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The unfinished promise of infrastructure in post-apartheid South Africa

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Abstract
This article explores aspects of the "unfinished" using notions of human-centered design in African public infrastructure and the importance of involving the "users" and "beneficiaries" in infrastructure development and delivery. Infrastructure, both conceptually as an idea and in its constructed material reality, has a huge impact on society, socially and economically, and has been promised as one of the most effective drivers of economic growth in South Africa. Increasingly in South Africa, facilities are falling into disrepair. Infrastructure is being adapted and used in unintended ways that often do not provide the socio-economic benefits intended. In considering medical infrastructure across three sites in post-apartheid South Africa, my argument asks how factors such as statecraft, governance and funding models, design considerations, project implementation methodologies, operational and maintenance policies affect the promise of infrastructural change in contemporary South Africa?

KEYWORDS
anthropocene, hospitals, maintenance, medical humanities, post-apartheid infrastructure, science studies, unfinished

INTRODUCTION

Is infrastructure more than material? This is the central question of my broader doctoral research from which this paper is drawn. It does this through a critical inquiry onto the question of the technicized notion of the "life cycle" as a conceptual point of departure. Instrumental modes

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of evaluation in engineering and construction terms evaluate the life cycle in ways that ignore the social aspects of buildings and structures. Turning this concept into a useful interrogative concept for a humanities study proposes a posing of questions of the "life" of structures beyond the confines of project cycles, allowing for a humanities reading of the buildings post-apartheid.

Introduced in 1994, the Reconstruction and Development Programme (RDP) which intended to integrate "growth, development, reconstruction and redistribution into a unified programme" (Ministry in the Office of the President, 1994, p. 8) aimed to re-map and restructure South African society spatially, legally, and economically to remedy the disastrous heritage of repression, inequality, and injustice. South Africa's strategic policy directions evolved to the "Growth, Employment and Redistribution (GEAR), the Accelerated and Shared Growth Initiative South Africa (AsgiSA), the New Growth Path (NGP), and the National Development Plan (NDP)." (Mikhaylov, 2018).

Development, in this conceptualization, focused on restoration of freedom and access to economic opportunities (Ministry in the Office of the President, 1994), measured using the materialistic definitions of the human development index, millennium development goals, and national plans (Ministry in the Office of the President, 1994, p. 37). Homelands (self-governing Bantustans) and townships (dormitory towns) were incorporated into the newly demarcated non-racial towns, municipalities, and provinces. Laws changed. Infrastructure investments were seen as drivers of change (Ministry in the Office of the President, 1994, p. 8). Capital projects that constructed new greenfield developments, and replaced inadequate and dilapidated brownfield facilities and infrastructure in the previously disadvantaged areas, aimed to not only create a legacy to stimulate long-term development, but to create jobs and opportunities for affirmative action, later defined as black economic empowerment and entrenched in the Preferential Procurement Act of 2000 (DTIC, 2023; Office of the Presidency, 2000). "South Africa's BBBEE policy (2003) combines neoliberal market-oriented economic policies with redistributive social policies and notions of social inclusion and social and economic justice. There are inherent tensions in such a policy" (Office of the Presidency, 2003; Patel & Graham, 2012). In *Laying ghosts to rest: Dilemmas of the transformation in South Africa* Mamphela Ramphele described the unintended consequences of the new policies and implementation combined with the ghosts of "racism, ethnic chauvinism, sexism, and authoritarianism" (Ramphele, 2008, p. 10).

While most infrastructure lasts or as I argue, "lives" longer than the people who built it, the new post-apartheid facilities were expected to last at least 30 years before major modifications, upgrades and repairs would be required (ASHRAE, 2015; National Treasury, 2012). The International Facilities Management Association defines the life cycle as "the planning, design, construction, operations, maintenance and capital improvements over time … and ultimately the cost of disposing of it" (IFMA, 2022). In this context, the hospital settings described in this article consider the life cycle of the facilities in a conceptual manner, both within and beyond the post-apartheid era, and the relevance of the facilities beyond their physical attributes as reflections of society.

My reading of the buildings and facilities in this article through reflection on my own practice as a professional engineer, inspection, discussion, and understanding in the hermeneutic sense involves reading beyond the literary understanding. In a similar manner, philosopher Hans-Georg Gadamer (1900–2002) argued that our perception of the world is not primarily theoretical but practical. Objects "disclose themselves to us as we move around in an already existing totality of meaningful relations." (Zimmermann, 2017).

Ideology and infrastructure

The themes of time, politics, and promise are salient to an understanding of the checkered past and uncertain future of the infrastructure I worked on as a professional Chief Engineer in

the Department of Health over a 5 year period from 2014 to 2019. Writing about Anand et al.'s edited book *The Promise of Infrastructure* (Anand et al., 2018). Zannah Matson highlights how the relationship between infrastructure and time in the field of critical infrastructure studies allows scholars to "interpret the complex relations that comprise our world, suggesting some of the ways that these relationships manifest spatially" (Matson, 2021).

Akhil Gupta argues that "if we think of infrastructures as unfolding over many different moments with uneven temporalities, we get a picture in which the social and political are as important as the technical and logistical" (Anand et al., 2018, p. 17). My own work uses this as point of departure and seeks to "articulate the political unevenness of life enmeshed with infrastructure" (Matson, 2021).

My argument is influenced by the growing body of interdisciplinary work in the fields of infrastructure and science studies in the humanities and considers the question of post-apartheid medical infrastructures' legacies. As Matson argues, infrastructure (and its promise) structures our relationship to the future and allows us to think "alongside the unfinished and interrupted forms that infrastructures often take." Apartheid was symbolized by its segregated infrastructure. "Infrastructures became symbols, conduits and forms of power, but they also shaped habits and the senses. This combination of the symbolic, the biopolitical, and the affective produced a very specific political terrain, one whose remainders shape the contemporary politics of infrastructure … for the most part apartheid infrastructures worked to prohibit the emergence of a (non racial) public" (von Schnitzler, 2018).

In *Seeing like a state: How Certain Schemes to Improve the Human Condition Have Failed* James Scott identifies four processes that when occurring simultaneously contribute to state implemented social-engineering disasters: the administrative ordering of nature and society, a high-modernist ideology, an authoritarian state that is willing and able to use the full weight of its coercive power to bring these high-modernist designs into being, and a prostrate civil society that lacks the capacity to resist these plans (Scott, 1998, pp. 4–5). The resulting technocratic hubris of the twentieth-century high-modernist ideology was built on a belief that societies can be made legible or easily read by simplifying reality to fit it into administrative categories, and that "to accomplish this goal, humans must be reduced to automatons working within simplified systems designed to enhance state command and control. In consequence, high modernists ignore the local knowledge inherent in society and block local initiative" (Laitin, 1999), "discarding local knowledge that is often critical to managing the complexities of social life and the natural environment" (Fukuyama, 1998).

