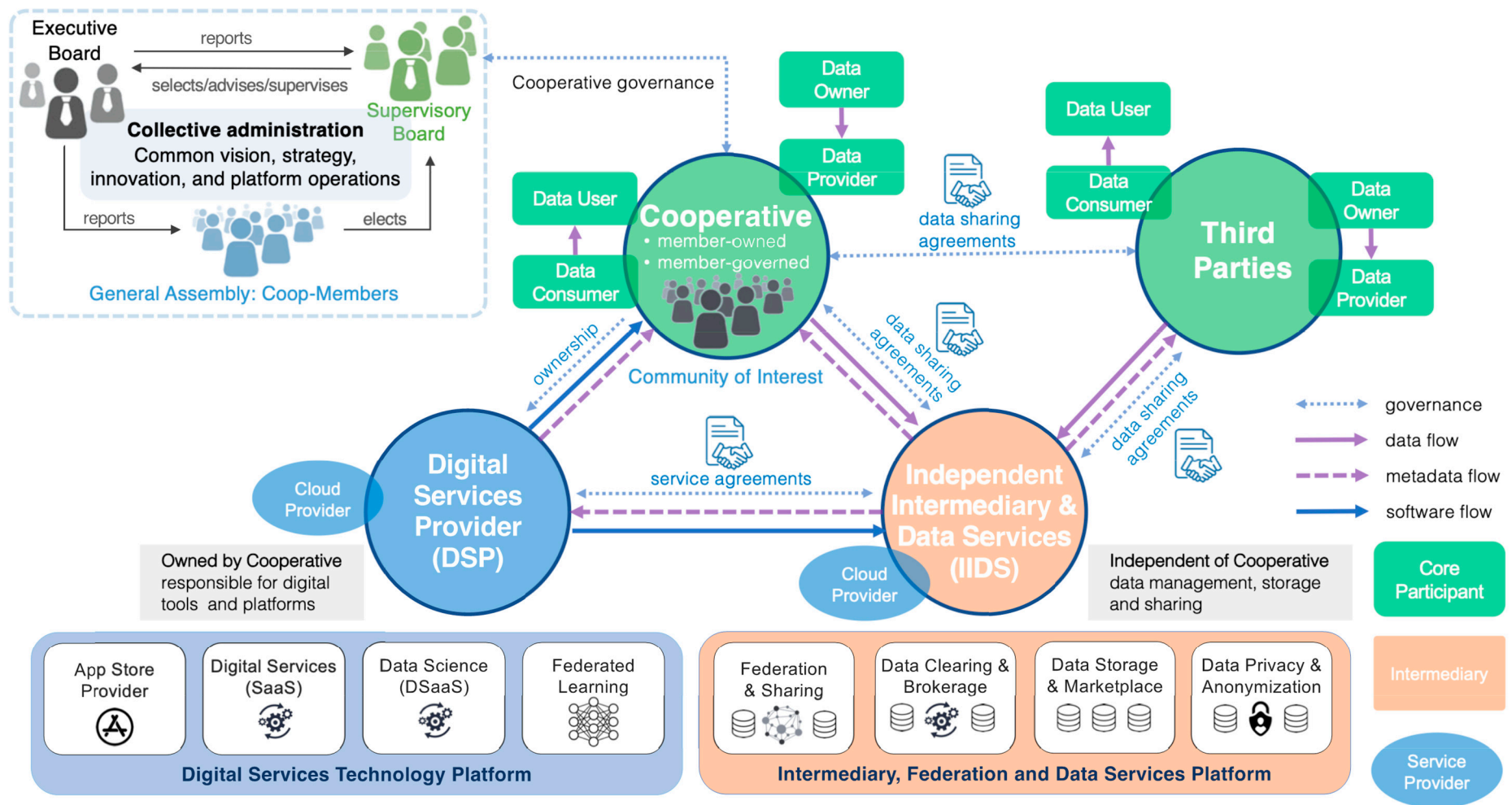


Figure 2. Example of the organizational structure of a data cooperative (own depiction).

2. Methods

Our research adopted a systematic and criterion-based approach to explore the concepts of digital commons, data cooperatives, and digital federation platforms. The primary sources of our data were academic literature, case studies, policy documents, and regulatory frameworks. To gather these, we followed a detailed methodological process outlined below.

We commenced our research with a comprehensive literature search, primarily using databases such as Google Scholar, Scopus, Web of Science, and the IEEE Xplore Digital Library. Our search encompassed a broad range of keywords and combinations thereof, including “digital commons”, “data cooperatives”, “digital federation platforms”, “platform cooperatives”, “data governance”, and “data sovereignty”, among others. The search was not confined to a particular time frame to capture the rich history and development of these concepts. However, we prioritized recent literature to maintain the relevance and applicability of our research. The titles, abstracts, and keywords of the searched articles were screened based on their relevance to our research topic. Full-text articles that met the initial screening criteria were then downloaded for detailed review.

For the selection of case studies, we followed a criterion-based approach. We sought case studies that provide substantial insight into the implementation and impact of data cooperatives, digital federation platforms, and platform cooperatives. We looked for examples that depict their governance structures, operational mechanisms, challenges, and achievements. The case studies were obtained from a variety of sources, including academic articles, reports from research institutions, grey literature, and online databases dedicated to platform cooperatives and digital commons. The selected case studies were then used to inform the analysis and provide real-world evidence for the discussions and arguments presented in the research.

In terms of analysis, we employed a thematic approach. Once the relevant literature and case studies were identified, we extracted and synthesized information related to the key themes of our research. We mapped the relationships between the key concepts of digital commons, data cooperatives, and digital federation platforms, and highlighted how they can contribute to more equitable and sustainable digital ecosystems. We also performed a critical analysis of the successes, challenges, and limitations associated with these concepts, thereby addressing the need for a balanced evaluation. Moreover, we explored how the structures and principles of digital commons, data cooperatives, and digital federation platforms can be harnessed to develop a policy framework that addresses the challenges of data concentration and digital inclusivity. Our analytical methods were systematically structured to develop our policy recommendations. It involved a rigorous process of synthesizing evidence from diverse sources, assessing various policy approaches, and shaping our recommendations accordingly. The step-by-step process we employed is outlined as follows:

The initial phase of our analysis involved synthesizing the collected evidence. After carefully reviewing the selected literature and case studies, we extracted and compiled relevant data regarding digital commons, data cooperatives, and digital federation platforms. This compilation was comprehensive, covering diverse dimensions, such as their structure, operation, impact, and challenges faced in implementation. Our evidence synthesis did not just rely on empirical data but also involved a critical interpretation of the findings in relation to the overall research context.

The synthesized evidence allowed us to identify various policy approaches, which were then thoroughly assessed. The assessment considered the feasibility, sustainability, effectiveness, and inclusivity of these approaches. This evaluation was not conducted in isolation; it was linked to the potential challenges of concentrated digital resources and capabilities. We conducted an in-depth analysis of the pros and cons of each policy approach, taking into account the complexities of the digital ecosystem and the diverse stakeholders involved.

The final phase of our analysis involved shaping our policy recommendations. The aim here was to develop policy suggestions that not only address the current challenges

but also anticipate future developments in the digital ecosystem. The recommendations were drawn from our comprehensive understanding of the strengths and limitations of different policy approaches and their alignment with the principles of digital commons, data cooperatives, and digital federation platforms. Our recommendations underwent a rigorous refinement process, which involved revisiting the synthesized evidence, reassessing the policy approaches, and realigning the recommendations to ensure their relevancy and appropriateness. In conclusion, our analytical methods involved a systematic and iterative process of synthesizing evidence, assessing policy approaches, and shaping recommendations. This approach facilitated the development of robust, evidence-based, and forward-thinking policy recommendations that can guide the future of digital commons, data cooperatives, and digital federation platforms.

We acknowledge the inherent limitations of our approach. The literature and case study selection may be influenced by the availability and accessibility of resources, and there may be relevant studies or examples not included in our review. Additionally, the complex and evolving nature of the concepts studied means that our analysis is context and time-sensitive. Despite these limitations, we strived to provide a comprehensive, balanced, and up-to-date overview of our research topic, guided by the principles of rigor and reflexivity.

3. Economic, Social, and Environmental Impact of Our Proposal

The implementation of our recommendations, including the establishment of digital federation platforms and data cooperatives, has the potential to generate significant economic and social benefits for small communities and SMEs [3]. Data's non-depletable nature and reusability in the 21st century knowledge economy make it a valuable form of capital [5]. Beneficial spill-overs arise when data are shared and repurposed for unforeseen growth opportunities or societal benefits [6]. Data cooperatives can enhance trust, create an environment for informed consent increasing data sharing, and consequently foster data-driven innovation [2]. Data access and sharing can create "super-additive" insights, leading to increasing returns to scope [53]. Under certain conditions, data may be considered an infrastructural resource. Data access and sharing have been shown to generate positive social and economic benefits for data providers, so-called direct impact, suppliers and users, so-called indirect impact, and the wider economy, called induced impact. However, quantifying these benefits is challenging [54]. Most recent studies [55] suggest that data access and sharing can increase the value of data for holders, create 10 to 20 times more value for users, i.e., indirect impact, and 20 to 50 times more value for the wider economy, i.e., induced impact. In some cases, data access and sharing may reduce data holders' producer surplus [56]. Overall, data access and sharing can generate benefits worth 0.1% to 1.5% of GDP for public-sector data and 1% to 2.5% of GDP (up to 4% in some studies) when including private sector data [57]. Data, akin to R&D for 21st century innovation systems, shares properties such as being an intangible asset, enabling knowledge creation with societal spill-overs, and facing investment incentive challenges [58]. Organizations may capture private benefits but not always recognize broader societal benefits [5]. Significant potential for value generation in an economy by cooperative data sharing and subsequent data value generation can be expected in those sectors which already have the activities with the largest share of total value added (value added by activity shows the value added created by the various industries (such as agriculture, industry, utilities, and other service activities). The indicator presents value added for an activity, as a percentage of total value added. All OECD countries compile their data according to the 2008 System of National Accounts (SNA). i.e., services (46–80%), industry (14–32%), etc. (Figure 3, [59]). However, it should be highlighted that sectors with low productivity and low digital maturity, i.e., construction, forestry, etc., might actually have the highest value growth potential. Data cooperatives play a crucial role in leveraging the collective strength of their members, resulting in various positive outcomes. While the correlation between the value generation of data cooperatives and the value added by producing goods and services might be

apparent, it is essential to note that one does not necessarily cause the other directly. The interplay is complex and influenced by a host of factors. For instance, the value generated by data cooperatives is multi-dimensional, encompassing not just economic but also social, democratic, and individual empowerment facets. It influences the decision-making, operational efficiency, and strategic planning that contribute to the production of goods and services. On the other hand, the value added by these sectors, such as services or industry, can enhance the resources and capabilities of data cooperatives, fueling their growth and strengthening their value proposition.

