saice
Civil Engineering
Sivili Inzhiniyeringi
May 2024 | Vol 32 No 4

SPOTLIGHT ON MARINE PAVING MANUFACTURING SPECIFICATIONS

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Road or rail: The freight conundrum

Historically, rail benefited significantly from the protection offered by government through the Motor Carrier Transportation Act (39 of 1930), giving rail a monopoly over freight transportation. However, the deregulation of the industry in the 1980s brought about a paradigm shift.

Following several steps towards deregulation, the Road Traffic Act (29 of 1989) abolished the economic regulation of the road transport industry, leading to a shift to road transportation, to the detriment of the railways. Many contentious debates followed in the early 1990s and 2000s over the seemingly unfair playing field; rail has to pay for its full infrastructure asset base and the maintenance thereof, while road hauliers are heavily subsidised by all vehicle owners through road taxation.

Does the "user pays" principle really apply? One may in fact find that road hauliers would lose their competitive advantage over rail if this principle was applied. Has South Africa then lost out on the opportunity to develop an integrated transport model/solution for the country that benefits both road and rail hauliers alike, and ultimately the population and the country's economic growth?

THE RISE OF ROAD

The road freight payload overtook rail between 2017 and 2018, and today accounts for approximately 85% of the freight payload transported. Long haul tonnage, where one would expect rail to excel, still has a road dominance of approximately 75%.

There is potential for a greater market share for rail transport, but efficiency must be key to this growth, and inter-modality could help to make logistics more efficient. More importantly, I think we confuse competition with cooperation. The transport sector needs to embrace a cooperative environment for the benefit of all.

One might argue that free market forces are good for the economy, and the current scenario needs to play itself out. But when ordinary citizens are feeling the "pain", who is in fact benefitting? Although SANRAL is keeping its head above water servicing the national road network, provincial roads are suffering the effects of maintenance backlogs, specifically in the Northern Cape, Eastern Cape, and KwaZulu-Natal. The magnitude and axle loading of the freight being hauled by road is accelerating the deterioration of the road network, in turn leading to increases in road haulier tariffs over time.

On the other hand, the rail sector has only itself to blame for its demise. Transnet Freight Rail (TFR) has a history of poor maintenance practices, poor service delivery, inefficiencies, underperformance, and lack of investment in an ageing infrastructure and rolling stock, exacerbated by years of unstable leadership and unchecked corruption and theft. This is unfortunately the backdrop against which road hauliers are (favourably) measured.

The historical development of South Africa's railways also restricts operations. Our Cape Guage system cannot accept double stacking, or higher/wider rolling stock. Topographical constraints also result in rail having to undertake longer trips to get to the hinterland compared to road hauliers – roughly 30% to 60% more in terms of route distance between major centres.

REVIVING RAIL

Partnership or "competition" to TFR by way of third-party access to the parastatal's rail network is a much-needed boost. TFR has been lacklustre in reviving the rail sector, and competition is overdue and can only be to the benefit of the economy. However, this initiative has been slow to materialise, and I sincerely hope that government offers full backing and commitment.

At the 2024 Sustainable Infrastructure Development Symposium South Africa, President Cyril Ramaphosa announced the latest Priority Projects, which included 123 road projects (R60.4 billion) and two rail projects (R10.11 billion). The latter will focus on upgrades to the Richards Bay Coal Terminal and additional lines at the Sishen Yard to accommodate manganese traffic. While this is a move in the right direction, I feel that rail got the short end of the straw in terms of budget, and the road-centric bias still persists.

As part of an integrated transportation system, rail needs to form the backbone of the economy, becoming the powerhouse in freight transportation. However, integration with road transportation is vital to bring efficiency and flexibility to the system. Furthermore, the integrated transportation system needs to be proactive in terms of market movements and demands, and not dictate these, as was historically the case.

It is vital that government establishes a long-term objective because an integrated transportation system, and associated infrastructure, needs time to be developed. Having said this, these objectives need to be phased in over the short to long term, with small wins along the way.

Andrew Clothier Pr Eng

SAICE President 2024
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Sivili Inzhiniyeringi = Tshivenda

ON THE COVER

The Mukona Group continues to invest heavily in skills and equipment, allowing it to remain abreast of the latest developments to offer specialised solutions for small to large geotechnical projects. The company is currently in the process of acquiring new equipment to expand its in-situ testing capabilities to assist mines in complying with the Global Industry Standard on Tailings Management.