These conditions will be familiar to anyone who experienced the machinations of the apartheid state, and the remnants of these elements that lingered in the post-apartheid era. In discussing the relationship between infrastructure and democracy, Antina von Schnitzler explores the administrative-technical transformations and points out that "governmental and juridico-political transformations are often 'out of sync' and shaped by distinct temporalities. From this perspective, while the first general election in 1994 marked the beginning of democratic rule in South Africa, the continuities and discontinuities with the late apartheid era often unfold at different speeds and in distinct register" (Anand et al., 2018, p. 147).

While economic infrastructures (mines, factories, power, and roads) provide the means of production and must satisfy a financial justification, the World Health Organizations' definition of social infrastructure, into which hospitals fall, is motivated by concepts of social justice, human rights, and maintaining social order (World Health Organization, 2016).

The study of infrastructure at the more-than-human scale made over more-than-human lifetimes offers a fresh view on time, politics, and promise in the 21st century. Infrastructure is formed by people using materials and resources, institutions, and processes, guided by ideology and politics. Location, aesthetics, scale, and scope are determined more by ideology than needs. The study of healthcare infrastructure is no exception.

"CHARLOTTE": CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

Charlotte Maxeke Johannesburg Academic Hospital (CMJAH, known simply as "Charlotte" for short) is the formal name of what was previously named the Johannesburg General Hospital, also known by its shorthand name as the "Jo'burg Gen." Construction started on the new Johannesburg General Hospital, during some of the darkest years of apartheid leading to the Soweto Uprisings of 1976.

The history of present-day Charlotte dates back to the 1880s when fortune seekers from all over the world flocked to the Witwatersrand after the discovery of the rich seam of gold beneath what would become the city of Johannesburg in 1884. The mining quickly formalized into a settlement, and within 10 years, Johannesburg was the largest town in South Africa. The first temporary hospital, a three-roomed brick, and thatch building that also doubled as the jail opened in 1886 (Latilla, 2018). The Johannesburg General Hospital, located on Hospital Hill between what was to become Braamfontein and Hillbrow in downtown Johannesburg, grew in line with demographic and political changes, with the replacement of old buildings and addition of new wings. The new Jo'burg Gen hospital, a huge brutalist concrete block that was constructed two kilometers away on Parktown Ridge, replaced the previous General Hospital in 1978. By 1988, many wards in the Whites-Only Jo'burg Gen had been closed due to underutilization, while overcrowding at the Baragwanath Hospital in nearby Soweto meant that there were sometimes "over 100 patients in a ward … [with] only 40 beds" (Critical Health, 1988, p. 44). The building became a symbol of domination resulting in protests in 1989 against segregated health care (Claiborne, 1989). Renamed on Heritage Day in 2008 after Charlotte Makgomo Maxeke, the first black woman to receive a Bachelor of Science in South Africa, the mega-structured facility was identified for transformation in a newly integrated society and designated as a central hospital in the National Health Act Regulations R655 and R186 in 2011 (Department of Health, 2011).

Over the years since 2008, the concrete megalith has morphed and transformed, emerging as an important, innovative, and reliable pillar of the healthcare system, providing specialist care not just for residents of the city of Johannesburg, but also as part of a referral network for patients from all over the Gauteng and neighboring provinces (Parliament of the Republic of South Africa 2022). Yet at the same time changing demographics, disease profiles, disasters, and emergencies, have had a major impact on the facilities. Over the years, the original state-of- the-art drug distribution system has been decommissioned, the coal-fired boilers replaced with gas boilers (Ndaba, 2013), electro-mechanical systems upgraded (Gauteng Treasury, 2013; SANews, 2013), processes adjusted to suit new treatment regimes (Catalysis, 2017; Heathcote, 2018), radiology equipment modernized (Phashe, 2016), and wards refurbished (Vulekamali, 2023). The academic hospital shares facilities with the University of the Witwatersrand faculty of health sciences.

Design, disaster, emergency, maintenance, and repairs

The "massive precast elements used in the construction of the first block at the new Johannesburg hospital" featured on the cover of The Civil Engineer in South Africa in January 1974 and again in April 1975. The building was "one of the most interesting precast structures in South Africa." (Kelly, 1972) The requirement for spacious treatment areas and interfloors meant that the only load bearing walls are in the lift and staircase cores. After careful structural analysis, a high-tech structural system using post-tensioning of the floor slabs and beams was chosen to distribute loads between these walls and columns according to their rigidity. In the interfloors, precast post-tensioned concrete trusses offer more space for service installation

and maintenance. A regular pattern of slots in the ceiling slab allowed easy entry of services into the treatment areas. The concrete structure was designed to withstand a fire for 2 hours (Kelly, 1972).

Fifty years later, the fire spread rapidly from the parking garage into the treatment areas and interfloors. The overall duration of the fire exceeded the 2-hour protection of the concrete structure and caused permanent irreversible damage to the floor slabs. The load bearing floor beams had been prefabricated and connected together by post-tensioning. The post-tensioned steel cables failed inside the concrete, the concrete cracked, causing deflection which increased in time. The structural frame supported precast floor panels, which lost their footing after the deflection and failed.

Firefighters from the hospital and the City of Johannesburg believed they had extinguished the fire, but it had taken hold, and flared up hours later in the evening, "which led to a decision to evacuate 821 patients and affected health care workers to 17 different facilities across the province for safety purposes and continued provision of care." (Parliament of the Republic of South Africa, 2022) As journalist Ufrieda Ho wrote in the Daily Maverick "Firefighters were not given building and floor plans of the hospital's emergency exit plan when they arrived on the scene the day of the fire … Smoke detection systems, fire alarms, sprinkler systems, and the mechanisms that would have triggered the magnetic smoke doors were also not in working condition. There was also water … low pressure to the hydrants" and fire hydrant couplings were not compatible with the fire hoses on Johannesburg Fire Service fire engines because some had reportedly been stolen. Poor maintenance of the aging hospital meant it would fail a basic fire compliance audit (Ho, 2021).