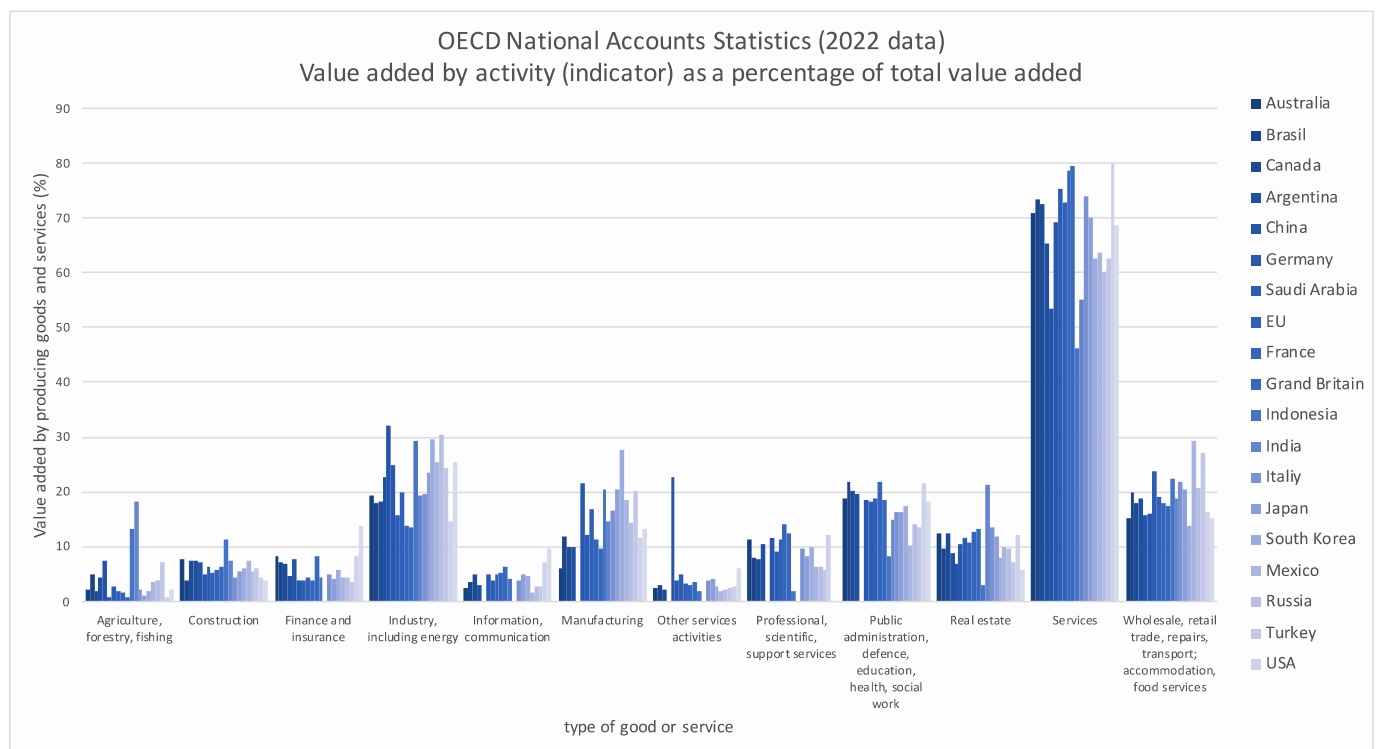


Figure 3. Value added by activity for all G20 economies [59]. Value added reflects the value generated by producing goods and services and is measured as the value of output minus the value of intermediate consumption. Value added also represents the income available for the contributions of labor and capital to the production process (own depiction).

Moreover, sectors with low productivity and digital maturity, such as construction and forestry, may hold untapped potential. Given the right digital tools, data-sharing infrastructure, and cooperative framework, these sectors could witness significant value growth. Therefore, the relationship between data cooperatives and value-added sectors is not linear causality but a complex, intertwined process influenced by multiple variables, both internal and external. In essence, it is a dynamic, symbiotic relationship where growth and value generation in one can potentially foster progress in the other.

By pooling cooperative resources (Figure 4A), these organizations promote improved resource allocation and job creation, which contributes to economic growth and supports community development. As members work together, sharing knowledge, skills, and resources, social cohesion within the community is also strengthened, fostering a sense of unity and collaboration. Data cooperatives can lead to improved resource efficiency and can lead to the collection of better data through the direct relationship that members have with the data governance mechanisms of the cooperative and shared aspirations by optimizing the use of available assets and reducing waste, ultimately promoting more sustainable practices. Furthermore, they can help establish fair and equitable compensation systems, ensuring that members receive appropriate rewards for their contributions. In

summary, data cooperatives harness the power of shared resources to drive economic, social, and environmental benefits, making them an essential component of modern data-driven ecosystems. The virtuous cycle of data cooperatives (Figure 4) encompasses four interconnected dimensions: (A) collaborative resource pooling, (B) cooperative innovation, (C) cooperative data market expansion, and (D) cooperative ROI. This cycle starts with pooling resources, which fosters innovation and expands market opportunities. As cooperative investments yield sustainable and inclusive returns, the cycle circles back to optimizing resources, reinforcing the positive economic, social, and environmental impacts. This interconnected cycle promotes a sustainable and inclusive future for data cooperative members and their communities.

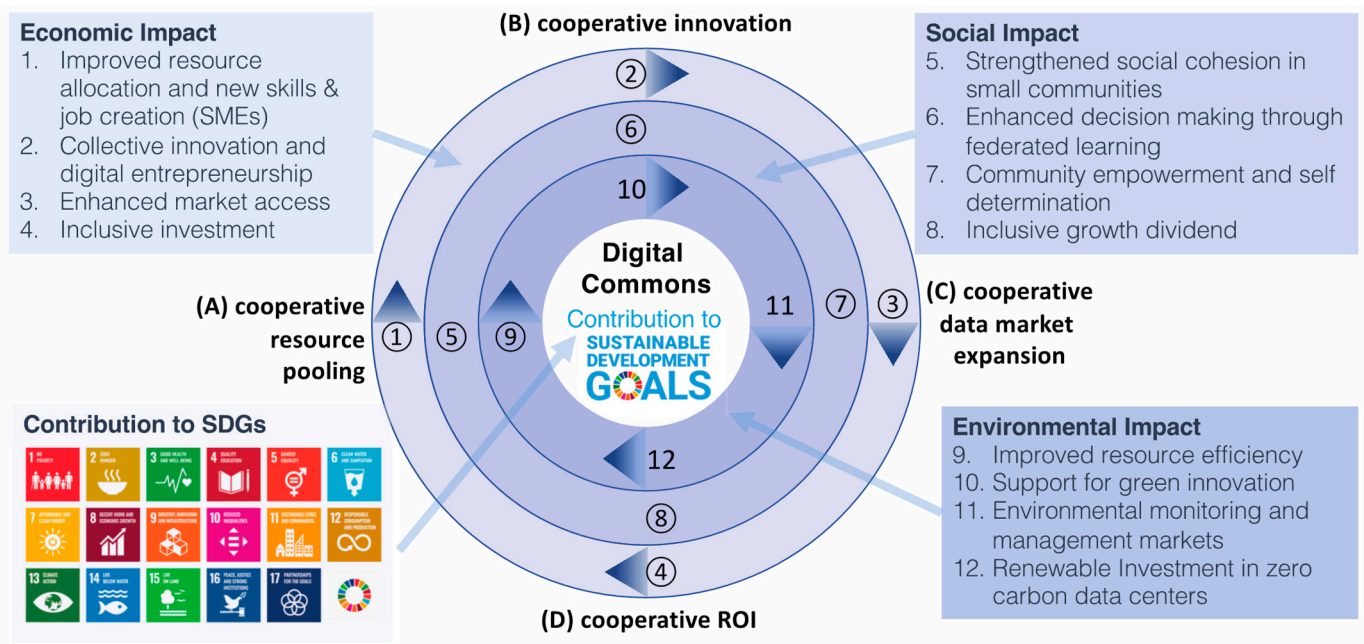


Figure 4. Virtuous cycle of economic, social, and environmental impact of data cooperatives (own depiction).

Cooperative innovation (Figure 4B) emphasizes the power of collaborative efforts within data cooperatives to drive ground-breaking ideas and solutions. By leveraging shared knowledge and resources, members can make better-informed decisions and explore novel approaches to challenges. This collective spirit not only fuels technological advancements and process improvements but also nurtures environmentally conscious practices and sustainable development. Through synergistic collaboration, data cooperatives enable their members to tackle complex global issues while fostering a culture of creativity and sustainability.