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ON THE COVER P4

▶ **Mukona In Situ's new 6×6 A.P. van den Berg CPT Truck, equipped with a twin cylinder HYSON 200 kN penetrometer, is suitable for soil investigations in pushing capacities up to 200 kN**

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ON THE COVER

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QUIZ

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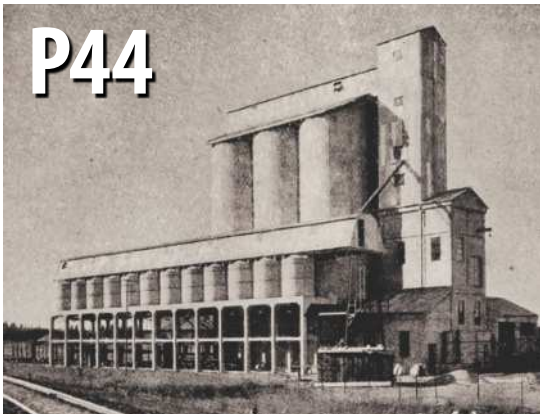

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Mukona continues to expand its offering to meet growing demand

The Mukona Group continues to invest heavily in skills and equipment, allowing it to remain abreast of the latest developments to offer specialised solutions for small to large geotechnical projects. The company is currently in the process of acquiring new equipment to expand its in-situ testing capabilities to assist mines in complying with the Global Industry Standard on Tailings Management (GISTM).

The GISTM, introduced in 2020, has set a new standard for tailings management and raised the bar for corporate responsibility around tailings dams. To comply with the new standard, mining companies are adopting and implementing best practices not only in planning, design, and construction, but also in operation, maintenance, monitoring, closure and post closure activities.

According to Solly Phalanndwa, Mukona Group's Founder and Managing Director, this has resulted in a greater demand for geotechnical in-situ testing at tailings dam facilities. Mukona In Situ, a division of the Mukona Group, has been offering geotechnical and geo-environmental site investigation since 2019, specialising in cone penetration testing (CPTu) techniques, pressure meter testing, electric vane shear testing (eVST), resistivity testing, MOSTAP sampling and flat dilatometer with seismic testing (SDMT).

As demand for specialised testing and equipment grows, Mukona In Situ is expanding its range of equipment to ensure that the latest and best solutions are available to the mining market in Southern Africa.

"We are building on our full suite of solutions to the civil engineering environment and fully investing in the mining environment so that we can offer a complete solution in terms of drilling and CPTu testing," says Phalanndwa.

NEW SONIC DRILLING RIG

The company has invested in a Comacchio GEO 602 sonic drilling rig, currently enroute from Italy. The machine, which is likely the first of its kind in South Africa, is a compact and powerful drilling rig suitable for many geotechnical works.

"In line with the GISTM, it is best not to use water when drilling cores in tailings dams for slope stability analyses, as the introduction of water can create instability. The sonic drill rig offers the ability to retrieve 100% core from the tailings without the use of water," explains Phalanndwa.

Mukona's rig will be fitted with two heads: the sonic drilling head for drilling through tailings, as well as a rotary head for drilling through hard layers and rock, and automatic SPT hammer for in-situ testing. The heads are interchangeable and can be swopped out while the rig is in position, allowing flexibility in drilling cores regardless of the material encountered.

In addition, the machine is equipped with an arm for rod handling, eliminating the need for manual handling of rods during operation. "This is important because it allows us to comply with mines' safety regulations and increases overall safety for our operators. It is a versatile machine," says Phalanndwa.

Mukona recently sent an operator and mechanic for a week of training at Comacchio's offices in Italy to ensure the team is fully equipped to operate and service the machine once it arrives in South Africa.

EXPANDED CPT OFFERING

In addition to the Comacchio GEO 602, Mukona In Situ recently acquired a new 6×6 A.P. van den Berg CPT Truck, imported from the Netherlands.

Phalanndwa highlights that the truck is self-stabilising, has an enclosed cabin, and comes equipped with a twin cylinder HYSON 200 kN penetrometer, making it suitable for soil investigations in pushing capacities from 140 kN to 200 kN.

This adds to Mukona's existing range of CPT testing equipment. "The Mukona In Situ division has invested heavily in high-quality, cutting-edge technologies and equipment which, combined with highly skilled and trained field staff, quick response times and quality reporting, provide our clients with accurate and reliable data, ensuring we meet each client's unique service requirements. Our in-house engineers can perform slope stability analysis and help ensure compliance of tailings dams as well as

Mukona In Situ's new 6×6 A.P. van den Berg CPT Truck

Two members of the Mukona team received training at Comacchio's offices in Italy

Mukona is currently undertaking a marine geotechnical investigation in Mossel Bay

a range of civil engineering applications like deep excavations, ground improvements and foundation designs," says Phalanndwa.

"We are constantly working to stay abreast of the latest technology trends and remain on par with the latest international developments in the civil, mining and tailings spaces. We meet with European product suppliers and some internationally-renowned experts at least once a year, in addition to continually engaging with our local suppliers, to ensure we can offer our clients the best and latest solutions and match international standards," he adds.

TURNKEY SOLUTIONS

What sets the Mukona Group apart is its ability to offer complete geotechnical turnkey solutions through its various divisions. Together with Mukona In Situ, Mukona Consulting Engineers and Mukona Geotechnics form a strategic alliance that offers "cradle to grave" solutions for small to large projects.

The consulting side of the business offers a wide range of cost-effective civil, structural and geotechnical consulting services to consulting engineers, contractors, mines, as well as private and public companies using state-of-the-art software, including Plaxis 2D, Plaxis 3D, MIDAS 3D GTNX, gINT, DatGEL, and LPile.

