

South Africa's Digital Transformation: Understanding the Limits of Traditional Policies and the Potential of Alternative Approaches

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Abstract

This paper analyses the readiness of South African information and communication technology (ICT) infrastructure for the implementation of Fourth Industrial Revolution technologies, which has been highly prioritised by policymakers in recent years. The discussion is centred around examples of smart cities and connectivity. Opportunities have been identified in the form of complimentary bottom-up initiatives. The analysis of the current state of internet access in South Africa, underlying infrastructure and policy developments are essential for understanding the bottlenecks for proceeding with the digital transformation agenda.

Keywords: telecommunications infrastructure, internet access, digital divide, digital transformation, smart cities.

1. Introduction

Even with the huge progress in advancing digital inclusion, the digital divide still exists in South Africa. According to recent demand-side data, the share of South Africans using the internet is 76% in 2022¹. While broadband infrastructure is largely available across the country, the internet is still not easily accessible to many households. The socially and economically marginalised are often not in position to benefit from the opportunities the internet provides, and to enhance their social and economic well-being, meaning that the digital divide even deepens as digital infrastructures evolve. Even in terms of policy interventions, there is evidence that certain actions have only improved access for those already using the internet, but did not address the barriers to adoption².

At the same time, the country is looking at boosting the Fourth Industrial Revolution (4IR) and implementation of emerging technologies. The Presidential Commission on the Fourth Industrial

¹ Andrew Partridge, 'After Access 2022: Internet Usage Trends in South Africa – Research ICT Africa' (2022) <<https://researchictafrica.net/publication/after-access-2022-internet-usage-trends-in-south-africa/>> accessed 20 March 2023.

² Ibid.

Revolution (PC4IR) was appointed in April 2019 to develop a 4IR strategy.³ 4IR became clearly the priority for the country and since then, the development of digital policies, independent of the sector, has been increasingly shaped around the 4IR context.

The telecommunications industry is undoubtedly playing a critical role in enabling digital transformation globally, since broadband infrastructure is one of the key enablers of the digital revolution. In South Africa, with the prioritisation of 4IR, some major policy developments around broadband expansion, such as spectrum auctions, were temporarily put on hold.

This paper explores whether South Africa has the underlying infrastructure to embark on its digital transformation journey. The first part of the paper will delve into the regulatory aspects and policy developments related to telecommunications infrastructure and internet access, as these provide the backbone for digital transformation. The second part analyses the digital transformation agenda focusing on the challenges and opportunities presented in the example of the smart cities narrative and 5G deployments. The foundation of this analysis is provided by the work carried out within the CyberBRICS project, namely a mapping study of digital policies in South Africa in two key areas: internet access and digital transformation, as well as monitoring the progress of their implementation⁴. By highlighting unresolved gaps in existing policy developments, the paper seeks to draw a parallel between these two key areas, and propose alternative ways to look at digital transformation.

The first part of the mapping study of digital infrastructures in the BRICS countries, and particularly in South Africa in the context of this paper, was focused on the following aspects of Internet access: the state of Internet access in the country (including country's ranking in the global ICT indices), international commitments, institutions, regulations, spectrum access, and financial resources that each of the BRICS countries is dedicating to connectivity. These complex architectures form the basis of digital public infrastructures of the BRICS countries.

The second part of the mapping study focused on digitisation of public services as an essential complement of the national digital public infrastructures. The analysis was structured around exploring the following aspects: national strategies and priorities, regulations, institutions, and critical sectors, such as digital identity, smart cities and digitisation of local administrations, digital money and payments, and other relevant examples.

³ Presidency of the Republic of South Africa, 'President Cyril Ramaphosa Appoints Commission on Fourth Industrial Revolution' (*South African Government*, 9 April 2019) <<https://www.gov.za/speeches/president-cyril-ramaphosa-appoints-commission-fourth-industrial-revolution-9-apr-2019-0000>> accessed 20 March 2023

⁴ Given the complexity of digital policies in general – and that of BRICS countries in particular – the mapping study aims at laying the foundation on which more research on digital policies in the BRICS can and will be developed. There are three areas of focus: 1) cybersecurity and personal data regulations, 2) Internet access policies, and 3) digital transformation strategies. This paper is based on the foundations provided by the mapping studies in themes 2) and 3).

Both mapping studies started with systematic mapping planning: in this step, the five researchers in the CyberBRICS project established a plan to be used as a basis to conduct the systematic mapping study. This included the joint definition of research questions. Each researcher performed an extensive literature review, and answered the mapping questions referring to official documents, datasets, literature, articles, books, and interviews with experts. After content analysis and documental analysis, the mapping studies were cross-reviewed and main insights were presented in internal workshops. The mapping study data were further analysed and used as the basis for this paper.

While the paper uses the two mapping studies as the primary documentary source, an additional analysis of scholarly literature available in academic journals was performed. This supplementary analysis encompassed topics such as smart cities, industrial revolution, open data, and digital transformation within the context of South Africa.

The paper is organised as follows. Section 2 provides an overview of South Africa's ICT sector, highlighting institutional challenges, demand side challenges and the need for a regulatory framework enabling alternative strategies. Section 3 focuses on South Africa's digital transformation by looking at the Fourth Industrial Revolution Agenda broadly, and smart cities in particular. Section 4 moves on to discuss the manner in which complementary bottom-up initiatives could reshape the country's digital ecosystem and enable an inclusive digital transformation. Section 5 concludes the paper.

2. South Africa's ICT sector

Looking at the global ICT indices⁵, South Africa generally ranks in the middle globally, but in the African context is often significantly ahead of other African states. Some of these indices reveal that South Africa has a relatively strong ICT governance framework and generally favourable policies, yet these remain largely unimplemented. At the same time, the country performs poorly on demand-side indices such as internet uptake, skills and digital awareness.

For example, the World Economic Forum's Network Readiness Index (NRI) focuses on international competitiveness. In the 2021 evaluation, South Africa was ranked 70th out of 130 countries, with the overall score 48.88.⁶ The score on 'governance' - which includes regulation - was relatively high - 61.25, however due to the low uptake (the score on 'people' and 'impact' was 46.42 and 42.25, respectively) the overall rank dropped significantly. The 'technology' score was

⁵ Global ICT indices include International Telecommunication Union (ITU) ICT Development Index (IDI), World Economic Forum (WEF) Network Readiness Index (NRI), Alliance for Affordable Internet (A4AI) Affordability Drivers Index, GSMA's Mobile Connectivity Index (MCI).

⁶ Portulans Institute, 'South Africa – Network Readiness Index' (*Network Readiness Index*, 2022) <<https://networkreadinessindex.org/country/south-africa/>> accessed 20 March 2023;

45.59. GSMA's Mobile Connectivity Index looks at mobile Internet uptake.⁷ South Africa scored 64.5 in the 2021 evaluation of the index, scoring 65, 53.9, 74.0, 67.0 in infrastructure, affordability, consumer readiness and content and services, respectively.⁸ The infrastructure index calculation is based on network coverage (90.8), network performance (60.4), other enabling infrastructure (67.4) and spectrum (30.7). Obviously, the fact that South Africa has failed to release high demand spectrum contributes to the low overall infrastructure index. Favourable taxation (85.4) does not compensate for extremely high levels of income inequality (0.0) and high mobile tariffs, hence the affordability index is the weakest of all four components. The affordability index is additionally composed of handset price (47.9) and mobile tariffs (74.7). The consumer readiness index is calculated based on mobile ownership (75.5), basic skills (61.9) and gender equality (85.4). Content and services index calculation is based on local relevance (64.6), availability (63.6) and online security (78.5).