Cooperative data market expansion (Figure 4C) highlights how data cooperatives facilitate greater market access and empower their members including individuals and SMEs. By pooling resources and sharing knowledge, cooperatives enable small businesses and communities to tap into new opportunities, extending their reach beyond geographical constraints. Additionally, data cooperatives play a vital role in promoting self-determination and fostering growth in environmental monitoring and management markets. This market expansion helps drive sustainable development, ensuring the prosperity of both members and the environment.

Cooperative ROI (return on investment, see Figure 4D) emphasizes the shared value creation and inclusive growth resulting from cooperative investment in data cooperatives. By prioritizing sustainable investments, such as renewable energy in zero-carbon data centers, cooperatives minimize their environmental impact while maximizing the benefits for their members. This approach ensures that the economic gains from the cooperative are

distributed equitably and reinvested in the cooperative itself, promoting a sustainable and inclusive growth model.

By highlighting the economic, social, and environmental impact of our proposal, we emphasize the importance and potential benefits of digital federation platforms and data cooperatives in fostering inclusive and sustainable growth for small communities and SMEs. These impacts serve as a compelling rationale for supranational organizations to act and support the implementation of our recommendations.

4. A Path to Transformation—10 Case Studies

This section demonstrates the practical application of our recommendations by showcasing transformative use cases and case studies from Asia and Africa, with limited examples from Europe and America (Table 2). It highlights the barriers and shortcomings that demand policy action proposed in Sections 5 and 6.

Table 2. Exemplary transformative case studies.

Case Study	Description
Case Study 1: Mobile Money in Africa (Kenya's M-Pesa)	M-Pesa, a mobile money platform launched in Kenya, revolutionized financial inclusion by providing affordable, accessible, and secure digital financial services to millions of unbanked individuals [60–62]. This example illustrates the transformative potential of a digital platform that effectively empowers small communities and businesses. However, the challenge remains to extend the benefits of such platforms to other sectors, including education, healthcare, and supply chain management, by establishing data cooperatives and adopting open standards [63,64].
Case Study 2: Digital Agriculture in Asia (India's eKutir)	eKutir [65,66], a social enterprise in India, leverages digital technologies to empower smallholder farmers through data-driven agricultural advice, access to finance, and market linkages. By pooling data and resources from various stakeholders, eKutir demonstrates the potential of a data cooperative to drive sustainable development in rural communities. Yet, scalability and replicability of this model require supportive policies and a robust digital governance framework [67,68].
Case Study 3: Collaborative Land Management in Africa (Ghana's Farmerline)	Farmerline [69], a Ghanaian agriculture technology company, provides smallholder farmers with timely and accurate agricultural information through mobile technology. By pooling data from various sources, Farmerline exemplifies the potential of data cooperatives to drive sustainable development and food security in rural areas. To scale and replicate this model, supportive policies and a strong digital governance framework are essential, along with financial support from international partners [69,70].
Case Study 4: Decentralized Renewable Energy in Asia (Bangladesh's SOLshare)	SOLshare [71], a peer-to-peer energy trading platform in Bangladesh, enables rural communities to access affordable, clean energy by connecting solar home systems in a decentralized network. The platform exemplifies the transformative potential of data cooperatives in promoting sustainable development. Nevertheless, the broader adoption of such models requires the development of open standards, APIs, and legal frameworks that support data sharing and collaboration [72,73].
Case Study 5: Fintech for Financial Inclusion in South America (Brazil's Nubank)	Nubank [74], a Brazilian digital bank, has successfully expanded access to financial services for millions of underserved individuals in the region. By leveraging digital technologies and data-driven solutions, Nubank illustrates the potential of innovative platforms to empower small communities and businesses. Further development of data cooperatives in this sector can facilitate better credit access and risk assessment for SMEs, requiring supportive policies and collaboration between stakeholders [75].
Case Study 6: Telemedicine in Asia (Indonesia's Halodoc)	Halodoc [76], an Indonesian telemedicine platform, connects patients in remote areas with healthcare professionals through digital consultations, improving access to quality healthcare services. This initiative demonstrates the value of digital platforms in addressing critical challenges faced by rural communities. The expansion of such platforms, combined with the establishment of data cooperatives, can empower local communities and healthcare providers to make more informed decisions. However, this requires the development of robust data governance structures and open standards [77,78].

Table 2. Cont.

Case Study	Description
Case Study 7: Community Networks in Africa (South Africa's Zenzeleni)	Zenzeleni [79,80], a community-owned telecommunications network in South Africa, provides affordable internet access to rural communities by leveraging cooperative ownership and management [81]. The initiative highlights the importance of local ownership and collaboration in bridging the digital divide. However, regulatory barriers and limited resources impede the expansion of such initiatives, calling for policy interventions and financial support from G20 countries [82,83].
Case Study 8: Construction Industry in Bavaria, Germany (Germany's GemeinWerk)	GemeinWerk [3] proposed the first construction data cooperative in Munich, Germany. The case study of this Bavarian Construction Data Cooperative, which was launched by the Bavarian Construction Industry Association and GemeinWerk Ventures and will be operated by cooperative members, aims to provide small and medium-sized enterprises in the construction industry with access to shared services and construction data via a digital collaborative platform and data cooperative. This platform improves collaboration and organization within the construction value chain. The project primarily targets governance innovations to intensify industry collaboration, enable trust-based data sharing among stakeholders, and create a pre-competitive space of trust that drives productivity and innovation among SMEs through ecosystem collaboration.
Case Study 9: Smart City Initiatives in Europe (Barcelona, Spain and Salus Coop, Spain)	Barcelona's smart city initiatives [84–86] leverage digital technologies and data-driven solutions to improve urban services and enhance the quality of life for its residents. By utilizing data from various sources, such as sensors and citizen feedback, the city has implemented projects related to transportation, waste management, and energy efficiency. This case study demonstrates the potential of data cooperatives and digital federation platforms to facilitate collaboration among stakeholders in urban environments, i.e., Salus Coop [10,20,38,49]. However, the expansion of such initiatives requires the development of open standards, robust data governance structures, and the active involvement of citizens in decision-making processes as the case of Barcelona has shown reverting the technocratic approach to smart city paradigm [87–90].
Case Study 10: Ride-hailing platform initiative. (Driver's Seat, USA)	Driver's Seat Cooperative [91] is a driver owned cooperative that operates in a number of cities in the US. It enables gig-economy workers working in the ride-hailing sector to collect, pool and analyze data collected on a smartphone whilst undertaking work for ride-hailing platforms such as Uber and Lyft. The pooled data allows insights to be fed back to members so that they can optimize their incomes. The cooperative also sells data and insights to city agencies to enable better policy decisions with the profits from sales being redistributed back to members.

4.1. Insights and Lessons from Case Studies: Unraveling the Potential of Data Cooperatives

Our diverse selection of case studies encapsulates the essence of data cooperatives from various angles. They provide tangible examples that elucidate the transformative potential of data cooperatives and showcase how they can overcome the hurdles of the digital age, further substantiating our general arguments. Let us delve into the details of some notable instances.

The M-Pesa platform in Kenya exemplifies the potency of digital platforms in enhancing financial inclusion (Case Study 1). While M-Pesa itself is not a data cooperative, the way it has leveraged data to empower communities demonstrates the value of data cooperatives. By extending such platforms to sectors such as education and healthcare through data cooperatives, we can further disseminate benefits at a broader level.

Similarly, the Farmerline initiative in Ghana (Case Study 3) presents an effective model of data cooperation that amalgamates data from various sources. It demonstrates how data cooperatives can enhance sustainable development and food security in rural regions. However, scaling and replication of this model require supportive policies and a robust digital governance structure, underlining the necessity of political will and agency in the growth of data cooperatives.

A striking example of the transformative potential of data cooperatives can be found in SOLshare (Case Study 4). This decentralized energy trading platform has brought affordable, clean energy to rural communities in Bangladesh. It emphasizes that with the right framework supporting data sharing and collaboration, data cooperatives can significantly contribute to sustainable development.

Zenzeleni (Case Study 7), a community-owned telecommunications network in South Africa, serves as an excellent example of how local ownership and collaboration can help bridge the digital divide. It also highlights the challenges such initiatives face, such as regu-

latory hurdles and limited resources, illustrating the critical need for policy interventions and financial support.

The Bavarian Construction Data Cooperative, GemeinWerk (Case Study 8), presents a unique model of a sector-specific data cooperative. Facilitating trust-based data sharing among stakeholders creates a pre-competitive space of trust that drives productivity and innovation among SMEs.

Lastly, Barcelona's smart city initiatives (Case Study 9) demonstrate the potential of data cooperatives in urban environments. The city has successfully leveraged data from various sources to improve urban services and enhance residents' quality of life. However, the expansion of such initiatives requires robust data governance structures, open standards, and active citizen participation, emphasizing the importance of multi-stakeholder engagement in data cooperatives.

In conclusion, these case studies validate our argument for the significance of data cooperatives in overcoming the challenges of the digital age. They illustrate that while potential hurdles exist, with the right blend of policy support, technological framework, and stakeholder collaboration, data cooperatives can become a critical player in democratizing data governance and fostering an inclusive digital common.

4.2. Barriers and Shortcomings of Data Cooperatives and Digital Federation Platforms

1. **Regulatory Barriers:** Existing regulations in many countries may not adequately support or even hinder the establishment and operation of data cooperatives and digital federation platforms, limiting their potential impact.
2. **Limited Resources:** Small communities and SMEs often face resource constraints that restrict their ability to develop and implement digital governance structures, open standards, and cooperative models.
3. **Digital Divide:** Unequal access to digital infrastructure, skills, and resources exacerbates existing inequalities, making it more challenging for marginalized communities to participate in and benefit from digital transformation efforts.
4. **Data Privacy and Security:** Ensuring data privacy and security is critical for the success of digital federation platforms and data cooperatives, requiring the development of robust governance frameworks and technical solutions.