Mukona Geotechnics provides specialised geotechnical services to a range of customers in the mining and civil engineering industries and owns its own fleet of drilling equipment, comprising over 50 rigs. These include rotary drill rigs, percussion drill rigs, piling rigs, pile driving rigs for solar post foundations, lateral support rigs, and CPTu testing rigs. The division is also in the process of acquiring several new large diameter piling rigs to meet growing demand.

"We are not just the investigators, but also the designers and the contractors, so we know the end product and how it will perform in the ground. By providing a turnkey offering, Mukona can offer the most suitable and cost-effective solutions for our clients," explains Phalanndwa.

Together, the Mukona Group is an accredited Level 1 B-BBEE business, boasting a broad range of in-house technical skills which include registered professional engineers, and professional natural scientists: engineering geology. The consulting and geotechnical divisions are also ISO 9001:2015 accredited and in the process of obtaining ISO 45001:2018 certification.

DIVERSE PROJECT EXPERIENCE

In addition to the work Mukona has been doing for mines, the geotechs division began geotechnical investigations for SANRAL's N2 Wild Coast Road Project packages 1, 2, 3, 6 and 7 in late 2022. "These are some of the biggest geotechnical investigation projects currently underway in the country, and we are running 20 drill rigs every day between the packages. There is going to be a lot of lateral support work and piling needed along the route, and hopefully we can be involved in the next phase. The packages are being managed by Operations Director Teboho Motaung and fulltime Site Managers Moses Gazu and Shadrack Phalanndwa," says Phalanndwa.

Although the contract does not require community participation (CPG), the Mukona team has been liaising with the community through a public liaison committee (PLC) to ethically manage the project and provide work opportunities where possible. Through the PLC, Mukona has identified local businesses for supplying necessary services including, but not limited to, plant hire, local accommodation and up to 75% local labour employment.

"As part of skills transfer, we have trained several local employees who are now certified as operators, SHE reps, site clerks, etc. which has allowed us to gradually withdraw our skilled employees and allow locals to continue the work. We have also provided a number of local graduate students with on-site work training exposure through the project and assisted some of them in completing their in-service training," explains Phalanndwa.

The Mukona Group also specialises in cross-border work and has undertaken work in Mozambique, Botswana, Zambia, Kenya, Swaziland and Zimbabwe. The team is currently busy with detailed studies for a wind farm project in Mozambique. They have also expanded their offshore drilling activities by employing the use of a 120 ton barge, mainly for marine geotechnical works currently underway in the Port of Mossel Bay, Westen Cape.

"Everything is established from Johannesburg, so we have to be very organised and have all of the appropriate paperwork in place to ensure that we can get our equipment through customs and onto site without delays. The Mukona team has a great deal of experience in this regard, ensuring we have all the tools and resources to execute cross-border projects," Phalanndwa adds.

These all add to the Group's impressive portfolio of successfully completed projects which include large solar and wind farms, road, and hydrogeological developments, as well as a variety of mining projects.

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SAICE, growing forward, growing younger

SAICE's Growing Forward strategy consists of eleven pillars, each with its own specific mission and focus aimed at the complete career lifecycle of an engineer. Its aim is to help members attain sustainable growth and advancement within the profession, within the institution itself, and within the broader civil engineering sector.

I recently came across a play on the Growing Forward title, put together by members of the Future Leaders Panel based in the Western Cape branch: ***Growing younger: Is SAICE ready?*** After seeing this I challenged one of our future leaders, Tshepo Lethea, to put together his thoughts on what it means for SAICE to grow younger, while growing forward.

It is important that we recognise the contribution that our future leaders have to make and provide opportunities for them to express themselves and their aspirations for a more sustainable future of SAICE. This is particularly so as we approach Youth Day on 16 June, where we remember the plight of our youth and the resilience and bravery they showed 38 years ago, while fighting for a better future for all South Africans.

Tshepo Lethea's thought piece below highlights the youth's perspective, putting a spotlight on the diverse range of expertise and experience that our membership base comes from, which ultimately contributes to the richness and depth of our organisation.

IS SAICE READY TO BE YOUTHFUL?

When I began writing this I was afraid. I feared that it wouldn't appear professional enough, that my style wouldn't be well-received, and that there were so many things to be afraid of. Ironically, these fears are precisely why I chose to write this. I decided to approach this piece authentically, as myself – a young person and engineer – in my own voice. As you read further, this decision will become clearer and more meaningful.

In the ever-evolving world of civil engineering, South Africa is experiencing a transformative shift. The traditional image of seasoned engineers with experience is still dominant. When we think of a civil engineer, we often think of an elderly white male in safety shoes and jeans, driving a bakkie. However, SAICE's member composition tells a very different story, one in which SAICE finds itself at a critical juncture – is it prepared for the infusion of youth, fresh perspectives, and innovative ideas?

Tshepo Lethea
Engineer Project Manager and Associate
Ensync Engineers

In 2015, Malcolm Pautz, as President of SAICE, contributed to the discourse with **his presidential address** titled "Transitional generations and the need for the young engineer to be counted." Almost a decade later, it remains relevant to us, serving as a testament to the youth of today and our appreciation of history. Malcolm identified the following immediate and impending challenges that we, as an institution, and particularly the next generation of engineers, must take accountability and responsibility for: partnerships, transformation, transitional generation, and leadership. This will be the exact structure of my article.