The sector policy overview seeks to explain the lack of progress due to inconsistent priorities. The National Planning Commission (NPC's) National Development Plan's (NDP)⁹ vision for the ICT sector is that 'by 2030 ICT is expected to underpin the development of an inclusive dynamic information society and knowledge economy' through the development of a 'comprehensive and integrated e-strategy that reflects the cross-cutting nature of ICTs'.

Since the National Development Plan from 2012 prioritised broadband expansion, the Government adopted a national broadband policy in a document entitled 'SA Connect: Creating Opportunities, Ensuring Inclusion'.¹⁰ The strategy is designed to provide universal accessibility across the country at a cost and quality that meets the needs of citizens, businesses and the public sector, as well as access to the creation and consumption of a wide range of converged applications and services required for effective economic and social participation. The SA Connect document contains several targets expressed as 'broadband access in Mbps user experience'. The targets also differentiate between targets for the population as a whole and targets for schools, health facilities and government facilities. There has not been significant progress on its implementation since then, which was even acknowledged in the draft National Infrastructure Plan 2050 (NIP 2050), first published in 2021 for public consultation. NIP 2050 but also clearly states that '2030 goals must stay', giving priority to competition of digital migration and spectrum auction. But will the broadband speed targets set in 2021 still be adequate in 2030? As internet usage becomes more bandwidth-intensive, we need to ensure that definitions for "broadband" follow these trends.

⁷ GSMA, 'GSMA Mobile Connectivity Index 2022' (2021) <<https://www.mobileconnectivityindex.com/>> accessed 20 March 2023

⁸ Ibid.

⁹ National Planning Commission, 'National Development Plan 2030' (2012) <<https://www.gov.za/issues/national-development-plan-2030>> accessed 20 March 2023

¹⁰ Department of Communications, 'South Africa Connect: Creating Opportunities, Ensuring Inclusion' (2013) <https://www.gov.za/sites/default/files/gcis_document/201409/37119gon953.pdf> accessed 20 March 2023.

Besides SA Connect, the other main policy initiative was the National Integrated ICT Policy White Paper¹¹, which was finalised in 2016 and accepted by Cabinet and Parliament. It focuses on improving access to infrastructure, competition (particularly in the services market), and inclusion of all citizens in the digital economy. The White Paper covers everything from revised institutional arrangements for the sector to universal access and service and cybersecurity. As yet, however, not much of the White Paper has been implemented. The opportunity costs of not addressing policy issues related to enhanced infrastructure provisioning have been high.¹² The delay in policy implementation is partially due to internal rearrangements within the sector governance.

2.1. Institutional challenges

The ICT sector struggled to come to terms with the shifting departmental structures in the past decade, the most affecting event being the separation of the Ministry of Communications into two ministries in 2014. Eventually in 2019 the two departments merged again to operate as one central ministry leading the country's ICT agenda, under the name of Department of Communications and Digital Technologies (DCDT).

One of the most critical access policy issues that keeps being postponed is the auction of high demand spectrum, which is directly contributing to affordability of mobile broadband - since efficient spectrum utilisation directly affects retail pricing. High prices of mobile data are often due to inefficient policy and regulatory related issues. A report by the GSMA from 2019 pointed out emerging evidence of a link between high spectrum prices and high consumer prices in developing countries.¹³ Vodacom, one of South Africa's largest mobile operators, stated in the same year that 'unquestionably the most significant obstacle to reducing input costs and, by extension, data prices is the fact that no new spectrum has been allocated to operators for the past 14 years'.¹⁴ Since 'internet access' in South Africa is almost synonymous with wireless access provision, it is no surprise that spectrum has such a central role in national policy.¹⁵

The developments around spectrum regulation reflect institutional instability in the sector. Since 2010, the Independent Communications Authority of South Africa (ICASA) has attempted to

¹¹ Department of Telecommunications and Postal Services, 'National Integrated ICT Policy White Paper' <https://www.gov.za/sites/default/files/gcis_document/201610/40325gon1212.pdf> accessed 20 March 2023

¹² Alison Gillwald, Onkokame Mthobi and Broc Rademan, 'After Access: The State of ICT in South Africa' (*Research ICT Africa*, 30 July 2018) <<https://researchictafrica.net/publication/state-of-ict-in-south-africa/>> accessed 20 March 2023

¹³ Pau Castells and Kalvin Bahia, 'The Impact of Spectrum Prices on Consumers' (GSMA 2019) Executive summary <<https://www.gsma.com/spectrum/wp-content/uploads/2019/09/Impact-of-spectrum-prices-on-consumers-summary.pdf>>.

¹⁴ Duncan McLeod, 'If You Want Data Prices to Fall, Give Us Spectrum: Vodacom' (*TechCentral*, 29 April 2019) <<https://techcentral.co.za/if-you-want-data-prices-to-fall-give-us-spectrum-vodacom/178866/>> accessed 20 March 2023

¹⁵ Charley Lewis, 'Lessons From Spectrum Auctions: A Benchmark Approach' (2018) <<https://papers.ssrn.com/abstract=3185752>> accessed 20 March 2023.

convene a spectrum auction four times, and each time the auction was withdrawn. There are multiple causes of these serial auction failures, but one of them is clearly the lack of coherent vision from the Ministry, which has seen a high turnover of different ministers - thirteen ministers in 13 years - which has led to disputes between the regulator and the Ministry. Along with the repeated change in leadership which caused disruption and discontinuity, ongoing clashes between ICASA's mandate and government (Ministerial) preferences on how and to whom spectrum should be allocated, together with constant legal battles between ICASA and the mobile operators, have been impeding progress in South Africa's telecommunications industry for over a decade.

The last auction process started in October 2019, with the planned timing of the spectrum hearings on the release of high demand spectrum for April 2020. This was disrupted by the COVID-19 crisis which has highlighted existing inequalities in the country, including the digital divide. After the South African government proclaimed a state of disaster at the end of March 2020, ICASA made additional radio spectrum available to ensure that the network can keep up with additional demand during the lockdown. The temporary assignment has been criticised as having favoured incumbents and not sufficiently encouraging innovation and digital inclusion.¹⁶ Ironically, some operators used this emergency spectrum to roll out 5G services¹⁷, evidently in more affluent neighbourhoods of major metropolitan areas - and therefore not necessarily helping solve the digital divide and bring more people online. However, the pace at which the temporary spectrum assignment was completed was bringing out hopes for a prompt realisation of the long overdue permanent auction. Nevertheless, with the constant prolongation of the state of disaster and national lockdown, ICASA kept extending¹⁸ the duration of the temporary spectrum assignment, and pushing back the auction deadline until early 2021, only to be met by two of the four national operators announcing a court case to stop the auction.¹⁹ Eventually the auction process resumed in early 2022, and successfully completed with the lawsuit settled.

Along with the repeated change in leadership which caused disruption and discontinuity, ongoing clashes between ICASA's mandate and government (Ministerial) preferences on how and to whom spectrum should be allocated, together with constant legal battles between ICASA and the

¹⁶ Alison Gillwald, Senka Hadzic and Pablo Aguera, 'Temporary COVID-19 Spectrum – a Missed Opportunity for Some Regulatory Innovation?' (*Research ICT Africa*, 29 April 2020) <<https://researchictafrica.net/publication/temporary-covid-19-spectrum-a-missed-opportunity-for-some-regulatory-innovation/>> accessed 20 March 2023

¹⁷ Duncan McLeod, 'Vodacom Unveils First 5G Deals - 800GB for R1 499' (*TechCentral*, 4 May 2020) <<https://techcentral.co.za/vodacom-unveils-first-5g-deals-800gb-for-r1-499/175894/>> accessed 20 March 2023

¹⁸ 'Three Months Grace Period to Allow Licensees to Wind down Their Use of Temporary Radio Frequency Spectrum' (*Independent Communications Authority of South Africa*, 30 August 2021) <<https://www.icasa.org.za/news/2021/three-months-grace-period-to-allow-licensees-to-wind-down-their-use-of-temporary-radio-frequency-spectrum>> accessed 20 March 2023

¹⁹ Bronwyn E Howell and Petrus H Potgieter, 'Spectrum Shortage and Merger by Any Other Name in South Africa' (2021) <<http://hdl.handle.net/10419/238027>>

operators, were impeding progress in South Africa’s telecommunications industry for over a decade.