These case studies highlight the transformative potential of data cooperatives and digital federation platforms in addressing the challenges faced by small communities and SMEs. However, overcoming the barriers and shortcomings highlighted above necessitates policy action, as proposed in the following sections. Additional case studies from the Global South, including South America, highlight the transformative potential of data cooperatives and digital federation platforms in various sectors. Overcoming the barriers and addressing the shortcomings highlighted in the previous section requires policy action and support from both national governments and international organizations. The case studies from Europe and the United States display the potential of data cooperatives and digital federation platforms to drive transformative change across various sectors and contexts. To fully realize the benefits of such models, it is crucial to address the identified barriers and shortcomings through policy action, capacity building, and the development of supportive legal and regulatory frameworks.

5. Data Cooperatives and Their Governance

5.1. Navigating the Data Governance Spectrum

In the intricate matrix of data governance, numerous solutions have emerged, including multistakeholderism, top-down regulation, technical decentralization, digital rights constitutionalism, and the notion of middleware companies and mediators of individual data. While these solutions present their merits, their ability to foster data sovereignty and promote an equitable digital world remains questionable. Here, we argue that data cooperatives offer a more comprehensive and effective approach, outperforming these alternatives in several crucial ways.

1. **Multistakeholderism and top-down regulation:** While these approaches aim to create a balanced digital ecosystem by integrating various stakeholders or enforcing strict regulations, they often fall short in promoting true data sovereignty. Multistakeholderism risks marginalizing less influential parties in decision-making processes, and top-down regulations can inadvertently stifle innovation and competition. In contrast, data cooperatives ensure that each member has an equal voice, fostering a more democratic governance structure that empowers individuals and communities.
2. **Technical decentralization:** While this approach champions technological solutions for data privacy, it lacks a holistic perspective. Technology alone cannot address the complex social, economic, and political issues associated with data governance. Data cooperatives, however, adopt an integrative approach that couples technological advancements with robust governance mechanisms to address these complex dimensions.
3. **Digital constitutionalism:** Although codifying digital rights into law is a significant step towards safeguarding data sovereignty, these rights remain theoretical unless individuals and communities are empowered to exercise them effectively. Data cooperatives provide the necessary framework for individuals to collectively assert and protect their digital rights, making these constitutional provisions a lived reality.

The proposals by Fukuyama [92] and Lanier [93], suggesting middleware companies and mediators of individual data, do share intellectual proximity to our data cooperative proposition. These approaches, much like data cooperatives, seek to foster a middle layer of governance, offering a balanced approach to data management. However, data cooperatives surpass these concepts in their emphasis on collective ownership, democratic decision-making, and an inherently cooperative ethos.

While middleware companies serve as third-party entities managing the interaction between end-users and internet companies, they still operate within a commercial logic that may not prioritize user interests. Similarly, while mediators of individual data can provide negotiation power for individuals, they do not inherently ensure an equitable distribution of benefits derived from data. On the other hand, data cooperatives operate on principles of democracy, openness, equality, and solidarity, ensuring that their members' rights and interests are paramount.

We echo Lanier and Weyl's [93] robust defense of mid-level solutions and extend it to champion data cooperatives specifically. They offer a promising avenue for just data governance, striking a balance between individual and state-level management, and providing a more participatory, equitable, and democratic model of data governance.

While we have addressed the distinguishing elements of data cooperatives, it is essential to recognize that no solution can operate in a vacuum. All these mentioned models and approaches have their unique strengths, and the ideal data governance framework will likely include components from each of them. Yet even in this amalgamated model, we posit that data cooperatives stand as an essential element due to their unique principles and potential. To reiterate, data cooperatives are fundamentally anchored in democratic governance, ensuring equitable involvement of all members. This cooperative ethos goes beyond the mere management of data; it is a conscious effort to reshape the power dynamics in the digital realm. It provides individuals and communities with the agency to determine how their data are used and how the benefits from this usage are distributed. It is this decentralization of power that is lacking in many of the other approaches discussed.

However, the integration of data cooperatives within the broader ecosystem requires strategic collaboration with other models. For instance, the legal structures provided by data trusts could be valuable in fortifying the legal standing of data cooperatives. Similarly, the technological advancements heralded by the idea of technical decentralization could enhance the secure and efficient operation of cooperatives. The principles of digital constitutionalism can complement the protective mechanisms within cooperatives, promoting a rights-respecting digital environment. In this vein, we need to carefully consider the insights from works such as Fukuyama's and Lanier and Weyl's [92,93]. The concept of middleware companies, for example, presents an interesting interface between the user and the

internet companies. These entities can potentially be orchestrated within the cooperative framework, functioning as service providers that uphold the cooperative's principles. Similarly, the mediators of individual data could serve a role within cooperatives, representing collective interests in negotiation with external entities.

Ultimately, the argument for data cooperatives is not just about the efficient management of data or the safeguarding of privacy. It is about fostering a democratic digital culture where power is distributed, voices are heard, and benefits are shared. It is a vision of the digital world that is inclusive, equitable, and just, where data sovereignty is a reality, not just a catchphrase. Therefore, while we acknowledge the value of the varied approaches toward data governance, we firmly believe that data cooperatives should take center stage in these discussions, given their transformative potential.

5.2. Evaluation of Current Policies in the Context of Data Cooperatives

Current policy measures, particularly within the European Union, have already begun to address several aspects related to data governance. The EU's Data Governance Act and forthcoming Data Act are crucial developments in establishing a framework for data sharing and handling, yet their alignment with the policy recommendations for the advancement of data cooperatives deserves further scrutiny.

The EU Data Governance Act, currently in effect, establishes a mechanism to facilitate data sharing among businesses, citizens, and government bodies while respecting data sovereignty. The Act provides for the establishment of data intermediaries, which will operate under stringent neutrality requirements, thereby offering a stepping stone towards our recommended structure of data cooperatives. However, the Act lacks explicit support for cooperative models and does not offer specific mechanisms to foster trust and engagement from data subjects, elements we deem critical for successful data cooperatives.

Furthermore, the Data Governance Act promotes sector-specific data spaces, which can be likened to our proposal for sector-specific data cooperatives. Yet, the Act does not sufficiently articulate ways to ensure that these data spaces cater to the interests of all stakeholders, particularly individuals and smaller businesses, which is a cornerstone of our recommendations.

The proposed Data Act, aimed at ensuring fair and open access to data generated by businesses and public bodies, is another promising policy development. While the Act embodies the principles of fair and equitable data sharing, the exact mechanisms to ensure these principles remain somewhat nebulous. Our policy recommendations advocate for clear, implementable strategies that not only ensure equitable access but also foster active participation of data subjects in data governance, elements not yet thoroughly addressed in the proposed Data Act.

In conclusion, while the current and proposed policy measures by the EU form a significant stride toward fair and equitable data governance, there are gaps that need to be addressed. These primarily pertain to explicit support for data cooperative models, fostering trust and engagement from data subjects, and implementing clear strategies to ensure equitable access and participation. Further policy development should aim to address these gaps, considering data cooperatives as a viable and effective model for democratic and inclusive data governance.

6. Recommendations for Implementation

To ensure the equitable development of digital entrepreneurship and promote community well-being, we present the following recommendations (Figure 5 and Table 3). These recommendations are supported by strong arguments and evidence from the case studies discussed earlier.

By implementing these recommendations, governments and civil society around the world can create an enabling environment for the growth of digital federation platforms and data cooperatives, fostering a more inclusive and equitable digital ecosystem that supports the sustainable development of small communities and SMEs.

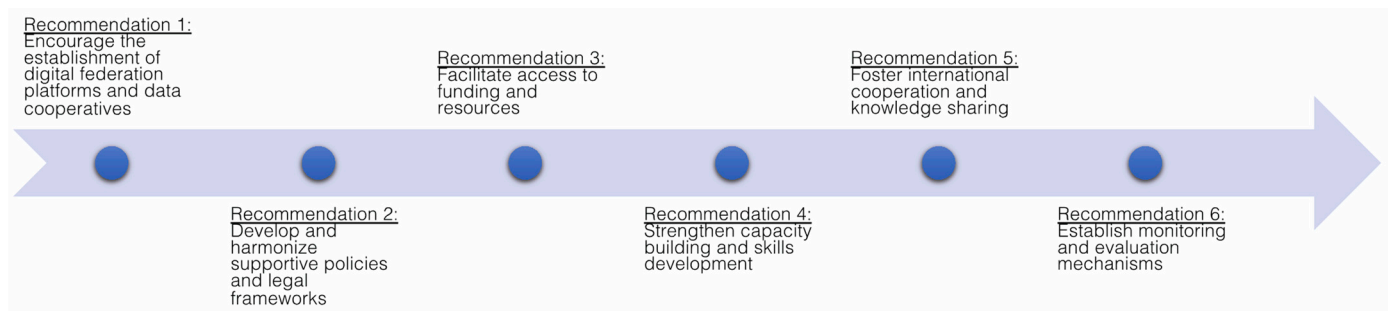


Figure 5. Proposed chronological order of recommendation implementation (own depiction).

Table 3. Recommendations to interested governments and civil society.