Partnerships

Malcolm wrote, "The means of achieving a better life for all and meeting all our challenges will not come through a divided state and private sector spheres, but through improved collaboration and through striving to work together rather than apart." He argued that stronger public-public partnership are necessary, and that young professionals must decide to hold themselves accountable for achieving greater collaboration.

With the benefit of time, I can confirm his foresight; the trend has indeed moved towards more partnerships. However, as young civil engineers, we have not been leading in this space. Instead, we have been passive, hoping for our superiors to include us. Recently, particularly in the last year, there has been a positive movement, not necessarily in the work environment, but among youth voluntary organisations, which have been collaborating more and more.

Transformation

Malcolm noted one of the successes of the post 1994 era was a growing black middle class which in turn translated to SAICE membership. "43% of our members now hail from the previously disadvantaged section of our population (54% are white and 3% are unspecified). Of the 43% black, coloured and Asian members, 70% are under 36 years of age, while 30% of our white members are under 36. It is interesting to note, too, that ladies (all races) make up 14% of SAICE's total membership."

Transformation by its definition is proactive towards achieving a more representative demographic society. Nine years later, 64% of members are from previously

The Future Leaders Panel (FLP) plays a crucial role in building capacity and attracting interest in the engineering profession for members younger than 36 years. The FLP provides platforms for networking, knowledge sharing, and mentorship, empowering young professionals to contribute to the industry's growth and development. We are very proud of our future leaders and the inroads they are making in growing, innovating and sustaining our industry.

My overall vision is to further enhance SAICE's efforts in developing and providing opportunities for young professionals. We need to foster mentorship initiatives and programmes that empower the next generation of engineers, technologists, and technicians to drive innovation and sustainable infrastructure development in South Africa.

I have a vision of young members of SAICE who are actively engaged in shaping the future of civil engineering, participating in the development of policies, standards, and initiatives that influence infrastructure on both national and international scales while working side by side with the older generation.

I want to challenge our future leaders. The question is not whether SAICE is growing younger while growing forward, but rather whether you, as a future leader, are growing with SAICE, serving within its structures, and contributing to the development of our industry.

I charge you to help us take this institution forward and, through your dedication and expertise, to play a vital role in advancing the profession and driving positive change in communities across South Africa and beyond. SAICE will only grow forward with you at its helm, serving in its capacities and contributing accordingly.

In the words of Nelson Mandela, **"Sometimes it falls upon a generation to be great. You can be that great generation. Let your greatness blossom. Of course the task will not be easy. But not to do this would be a crime against humanity, against which I ask all humanity to rise up."**

Sekadi Phayane-Shakhane Pr Eng

Chief Executive Officer
SAICE

disadvantaged sections of our population – a substantial change. More interesting is that the total number of SAICE members, across all demographics, over the age of 36 is almost equal to the total number of previously disadvantage groups under 36 years old.

Transitional generation

Malcom stated the following: "I don't believe the traditionalists or the baby boomers will achieve the change necessary to take South Africa and the continent forward in meeting the National Development Plan or Millennium Development Goals, but they can certainly play an instrumental role."

He demonstrated a lot of faith in the engineers and strongly believed they were the only hope for a better life for all. However, the integration of younger professionals into the engineering ecosystem is not without its challenges. Generational gaps, differences in work styles, and varying expectations can create friction within the workplace. SAICE, as a custodian of the profession, must foster an environment that promotes collaboration between seasoned engineers and the incoming generation.

Recognising the value of diversity in thought and experience will be paramount to the industry's success. Sadly, I think many leaders in the industry do not actually believe in young people and their abilities. They find it difficult to trust that, although our abilities need improvement, we have well-meaning intentions. The inclusion of youth in SAICE often feels more like a box-ticking exercise than a genuine display of confidence in our abilities.

Leadership

Malcolm stated, "One of my key aims as President will indeed be to encourage the youth and elders towards bridging the gap in communication. After all, it's the youth who will provide the leadership, with guidance from the elders."

We have made some progress, but we are still very behind on youth leadership. Much more needs to be done to create a conducive environment and even more must be done by us as the youth to take on the responsibility.

So, is SAICE ready to be youthful?

My simple answer is it will never be, it shouldn't be, and we can't afford to wait for that. Ready or not the world is changing and SAICE, in terms of membership, is already youthful. What ought to happen now is to adjust and change our perspective.

The youth are not a charity case. They bring immense value and how they are treated as a major stakeholder must not be based on pity or favours. The engineering industry is experiencing a rejuvenation, with a surge of young professionals entering the field. These emerging engineers bring with them a wealth of technological acumen, digital literacy, and a penchant for sustainability – characteristics that are crucial in navigating the challenges of the 21st century. As South Africa marches towards a future defined by smart infrastructure and sustainable development, the importance of this new talent pool cannot be overstated.

In conclusion, I firmly believe that it is the youth who will propel us forward. As mentioned at the start, I was hesitant to write this, but I have come to understand that we, as the youth, have a significant stake in the future – it will affect us the most. The changes we seek at SAICE should not require permission; we must take responsibility and act on what we believe is best, whether we are afraid or not.