With adequate maintenance of between 4 and 15% of the rebuilding cost, the useful life of a facility should be 30 years before it needs major upgrades or reconstruction (CIDB, 2007). However, breakdowns and catastrophic failures as a result of reactive "run-to-failure" maintenance strategy often impair the functionality and value of a facility (National Treasury, 2008). The state could generate immediate savings by moving to preventative maintenance instead of the current reactive "run-to-failure" maintenance strategy. "Many facilities purely reliant on reactive maintenance could save much more than 18% by instituting a proper preventive maintenance program" (Department of Energy, 2001, p. 5.3). The risk of catastrophic equipment failures, and savings of up to 40%, can be achieved by implementing a predictive maintenance approach (Figure 1).

Probing by the National Council of Provinces (NCOP) revealed that the Departments of Health, Department of Infrastructure Development (DID), Premier's Office and City of Johannesburg "failed to resolve the CMJAH matter because the City of Johannesburg insisted that prior to issuing the Certificate of Occupation, the facility should meet all compliance requirements as per statutory requirements." (Parliament of the Republic of South Africa, 2022) The hospital did not comply with the National Building Regulations updated in 1984, 1989, 1995, and 2008 which had been improved since it opened in 1978 (SAGov, 2023b). In addition, it did not help that CMJAH owed the City of Johannesburg over R200 million for basic services, including water and electricity (Maromo, 2022).

After slow progress was made by the Gauteng Department of Health and the Gauteng Department of Infrastructure Development (DID), civil society stepped into the void. Six months after the fire, the South African Pandemic Relief Effort (SPIRE) Fund and the Solidarity Fund, both established to respond to the COVID-19 crisis, raised millions for the refurbishment and re-opening of the Accident and Emergency and related sections. In a fast track project, the accident and emergency, radiology, and COVID wards were upgraded and repaired, re-opening in 2022. This innovative collaboration between the state and civil society provided a model for emergency interventions. The NGO, Gift of the Givers, raised a donation to convert the unused dining hall into a replacement storage area. Eventually, the Gauteng Premier announced that responsibility for the hospital would be transferred to the National

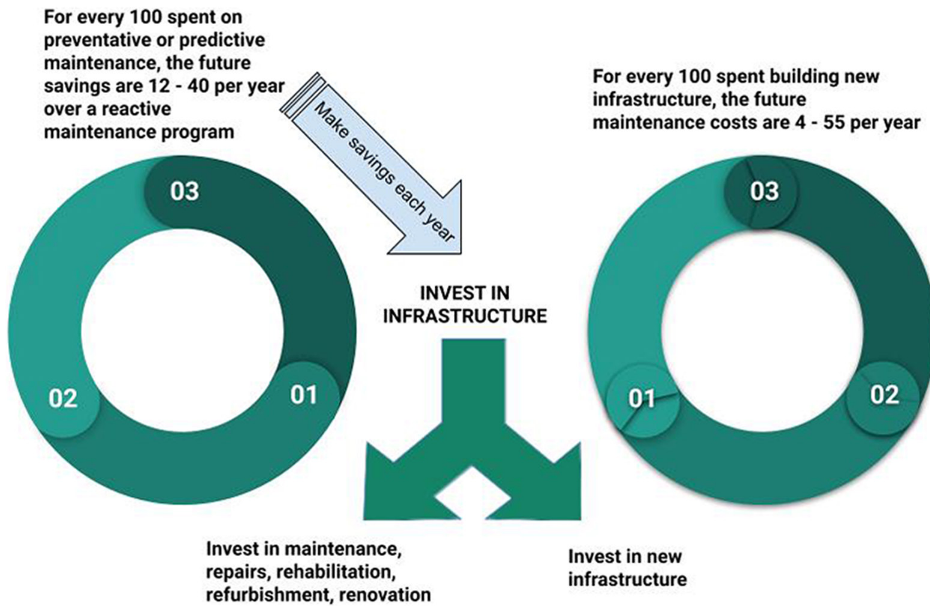

FIGURE 1 Investing in maintenance generates significant savings (Roper, 2022).

Department of Health, with the Development Bank of South Africa (DBSA) as the new implementing agent. The Minister announced that approximately one billion South African Rands was secured to fund the repair project and to ensure that the hospital is brought up to modern health and safety requirements (Parliament of the Republic of South Africa, 2022). In the meantime in 2022, 312 members of staff were deployed to other hospitals to care for patients relocated during CMJAH's closure.

The impact of the technical designs, operational and maintenance habits of the hospital management on lives and health services underscores my proposition that infrastructure is more than material. The disastrous fire set back the service platform possible at the central academic hospital, affecting the entire referral network, thousands of patients, undergraduate and postgraduate students from the University of the Witwatersrand Faculty of Health Sciences. In effect, it rendered the infrastructure unfinished, in urgent need of re-development once again.

LETABA REGIONAL HOSPITAL IN NKOWANKOWA, "NKOWA[2]," SOUTH AFRICA

The Mopani District is in the north-eastern lowveld of South Africa, bounded to the north by Zimbabwe and to the east by Mozambique. Letaba hospital is in Nkowankowa, in the Ritavi district, a township that borders on the town of Tzaneen, which was established in 1962 when people were relocated from Tsaneng (Tzaneen) and Masakeng during the apartheid era. The township is a mixture of an extensive residential area, a vibrant business area, and an industrial zone (Ntsimane, 2012). Letaba Regional Hospital provides level 2 acute healthcare services to more than a million people in the Mopani District. Although the hospital was founded in 1964, its spatial and temporal importance have emerged since 1886.

Swiss missionaries founded a mission at Shiluvane on the north-eastern Drakensberg escarpment in what is now the Limpopo province of South Africa in 1886. The mission station,

typical of others designed by mission societies, comprised a church, school, a dispensary, and a clinic. The mission clinic at Shiluvane developed into a hospital with funds from the then Native Affairs Department for a building project, which opened in 1944 just prior to the formal implementation of statutory apartheid in South Africa in 1948. As Benneth Masumbe describes the "Shiluvane Hospital was set up to minister to the needs of both the Nkunas and the Maakes whose chiefs, Muhlaba and Speke, were inseparable friends" (Masumbe, 2002, p. 99).