Recommendation	Description
<p>Recommendation 1: Encourage the establishment of digital federation platforms and data cooperatives</p>	<ul style="list-style-type: none"> ❖ Promote the creation of digital federation platforms and data cooperatives to empower small communities and SMEs by providing access to resources, information, and decision-making power. ❖ Facilitate knowledge sharing and provide technical assistance to support the development and implementation of these platforms and cooperatives. ❖ Initiate and support creative programs such as “Digital Innovation Hubs” that bring together SMEs, communities, and technology experts to collaboratively develop and implement digital solutions tailored to local needs, fostering a culture of innovation and entrepreneurship in the digital space.
<p>Recommendation 2: Develop and harmonize supportive policies and legal frameworks</p>	<ul style="list-style-type: none"> ❖ Develop and align policies and legal frameworks that foster digital inclusion, open standards, and data governance. ❖ Encourage member countries to remove regulatory barriers that hinder the establishment and operation of data cooperatives and digital federation platforms. ❖ Create a “Digital Policy Innovation Lab”—a collaborative, multi-stakeholder platform that brings together policymakers, technologists, SMEs, and community representatives to co-design, pilot, and refine innovative regulatory frameworks and policy solutions that promote digital entrepreneurship and ensure a fair and inclusive digital ecosystem.
<p>Recommendation 2: Develop and harmonize supportive policies and legal frameworks</p>	<ul style="list-style-type: none"> ❖ Develop and align policies and legal frameworks that foster digital inclusion, open standards, and data governance. ❖ Remove regulatory barriers that hinder the establishment and operation of data cooperatives and digital federation platforms. ❖ Create a “Digital Policy Innovation Lab”—a collaborative, multi-stakeholder platform that brings together policymakers, technologists, SMEs, and community representatives to co-design, pilot, and refine innovative regulatory frameworks and policy solutions that promote digital entrepreneurship and ensure a fair and inclusive digital ecosystem.

Table 3. Cont.

Recommendation	Description
<p>Recommendation 3: Facilitate access to funding and resources</p>	<ul style="list-style-type: none"> ❖ Establish funding mechanisms, such as grants, low-interest loans, or other financial instruments, to support the development and implementation of digital federation platforms and data cooperatives, particularly in resource-constrained regions. ❖ Explore partnerships with multilateral organizations, regional development banks, and private sector stakeholders to mobilize resources and support capacity building initiatives. ❖ Launch a “Digital Entrepreneurship Challenge,” a global competition that encourages SMEs and communities to develop innovative digital solutions using data cooperatives and digital federation platforms. Winners would receive financial support, mentorship, and access to resources, fostering a culture of innovation and collaboration in the digital space.
<p>Recommendation 4: Strengthen capacity building and skills development</p>	<ul style="list-style-type: none"> ❖ Support the development and delivery of capacity building and skills development programs for small communities and SMEs, enabling them to effectively participate in the digital economy. ❖ Collaboration with international organizations, educational institutions, and the private sector should be leveraged to create and implement relevant training programs. ❖ To inject creativity into capacity building and skills development, promote the establishment of “Digital Skill-Share Networks”, which are peer-to-peer learning platforms where SMEs, communities, and experts can exchange knowledge and skills in digital technologies and data governance. These networks would foster a collaborative learning environment, encouraging participants to share experiences, insights, and best practices in a dynamic and engaging manner.
<p>Recommendation 5: Foster international cooperation and knowledge sharing</p>	<ul style="list-style-type: none"> ❖ Promote international cooperation and knowledge sharing among member countries to identify and disseminate best practices related to digital federation platforms and data cooperatives. ❖ Collaboration with multilateral organizations, regional development banks, and other stakeholders should be encouraged to facilitate the exchange of experiences and insights. ❖ Organize an annual “Global Digital Commons Summit” that brings together representatives from member countries, SMEs, communities, multilateral organizations, and the private sector. This summit would serve as a platform for showcasing innovative projects, exchanging best practices, and forming new partnerships related to digital federation platforms and data cooperatives, thus strengthening the global digital ecosystem.
<p>Recommendation 6: Establish monitoring and evaluation mechanisms</p>	<ul style="list-style-type: none"> ❖ Develop mechanisms to monitor and evaluate the impact of digital federation platforms and data cooperatives on small communities and SMEs. ❖ Use this information to identify areas for improvement and ensure that these initiatives effectively contribute to the achievement of SDGs 8, 9, and 11. ❖ Launch a “Digital Impact Dashboard”—an interactive, publicly accessible platform that visualizes the progress and impact of digital federation platforms and data cooperatives on small communities and SMEs. This dashboard would not only increase transparency and accountability but also facilitate the identification of success stories and areas for improvement, encouraging continuous learning and adaptation within the digital ecosystem.

7. Governments' Role and Beyond

Governments around the world play a crucial role in addressing the policy challenges identified in this review article. Supranational organizations' (such as the OECD, G20, G7, EU, ASIAN etc.) collective influence, resources, and commitment to fostering inclusive and sustainable growth make them well-positioned to create viable opportunities for small communities and SMEs in the digital landscape. Those supranational organizations can contribute to the establishment and support of open digital federation platforms and data cooperatives in several ways (Table 4):

Table 4. Summary table of proposed roles of supranational organizations in supporting data and platform cooperatives.

Recommendation	Description
Policy Harmonization	Encourage member countries to develop and align policies that promote digital inclusion, support the establishment of data cooperatives, and foster a more equitable digital economy. This can include measures such as incentives for SMEs to participate in cooperatives and the adoption of open standards and APIs.
Financial Support	Facilitate access to funding for the development and implementation of digital federation platforms and data cooperatives, particularly in regions where resources are scarce. This can include grants, low-interest loans, or other financial instruments that help kickstart these initiatives.
Capacity Building	Support capacity building and skills development programs for small communities and SMEs, empowering them to participate in the digital economy and make effective use of digital resources. This may involve collaborating with international organizations, educational institutions, NGOs, and the private sector to develop and deliver relevant training programs. This could include using the existing knowledge in established and flagship co-operative groups (i.e., Mondragon [94]) to leverage through this organizational model further implementations in the current digital economy and society.
Knowledge Sharing	Promote knowledge sharing and the exchange of best practices among member countries regarding the implementation of digital federation platforms and data cooperatives. This can help identify effective models and strategies that can be adapted and scaled across different contexts.
International Cooperation	Foster international cooperation and partnerships to support the development of digital federation platforms and data cooperatives, including collaboration with multilateral organizations, regional development banks, and other stakeholders.
Monitoring and Evaluation	Establish mechanisms for monitoring and evaluating the impact of digital federation platforms and data cooperatives on small communities and SMEs. This can help to identify areas for improvement and ensure that these initiatives are effectively contributing to the achievement of SDGs 8, 9, and 11.

By actively engaging in these efforts, supranational organizations can create an environment that encourages the growth of digital federation platforms and data cooperatives, supporting a more inclusive and equitable digital ecosystem for small communities and SMEs. In doing so, supranational organizations can make significant strides in addressing the policy challenges identified in this brief, promoting sustainable development, and advancing the global digital economy [95,96].

8. Addressing Key Considerations in Data Cooperative Implementation

In our quest to explore the transformative potential of data cooperatives for digital commons, we aim to bridge the gap between theory and practice by delving into the intricate aspects of their implementation. This paper navigates through the complex landscape of data cooperatives by providing a comprehensive understanding of their associated nuances. Consequently, this section unravels four critical dimensions, which surfaced from our in-depth exploration of relevant case studies and literature: potential risks and

limitations, interconnected data governance, the Global North–South divide, and the dynamics of political agency. It is essential to approach our investigation of data cooperatives through an integrative lens, thereby weaving together the threads of risks, limitations, geopolitical contexts, and political agency. This approach facilitates a more holistic and pragmatic comprehension of the data cooperative environment, thereby contributing to the understanding and successful realization of digital commons.

8.1. Risks and Limitations of Data Cooperatives

While data cooperatives present a promising avenue toward the democratization of the digital sphere, our comprehensive analysis underscores that this potential is not devoid of its challenges. Primary among these are concerns related to data privacy, operational scalability, and regulatory compliance.

The delicate balance of individual privacy within the data cooperative model necessitates the deployment of robust safeguards. In an environment characterized by extensive data sharing, the implementation of rigorous data anonymization protocols and stringent cybersecurity measures are imperative to uphold the sanctity of privacy.

Furthermore, as cooperatives scale, the complexity of maintaining effective, participatory decision-making processes magnifies. Balancing the growth in data volume with active participatory governance becomes an increasingly nuanced task, demanding careful strategizing and adept management.

Lastly, the multifaceted nature of regulatory landscapes poses additional challenges. With the rules governing data usage varying widely across jurisdictions, creating a unified operational framework is a daunting endeavor. The need for a sophisticated regulatory approach that accommodates these variations is thus highlighted.

While we have underscored the transformative potential of data cooperatives, our responsibility is to also illuminate their inherent pitfalls, challenges, and constraints. This balanced perspective offers a holistic view of the data cooperative landscape, enabling us to explore solutions while being mindful of the potential hurdles.

8.2. Interconnected Data Governance

Data governance encompasses a vast array of policies, regulations, and practices, rendering it a complex, interconnected concept rather than an isolated one. The potency of data cooperatives, therefore, can be amplified significantly when harmoniously integrated with other data governance paradigms, including data trusts and personal data stores.

For instance, data trusts could serve as legal scaffolds, facilitating collective decision-making pertaining to data, and thereby strengthening the cooperative model's structure. Concurrently, personal data stores have the potential to enhance individual autonomy by offering individuals greater control over their data.

When these governance models are strategically amalgamated with the data cooperative paradigm, the result could be a substantial boost to equitable data practices and an increased agency for individuals in the digital arena. Hence, our exploration of data cooperatives must consider the larger context, recognizing the valuable role played by other forms of data governance and their potential to synergistically enhance the effectiveness of data cooperatives, thereby further advancing the cause of digital inclusivity.