2.2. Demand-side challenges and need for alternative access strategies

South Africa’s two major mobile operators, Vodacom and MTN, provide mobile broadband coverage to over 95% of the South African population. However it is more than 5% of the population that remains unconnected, but approximately 30% or six times more, according to both Research ICT Africa’s demand-side data (Partridge 2022) and to an estimate by the International Telecommunications Union (ITU) from 2020.^{20,21} This is nothing unusual: latest research by GSMA shows that on a global scale mobile coverage has reached 95%. At the same time, 3.2 billion people, or 40% of the global population, who live in areas covered by mobile broadband, still face challenges in actually getting online.²²

The challenges to connecting South Africa’s remaining 30% of the population are for the most part demand-side challenges, a major barrier being the lack of awareness and knowledge of how to use the Internet (Partridge 2022). For those who are already online, the barrier to use the Internet more is the high cost of prepaid data packages. Further barriers include lack of relevant content and services.²³

Both supply-side and demand-side data are essential for getting an accurate picture of broadband availability, adoption, and usage. They also serve as the basis for good policy-making. Unfortunately, the availability of such data tends to be most incomplete in underserved places – and those would benefit most from new interventions. An essential step in solving the digital divide is increasing the level of transparency in the ICT sector through open data strategies to better understand the availability and distribution of telecommunication infrastructure and resources, including spectrum, but also the often ignored demand side value of resource allocation. Connect2Recover, a recent report by the ITU on the importance of broadband for post-pandemic recovery, highlights the need for open telecom data collection methodologies, in order to identify connectivity gaps as accurately as possible.

The fact that there is 95% coverage and yet a significant part of the population remains unconnected suggests evident flaws with the current approach, which fails to bring affordable

²⁰ The World Bank, ‘Individuals Using the Internet (% of Population) - South Africa | Data’ (*World Bank Open Data*, 2021) <<https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations=ZA>> accessed 20 March 2023

²¹ Similar to the results from RIA’s household survey data.

²² GSMA, ‘Mobile Internet’s “Usage Gap” Is Almost Eight Times the Size of the “Coverage Gap”, GSMA Research Reveals’ (*GSMA*, 19 October 2022) <<https://www.gsma.com/newsroom/press-release/mobile-internets-usage-gap-is-almost-eight-times-the-size-of-the-coverage-gap-gsma-research-reveals/>> accessed 20 March 2023

²³ Alison Gillwald, Onkokame Mthobi and Broc Rademan, ‘After Access: The State of ICT in South Africa’ (*Research ICT Africa*, 30 July 2018) <<https://researchictafrica.net/publication/state-of-ict-in-south-africa/>> accessed 20 March 2023

connectivity to South Africans.²⁴ Literature suggests that the almost universal mobile coverage is the result of market forces, and not necessarily a policy outcome.²⁵ The costs to roll out infrastructure to provide coverage to the remaining 5% of the population are disproportional. Existing operators are not eager to expand infrastructure into remote areas with low population density, where they do not see a business case and return on investment. Current regulations do not accommodate complementary access solutions such as community networks, which are bottom up connectivity solutions deployed and owned by the communities themselves.²⁶

The National Infrastructure Plan 2050 envisions provision of affordable and accessible broadband in low income communities, albeit without much detail on how it will be achieved. Lessons from failed SA Connect implementation and corrupt universal service and access initiatives should be reviewed to address this problem using new models. Examples of alternative network deployment mechanisms are community networks, micro Internet Service Providers (ISPs), and secondary use of spectrum in rural areas.

Community networks are a complementary connectivity solution in regions where traditional ISPs are either not interested to operate, or find it difficult to provide services or to establish a business model. These small scale initiatives are owned and primarily managed by the communities themselves. The idea is to provide affordable access while building the community and strengthening the local economy - ideally the income generated is being used for and by the communities. In May 2018 South Africa became the first country in the continent to support community networks as a viable communication system provider.²⁷ The minister of communications at that time highlighted in a speech that “the community ownership model advances components of the ICT Development Index and development goals highlighted in the [National Integrated ICT Policy] White Paper. The model further addresses the key barriers for universal access which the department’s Internet for All project seeks to address.”

From a licensing perspective, the process of making a community network legal in South Africa has been well documented and elaborated by the founders of Zenzeleni community network.²⁸ By

²⁴ According to the UN Broadband Commission, affordability of data prices is defined as the price of 1 GB of data having to be less than 2% of disposable income.

²⁵ Charley Lewis, ‘Universal Access and Service in South Africa: Policy Success, Policy Failure and Policy Impact’ (2017) <<https://papers.ssrn.com/abstract=2980803>> accessed 20 March 2023

²⁶ Carlos Rey-Moreno and Shaun Pather, ‘Advancing Rural Connectivity in South Africa through Policy and Regulation: A Case for Community Networks’, *2020 IST-Africa Conference (IST-Africa)* (2020) <<https://ieeexplore.ieee.org/abstract/document/9144051/authors#authors>> accessed 20 March 2023

²⁷ ‘South Africa Becomes the First Country in the Region to Support Community Networks’ (*Association for Progressive Communications*, 23 May 2018) <<https://www.apc.org/en/news/south-africa-becomes-first-country-region-support-community-networks>> accessed 20 March 2023

²⁸ C Rey-Moreno and others, ‘Making a Community Network Legal within the South African Regulatory Framework’, *Proceedings of the Seventh International Conference on Information and Communication Technologies and Development* (ACM 2015) <<https://dl.acm.org/doi/10.1145/2737856.2737867>> accessed 20 March 2023

registering the network as a cooperative, Zenzeleni was able to obtain network service exemption for being a private network. Service provision license was exempt due to the non-profit nature of the cooperative: non-profit operators are recognized and mentioned in the Electronic Communications Act²⁹ as eligible for license exemption. If exempted from holding a license, one is exempted to pay registration, renewal and annual fees. The cost of registering a cooperative is almost negligible, less than 30 USD.

This does not mean that there are no challenges when it comes to community networks adoption and expansion. Limited resources of cooperatives or small local ISPs make it difficult to expand access to every user, together with the limited range of WiFi, which is the ultimate technology of choice for community networks due to its use of unlicensed spectrum. A policy brief published by the Internet Society elaborates on the critical importance of access to spectrum in order to provide unconnected communities in developing regions with access to ICTs.³⁰

Currently, commercial national operators and non-profit community networks in South Africa are subject to the same spectrum fee regime. Novel ways of licensing would enable SMMEs, small ISPs and non-profit community networks to enter into the market. In September 2022, the DCTD published a new draft spectrum policy for public comment. The Next Generation Radio Frequency Spectrum Policy for Economic Development (Spectrum Policy) supports the deployment and licensing of alternative infrastructure networks, and aims to adopt spectrum management approaches that promote participation of local small and medium enterprises (SMEs) and emergence of new entrants into the ICT sector.³¹ Although still only a draft, it is a very progressive and inclusive spectrum policy, aiming to address gaps and limitations, including the failure to lower the cost of communications.