In a later wave of apartheid era missionary activity, the Dutch Reformed Church (DRC) established missions between 1957 and 1965 (Van der Merwe, 2011), including the Letaba mission 21 kilometers from Shiluvane. Tshilidzini, Nthume, Messina, Bethesda, Soekmekaar, Turfloop, Letaba, Nkhensani, Lebone, Meetse-a-bophelo, Pietersburg, and Kranspoort missions fell under the Presbytery of Kranspoort (Kgatla, 2015). "The Nationalist Government and the DRC dovetailed closely to develop and support a mission policy that would completely restructure South Africa to be totally under the tutelage of 'grand' apartheid where various ethnic groups would have their own homelands" (Kgatla, 2015, p. 485). Land rights were a major point of contention from the inception of these new missions. In the 1950s, there was strong resistance and active protests against the apartheid government's segregationist policies around land. Grievances about land allocation, rights of residence, irrigation water, and burial rights within the first DRC mission station at Kranspoort eventually led to an open rebellion in 1957, and expulsion of congregants from the mission (Kgatla, 2015, p. 482).

By the time the new Letaba Hospital was established in 1963, mission hospitals had become increasingly dependent on central government funding. The DRC mission strategy included providing social services (Jordaan, 2011), establishing schools for the blind and deaf and 78 mission hospitals, including the hospitals at Nkhensani, Tshilidzini, Meetse-A-Bophelo, Bakenberg, Letaba, and Mogalakwena now in Limpopo province (Kgatla, 2015). Letaba hospital, the Letaba special school and Yingisane special school for the deaf were established at the Letaba mission. Letaba special school opened in 1969, and in April 1989, the deaf learners moved to the new Yingisani School for the Deaf on the same site (Department of Social Development, 2015).

The Mission hospitals were nationalized from 1974 (Ntsimane, 2012). "Missionary bodies were desirous of state-run medical and nursing services as that was the norm in civilised countries. Their involvement in these spheres was viewed as temporary …. The Nationalist Government had serious misgivings about missions' continued dominance of the provision of medicine and primary health care to the indigenous populace" (Masumbe, 2002, p. 108).

As Manu Ramutsindela describes "In the former bantustans, apartheid has naturalized both physical and non-physical boundaries, and the institutions and structures that govern people who lived in those bantustans. Those boundaries and the spaces which they delimit have not been successfully challenged in a democratic South Africa" (Ramutsindela, 2007, p. 53).

Infrastructure and inequality

"In an attempt to divide and marginalise the black population, the apartheid regime forcefully relocated some 3.5 million South Africans to rural homelands between 1960 and 1980" (Abel, 2019). In what is the present-day Limpopo Province, the apartheid government divided land between the previous homeland territories of Lebowa, Venda, and Gazankulu perpetuating the Nationalist Party's policies of ethnic separation. The earlier colonial efforts at the creation of tribalism (Vail, 1989) and fixed tribal territories dispossessed homesteads of land, changed the concepts of land, land use and communities, and affected land restitution post 1994 (Hay, 2014). The division of land was highly contested. In 1987, the Minister of Development Aid and Education planned the installation of a boundary between Lebowa

and Gazankulu in the Ritavi district (Mokgawa, 2008). In response the Lebowa government demanded that "the so-called 'cattle proof fence' now under construction … which is regarded as 'a wall of shame' should be stopped forthwith and that the [South African Police] SAP and [South African Defence Force] SADF should refrain from political issues such as national boundaries … dragooning our subjects by a barrel of a gun to accept the envisaged boundary" (Mokgawa, 2008, p. 44).

The division of land and people along these artificial homeland boundaries also impacted the already inequitable healthcare system. Further ethnic hostility arose when Shiluvane Hospital, which had been controlled by the homeland of Lebowa from 1976 to 1981, was handed over to the homeland of Gazankulu in 1981. "This caused the chief minister of Lebowa to remove all Northern Sotho patients, nurses and hospital staff to nearby Sotho hospitals … Because of the ethnic bitterness generated by this affair, southern Tsonga-speakers in 1984 would rather spend the money and time involved in traveling an extra 60 kilometers to a Tsonga hospital than face possible ill-treatment at the nearby Sotho hospital" (Vail, 1989, p. 106). Eventually patients, nurses, and hospital staff had been relocated to ethnically focused hospitals in the similarly categorized ethnic homeland areas of Lebowa, Gazankulu, and the Transvaal (Maepa, 2020).

Fragmentation and duplication of health services and institutions on the boundary between Lebowa and Gazankulu posed significant challenges. "The challenges that already existed in terms of community health service delivery were accelerated by such divisions, thus hampering the expected positive implementation of primary health care programmes already in place" (Maepa, 2020, p. 132). Administrative and financial constraints affected the administration and management of both Lebowa and Gazankulu homelands' Departments of Health leading to a breakdown in healthcare services, a vaccine cold chain compromised by poor communications between both administrations and the South African Railways, and low immunization rates contributed to the poliomyelitis epidemic of 1982 (SASPU National, 1982). The overflowing Letaba Hospital had to accommodate paralyzed patients on the floors, as the 350 beds were insufficient for the patient numbers.

The expensive duplication of facilities based on the racialized ethnic allocation of space by the apartheid state's ideology resulted in the construction of the new Dr CN PHatudi hospital. In 1989, "Plans to build an R11m hospital in Lebowa in memory of the late chief minister, Dr Cedric Phatudi, were criticised because it would be only 5km from the Shiluvane Hospital in Gazankulu, which was usually used to only 55 percent of capacity. According to the Minister of Education and Development Aid the proposed hospital was 'a monument to the reality of inter-ethnic antipathy which we have to take into account in many cases – of the unwillingness of the government of one group to have its people share the same facilities with the population of another group just over the border'" (South African Institute for Race Relations (SAIRR), 2020, p. 94).

This, according to the Minister of Education and Development Aid, was necessary because "the area's multi-ethnic composition made the sharing of the two hospitals impossible" (Savage, 1990, p. 26). These inputs were ignored, and the new Dr CN Phatudi Hospital was constructed in Maake, Lebowa, just a few kilometers from Shiluvane Hospital in Gazankulu (Maepa, 2020). By 1994, eight hospitals served the Mopani District: Letaba hospital, Shiluvane, Nkhensani, Maphutha Malatji and Kgapane in Gazankulu, Dr CN Phatudi and Sekororo in Lebowa, and Van Velden in the Transvaal (Monticelli et al., 2012).

Reimagining Letaba hospital in Nkowa[2]

By 1994, Gazankulu constituted "a geographically defined and poverty-stricken colony within the borders of South Africa." Influx control and resettlement schemes had resulted in gross

overcrowding. Two thirds of the working population worked as migrant laborers, as only a fraction of the population could make a bare living from agriculture (Vail, 1989, p. 107). Half the population was under 15 (Rikhotso, 1997, p. 41).