8.3. The Global North–South Divide

The distinct divide between the Global North and South delineates unique implications for data cooperatives, presenting both distinct challenges and opportunities. Disparities in technological advancements and resource availability have etched an uneven digital terrain, typically characterizing the Global North with superior technological capabilities compared to the Global South.

Though this scenario poses certain hurdles, it also unveils opportunities for fostering digital solidarity. Data cooperatives in the Global North could function as a lighthouse,

sharing resources, insights, and technology with their counterparts in the Global South, thus cultivating a more balanced digital ecosystem.

However, these initiatives must be judiciously crafted to respect local contexts and uphold the principles of data sovereignty to ensure genuine efficacy. The dichotomy between the Global North and South influences the growth trajectory of data cooperatives in intricate ways.

The inherent uneven development, a by-product of diverse technological resources and availability, has created a digital divide between these two regions. Our proposed policy framework and the establishment of digital federated platforms are meticulously designed to provide blueprints relevant to both contexts. Yet, the disparities in resource availability, digital infrastructure, and data governance policies call for a finely calibrated, context-sensitive application.

By emphasizing the promotion of local capacity-building, stimulating South–South collaborations, and endorsing context-sensitive policies, we could potentially navigate toward a more balanced and inclusive digital landscape.

8.4. The Role of Political Agency

The realization and expansion of data cooperatives hinge significantly on political agency and willpower, spanning the roles of local, national, and supranational entities in cultivating a conducive environment. For instance, local authorities can weave data cooperatives into their smart city initiatives, while national governments can lay the groundwork for supportive legislation and funding. Supranational entities, such as the European Union, are primed to harmonize regulations across borders, thereby streamlining the functioning of cross-border cooperatives. It is paramount, however, to calibrate these efforts to ensure they do not compromise the democratically driven ethos integral to cooperatives.

In addressing these pivotal aspects, we aspire to furnish a balanced, comprehensive perspective on the data cooperative model. Our intent is to deliver a nuanced understanding capable of guiding effective policymaking and fostering an equitable, inclusive digital commons.

Political agencies' role in nurturing data cooperatives is multi-layered, extending beyond the top-down influence of supranational organizations. Indeed, local, community-driven data access, usage, and governance serve as the vital lifeline for initiating and sustaining data cooperatives. Nonetheless, transformative change often hinges on facilitative policies, regulatory backing, and financial incentives, most effectively offered at the national and supranational levels.

In acknowledging these dynamics, it is essential to appreciate the hybrid nature of governance arrangements across various geographical scales. Power and politics within data governance regimes are distributed, mirroring the involvement of a spectrum of actors ranging from community members to global institutions. Consequently, data cooperatives should be perceived as components of a broader socio-political ecosystem, requiring active participation from stakeholders across all tiers.

To encapsulate, this thorough understanding of the complexities surrounding data cooperatives provides a more robust foundation for executing our policy recommendations. It arms us with the acuity to foresee challenges, to strategically align with complementary data governance models, to adapt to geographical disparities, and to engage optimally with political agencies. The ultimate aim is democratizing digital resources and capabilities.

9. Conclusions

The digital age, characterized by rapid technological advancements and data-driven economies, poses unique challenges and opportunities for small communities and small and medium enterprises (SMEs). Data cooperatives and digital federation platforms have emerged as viable solutions to tackle these challenges, enabling the democratization of digital resources and providing avenues for collective decision-making and shared value creation. Through the detailed exploration presented in this paper, we underscored the trans-

formative potential of data cooperatives and digital federation platforms. We delved into their nuances, highlighting key considerations such as risks and limitations, interconnected data governance, the Global North–South divide, and the dynamics of political agency.

Our study reaffirms that data cooperatives are not a panacea and come with their inherent challenges, such as privacy concerns, operational scalability, and regulatory compliance. Nevertheless, they offer promising prospects for fostering a more inclusive and equitable digital ecosystem, especially when intertwined with other data governance models such as data trusts and personal data stores. The geopolitical context, characterized by the North–South divide, influences the trajectory of data cooperatives. Although it introduces disparities in technological advancements and resource availability, it also presents opportunities for fostering digital solidarity. A key strategy toward a balanced digital ecosystem is the promotion of local capacity-building, fostering South–South collaborations, and endorsing context-sensitive policies.

The role of political agency is vital in shaping an environment conducive to the growth of data cooperatives. From local to supranational entities, supportive legislation, and funding, as well as harmonization of regulations, can facilitate the expansion of these cooperatives. Yet, it is crucial to ensure these efforts do not compromise the democratically driven ethos integral to cooperatives. The recommendations we propose for governments and civil society provide a strategic blueprint to harness the potential of data cooperatives and digital federation platforms effectively. From encouraging the establishment of these platforms to harmonizing supportive policies, providing access to resources, strengthening capacity building, fostering international cooperation, and establishing evaluation mechanisms—these steps would drive a more inclusive and equitable digital ecosystem.

The establishment and successful implementation of data cooperatives and digital federation platforms represent an essential step towards a digital commons that serve the needs of all stakeholders. By providing a platform for collective decision-making and shared value creation, they offer a promising route toward digital equity and inclusivity. The insights gleaned from this study lay a robust foundation for executing policy recommendations and advancing toward a democratized digital landscape.

Author Contributions: Conceptualization, M.M.B. and A.P.; methodology, I.C. (Igor Calzada) and T.S.; validation, K.N., T.S., J.T. and D.S.; formal analysis, M.M.B., K.N., T.J., S.M. and V.M.; investigation, I.C. (Isabel Cane), D.S., J.T., S.M. and J.Z.; resources, M.M.B.; data curation, I.C. (Isabel Cane), B.V. and J.Z.; writing—original draft preparation, M.M.B., I.C. (Igor Calzada), M.M., B.V. and A.P.; writing—review and editing, A.K., T.S., M.M., M.M.B., I.C. (Igor Calzada) and M.M.; visualization, M.M.B.; supervision, A.P. and J.T.; project administration, M.M.B.; funding acquisition, M.M.B. All authors have read and agreed to the published version of the manuscript.

Funding: The article processing charges (APC) were fully funded by the Baden-Württemberg Ministry of Science, Research and Culture (Ministerium für Wissenschaft, Forschung und Kunst Baden-Württemberg) and the University of Applied Sciences Konstanz (HTWG Hochschule Konstanz Technik, Wirtschaft und Gestaltung). Furthermore, an overall discount of 10% on the APC was granted within the framework of the Open Access Program, in which one of the authors of the TU Munich participates.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Lehdonvirta, V. *Cloud Empires: How Digital Platforms Are Overtaking the State and How We Can Regain Control*; MIT Press: Cambridge, MA, USA, 2022.
2. Bresciani, S.; Ciampi, F.; Meli, F.; Ferraris, A. Using big data for co-innovation processes: Mapping the field of data-driven innovation, proposing theoretical developments and providing a research agenda. *Int. J. Inf. Manag.* **2021**, *60*, 102347. [CrossRef]
3. Bühler, M.M.; Nübel, K.; Jelinek, T.; Riechert, D.; Bauer, T.; Schmid, T.; Schneider, M. Data cooperatives as a catalyst for collaboration, data sharing and the digital transformation of the construction sector. *Buildings* **2023**, *13*, 442. [CrossRef]
4. Tait, J. Open Data Cooperation—Building a Data Cooperative. Available online: <https://www.opendatamanchester.org.uk/947/> (accessed on 4 April 2023).