Celebrating another R10 000 winner

The most recent winner of SAICE's Know Your Sector Competition, Zunaid Areff Pr Eng, is a Principal Geotechnical Engineer at the City of Cape Town. His speciality lies in geotechnical engineering, and he is particularly interested in the safe and responsible design and operation of municipal and hazardous waste facilities as well as waste-to-energy projects such as landfill gas extraction.

Reflecting on what being an engineer means to him, Zunaid said, "To be constantly reminded that irrespective of how advanced we may consider ourselves, we can never surpass the perfection of the designs of God in nature. But we can learn from it to advance our understanding in the field and better serve humanity and our environment."

Zunaid describes winning the competition as a reminder that creation is nothing more than a network of conduits to manifest some of the innumerable favours of Allah (God). He plans to save his R10 000 winnings to use towards something that will benefit his family.

Zunaid says he enjoys being in company and in situations where he is able to learn and experience new things, and he is currently learning to surf. This desire to learn and grow is reflected in the attitude with which he approaches life: "Seek knowledge from the cradle to the grave to understand your purpose. Our purpose is not defined by our job title, salary or society. Our purpose is determined by the very One who created us." □

Know Your Sector Competition

Stand a chance to win R10 000 in cash!

QUIZ?

In this month's edition of *Civil Engineering* we are continuing our Fun Quiz to promote knowledge of our industry service providers. Simply click on the adverts (or the logos) of the participating companies to access their websites, and then search for the answers to the following questions:

QQ1: Zutari
How does Zutari deliver impact through infrastructure, making the world a better place?

Q2: Mukona Geotechnics
Which in-situ test does Mukona offer to measure cohesion and friction angle?

Q3: Schurco Slurry
In which year will heavy-duty centrifugal slurry pump manufacturer, Schurco Slurry, be turning 50 years old?

Q4: Astra Industrial Innovations
Our access handles offer superior design and functionality with the end users in mind. In particular, one of our handles nests into the housing for minimal protrusion and pops up to swing smoothly for easy latch actuation. Which of the handles best fits this description?

TO ENTER: Click on the link to submit your answers (submissions, one per reader, will be collected until **15 June 2024**, whereafter the winner will be announced from a random draw).

CLICK HERE TO ENTER THE QUIZ

PS: Advertisers who wish to capitalise on the reader attention here by including their marketing messages into our monthly **Fun Quiz** should please contact Barbara Spence (barbara@avenue.co.za / 011 463 7940 / 082 881 3454).

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Municipal finances in dire straights

South Africa's 112 largest municipalities had a combined operating deficit of R27 billion in 2023, once again calling into question their ability to meet their service delivery mandate.

The latest Municipal Financial Sustainability Index (MFSI) for the financial year ending in June 2023 was recently released by Ratings Afrika. The analysis, which explores the financial results of the 104 largest local municipalities and eight metros (totalling 112 municipalities), considers municipalities' operating performance, liquidity management, debt governance, budget practices, affordability and infrastructure development.

Based on these metrics, the MFSI provides a score out of 100 indicative of each municipality's financial sustainability. In their latest report, Ratings Afrika analysts Leon Claassen and Charl Kocks refer to the "ruination of the South African municipalities", indicating that the financial sustainability of the South African municipal sector has deteriorated dramatically since the MFSI was first published in 2011.

CASH SHORTFALLS

According to the Ratings Afrika report, the two key forces that drive a municipality's financial sustainability are the generation of operating surpluses and positive working capital balances. However, the majority of the South African municipalities are still operating at deficits, with the aggregate deficit for 2023 totalling R27 billion.

Continual deficits have culminated in large working capital (liquidity) shortfalls for most municipalities. The aggregate liquidity shortfall in 2023 totalled R84.5 billion, up from R65 billion in 2022. A major contributing factor is the low average revenue collection rate of 83%, highlighting an inability to collect what is due for services and property.

Liquidity shortfalls mean municipalities do not have the cash available to pay service providers like Eskom, water utilities and other creditors within the 30 days required by the Municipal Finance Management Act (MFMA). "Without working capital it becomes almost impossible for these municipalities to provide an acceptable level of services," states the report.

BEST AND WORST PERFORMERS

Although the situation is dire for most municipalities, there are a handful that have managed to achieve financial sustainability. Midvaal and Mossel Bay, each scoring 74 out of 100, are the most financially sustainable municipalities of 2023. Close behind, Saldanha Bay scored 73, Swellendam 72 and Swartland (Malmesbury) 71.

Cape Town is the only metro still considered to be highly sustainable financially in 2023 with a score of 70. Given that the average score for South Africa's eight metros is just 43, Cape Town is outperforming the rest of the metros by a large margin.

Common among these high-scoring municipalities are well-entrenched financial policies, budgets based on sound long-term financial strategies, strict financial control, good revenue collection and adherence to good budgetary practices.