Solving the connectivity challenge is not all about large telecom operators deploying infrastructure using their own business models. In order to achieve the broadband plan targets, we have to explore complementary options that address the real needs of those unconnected, and this is only possible by using human-centred design and bottom-up initiatives. Eventually, empowerment of historically disadvantaged groups can be achieved via community networks such as Zenzeleni in the Eastern Cape. This does not only include affordable access to the internet, but also access to e-Government and digital services in the public sector.

²⁹ Electronic Communications Act, 2005 [36]

³⁰ Internet Society, 'Policy Brief: Spectrum Approaches for Community Networks' (Internet Society (ISOC) 2017) <https://www.internetsociety.org/wp-content/uploads/2017/10/Spectrum-Approaches-for-Community-Networks_20171010.pdf>

³¹ Department of Communications and Digital Technologies, 'Next Generation Radio Frequency Spectrum Draft Policy' (2022) <https://www.gov.za/sites/default/files/gcis_document/202209/46873gen1271.pdf>.

Good quality infrastructure is without doubt the backbone for digital transformation. However if this infrastructure does not provide affordable access to everyone, the perks of digitalization may end up benefiting only the few.

3. South Africa's digital transformation

In 2017, the (former) Department of Telecommunications and Postal Services - DTPS (now Department of Communications and Digital Technologies) developed a National e-government strategy³² aimed at guiding the digital transformation of public service in South Africa into an inclusive digital society. Implementing a digital-first approach to government services has the potential to enhance accessibility and efficiency, but issues such as unsupportive strategies, inadequate infrastructure, and ineffective development practices can hinder progress. These obstacles can transform well-intentioned initiatives into costly tools that exclude marginalized populations, particularly those who rely heavily on state services. Additionally, poor platform design and limited Internet access further impede citizen engagement. Failure to tackle these challenges could reinforce existing inequalities and introduce new disparities in civic involvement.

The digital transformation agenda is not free of institutional problems. The State IT Agency (SITA) - responsible for the acquisition, installation, implementation, and maintenance of IT in the public sector - has suffered governance challenges since its establishment. The Agency has had a high turnover of CEOs, while only a few completed their terms.³³ This naturally leads to reputational damage and loss of trust. Leadership and governance challenges represent possibly the biggest constraints in digital transformation to smart governance, even with notable achievements such as the development of supportive policies.

3.1. Fourth Industrial Revolution - hype or reality?

In April 2019 the Presidential Commission on the Fourth Industrial Revolution (PC4IR) was appointed to develop a 4IR strategy for South Africa. The PC4IR report³⁴ can be seen as a more broad digital transformation strategy as it addresses issues beyond government services. The Commission, chaired by the President, is tasked with identifying relevant policies, strategies and action plans to help South Africa become a major player in 4IR. The Commission comprises thirty members from a variety of stakeholder groups (including government, business, labour, civil

³² Department of Telecommunications and Postal Services, 'National E-Government Strategy and Roadmap' (Department of Telecommunications and Postal Services 2017) <<https://www.ellipsis.co.za/wp-content/uploads/2017/04/gg41241-National-e-Government-Strategy-and-Roadmap.pdf>> accessed 20 March 2023

³³ More Ickson Manda and Judy Backhouse, 'Inclusive Digital Transformation in South Africa: An Institutional Perspective', *Proceedings of the 11th International Conference on Theory and Practice of Electronic Governance* (Association for Computing Machinery 2018) <<https://dl.acm.org/doi/10.1145/3209415.3209486>> accessed 20 March 2023

³⁴ Presidential Commission on the 4th Industrial Revolution (PC4IR), 'Report of the Presidential Commission on the 4th Industrial Revolution' (2020) <https://www.gov.za/sites/default/files/gcis_document/202010/43834gen591.pdf> accessed 20 March 2023

society, academia) and needs to act accordingly to guarantee alignment to the National Development Plan. The Department of Communications and Digital Technologies is the lead department within the government tasked with driving 4IR readiness for the country.

Multiple entities are involved in country's innovation-related policies and programmes: Department of Science and Innovation (DSI) (formerly the Department for Science and Technology (DST)), the Department for Trade, Industry and Competition (DTIC), the Department of Planning, Monitoring and Evaluation; and the Technology Innovation Agency (TIA). In addition, a number of other ministries are involved in broader elements of related policy development and implementation. These government entities cooperate with various actors, such as research councils, universities, and industry associations in developing national policies and programmes.

PC4IR was appointed in April 2019, and 4IR became clearly the priority for the country's newly elected government in May 2019: since then every new digital policy, independent of the sector, was shaped around the 4IR context. As all efforts were suddenly concentrated to develop a 4IR policy, several ongoing developments were abandoned to some degree, including the critical allocation of high demand spectrum which at that moment was crucial for broadband expansion and affordable access. The excessive attention given to the topic has been widely criticised - mostly for its technological lens leading to digital paradox and amplified inequalities, the fact that digital policies are being developed in siloes, instead of an integrated approach across sectors³⁵, and for eventually being a distraction from unfinished policy processes and institutional failures.³⁶ Further critique includes focus on 4IR and technologies which do not acknowledge the inequalities in schools, differences in educational performance, and lack of facilities and basic resources in South African schools. While the science, technology and innovation landscape may be characterised by strong institutions, the lack of interaction among the key ICT actors poses a challenge in South Africa's path to a leadership position in 4IR. (Moll 2021) even argues that there is no such phenomenon as a 4IR.³⁷

The African Union has developed a Digital Transformation strategy for Africa³⁸ which seeks to harness innovation and digital technologies, seeing it as a leapfrogging opportunity. However, a study undertaken to determine the primary obstacles hindering the adoption of Industry 4.0 in Africa, on the example of Tanzania, indicated that while Industry 4.0 was gaining momentum, the

³⁵ Alison Gillwald, '4IR in SA Is Too Important to Remain in the Domain of the Elite' (*Research ICT Africa*, 8 July 2019) <<https://researchictafrica.net/2019/07/08/4ir-in-sa-is-too-important-to-remain-the-domain-of-the-elite/>> accessed 20 March 2023

³⁶ Alison Gillwald, 'SA Must Be Wary of Big Promises Made about 4IR - TechCentral' (*TechCentral*, 4 October 2019) <<https://techcentral.co.za/sa-must-be-wary-of-big-promises-made-about-4ir/180191/>> accessed 20 March 2023

³⁷ Ian Moll, 'The Myth of the Fourth Industrial Revolution' (2021) 68 *Theoria* 1 <<https://www.berghahnjournals.com/view/journals/theoria/68/167/th6816701.xml>>

³⁸ African Union, 'The Digital Transformation Strategy for Africa (2020-2030)' (African Union 2020) <<https://au.int/sites/default/files/documents/38507-doc-dts-english.pdf>> accessed 20 March 2023

transition to this stage was significantly impeded by the lack of a robust supportive infrastructure network.³⁹ A review of South Africa's National Development Plan performed by Research ICT Africa⁴⁰ argues that fixation on new and emerging technologies cannot deliver inclusivity and equity envisioned in the NDP as essential to the country's progress. South Africa's readiness for more widespread 4IR adoption is hindered by inconsistent policy and regulatory failure in key enabling areas, particularly the telecommunications and energy sectors. The barriers to adoption of 4IR in Africa in general, and South Africa in particular, have been studied in literature. Factors that impede the uptake of the 4IR for sustainable development in Africa include the lack of relevant policies, limited proficiency in 4IR technologies, inadequate supporting infrastructure, and a lack of active engagement from stakeholders.⁴¹ (Sutherland 2019) highlights several problems with regards to 4IR in South Africa: notable poor record in effective policy formulation and implementation, particularly across different departments, inadequate infrastructure reflecting governance weaknesses and instances of state capture, and the potential effect on work and employment caused by a reduced demand for low levels of skills.⁴²

Access to affordable Internet, affordable devices, and the digital skills to use them is necessary for empowerment and digital transformation across the world. Digital communication infrastructure is increasingly becoming an integral part of other sectors such as finance, health, education, and others. Globally, broadband policies need to incorporate issues from these sectors, and the other way around.⁴³ One area where digital infrastructure and especially its governance is becoming more and more prevalent are smart cities.