5. Organisation for Economic Co-operation and Development (OECD). *Data-Driven Innovation: Big Data for Growth and Well-Being*; OECD Publishing: Paris, France, 2015.
6. Corrado, C.; Hulten, C.; Sichel, D. Intangible capital and US economic growth. *Rev. Income Wealth* **2009**, *55*, 661–685. [CrossRef]
7. Hummel, P.; Braun, M.; Tretter, M.; Dabrock, P. Data sovereignty: A review. *Big Data Soc.* **2021**, *8*, 2053951720982012. [CrossRef]
8. Jarke, M.; Otto, B.; Ram, S. Data sovereignty and data space ecosystems. *Bus. Inf. Syst. Eng.* **2019**, *61*, 549–550. [CrossRef]
9. Institute, A.L. *Exploring Legal Mechanisms for Data Stewardship*; Ada Lovelace Institute and UK AI Council: London, UK, 2021.
10. Calzada, I. Data co-operatives through data sovereignty. *Smart Cities* **2021**, *4*, 1158–1172. [CrossRef]
11. Cuno, S.; Bruns, L.; Tcholtchev, N.; Lämmel, P.; Schieferdecker, I. Data governance and sovereignty in urban data spaces based on standardized ICT reference architectures. *Data* **2019**, *4*, 16. [CrossRef]
12. Floridi, L. The Fight for Digital Sovereignty: What It Is, and Why It Matters, Especially for the EU. *Philos. Technol.* **2020**, *33*, 369–378. [CrossRef]
13. Jelinek, T. Technology Silos of Today or the End of Global Innovation. In *The Digital Sovereignty Trap*; Springer: Berlin/Heidelberg, Germany, 2023; pp. 19–33.
14. Walter, M.; Kukutai, T.; Carroll, S.R.; Rodriguez-Lonebear, D. *Indigenous Data Sovereignty and Policy*; Taylor & Francis: London, UK, 2021.
15. Carroll, S.R.; Garba, I.; Figueroa-Rodríguez, O.L.; Holbrook, J.; Lovett, R.; Materechera, S.; Parsons, M.; Raseroka, K.; Rodriguez-Lonebear, D.; Rowe, R. The CARE principles for indigenous data governance. *Data Sci. J.* **2020**, *19*, 43. [CrossRef]
16. Bunting, M.; Lansdell, S. Designing Decision Making Processes for Data Trusts: Lessons from Three Pilots. 2019. Available online: <https://theodi.org/wp-content/uploads/2019/04/General-decision-making-report-Apr-19.pdf> (accessed on 26 June 2023).
17. Baars, H.; Tank, A.; Weber, P.; Kemper, H.-G.; Lasi, H.; Pedell, B. Cooperative Approaches to Data Sharing and Analysis for Industrial Internet of Things Ecosystems. *Appl. Sci.* **2021**, *11*, 7547. [CrossRef]
18. Ferdinand-Steinbeis-Institut (FSTI). Datengenossenschaft.com (Data Cooperative). Available online: <https://www.datengenossenschaft.com/> (accessed on 14 November 2022).
19. Miller, K. Radical Proposal: Data Cooperatives Could Give Us More Power over Our Data. Available online: <https://hai.stanford.edu/news/radical-proposal-data-cooperatives-could-give-us-more-power-over-our-data> (accessed on 14 November 2022).
20. Scholz, T.R.; Calzada, I. Data cooperatives for pandemic times. In *Data Cooperatives for Pandemic Times*; Public Seminar: New York, NY, USA, 2021.
21. Tait, J. The Case for Data Cooperatives. Available online: <https://thedataeconomylab.com/2021/09/06/the-case-for-data-cooperatives/> (accessed on 26 June 2023).
22. Sgarro, V. *Understanding Democratic Decision-Making in Cooperatives*; Platform Cooperatives: New York, NY, USA, 2023.
23. Calzada, I. Postpandemic technopolitical democracy: Algorithmic nations, data sovereignty, digital rights, and data cooperatives. In *Made-to-Measure Future(s) for Democracy? Views from the Basque Atalaia*; Springer International Publishing: Cham, The Netherlands, 2022; pp. 97–117.
24. Hardjono, T.; Pentland, A. Empowering artists, songwriters & musicians in a data cooperative through blockchains and smart contracts. *arXiv* **2019**, arXiv:1911.10433.
25. Hardjono, T.; Pentland, A. Data cooperatives: Towards a foundation for decentralized personal data management. *arXiv* **2019**, arXiv:1905.08819.
26. Marjanovic, O.; Zhu, J.; Krivokapic-Skoko, B.; Lewis, C. Will the real data coop stand up!: Data cooperatives in the coop sector—current challenges and future opportunities. In Proceedings of the 14th ICA CCR Asia-Pacific Research Conference, Newcastle, Australia, 12–14 December 2019.
27. Salau, A.; Dantu, R.; Morozov, K.; Upadhyay, K.; Badruddoja, S. Towards a Threat Model and Security Analysis for Data Cooperatives. In Proceedings of the 19th International Conference on Security and Cryptography-SECURITY, Lisbon, Portugal, 11–13 July 2022; pp. 707–713.
28. Shah, P.R.; Juenke, E.G.; Fraga, B.L. Here Comes Everybody: Using a Data Cooperative to Understand the New Dynamics of Representation. *PS Political Sci. Politics* **2022**, *55*, 300–302. [CrossRef]
29. Mannan, M.; Schneider, N. Exit to community: Strategies for multi-stakeholder ownership in the platform economy. *Geo. L. Tech. Rev.* **2021**, *5*, 1.
30. Mannan, M. Theorizing the emergence of platform cooperativism: Drawing lessons from role-set theory. *Ondernem. Tijdschr.* **2022**, *2*, 64–71.
31. Mannan, M.; Pek, S. *Solidarity in the Sharing Economy: The Role of Platform Cooperatives at the Base of the Pyramid*; Springer: Berlin/Heidelberg, Germany, 2021.
32. Bunders, D.J.; Arets, M.; Frenken, K.; De Moor, T. The feasibility of platform cooperatives in the gig economy. *J. Co-Oper. Organ. Manag.* **2022**, *10*, 100167. [CrossRef]
33. Kuncoro, E.A. Platform Cooperative as a Business Model: An Innovation toward a Fair Sharing Economy in Indonesia. Available online: https://binus.ac.id/wp-content/uploads/2022/09/Orasi-Ilmiah_Engkos-Achmad-Kuncoro_English-24-September-2022_FA-NEW-3.pdf (accessed on 26 June 2023).
34. Pentzien, J. *The Politics of Platform Cooperativism*; Institute for Digital Cooperative Economy: New York, NY, USA, 2020. Available online: https://ia801701.us.archive.org/10/items/jonas-pentziensingle-web_202012/Jonas%20Pentzien_single_web.pdf (accessed on 26 June 2023).

35. Platform Cooperativism Consortium, Platform Co-op Directory. "The Platform Co-Op Directory Is a Place Where You Can Search for and Connect with Co-Operatives and Other Members of the Co-Operative Community". 2021. Available online: <https://directory.platform.coop/#1/31.1/-84.8> (accessed on 26 June 2023).
36. Scholz, T. Platform cooperativism. In *Challenging the Corporate Sharing Economy*; Rosa Luxemburg Foundation: New York, NY, USA, 2016.
37. Scholz, T. A Portfolio of Platform Cooperativism, in Progress. *Ökol. Wirtsch. Fachz.* **2018**, *33*, 16–19. Available online: <https://www.oekologisches-wirtschaften.de/index.php/oew/article/view/1646> (accessed on 26 June 2023).
38. Calzada, I. Platform and data co-operatives amidst European pandemic citizenship. *Sustainability* **2020**, *12*, 8309. [CrossRef]
39. Chan, A.; Bradley, H.; Rajkumar, N. Reclaiming the Digital Commons: A Public Data Trust for Training Data. *arXiv* **2023**, arXiv:2303.09001.
40. Dulong de Rosnay, M.; Stalder, F. Digital commons. *Internet Policy Rev.* **2020**, *9*, 1–22. [CrossRef]
41. Huang, S.; Siddarth, D. Generative AI and the Digital Commons. *arXiv* **2023**, arXiv:2303.11074.
42. Ostrom, E. *Governing the Commons: The Evolution of Institutions for Collective Action*; Cambridge University Press: Cambridge, UK, 1990.
43. Sharma, C. Tragedy of the Digital Commons. *N. Carol. Law Rev. Forthcom.* **2022**, *101*, 4. [CrossRef]
44. Siddarth, D.E.G.W. The Case for the Digital Commons. 2021. World Economic Forum. Available online: <https://www.weforum.org/agenda/2021/06/the-case-for-the-digital-commons/> (accessed on 26 June 2023).
45. Walljasper, J. Elinor Ostrom's 8 Principles for Managing a Commons. on the Commons 2011. Available online: <https://www.onthecommons.org/magazine/elinor-ostroms-8-principles-managing-commmons/index.html> (accessed on 26 June 2023).
46. Bechtold, S. *Vom Urheber-Zum Informationsrecht: Implikationen des Digital Rights Management*; Beck München: Munich, Germany, 2002.
47. Calzada, I. The right to have digital rights in smart cities. *Sustainability* **2021**, *13*, 11438. [CrossRef]
48. Calzada, I.; Almirall, E. Data ecosystems for protecting European citizens' digital rights. *Transform. Gov. People Process Policy* **2020**, *14*, 133–147. [CrossRef]
49. Calzada, I.; Pérez-Batlle, M.; Batlle-Montserrat, J. People-centered smart cities: An exploratory action research on the cities' coalition for digital rights. *J. Urban Aff.* **2021**, 1–26. [CrossRef]
50. Monti, A. *The Digital Rights Delusion: Humans, Machines and the Technology of Information*; Taylor & Francis: London, UK, 2023.
51. Pangrazio, L.; Sefton-Green, J. Digital rights, digital citizenship and digital literacy: What's the difference? *NAER J. New Approaches Educ. Res.* **2021**, *10*, 15–27. [CrossRef]
52. Polona, C. Digital Rights and Principles. 2023. EPRS: European Parliamentary Research Service. Belgium. Available online: <https://policycommons.net/artifacts/3370762/digital-rights-and-principles/4169587/> (accessed on 26 June 2023).
53. Lim, Y. Tech Wars: Return of the Conglomerate-Throwback or Dawn of a New Series for Competition in the Digital Era. *J. Korean L.* **2020**, *19*, 47. [CrossRef]
54. Organisation for Economic Co-operation and Development (OECD). *Mapping Approaches to Data and Data Flows*; OECD: Paris, France, 2020.
55. Reimsbach-Kounatze, C. Enhancing access to and sharing of data: Striking the balance between openness and control over data. In *Data Access, Consumer Interests and Public Welfare*; Nomos: Baden-Baden, Germany, 2021; pp. 25–68. [CrossRef]
56. Organisation for Economic Co-operation and Development (OECD). *OECD Digital Economy Outlook 2020*; OECD: Paris, France, 2020.
57. Organisation for Economic Co-operation and Development (OECD). *Enhancing Access to and Sharing of Data*; OECD: Paris, France, 2019.
58. Organisation for Economic Co-operation and Development (OECD). Responding to societal challenges with data: Access, sharing, stewardship and control. In *OECD Digital Economy Papers*; OECD Publishing: Paris, France, 2022; Volume 342. [CrossRef]
59. Organisation for Economic Co-operation and Development (OECD). Value added by activity (indicator). *Natl. Acc. A Glance* **2023**. [CrossRef]
60. Jack, W.; Suri, T. *Mobile Money: The Economics of M-PESA*; National Bureau of Economic Research: Cambridge, MA, USA, 2011. [CrossRef]
61. Kingiri, A.N.; Fu, X. Understanding the diffusion and adoption of digital finance innovation in emerging economies: M-Pesa money mobile transfer service in Kenya. *Innov. Dev.* **2019**, *10*, 67–87. [CrossRef]
62. Mbiti, I.; Weil, D.N. Mobile banking: The impact of M-Pesa in Kenya. In *African Successes*; Volume III: Modernization and Development; University of Chicago Press: Chicago, IL, USA, 2015; pp. 247–293.
63. Omwansa, T. Omwansa, T. M-PESA: Progress and Prospects. *Innovations*. 2009, pp. 107–123. Available online: https://d1wqtxts1xzle7.cloudfront.net/87040674/innov-gsma-omwansa-libre.pdf?1654464218=&response-content-disposition=inline%3B+filename%3DM_PESA_Progress_and_prospects.pdf&Expires=1688009710&Signature=BezXWNQdUqfT4EoqqikY8R-vb6WqKtQ7xHYBznf7lke0c7c5LLVY46jH9pMNcZjsHvwl1tU~v1DGQ7CFOTTuUUhkYOPW-vOM1m-9sW4aAqw4tMqucMx~39v7i5Iu4wDPPgfThHrKmfkmue0r8qNZJaIRVoYXwwgKLM3TuBUtVu2iGloa68dlkq4x0uw1e5zQZKEhlcFV-liOHLXZLxKexNnyn-RBMkwUuBPZNu-eG7WwxS6cMQZ3Yz~XKxLSHOARvaQp7W4cQnnsM-0xmll5k0Ig-thOEA1oVq~EuIBxYufIC-IxtnJP8rGjStEF6CEDwicxW2Elb1HVg5Rtp-WHg__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA (accessed on 26 June 2023).
64. Van Hove, L.; Dubus, A. M-PESA and financial inclusion in Kenya: Of paying comes saving? *Sustainability* **2019**, *11*, 568. [CrossRef]