On the other end of the spectrum, Amahlathi (Stutterheim) scored a meagre 7 out of 100, followed by Matjhabeng (Welkom) with a score of 10, and Lesedi (Heidelberg) with 21. Mangaung was the lowest-scoring metro with a score of 27. Common among the low-scoring municipalities is extremely weak liquidity positions with expenditures far exceeding operating revenue, resulting in relatively large operating deficits.

OUTLOOK

Ratings Afrika expects cash shortfalls to grow as most municipalities continue to realise losses, while revenue collection is expected to remain subdued due to slow economic growth, leading to worsening service delivery.

The report suggests: "To prevent a total collapse of these municipalities, the only solution is for the Government to bail them out to the amount of R85 billion. This will however only bring the municipalities onto a level footing to pay their creditors as stipulated by the MFMA. Unfortunately this R85 billion charge will have to be borne by already overburdened taxpayers."

With municipal infrastructure crumbling in many parts of the country, the outlook is certainly cause for concern. Water and sanitation Minister Senzo Mchunu recently announced R153 billion allocated to address water infrastructure backlogs in municipalities over the next seven years. However, he stated that, "there are limitations to which national support programmes can turn around the decline at municipal level".

In his 2024 State of the Nation Address President Cyril Ramaphosa stated that various national agencies are working together to enhance technical capacity in local government and to improve planning, coordination and fiscal oversight. He then pointed to the District Development Model (DDM), first introduced in 2019, stating that it has proven to be an effective instrument to enhance cooperative governance and collaboration.

However, the average MFSI score for local municipalities increased from 36 in 2019 to just 37 in 2023. Meanwhile the average MFSI score for metro municipalities decreased from 48 in 2019 to 43 in 2023. Has the DDM really had a significant impact?

With municipalities at the coalface of service and infrastructure delivery, it is vital that work on professionalising the public service is undertaken with urgency and integrity. Failure to turn the situation around will result in dire consequences for the public at large.

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HOW DOES ELECTRONIC ACCESS WORK?

Electronic access solutions (EAS) streamline the incorporation of standard automotive features, such as remote-controlled, keyless entry door systems, into various equipment. An EAS is composed of three primary components: an access control or input device, an electromechanical lock or latch, and a system for monitoring the status of the access point. These elements work together to enhance security, improve safety and ensure reliable operation in various applications.

Similar to the technology used in automotive applications, off-highway and other security equipment that has been outfitted with electronic locks, such as Southco's R4-EM Electronic Rotary Latch series, allows the equipment owner to remotely unlatch vehicles via a signal through a connected electronic access controller. Some of the electronic access solutions available to users include:

AC-10 Electronic Access Controller

The AC-10 is a versatile electronic access controller that offers secure and convenient access control for a wide range of applications. It features a user-friendly interface and advanced features, allowing businesses to easily manage access to their facilities. With customisable options, the AC-10 provides flexibility and scalability to meet the unique requirements of each business.

R4-50 Electromagnetic Lock

The R4-50 electromagnetic lock is a robust and durable solution that provides an additional layer of security. With its sleek design and powerful holding force, it is ideal for securing doors, cabinets, and other access points. The R4-50 ensures that only authorised individuals have access to restricted areas, enhancing overall security.

Electronic access solutions (EAS) streamline the incorporation of standard automotive features, such as remote-controlled, keyless entry door systems, into various equipment.

EA-BT Bluetooth Controller

Southco's EA-BT Bluetooth controller offers a wireless access control solution, eliminating the need for physical keys or cards. This innovative product allows users to unlock doors and access devices using their smartphones. With its advanced encryption technology, the EA-BT ensures secure and convenient access, making it an ideal solution for businesses seeking modern and flexible access control options.

E5 Electronic Swinghandle

The E5 electronic swinghandle combines electronic access control with a traditional swinghandle design. It offers secure access to cabinets, enclosures, and equipment while providing convenience and ease of use. The E5 is compatible with various industry-standard protocols, making it a versatile solution for businesses in a range of sectors.

Intelligent electronic locking mechanisms can provide intelligence not available with traditional mechanical key locking solutions. EAS can be used to create a digital record of activity, allowing the equipment owner to view the status of each access point, such as when an engine hood or toolbox was opened and by whom. ◻

Quay wall undermining repairs: A case study of Point A & B Berths in the Port of Durban

Durban's Point Precinct comprises multiple quays that service South Africa's maritime economy. The quays primarily handle containers, breakbulk and RoRo commodities and have dedicated quay servicing passenger vessels for Durban's booming cruise industry. Most of the quay walls were constructed in the 1970s from either blockwork or caissons. Transnet National Ports Authority (TNPA) recently embarked on a project to proactively protect the quays from undermining by installing scour rock as a preventative measure.

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The project was implemented because minor pockets of scour adjacent to the quay walls became evident during annual soundings of the quay basin. The intended scour rock will fill in the existing voids and provide a robust barrier between the forces induced by vessels' propulsion units and the underlying seabed to minimise the chances of undermining due to erosion.