3.2. Smart cities or smart communities?

South Africa's 2012 National Development Plan does not specifically promote the concept of smart cities, however it does identify ICT as a critical enabler of economic activity and envisages an increasingly important role of information infrastructure to connect public administration and active citizens.

³⁹ Awinia, C.S. 'Infrastructure Network Support and Leapfrogging Africa to Industry 4.0: The Case of Tanzania.' *Procedia Computer Science* 217 (2023): 1-10. <<https://doi.org/10.1016/j.procs.2022.12.196>> accessed 20 March 2023

⁴⁰ Research ICT Africa, 'New Report! RIA Reviews National Development Plan Regarding SA's Digital Readiness' (*Research ICT Africa*, 11 December 2020) <<https://researchictafrica.net/2020/12/11/icymi-ria-produces-report-for-national-planning-commission-on-sas-digital-readiness/>> accessed 20 March 2023

⁴¹ Kibe, L., Kwanya, T. and Nyagowa, H. (2023), 'Harnessing fourth industrial revolution (4IR) technologies for sustainable development in Africa: a meta-analysis', *Technological Sustainability*, Vol. 2 No. 3, pp. 244-258. <<https://doi.org/10.1108/TECHS-01-2023-0004>> accessed 20 March 2023

⁴² Sutherland, Ewan. 'The fourth industrial revolution—the case of South Africa.' *Politikon* 47.2 (2020): 233-252. <<https://doi.org/10.1080/02589346.2019.1696003>> accessed 20 March 2023

⁴³ ITU/UNESCO Broadband Commission for Sustainable Development, 'The State of Broadband 2021: People-Centred Approaches for Universal Broadband' <https://www.itu.int/dms_pub/itu-s/opb/pol/S-POL-BROADBAND.23-2021-PDF-E.pdf>

The absence of a coherent national-level smart city strategy may be attributed to the constitutional framework that views city development as the responsibility of local governments.⁴⁴ The South African constitution is very specific about the fact that local government drives local development and gives a lot of autonomy to local governments. Generally, one can say that the initial narrative around smart cities in South Africa was about *digital* cities. It was around ICT infrastructure and the digital divide, and was shaped nationally. From there, with the emergence of the concept of datafication (globally), the trend moved towards smart (e.g., data-driven) initiatives, and these are being implemented locally. Whether data-driven solutions can foster inclusivity, especially in urban spaces in the Global South, remains questionable.⁴⁵ This is largely due to the absence of data from a significant portion of the population and particularly among those in the informal sector, which is dominant in South Africa's urban poor. A report by the OECD states that poorly planned smart city Initiatives, in a developing country context, exacerbate socio-economic inequalities, spatial segregation and public funding injustice even further.⁴⁶ Smart city strategies need to be informed by the factors they seek to transform. In the South African case, these would be spatial inequalities, digital divide and a significant presence of the informal sector.

The historical legacy of Apartheid spatial planning has resulted in extreme spatial disparities, with segregation occurring along economic, social, and racial lines.⁴⁷ The Group Areas Act of 1950 forcibly relocated non-white people to the outskirts of major cities, leading to the creation of townships and informal settlements. Despite the end of apartheid nearly thirty years ago, these disparities and segregation persist in contemporary South African cities. And while South Africa regards itself as a developmental state, city governments are often pressured to follow a neo-liberal trajectory focused on economic growth rather than poverty reduction and alleviation. Problems that exist in South African cities not only will not be solved using technologies, on the contrary. The so called “dashboard urbanism” decontextualises the city, and overly relying on quantitative data may perpetuate existing inequalities.⁴⁸ The disruption that comes with the smart city narrative often highlights digital infrastructure gaps and unequal access for citizens of different socio-economic backgrounds. So what are the alternatives?

⁴⁴ Odendaal, N. 'Towards the digital city in South Africa: Issues and constraints.' *Journal of Urban Technology* 13.3 (2006): 29-48. <<https://doi.org/10.1080/10630730601145997>> accessed 20 March 2023

⁴⁵ Jaideep Gupte, 'Blended Data Infrastructures and Localisation: Smart Urbanism in the Age of Pandemic' (*Urbanet*, 11 August 2021) <<https://www.urbanet.info/smart-urbanism-in-the-age-of-pandemic/>> accessed 20 March 2023

⁴⁶ OECD, 'Smart Cities and Inclusive Growth' (OECD 2020) <https://www.oecd.org/cfe/cities/OECD_Policy_Paper_Smart_Cities_and_Inclusive_Growth.pdf>

⁴⁷ Ivan Turok, 'Worlds Apart: Spatial Inequalities in South Africa', *Confronting Inequality* (2018).

⁴⁸ Nancy Odendaal, 'Appropriating "Big Data": Exploring the Emancipatory Potential of the Data Strategies of Civil Society Organizations in Cape Town, South Africa' in Paolo Cardullo, Cesare Di Felicianantonio and Rob Kitchin (eds), *The Right to the Smart City* (Emerald Publishing Limited 2019) <<https://doi.org/10.1108/978-1-78769-139-120191012>> accessed 20 March 2023

In his State of the Nation Address (SONA) in June 2019, President Cyril Ramaphosa expressed his dream of building a South African smart city, founded on the technologies of the Fourth Industrial Revolution. In the February 2020 SONA, this commitment was further elaborated.⁴⁹ However, there is evidence of several failed mega cities and “smart from scratch” cities in Africa.⁵⁰ They tend to fail at the point of implementation, and burn huge amounts of government funding.⁵¹ Examples of defunct megaprojects are the failed "futuristic" Modderfontein New City project that was estimated to cost ZAR 84 billion (ca. USD 5 billion), the controversial ZAR 140 billion (ca. USD 8.5 billion) WesCape Project and various publicised "Smart City" projects in Ekurhuleni, the City of Johannesburg, and the City of Cape Town (CoCT). A policy paper by Research ICT Africa suggests that these top-down, technology oriented views overlook the human-centric criteria which make our cities “smart”.⁵² Instead of futuristic projects, which do not address inequality problems, the funds should rather be redirected to bottom-up solutions which use ICTs in a manner that addresses spatial inequalities and embraces informalities.

The President's announcement coincides with the African Union's (AU) Agenda 2063, the continent's strategic framework for transforming Africa into the global powerhouse of the future. But, despite the continental vision and global streamlining according to Sustainable Development Goals, the reality is that in many African countries, economic growth, demographic transition and urbanisation does not follow the traditional economic trajectory witnessed in other regions. Most South African cities are facing inefficient public service delivery, a proliferation of informal settlements, high poverty rates, unemployment and increasing inequality. However, a top-down approach revolves around efficiency and optimisation of urban processes and fails to consider the recipients of these processes. Furthermore, if not carried out carefully, digitalization of urban services management and operation involves risks such as integration with legacy systems, operational requirements, interoperability of data, cybersecurity, data privacy and regulatory constraints.