During the 1990s, with the demise of the apartheid state, the unbanning of the African National Congress and the dawning of a new era, nine new provinces replaced the four old provinces and the homelands. "During the drafting of the Interim Constitution, a Commission for the Delimitation/Demarcation of Regions (CDDR) was appointed to address the issue of bantustan boundaries and the reconfiguring of regions in South Africa" (Narsiah & Maharaj, 1999, p. 44). Disputed boundaries were referred to the Negotiating Council for a final decision.

The newly demarcated Northern Province, now Limpopo, was the poorest region in the country. Forty eight per cent of the population were unemployed in 1996, while 40% of households had no source of regular income. The infant mortality rate in the province, 57 per 1000 births, was extremely high. The province also had the lowest literacy rate and the fastest population growth rate in the country.

Properties on the former mission stations were either retained by the Dutch Reformed Church, transferred to the local municipalities or in a few cases handed over to the local congregations (Kgatla, 2015). The hospital site was taken over by the Department of Health, while the Yingisane and Letaba special school sites were taken over by the Department of Basic Education in 1998 when the Dutch Reformed Church withdrew its support (Department of Social Development, 2015).

Health care had been used as an instrument of apartheid policy in South Africa as Max Price argued in *Health care as an instrument of Apartheid policy in South Africa* (Price,1986).

Between 1994 and 2011, the new Northern Province (renamed Limpopo Province since 2003) consolidated land previously administered by four separate homeland administrations, but "experienced challenges with the asset register due to the magnitude of the portfolio, problems with the Asset Management and Property Management System, the data input at regional and provincial level and capacity constraints" (PMG, 2011). The lack of information led to qualified audits for many years (Myeni, 2021).

On paper, there was an undersupply of hospitals in the Mopani District: each had previously served the ethnically separated populations. Bed provision levels were low for all acute levels of care at 1.22 beds per 1000 population, 6% less than the recommended norm of 1.3 beds per 1000 population (Limpopo Department of Health and Social Development, 2005). However, by 2012, after the conversion of Shiluvane hospital into a care home, the usable bed utilization rate (UBUR) in four of the six hospitals in Mopani District was lower than the national average (Monticelli et al., 2012).

Introduction of the District Health System (DHS) model after 1994 aimed to reorganize, restructure, and decentralize the "fragmented and inefficient apartheid health system into a coherent and unified national health system capable of addressing the health needs of the population, especially those living in poverty" (Health Systems Trust, 1999, p. 132). To create equity, efficiency, and effectiveness, the health districts and their management structures became the core building blocks of the entire health system (Health Systems Trust, 1999, p. 132).

In 1995/96, the Council for Scientific and Industrial Research (CSIR) completed the first National Health Facilities Audit (NHFA) of the consolidated health estate in South Africa (Wall et al., 2008). The PREMIS (Professional Real Estate Management Information System) provided a baseline assessment of the condition, suitability, utilization, and standard of public sector hospitals and health centers and estimated the replacement value and a condition-based maintenance backlog based on field data. The data motivated the Hospitals Revitalisation Programme. "Follow-up studies in Limpopo indicated that the NHFA had enabled the province to target and replace poor quality facilities, to renovate facilities, and to use available capital funding proactively to shift the location of facilities to more optimally placed locations

better placed to serve the needs of target communities. Through effective planning based on facilities assessments, the overall condition of the estate showed a substantial improvement between facilities assessments undertaken in 1995 and 2005" (Wall et al., 2008). The authors commented that "the relationship between health service delivery and infrastructure illustrates that facilities are a key resource that need to be managed alongside staff, equipment (health technology) and drugs."

By 2011, the National Health Act Regulations R655 and R186 designated Letaba Hospital as a Regional Hospital to serve more than a million people referred from the surrounding district hospitals within the Mopani District Municipality (Department of Health, 2011). The service catchment spanned 250 kilometers by 200 kilometers.

To redress the historical inadequacies of apartheid era health care and facilities, Letaba was included in the Hospital Revitalisation Programme, which aimed to improve the accessibility, affordability, and acceptability of hospital services through the modernization of infrastructure, provision of appropriate health technology, and delivery of quality health care in an efficient and effective way meeting quality standards affected by organizational development (KwaZulu-Natal Department of Health, 2001). The district hospitals in the new health catchment would also be upgraded: Nkhensane in Giyani, Maphutha Malatjie in Namakgale, Dr CN Phathudi in Maake, van Velden in Tzaneen, Sekororo, and Kgapane in Modjadjiskloof. By 2006, the new outpatient department, casualty, theaters, radiology, central steam sterilization department (CSSD), intensive care unit (ICU), six new wards, kitchen, mortuary, and pharmacy were in use, and plans for further expansions were in place (Vulekamali, 2023). Snapshots taken in 2005, 2015, and 2018 show the rapid pace of construction (Figure 2).

As these new buildings began to fill the old mission hospital campus, old clinker brick single skin buildings were replaced by modernist single story bungalows, with the uniform color theme, and long lasting marmoran wall finishes creating a coherent style across the work of the multiple architectural and engineering teams appointed by the Department of Public Works. In the modernist style, form followed function, the buildings rejected ornament and embraced minimalism, but reflected little of the local cultural heritage. "In the planned hospital there is only the swift provision of professional medical services. And yet both we and the planners know that each of these sites is the intersection of a host of interconnected activities that defy such simple descriptions" (Scott, 1998, p. 347). The overall effect provided a homely

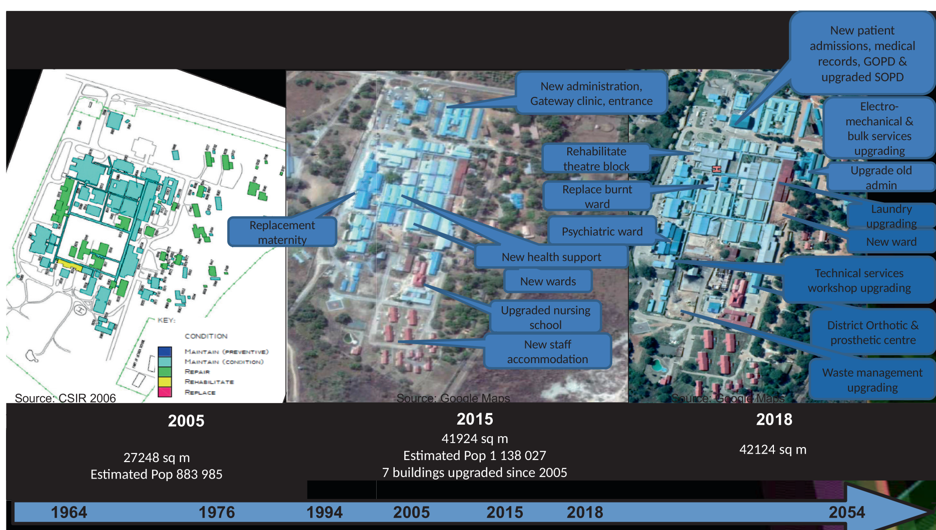

FIGURE 2 Timeline of infrastructure revitalization between 2006 and 2019 at Letaba Hospital (Roper, 2019).