The project was designed by TNPA and awarded to Stefanutti Stocks as the primary contractor. The project scope entailed dredging the seabed to the design level, levelling the seabed, and placing an 800 mm deep layer of scour rock along berths A, B and C in the point container terminal. The quays where the scour rock was placed were the oldest blockwork quays in the Point Precinct. The construction sequence required the contractor to use multibeam scanning technology to scan the seabed prior to levelling to identify high and low spots as well as to employ divers to investigate the magnitude of scour that may have occurred along the quay edge. The aim was to verify the stability of the block quay wall and ensure that the quay was not compromised by undermining of the toe of the structure.

The diving inspection found significant undermining of the quay wall that could not have been picked up using multibeam survey. Scour pockets of approximately 1.5 m below the toe level were present over a length of 48 m of the quay. The scour pockets protruded to a maximum of 5.8 m below the foundation of the quay forming a large cavity under the quay wall that spanned close to 54 m. This essentially meant that certain sections of the quay were solely supported by the interlocking of the wall blockwork and that a quick, long-term and cost-effective engineering solution was necessary to repair the quay wall and ensure that the quay is stable and fit for purpose.

ASSESSMENT AND ROOT CAUSE ANALYSIS

A full assessment of the quay wall was conducted to ensure that the cause of the scour was understood and that the proposed repair method would ensure stability of the structure. The following possible causes were considered:

- Scour due to vessels' bow thrusters
- Scour due to tidal current
- Over dredging.

Scour due to vessels' bow thrusters

Seagoing vessels rely on propellers and bow thrusters for manoeuvrability in the harbour basin, especially during berthing operations. The propellers and bow thrusters induce hydrodynamic forces over

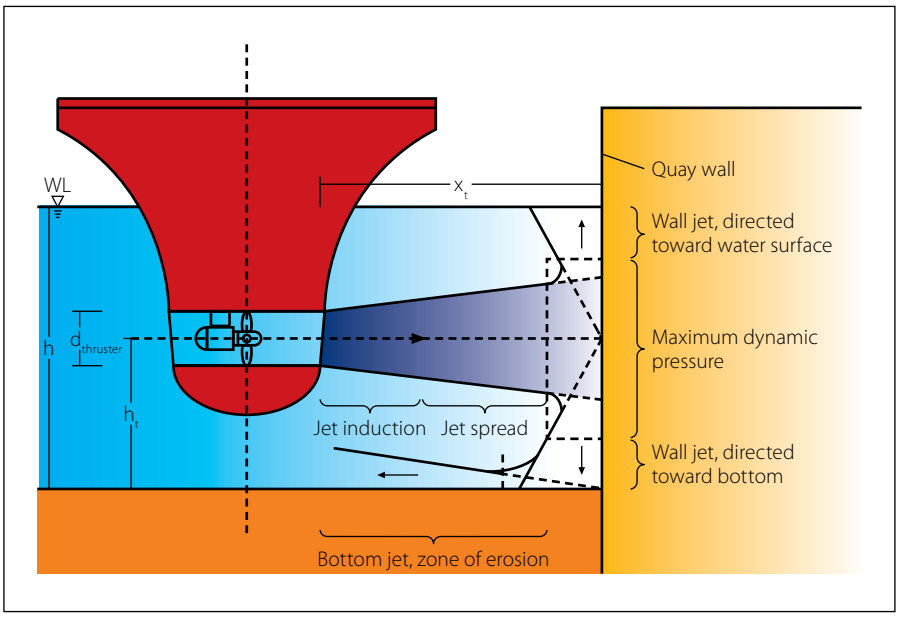

Figure 1 Jet velocity dispersion diagram of bow thruster against a quay wall (after Van den Brink, 2014)

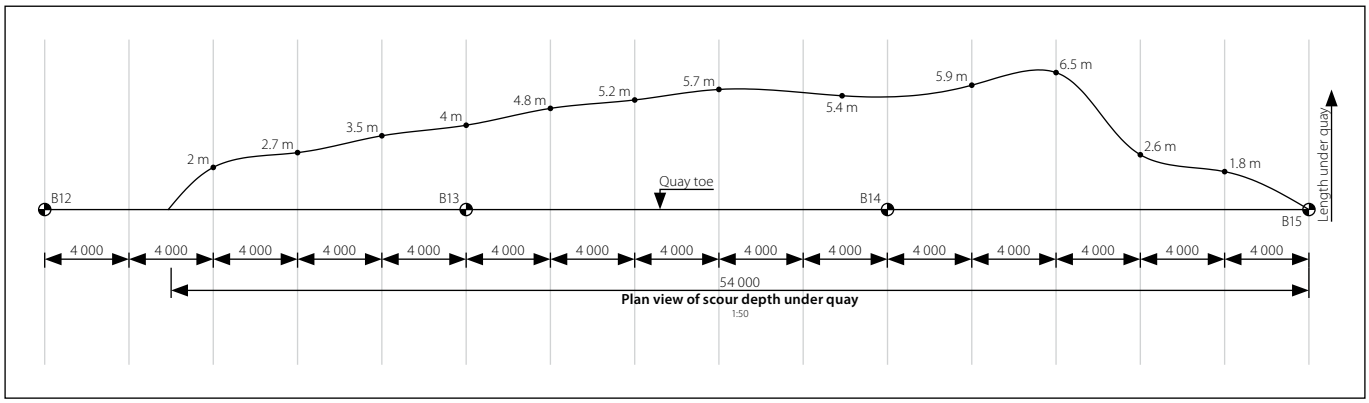

Figure 2 Depiction of the length of scour under the quay

the sediments and can generate scour depressions or holes at the toe of the quay wall, which can in turn compromise the stability of the structure. The turbulent jet flow from the propeller reaches the seabed or is deflected by the quay structure to the berth basin, leading to the development of scour pockets over time (Curulli *et al*, 2022).