⁴⁹ ‘South Africa’s New Mega Smart City – Here Is What It Will Look Like’ (22 October 2022) <<https://web.archive.org/web/20221022205828/https://mybroadband.co.za/news/business/339282-south-africas-new-mega-smart-city-here-is-what-it-will-look-like.html>> accessed 30 March 2023.

⁵⁰ Frances Brill and Ricardo Reborado, ‘What a Failed Johannesburg Project Tells Us about Mega Cities in Africa’ (*The Conversation*, 5 March 2019) <<http://theconversation.com/what-a-failed-johannesburg-project-tells-us-about-mega-cities-in-africa-112420>> accessed 20 March 2023

⁵¹ Carey Baraka, ‘Kenya’s First Smart City Promised Everything. 13 Years on, It’s Still a Construction Site’ (*Rest of World*, 1 June 2021) <<https://restofworld.org/2021/the-failed-promise-of-kenyas-smart-city/>> accessed 20 March 2023

⁵² Shamira Ahmed and Alison Gillwald, ‘Smart Townships Will Build Smarter Cities’ (*Research ICT Africa*, 31 August 2020) <<https://researchictafrica.net/publication/smart-townships-will-build-smarter-cities/>> accessed 20 March 2023

3.2.1. The importance of data

It is the availability of data, or lack thereof, which leads to the divide between ‘smartness’ of cities in the Global South vs. North, or even between different neighbourhoods in highly unequal settings such as South African cities.

The term “data” in the smart cities context is mostly associated with “big data” generated by sensors, Internet of Things (IoT) devices, machine-to-machine (M2M) communications and other automated processes. However, more traditional forms of data collection continue to contribute significantly to certain smart city objectives. Affiliates of Slum Dwellers International (SDI) in South Africa, for instance, have undertaken data production on informal settlements for over two decades.⁵³ Emphasizing active citizenship and "bottom-up governance," these citizens contribute data regarding living conditions in their communities. While the City of Cape Town's official open data portal primarily aimed to foster innovative entrepreneurship, local civil society organizations are leveraging data-driven solutions to address livelihood challenges of the urban poor, often relying on grassroots data production.⁵⁴

For example, an organisation called Violence Prevention through Urban Upgrading (VPUU) uses a participatory design approach to risk reduction and evidence-based violence prevention strategies, often incorporating ICTs and data-driven solutions. This includes the use of mobile inspection tools designed to enhance service delivery in low-income areas and informal settlements. However, to initiate such projects in informal settlements, these areas must first be geographically identified, as they are typically absent from official maps used for resource management and decision-making.

In an urban environment lacking conventional addresses and street identifiers, geo-locating local infrastructure becomes imperative for identifying items requiring repair or replacement. To facilitate a project of monitoring and fault reporting of sanitation infrastructure, VPUU geo-located every piece of infrastructure in Monwabisi Park and created an attributed asset register. Direct collaboration with the City of Cape Town's fault reporting stations facilitates prompt responses due to standardized reports, with local fieldworkers guiding repair teams to address identified issues. This community engagement approach seeks to involve the entire community in their own service delivery, with success measured through quantitative data, such as faster response times and shorter waiting periods for infrastructure repairs, as well as qualitative data obtained through user satisfaction surveys.

⁵³ ‘Country - Slum Dwellers International’ (8 January 2023) <<https://sdinet.org/explore-our-data/country/>> accessed 20 March 2023

⁵⁴ Britta Ricker, Jonathan Cinnamon and Yonn Dierwechter, ‘When Open Data and Data Activism Meet: An Analysis of Civic Participation in Cape Town, South Africa’ (2020) 64 *The Canadian Geographer / Le Géographe canadien* 359; Ivan Turok, ‘Worlds Apart: Spatial Inequalities in South Africa’, *Worlds Apart: Spatial Inequalities in South Africa* (2018)

There are other notable initiatives across the country, contributing to a shared comprehension of the impact that data accessibility can have on promoting fair and equitable service provision. Open Cities Lab⁵⁵ (formerly Open Data Durban) combines digital technologies, open data and co-design to foster inclusive urban environments, guided by the principles of transparency, inclusivity, skill development, and active engagement. WhereIsMyTransport⁵⁶ produces urban mobility data platforms in major Global South cities, emphasizing the inclusion of data from informal modes of public transport, prevalent in South African cities.

The term ‘smart’ itself is often associated with futuristic and highly efficient urban spaces resulting from the deployment of advanced technologies. However, the International Telecommunication Union (ITU) advocates for simplicity in achieving smart and sustainable cities.⁵⁷ The ITU describes a smart and sustainable city as an “innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects”. Criteria that make an intervention simple are affordability, rapid outcomes, limited scope, utilization of established technologies, tapping into existing local expertise, simplicity, and long-term sustainability. Sustainability, in this context, signifies either a plan for continued operation beyond initial investment or contribution to one or more sustainable development goals (SDGs) without conflicting with any of the SDGs. This implies that interventions that increase inequality (SDG 10) are not sustainable.⁵⁸ This prompts questions about the suitability of 5G, often hailed as the backbone of smart city applications, considering the recommendation to employ only proven technologies.

3.3. Complementary solutions

The PC4IR report⁵⁹ states that “5G becomes the glue to everything smart, and it creates the super-fast highway in which all the other applications of a connectedness required in a smart city implementation is enabled.” It acknowledges the role the telecommunication sector plays in 4IR initiatives. But whether or not 5G will support South Africa’s *inclusive* transition into the 4IR, is debatable. With very high bandwidth and low latency connectivity, much of 5G’s focus is about enabling the Internet of Things (IoT) applications which are essential for the futuristic, technoutopian version of smart cities. In fact, big tech giants have already managed to sidetrack the smart cities discourse (and that of 4IR in general), moving the aspect away from citizens and their actual

⁵⁵ Open Cities Lab, ‘Homepage’ (*Open Cities Lab*, n. d.) <<https://www.opencitieslab.org/>> accessed 20 March 2023

⁵⁶ WhereIsMyTransport, ‘Trusted Mobility and Location Data for Emerging Markets’ (n. d.) <<https://whereismytransport.com/null>> accessed 20 March 2023

⁵⁷ United for Smart Sustainable Cities and (U4SSC) initiative, ‘Simple Ways to Be Smart’ (2021) <<https://www.itu.int/hub/publication/t-tut-smartcity-2021-03/>> accessed 20 March 2023

⁵⁸ United Nations, ‘The 17 Goals: Sustainable Development’ (*United Nations Department of Economic and Social Affairs*, n. d.) <<https://sdgs.un.org/goals>> accessed 20 March 2023

⁵⁹ Presidential Commission on the 4th Industrial Revolution (PC4IR), ‘Report of the Presidential Commission on the 4th Industrial Revolution’ (2020) <https://www.gov.za/sites/default/files/gcis_document/202010/43834gen591.pdf>

needs. When priority is inclusion, using proven, pre-existing technologies is a more practical and effective approach rather than experimenting with new ones - and it is one of simple ways to be smart.

It is not entirely clear what the specific use cases driving 5G implementation in the South African context are, that benefit the end user. ICASA's report on readiness for 5G focuses largely on industrial applications and 4IR.⁶⁰ If not rolled out carefully, 5G is very likely to exacerbate South Africa's enduring digital divide. 5G, by its inherent design, does not prioritize ubiquitous and affordable access; instead, it is engineered to cater to advanced services for corporate entities and affluent households, thereby benefiting a narrow segment of the population.