atmosphere, providing views of sky and trees from most wards, well ventilated by natural air flows through the open windows, promoting health by contributing to salutogenic factors that support human health and well-being (Golembiewski, 2022). While many contemporary urban hospitals require artificial mechanical ventilation, the drive toward green buildings is signified by a return to natural ventilation. Globally, buildings use 35% of energy, and 38% of carbon emissions come from buildings and the building industry (UNEP, 2020). At Letaba Hospital, only the theater block, pharmacy stores, patient admissions, and medical records facilities were mechanically ventilated.

In 2011, the Limpopo provincial government imposed stringent austerity measures to try to make up for budget shortfalls and requested a bailout of at least R700 million from the National Treasury. After allegations of corruption, an emergency Cabinet meeting held in Pretoria decided to place the Limpopo provincial government under partial administration by the national government in terms of Section 100 of the Constitution. From December 5, 2011, the Cabinet took over management of the Departments of education, health, roads and transport, public works, and the treasury, after the province said it could not pay its bills (News24, 2011).

When the four Limpopo departments were placed under Section 100 Administration, the National Health Department spokesperson explained that “a diagnosis had to be done in order to understand the underlying causes that may have led to poor financial management” (Shamase, 2012). Reports on the investigations highlighted poor tender and procurement systems which resulted in irregular expenditure, some service providers were not meeting the required standards, hiring of excess administrative staff while there were shortages of health professionals, poor management had resulted in poor monitoring and ineffective supervision in terms of service delivery, and suspected fraudulent and corrupt transactions which had been handed over to law enforcement agencies (Shamase, 2012).

National government handed back full executive powers to the elected MECs (Members of the provincial executive council) of the affected provincial departments and the accounting officer roles to the Heads of Departments in 2015. New systems had been put in place for asset management, supply chain management and revised organizational structures for provincial treasury. “The intervention has brought a significant level of financial health to Limpopo” (IOL, 2015).

But healthcare services had been negatively impacted. For example, Letaba's failure to service its equipment from mid-2010 to mid-2012 had a dire impact on patients. In June 2012, the radiology unit at Letaba hospital was shut down after a warning by the principal radiation control officer in May that the X-ray equipment did not comply with the licensing conditions of the radiation control board: “Our records reveal that there is gross noncompliance with the licence conditions in your hospital. No annual quality control tests were performed in the past 24 months. Failure to comply will result in the sealing of the X-ray units and cancellation of the licence.” One frustrated employee said: “It broke down because it was not being serviced, just like all the others. When you ask why machines are not being serviced, you are told it costs too much money. But why have this equipment if you don't service it? Of course it will break down” (Shamase, 2012). As none of the radiology machines worked, no orthopedic surgeries could take place.

Construction under the Hospital Revitalisation Programme resumed in 2015, with projects focused on resolving the maintenance backlog, and addressing the poor health conditions as a result of poverty, inequality, poor social determinants of health, and poor access to services. Infrastructure projects at the regional hospital targeted maternal and newborn care, acute psychiatric services, orthopedic surgery, orthotic and prosthetic care, and specialist outpatient services. It took time to re-start the construction projects. First, the construction contracts had to be closed using contract law. The remaining work was quantified, and procurement procedures were followed to appoint replacement contractors to pick up the abandoned partly completed works (Vulekamali, 2023). Essential repairs renewed the electro-mechanical services providing

electricity, backup power, water, steam, oxygen, and other essentials. Sterilization, operating theater, laundry, kitchen, and medical equipment were repaired or replaced. Environmental damage was repaired, and the site landscaping and stormwater management systems were upgraded to prevent future flooding. Security lighting, including solar street lights, were installed to improve safety. The new patient admissions and medical records building streamlined and reduced patient waiting times (Roper, 2019), and the specialist orthopedic outpatient department attracted new specialists.

Organizations must balance consistency and change, business as usual and innovation. In project management terminology, projects are the way organizations change and adapt to the constantly shifting environment, and a project is change (Mathis, 2014). The PRINCE2 project management methodology defines a project as "a temporary organisation that is created for the purpose of delivering one or more business products according to a specified business case" (AXELOS Limited, 2017, p. 380). Projects have an end and aren't designed to last very long. The project team ensures the project delivers the intended goal, within a defined timeframe and budget.

Implementing capital projects within a functioning hospital is complex and risky. To mitigate and reduce risks to patients and staff, and protect the integrity of the construction contracts, included careful sequencing, decanting patient services, planning and alignment with healthcare services, user and beneficiary involvement, inclusive project governance, health and safety, and contract management. Adding spice, the projects were affected by flooding, fire, electricity and water outages, cable theft and damage, armed robbery, strikes, community protests, over and above the normal contractual delays caused by inclement weather, long lead times for specialist fixtures, fittings and equipment, contractor cash flow challenges, and the rework required when quality standards were not met.

From its inception as a missionary hospital in 1964, taken over by Gazankulu homeland in 1977, revitalized after 1994, Letaba Hospital developed into a dispersed collection of 105 buildings on a 10 hectare site, on the outskirts of Nkowa[2]. The Regional Hospital now serves an estimated 1.2 million people referred from the surrounding district hospitals within the Mopani District Municipality. This case study tells a story of a different type of infrastructure, set in an ex homeland, serving an ever increasing population. The life-story positions the infrastructure, projects, decisions, and people within the temporal and spatial realities over its life cycle.

After 15 years of construction and revitalization, the hospital finally opened sufficient wards to provide the 400 beds approved in the National Health Act Regulations 655. In 2023, construction continued on rebuilding the industrial laundry, to be equipped with new energy and water efficient machinery and equipment (Vulekamali, 2023). Only a few buildings broke the new stylistic uniformity: the original church which was still used by singing staff during lunch breaks, a colorful outdoor rest area and the laboratory, storerooms, boiler house, and the staff houses which had not yet been upgraded. With the growing population and changing healthcare needs, one may wonder about the unfinished nature of this infrastructure.