65. Dubé, L.; McRae, C.; Wu, Y.-H.; Ghosh, S.; Allen, S.; Ross, D.; Ray, S.; Joshi, P.K.; McDermott, J.; Jha, S. Impact of the eKutir ICT-enabled social enterprise and its distributed micro-entrepreneur strategy on fruit and vegetable consumption: A quasi-experimental study in rural and urban communities in Odisha, India. *Food Policy* **2020**, *90*, 101787. [CrossRef]
66. McRae, C.; Annosi, M.; Dubé, L. Tracing Digital Transformation Pathways from Subsistence Farming to Equitable and Sustainable Modern Society: Revisiting the eKutir ICT Platform-Enabled Ecosystem as an Interstitial Space. In Proceedings of the ICIS 2022 Proceedings, Copenhagen, Denmark, 9–14 December 2022.
67. Moore, S.; Annosi, M.C.; Gilissen, T.; Mandelbaum, J.; Dube, L. The social impact of ICT-enabled interventions among rural Indian farmers as seen through eKutir’s VeggieLite intervention. In *How Is Digitalization Affecting Agri-Food?* Routledge: London, UK, 2020; pp. 93–98.
68. Sengupta, T.; Narayanamurthy, G.; Hota, P.K.; Sarker, T.; Dey, S. Conditional acceptance of digitized business model innovation at the BoP: A stakeholder analysis of eKutir in India. *Technol. Forecast. Soc. Chang.* **2021**, *170*, 120857. [CrossRef]
69. Senyo, W. Farmerline: A for-profit agtech company with a social Mission. In *Digital Technologies for Agricultural and Rural Development in the Global South*; CAB International: Wallingford, UK, 2018; pp. 123–126.
70. Delinthe, L.; Zwart, S.J. Digital Services for Agriculture. In Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA). 2022. Available online: <https://hdl.handle.net/10568/126217> (accessed on 26 June 2023).
71. Agnihotri, A.; Bhattacharya, S. SOLshare: Revolutionary Peer-to-Peer Solar Energy Trading in a Developing Market. In *SAGE Business Cases*; SAGE Business Cases Originals; SAGE Publications: Thousand Oaks, CA, USA, 2022.
72. Flanagan, K. For the common good. *Renew Technol. A Sustain. Future* **2020**, 76–79. Available online: <https://www.jstor.org/stable/48587590> (accessed on 26 June 2023).
73. Groh, S.; Zürpel, C.; Waris, E.; Werth, A. Analytics on pricing signals in peer-to-peer solar microgrids in Bangladesh. *Econ. Energy Environ. Policy* **2022**, *11*, 2022. [CrossRef]
74. Sirota, F.; Fratini, G. A Case about Nubank: The Story of an Innovative Fintech in Brazil. Master’s Thesis, Politecnico di Milano, Milan, Italy, 2019.
75. da Rosa, S.C.; Schreiber, D.; Schmidt, S.; Junior, N.K. MANAGEMENT PRACTICES THAT COMBINE VALUE COCREATION AND USER EXPERIENCE An Analysis of the Nubank Startup in the Brazilian Market. *Rev. De Gestão Finanças E Contab.* **2017**, *7*, 22–43.
76. Kushendriawan, M.A.; Santoso, H.B.; Putra, P.O.H.; Schrepp, M. Evaluating User Experience of a Mobile Health Application ‘Halodoc’ using User Experience Questionnaire and Usability Testing. *J. Sist. Inf.* **2021**, *17*, 58–71.
77. Mangkunegara, C.N.; Azzahro, F.; Handayani, P.W. Analysis of factors affecting user’s intention in using mobile health application: A case study of Halodoc. In Proceedings of the 2018 International Conference on Advanced Computer Science and Information Systems (ICACSIS), Yogyakarta, Indonesia, 27–28 October 2018; pp. 87–92.
78. Tarmidi, D. The influence of product innovation and price on customer satisfaction in halodoc health application services during COVID-19. *Turk. J. Comput. Math. Educ.* **2021**, *12*, 1716–1722.
79. Bidwell, N.; De Tena, S.L. Alternative Perspectives on Relationality, People and Technology during a Pandemic: Zenzeleni Networks in South Africa. In *COVID-19 From the Margins*; Institute of Network Cultures: Amsterdam, The Netherlands, 2021.
80. Hussen, T.S.; Bidwell, N.J.; Rey-Moreno, C.; Tucker, W.D. Gender and participation: Critical reflection on Zenzeleni networks in Mankosi, South Africa. In Proceedings of the First African Conference on Human Computer Interaction, Nairobi, Kenya, 21–25 November 2016; pp. 12–23.
81. Academy of Science of South Africa (ASSAf) and Department of Science and Innovation (DSI). Building Profitable and Sustainable Community Owned Connectivity Networks. 2020. Available online: <https://doi.org/10.17159/assaf.2019/0065> (accessed on 26 June 2023).
82. Pather, S. Op-ed1: Towards an enabling environment for a digital ecosystem: A foundation for entrepreneurial activity. *J. Entrep. Innov.* **2021**. [CrossRef]
83. Rey-Moreno, C.; Pather, S. Advancing rural connectivity in south africa through policy and regulation: A case for community networks. In Proceedings of the 2020 IST-Africa Conference (IST-Africa), Virtual, 18–22 May 2020; pp. 1–10.
84. Bakıcı, T.; Almirall, E.; Wareham, J. A smart city initiative: The case of Barcelona. *J. Knowl. Econ.* **2013**, *4*, 135–148. [CrossRef]
85. Bibri, S.E.; Krogstie, J. The emerging data-driven Smart City and its innovative applied solutions for sustainability: The cases of London and Barcelona. *Energy Inform.* **2020**, *3*, 1–42. [CrossRef]
86. Capdevila, I.; Zarlenga, M.I. Smart city or smart citizens? *The Barcelona case. J. Strategy Manag.* **2015**, *8*, 266–282. [CrossRef]
87. Gascó-Hernandez, M. Building a smart city: Lessons from Barcelona. *Commun. ACM* **2018**, *61*, 50–57. [CrossRef]
88. Smith, A.; Martín, P.P. Going beyond the smart city? Implementing technopolitical platforms for urban democracy in Madrid and Barcelona. In *Sustainable Smart City Transitions*; Routledge: London, UK, 2022; pp. 280–299.
89. Calzada, I.; Cobo, C. Unplugging: Deconstructing the smart city. *J. Urban Technol.* **2015**, *22*, 23–43. [CrossRef]
90. Calzada, I. (Smart) citizens from data providers to decision-makers? *The case study of Barcelona. Sustainability* **2018**, *10*, 3252.
91. Driver’s Seat. Driver’s Seat—Know More. Earn More. Use Your Data to Maximize Rideshare And Delivery Earnings and Take Control of Your Work. Available online: <https://driversseat.co/> (accessed on 3 April 2023).
92. Fukuyama, F.; Richman, B.; Goel, A. How to save democracy from technology: Ending big tech’s information monopoly. *Foreign Aff.* **2021**, *100*, 98.
93. Lanier, J.; Weyl, E.G. A blueprint for a better digital society. *Harv. Bus. Rev.* **2018**, *26*, 2–18.

94. Calzada, I. 16. knowledge building and organizational behavior: The Mondragón case from a social innovation perspective. In *The International Handbook on Social Innovation: Collective Action, Social Learning and Transdisciplinary Research*; Edward Elgar Publishing: Northampton, MA, USA, 2013; p. 219.
95. Massimo, C.; Marina, M.; Jiri, H.; Igor, C.; Steven, L.; Marisa, P.; Jaap, B. *Digitranscope: The Governance of Digitally-Transformed Society*; Publications Office of the European Union: Luxembourg, 2021.
96. Bignami, F.; Calzada, I.; Hanakata, N.; Tomasello, F. Data-driven citizenship regimes in contemporary urban scenarios: An introduction. *Citizsh. Stud.* **2023**, *27*, 145–159. [[CrossRef](#)]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.