Complementary solutions grounded in local innovation present a promising opportunity to reach marginalised communities. Initiatives such as community networks for access provision or grassroots data production for enabling service delivery hold significant potential. Informal settlements, which often remain underrepresented in official data repositories, stand as prime examples of areas where such interventions are crucial. Notably, the case of Violence Prevention through Urban Upgrading (VPUU) merits attention, as the organization has established community networks in three informal settlements in Cape Town.⁶¹ Leveraging these networks, VPUU not only supports their ICT-enabled service provision operations and infrastructure monitoring but also extends internet access to marginalized citizens. This local approach underscores the importance of community-based solutions in addressing the digital disparities that conventional technologies like 5G may inadvertently perpetuate.

Grassroots movements seem to have more cohesion and leverage their activities to achieve multiple goals, while policies related to broadband provision, e-government, smart cities or 4IR are being developed in silos. If the digital revolution is the basis for service delivery, maybe it is time for joint strategies for mitigating digital divides and fostering civic participation?

4. Discussion

Although connectivity on its own will not reduce economic inequality, connectivity is a precondition for participation in a digital economy and society. Barriers in achieving universal connectivity and equitable adoption of ICTs are demand side challenges and a series of unimplemented policies. Even with its novel and bold moves with regards to the new draft spectrum policy, fact is that the DCDT has not been able to demonstrate its ability to promptly implement spectrum policies over the past fifteen years. Moreover, the new draft policy proposes

⁶⁰ Independent Communications Authority of South Africa, 'The State of 5G in South Africa: From Readiness to Recommendations' (2021) <<https://www.icasa.org.za/uploads/files/ICASA-2021-5G-Annual-Report.pdf>> accessed 20 March 2023

⁶¹ VPUU, 'Bridging the Digital Divide: Local Communities Building Local Networks for Internet and Education Access' (2021) <https://vpuu.org.za/wp-content/uploads/2021/04/VPUU_SOTW_VNET_WORKING_26.3.pdf>

to shut down older generation networks such as 2G and 3G, in order to boost the deployment of newer technologies such as 5G - a move that received mixed reactions. It may be a trend to discontinue older technologies in more developed countries, yet not to be followed in a country where 60% of the population still uses 3G services⁶² and about 14 million customers are still using 2G phones.⁶³

Similarly, a top-down approach to smart cities may work in places where the majority of city residents are connected, and under the assumption that the city has an established competitive knowledge economy with citizens already possessing the necessary devices and digital skills. Another challenge is to start addressing the prevailing focus on technology without tackling underlying governance issues. An approach that focuses solely on technology does not address the complex and multi-dimensional needs of cities, and needs of those who remain digitally excluded or inequitably connected.

Smart city projects overseen by the private sector are often conceptualized as systems rather than places, shaping people's roles into that of consumers rather than active citizens.⁶⁴ These governance models, private-sector led and characterized as 'post-democratic',⁶⁵ have given rise to significant ethical concerns. These issues pertain to surveillance, law enforcement, and the notion of citizenship, potentially deepening existing inequalities in society.⁶⁷

The vision of the "smart city" concept is built upon the foundation of innovative governments, robust institutions, and effective partnerships among diverse urban stakeholders. This underscores the fact that achieving a "smart city" goes beyond public urban entities merely adopting digital technologies; fundamentally, a smart city must comprehensively address the requirements of all its citizens through the utilization of ICTs. In contrast, African cities are marked by institutional constraints, exclusionary policies and overburdened local governments.⁶⁸⁶⁹

⁶² Paula Gilbert, 'South Africa's 2G, 3G Switch-off Plan Raises Eyebrows' (*Light Reading*, 9 September 2022) <<https://www.lightreading.com/2g3g4g/south-africas-2g-3g-switch-off-plan-raises-eyebrows/d/d-id/780279>> accessed 20 March 2023

⁶³ Vaughan O'Grady, 'South Africa Invites Comment on 2G and 3G Shutdown Plans' (*Developing Telecoms*, 6 September 2022) <<https://developingtelecoms.com/telecom-business/telecom-regulation/13943-south-africa-invites-comment-on-2g-and-3g-shutdown-plans.html>> accessed 20 March 2023

⁶⁴ Cardullo, P., Kitchin, R., & Di Feliciano, C. 'Living labs and vacancy in the neoliberal city.' *Cities* 73 (2018): 44-50. <<https://doi.org/10.1016/j.cities.2017.10.008>> accessed 20 March 2023

⁶⁵ Brenner, N., Marcuse, P., & Mayer, M. 'Cities for people, not for profit.' *City* 13.2-3 (2009): 176-184. <<https://doi.org/10.1080/13604810903020548>> accessed 20 March 2023

⁶⁶ Van Noorloos, F., & Kloosterboer, M. 'Africa's new cities: The contested future of urbanisation' *Urban studies* 55.6 (2018): 1223-1241. <<https://doi.org/10.1177/0042098017700574>> accessed 20 March 2023

⁶⁷ Kitchin, R. 'The ethics of smart cities and urban science.' *Philosophical transactions of the royal society A: Mathematical, physical and engineering sciences* 374.2083 (2016): 20160115. <<https://doi.org/10.1098/rsta.2016.0115>> accessed 20 March 2023

⁶⁸ Boyle, L. 'Identifying the Opportunities and Challenges that Exist for Cape Town's Smart City Development.' (2019). <<https://open.uct.ac.za/handle/11427/32095>> accessed 20 March 2023

⁶⁹ Boorsma, B. 'A New Digital Deal: Beyond Smart Cities, how to Best Leverage Digitalization for the Benefit of Our Communities.' *Rainmaking Publications*, 2017.

On the other side, the success of local bottom-up governance strategies demonstrates that even without a robust strategy based on emerging technologies - and buzzwords like 4IR and 5G - communities are able to transform themselves. Grassroots movements have repeatedly shown the ability to build synergy between different actors in the process - those who produce and collect data, perform community mapping, own and operate infrastructure, or provide other services. Including them in the policy making process could help address some of the missing pieces in the digital transformation agenda. (Plantinga 2021) explores emerging questions around the ways in which grassroots movements could meaningfully engage with conventional innovation and inclusive development processes, and also delve into the methods through which South African public officials can interact with these movements to achieve national development goals, alongside the significance of ICTs within these contexts. While the South African government explores alternative governance models characterized by increased openness, it becomes imperative to inquire whether these initiatives genuinely result in the active involvement of marginalized actors and the achievement of inclusive development objectives.⁷⁰

4.1. Regulatory sandbox

Regulators in several countries have finally started recognizing the potential of community networks and non-profit ISPs as a viable alternative access solution. What has definitely helped are the global policy and advocacy efforts led by organisations such as The Association for Progressive Communications (APC), The Internet Society (ISOC), the Internet Governance Forum Dynamic Coalition on Community Connectivity (IGF DC3).⁷¹ Community networks and their associated movements are helping drive change on licensing, funding, spectrum allocation and assignment, and universal service funds. This way they are shaping the connectivity discourse from the bottom up, and influencing policy making - both on a national and global scale.

These regulatory advances laid the foundations for many subsequent developments in different parts of the world, including the creation of programs that allow alternative service providers to apply for universal service funds (USF). For example, the Argentine telecom regulator ENACOM (Ente Nacional de Comunicaciones) created the Roberto Arias program⁷² and the Barrios Populares program⁷³ as ‘special projects’. ENACOM is also the entity in charge of the implementation of the universal service funds.⁷⁴

⁷⁰ Plantinga, P., & Adams, R. ‘Rethinking open government as innovation for inclusive development: Open access, data and ICT in South Africa.’ *African Journal of Science, Technology, Innovation and Development* 13.3 (2021): 315-323. <<https://journals.co.za/doi/abs/10.1080/20421338.2020.1746046>> accessed 20 March 2023

⁷¹ All these organisations work with grassroots movements and follow a bottom-up approach.