MAPHUTHA MALATJI DISTRICT HOSPITAL IN NAMAKGALE "LUCKCITY"

Maphutha Malatji District Hospital is located in Namakgale, a township 13 km outside Phalaborwa in Mopani District Municipality in Limpopo Province, bordering the Kruger National Park in South Africa. The hospital serves the towns of Phalaborwa, Namakgale, Lulekani (nicknamed Lukcity), and the surrounding villages. Specialist cases are referred to the Letaba Regional Hospital.

Phalaborwa town grew after 1956 around the mines which have created an open pit nearly 1900 m in diameter and 762 m deep, nearly six times the size of Kimberley's famous Big Hole. Namakgale

township was established in 1959 and Lulekani in 1979, largely by migrant laborers and their descendants originating from Bolobedu, Tzaneen, Ga-Sekororo, and Bushbuckridge. Employment was mainly at three mines, the Palabora Mining Company, Sasol Agri, and FOSKOR. Within the Mopani District, Ba-Phalaborwa Local Municipality had the highest labor force participation rate of 56% in 2018 (COGTA, 2020), but 55% were living below the poverty line.

The story of the hospital is the life story of a smaller hospital originally built in the township of the mining town, with a sister hospital in the town under the racially segregated apartheid health system. Maphutha Malatji District Hospital, in 2022, finds itself the only hospital in an urban cluster serving a large, youthful, generally unemployed population. The changing hospital infrastructure in many ways follows that of Palaborwa, Namakgale, and Lukelani, as they transformed and urbanized.

After 1994, communities across South Africa were reeling from the impact of the HIV/AIDS epidemic. HIV/AIDS denialism had a significant impact on public health policy from 1999 to 2008, during the presidency of Thabo Mbeki who criticized the scientific consensus that HIV does cause AIDS. Civil society had stepped into the void. The mines pooled their corporate responsibility funds with contributions from the Department of Health and municipality to establish the Palabora Foundation, providing education, skills and business development, and health awareness programs within the surrounding communities (Palabora Foundation, 2016). The Palabora Foundation launched the Phelang Community Centre (PCC) and support group, which served the mining, village and town communities in the greater Phalaborwa municipal area. PCC implemented an effective HIV collaborative management approach to minimize the impact of HIV and AIDS in the community, using a multi-sectoral collaborative approach, and working in partnership with a range of community structures within a 50-kilometer radius of Phalaborwa (Mandiveyi & Roper, 2007).

Reforms after 1994 demarcated the new geographic areas served by the new provincial departments, and incorporated the premises and fixed assets previously managed by the various homelands into a single management structure. Decentralization of infrastructure budgets changed the flow of funds, which had previously transferred from the national government to the homeland governments.

In response to the critical needs for health care in an under-served area with a growing population, and after a 1995 assessment of public hospitals, the Department of Health launched infrastructure projects under the Hospital Revitalisation Programme in 2004 (Mail & Guardian, 2004). At the hospital, large scale infrastructure projects were rolled out between 2006 and 2022 under the Hospital Revitalisation Programme (Figure 3). New wards, theaters, and gateway clinic were constructed, and old buildings were demolished.

The Doctors' strike 2009 lobbied for the government to implement the occupation specific dispensation (OSD) decided 2 years earlier, which would see salaries increased in line with international standards and improved working conditions. In 2010 in a 3-week strike, 1.3 million public servants, including nurses, health practitioners, and teachers, went on strike for increased pay, “motivated in part by government's excessive expenditure on the 2010 Soccer World Cup, which left strikers unconvinced of the state's claim that it could not meet their demands” (Daily Vox, 2014). Army medics were deployed into 37 hospitals, including at Maphutha Malatji District Hospital, as striking workers blocked entrances, assaulted colleagues, and disrupted surgery (The Guardian, 2010). Damage to the economy was estimated at over a billion rand a day. By September, hundreds of doctors had been fired for their participation in the strike (Mkhize, Evans and SAPA, 2009), further exacerbating the shortage and maldistribution of doctors across rural South Africa. By 2017, the Mopani district had only 9.7 doctors per 100,000 population (Ntuli & Maboya, 2017), including some of the 240 Cuban doctors placed in rural hospitals in Eastern Cape, Free State, KwaZulu-Natal, North West, Mpumalanga, Limpopo, and Gauteng since 1996 under a bilateral agreement to share skills and services and alleviate medical staff shortages (Sowetan, 2009).

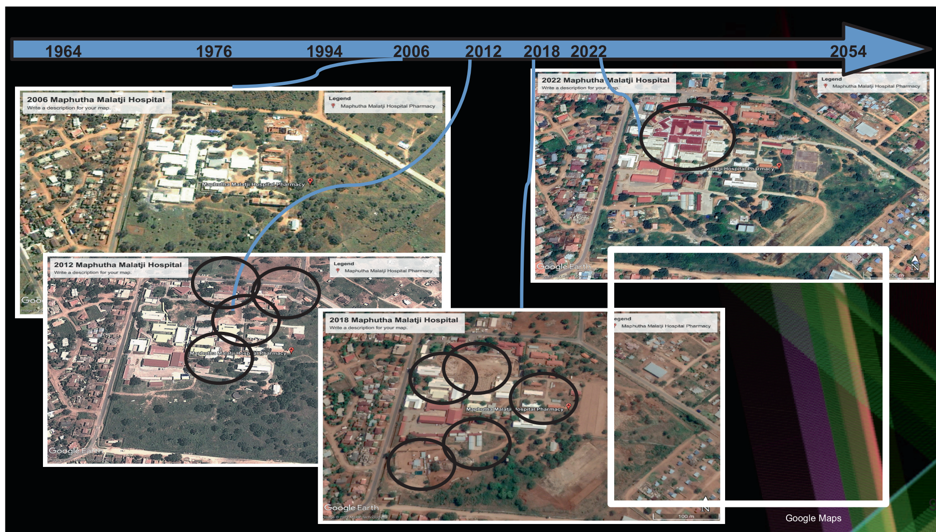

FIGURE 3 Timeline of infrastructure revitalization between 2006 and 2019 at Maphutha Malatji Hospital (Roper, 2019).

The hospital was unfinished. But in 2011, the Limpopo Provincial Government imposed stringent austerity measures to try to make up for budget shortfalls. They requested a bail-out triggering a Cabinet decision to take over management of the Departments of Education, Health, Roads and Transport, Public Works, and the Treasury (News24, 2011). The construction projects at the hospital ground to a halt.

In 2014, nine babies died in Luckcity's hospital, prompting a departmental investigation (TimesLive, 2014), and eventually a protest by the National Education Health and Allied Workers Union (NEHAWU) and the Democratic Nursing Organization of South Africa (DENOSA) calling for the appointment of additional infection prevention and control staff, and the dismissal of the hospital's chief executive officer and the nursing manager (Letaba Herald, 2015). Four years later, an opposition political party reported an average of 28 percent of the 230 babies born had died in hospital (Democratic Alliance, 2018). Medical negligence claims running into billions of South African Rands led to large payouts, straining the health budget. The Limpopo Health Department's annual report for the 2020/2021 financial year reported contingent liabilities of 12 billion South African Rands in negligence claims (LDoH, 2021).

In the wake of the Section 100 administration, the hospital revitalization was unfinished. Some buildings had been demolished between 2006 and 2012 in preparation for newer, modern facilities leaving the heart of the site empty for redevelopment. Construction of the replacement building had been affected by dependence on completion of earlier projects, delays during the Cabinet's Section 100 administration, and a fire. Projects were restarted after 2014. The urgent conversion of parts of the under-utilized pediatric ward into a new neonatal intensive care unit aimed to relieve pressure on the overcrowded maternity facilities (Department of Health, 2017). Renovations and alterations to the existing wards aimed to improve hygiene and functionality, and install temporary structures so that the hospital could continue functioning safely during the construction of the R445 million outpatient department, casualty unit, X-Ray, pharmacy, health support, and a helipad (Vulekamali, 2023).

The Department of Public Works, Roads, and Infrastructure (LDPWRI) appointed private sector professional service providers for design and construction monitoring: architects, quantity surveyors, and civil, electrical, and mechanical engineers. The LDPWRI took on project

management. As the Department of Health chief engineer, our team of construction professionals, architects, and quantity surveyors reviewed the designs to ensure they met the needs of the end users, national building regulations, and the national health design guidelines. We secured the budget from the ring-fenced Health Facilities Revitalisation conditional grant, and the LDPWRI advertised the construction contracts.

The LDPWRI awarded two contracts (LDPWRI, 2017). LDPWRI-B/14042 was awarded in 2016 to Mapitsi Joint Venture at a value of 30 million South African Rands for completion of works to linen buildings, kitchen, gateway clinic, wards, new walkways, and demolition of dilapidated walkways including electrical, mechanical installation and associated external works. Entering into a joint venture with a larger company allowed smaller construction companies to tender for larger projects than their Construction Industry Development Board (CIDB) grading would normally have allowed.

The larger project was advertised a year later, after a detailed review of the business case and concept for the hospital revitalization by national and provincial Treasury, Health and Public Works experts. LDPWRI-B/15004 was awarded in 2017 to Vharanani Properties Joint Venture at a value of 354 million South African Rands for construction of new OPD, admissions, allied health, accident and emergency unit, victim support, electrical, mechanical installations, and associated external works (Figure 4). In 2018, Vharanani Properties Joint Venture, a 100 percent black-owned construction company established in 2001, was recognized as the best performing black owned and managed construction company in South Africa (Clinton, 2020). However, despite their good reputation, the company almost immediately experienced cash flow problems. When the hospital project commenced in 2017, the Gauteng Human Settlements Department had only made a part payment on a R5.2 million invoice submitted by Vharanani Properties for work completed on an earlier project for the construction of low-cost housing and rental units in Tshwane (Sidimba, 2022). This severely impacted Vharanani Properties' cash flows, negatively affecting their ability to purchase materials and pay labor on their other construction projects.

At the same time, concerned residents in Namakgale complained to the Limpopo Department of Public Works, Roads, and Infrastructure “that the main contractor Vharanani Properties which was contracted by the department has appointed sub-contractors without issuing advertisements and further failed to hire locals” (CapricornFM News, 2019).

Completion of this final building at Maphutha Malatji hospital under the hospital revitalization program required coordination between the hospital management, contractor, professional service providers, and provincial and district officials of the departments of public works and health. It also required the support of local labor, businesses, and politicians. The

FIGURE 4 Construction of the new admissions, accident and emergency, radiology, pharmacy, and health support units at Maphutha Malatji Hospital (Roper, 2019).

project will be closed out. Keys, warranties, and maintenance files will be handed over to the hospital management. Users, the health care and support staff, and beneficiaries, the patients and service providers, will become used to the finished infrastructure. The infrastructure resulted from the dreams and aspirations of a generation. In their everyday relationships with the infrastructure, I hope that users and beneficiary value nurture and maintain it so that it remains relevant and functional for the next generation.

CONCLUSION

In the life stories of these three hospital projects, the infrastructure emerges not only as a physical manifestation of the ideology, first under the Apartheid regime, and later transformed under the new administration. It also reflects the dreams of the electorate and civil servants, like me, who aimed to implement construction projects in a way that would build the capacity of the construction sector, develop new service providers, create employment, train workers under the expanded public works program, and stimulate the economy. The resulting infrastructure promised to provide healthcare services, address the sustainable development goals, and shift South Africa from its repressive underdeveloped and inequitable past, into a secure future as a middle income country. It is my hope that the promise of more equitable and upgraded infrastructure in the projects that I have been involved with might have contributed to measurable increases in the health of South Africa's population, with average life expectancy recovering from a low of 54 years in 2003 at the height of the HIV epidemic, to 65 over the intervening 30 years (Macrotrends, 2023). Throughout these transformative years, the histories of the unfinished infrastructure demonstrated how infrastructure is more than material.

Returning to *The Promise of Infrastructure*, Anand et al. explored how dramatic infrastructure projects redefined the image and life experience of nation states and established new nations, including post-apartheid South Africa, in a different relationship with the global economy (Anand et al., 2018). They argued that Infrastructures have been central to the work of government since the nineteenth century, when Keynesian investments in public infrastructure stimulated the economy and sought redress for the inequities of the past. As my research tracks the material and social changes that affected the three hospitals over 30 years, my work seeks to casts light on concerns beyond the life cycle, and questions of their societal and physical materiality as a way to think about how we think about ordinary functional infrastructure as heritage, or not, in the face of the climate urgency and its associated impact on health in the Anthropocene.

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