⁷² Ente Nacional de Comunicaciones, ‘Redes Comunitarias Roberto Arias’ (ENACOM, n. d.) <https://www.enacom.gob.ar/redes-comunitarias-roberto-arias_p5049> accessed 20 March 2023

⁷³ Ente Nacional de Comunicaciones, ‘Programa Barrios populares’ (ENACOM, n. d.) <https://www.enacom.gob.ar/programa-barrios-populares_p4615> accessed 20 March 2023

⁷⁴ The USF holder is often the regulator itself, but often the ICT Ministry (or equivalent) or an independent agency. In the case of South Africa, the Universal Service and Access Fund (USAF) is managed by the Universal Service and Access Agency of South Africa (USAASA).

There is no doubt that the advocacy work of civil society and grassroots movements such as Altermundi created the conditions for the possibility of both programs, with the recognition of the community networks license in 2018 being an important starting point from the regulatory point of view. The establishment of a Sub-Directorate for Special Projects within ENACOM helped facilitate the dialogue between the regulator (which in this case is also the USF holder) and small operators including community networks representatives.

The importance of civil society when advocating for changes in spectrum policy, in order to accommodate needs of alternative operators, has been emphasised in (Hadzic 2019).⁷⁵ The key, however, is in adequately communicating the collected evidence and proposing new regulatory adjustments to a receptive audience - not all regulators are equally progressive and open to new ideas. The temporary assignment of spectrum to address the demand for bandwidth with the COVID-19 lockdown was seen as a missed opportunity for a regulatory sandbox.⁷⁶ The assigned spectrum could have been more innovatively applied to address the diverse needs of the country.

A regulatory sandbox could facilitate testing of new regulatory prototypes to integrate grassroots, bottom-up initiatives and community actions - whether for local data production or community infrastructure rollout - into the conventional regulatory landscape. In South Africa's telecom and digital technologies sector, this could result in a move from endless consultation processes that often hinder implementation of policy. For example, in the financial sector there is a growing trend for regulatory sandboxes to promote innovation in the sector while keeping alert to emerging risks. South Africa followed this trend: the Intergovernmental Fintech Working Group (IFWG), a collaborative effort of South African financial sector regulators to foster responsible fintech innovation, created a regulatory sandbox offering a controlled and live environment for innovators to test new financial products and features against existing regulation.⁷⁷ (Rachondras 2021) thoroughly examines the methodological shortcomings of experimental legal regimes, advocating for a shift towards a transparent and objective approach in the formulation of experimental regulations and regulatory sandboxes.⁷⁸ Research on regulatory sandboxes in developing countries suggests that the creation of thematic regulatory sandboxes, concentrating on distinct national

⁷⁵ Senka Hadzic, 'A Global South Perspective on Alternative Spectrum Policy' (*Research ICT Africa*, 18 December 2019) <<https://researchictafrica.net/publication/a-global-south-perspective-on-alternative-spectrum-policy/>> accessed 20 March 2023

⁷⁶ Alison Gillwald, Senka Hadzic and Pablo Aguera, 'Temporary COVID-19 Spectrum – a Missed Opportunity for Some Regulatory Innovation?' (*Research ICT Africa*, 29 April 2020) <<https://researchictafrica.net/publication/temporary-covid-19-spectrum-a-missed-opportunity-for-some-regulatory-innovation/>> accessed 20 March 2023

⁷⁷ IFWG, 'IFWG: Regulatory-Sandbox' (*IFWG: The Innovation Hub*, 2023) <<https://www.ifwg.co.za/Pages/Regulatory-Sandbox.aspx>> accessed 20 March 2023

⁷⁸ Ranchordás, S. 'Experimental regulations and regulatory sandboxes: Law without order?.' *University of Groningen Faculty of Law Research Paper* 10 (2021). <<http://dx.doi.org/10.2139/ssrn.3934075>> accessed 20 March 2023

financial and developmental priorities (such as remittances) might be favoured over those that encompass various national agendas. This approach is believed to optimise the utilisation of limited resources.⁷⁹

5. Conclusion

South Africa has developed some of the most progressive policies in promoting both broadband and digital transformation, however significant challenges have been experienced in their implementation. These include institutional barriers, lack of integrated planning and coordination of policy development and implementation, as well as demand side issues. Shifting departmental structures, frequent ministerial turnover and delayed auctioning of high-demand spectrum are some of the institutional challenges facing South Africa's telecom regulation sector. And in such a dynamic sector, decisions can be overtaken by sometimes unpredictable events, as was the case with Covid19 and the postponed spectrum auction. The new draft spectrum policy gives hope that the sector is moving in the right direction – it remains to be seen what the consultation process brings and how the eventual implementation moves ahead.

Would establishing an independent agency reduce the impact of political events on the sector (e.g., due to cabinet reshuffle)? The Universal Service and Access Agency of South Africa (USAASA) is an example of inefficiency of such a setup: as an independent agency, it has faced repeated allegations of corruption and mismanagement of universal service funds. On the other side, ICASA also failed to establish a coherent framework for calculation of annual licence fees and universal service fund contributions, which led to creation of loopholes that allow licensees to delay their payments. Overall, the regulator is facing a challenge to enforce compliance.

Changes in access policy and regulation are required as the telecommunications landscape evolves. Despite having some of the most developed telecommunications infrastructure on the continent, many South Africans struggle to afford access to the internet. And 5G is rather unlikely to solve that problem, unless implemented carefully. Regulators and USF holders need to be aware of community networks' existence and their potential to bridge the digital divide in the local, national context. Nonetheless, grassroots initiatives could be linked with advocacy efforts to influence policy in other domains, beyond connectivity.

Despite the growing acknowledgment of community networks, both within South Africa and globally, the progression of bottom-up smart city initiatives encounters significant challenges. A prevailing perception persists, favoring quantitative data for its perceived reliability, objectivity, and lack of bias, thereby deeming it more valuable and efficient. Initiatives led by local civil society organizations, characterized by blended data—comprising a fusion of informal and formal

⁷⁹ Wechsler, M., Perlman, L., & Gurung, N. 'The state of regulatory sandboxes in developing countries.' <<http://dx.doi.org/10.2139/ssrn.3285938>> accessed 20 March 2023

data—often encounter skepticism. Such data is occasionally deemed risky, less credible, or excessively activist in nature. Contrary to this perception, it is imperative to recognize citizen-led data as a legitimate and authentic complement to the decision-making process, deserving official adoption for its inherent value in providing a more comprehensive understanding of complex urban dynamics. Efforts to bridge the gap between these perceptions and the actual potential of citizen-led data are crucial for fostering more inclusive and effective smart city strategies.

Access, inclusion and digital literacy are some of the drivers of citizen participation and their associated innovations such as smart cities. Lack of connectivity is a threat to inclusive e-government. The Covid19 pandemic (and its aftermath) placed ICT to the top of essential instruments for post-pandemic recovery - and regulations adapted and declared it as such. The crisis has highlighted both the need for affordable access, and the need for citizen driven disaster response. It had huge economic effects on people's livelihoods, especially the informal sector. Recovery should rely on participatory processes. In the post-pandemic cities, digital public infrastructure is likely to become as essential as roads and parks - shouldn't the citizens be the ones co-designing digital public spaces?

A regulatory sandbox could facilitate testing of new prototypes to integrate grassroots, bottom-up initiatives - whether for data production or infrastructure rollout - into the conventional regulatory landscape. However, the first step is to officially recognise these complementary solutions.

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