The dynamic pressure induced by the jet stream is proportional to the size of the bow thrusters. Since the Point terminal quays are frequented by larger vessels, the hydrodynamic forces are greater due to the larger propellers, resulting in a higher rate of erosion.

Scour due to tidal current

The seabed soil response at a quay wall is affected by the current around the structure and through the seabed. The acceleration of the current and the turbulence that is generated around the quay leads to locally enhanced transport of sediment, and the creations of local gradients in the sediment transport rate which lead to local erosion of the seabed around the structure (Whitehouse *et al*, 2010).

Scour due to tidal currents is not always easy to detect or identify because the in-situ composition of the seabed material affects the rate of erosion and the deposit location of the eroded sediments. For example, if the seabed is comprised of sand or gravel, the material will likely form local deposits which are associated with the scour, whereas if the in-situ material is a clay or silt, the eroded material will likely be carried away from the site of erosion, leaving a scour pocket that is not readily infilled by natural processes. The rate of scour is relative to the intensity of tidal currents and may erode at a faster rate during storm conditions when tidal currents are stronger (Whitehouse *et al*, 2010).

Scour due to over-dredging

Over-dredging was a factor that could not be discounted as a cause of the scour at the quay. Dredging close to the quay requires clamshell or bucket excavators, as traditional cutter suction dredgers are unable to get close enough to the quay wall to effectively dredge excess material. The clamshell and bucket excavators rely on GPS trackers located near the bucket to determine the finished surface bed level. Inaccuracies in the device or operations could lead to incorrect levels being taken, leading to over-dredging of the berth pocket. Excessive dredging might have led to the formation of scour pockets near the quay wall, resulting in gradual deterioration over time.

Further testing

It was noted that the multibeam was limited to only determining the depth of the scour pocket at the toe of the quay wall. A dive team was dispatched to inspect the scour pocket and measure the projected length of the cavity under the quay. The murky water left the divers with near zero visibility, which posed a danger for the divers. The divers therefore used rods which were extended under the quay at 4 m intervals to determine the length of undermining (see Figure 2).

TNPA and Stefanutti Stocks undertook an additional study in which a sonar-enabled remotely operated vehicle (ROV) was deployed to accurately determine the extent of scour. The ROV was positioned under the quay in areas that were not accessible to divers. The multibeam sonar took horizontal measurements from the toe of the quay to determine how deep the scouring extends beneath the quay (see Figure 3).

The ROV depth sensor was used to take depth measurements at the toe of the quay and on the seabed directly beneath the quay to determine the vertical measurement of the scouring. After numerous

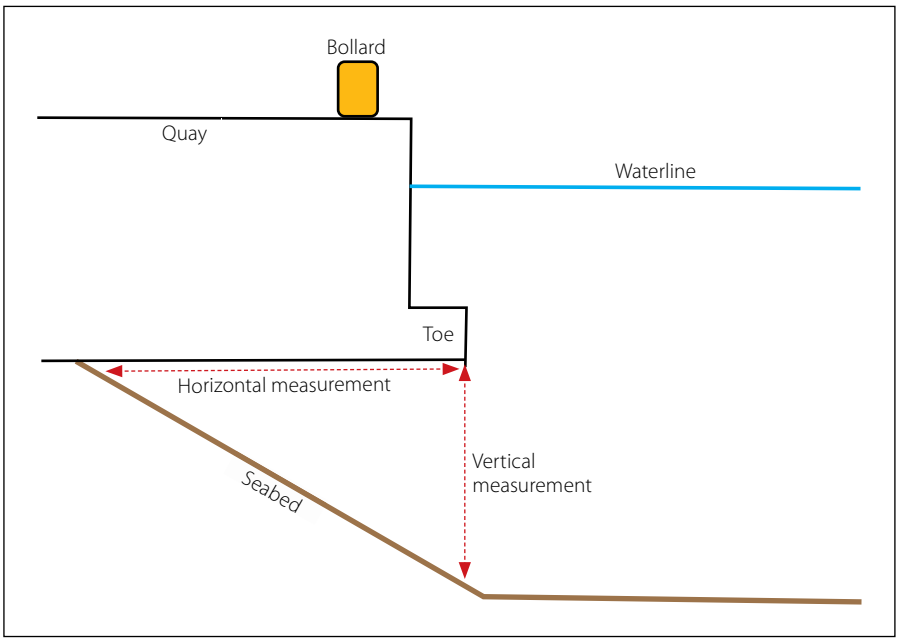

Figure 3 Depiction of the measurements taken by ROV (Marine Solutions, 2023)

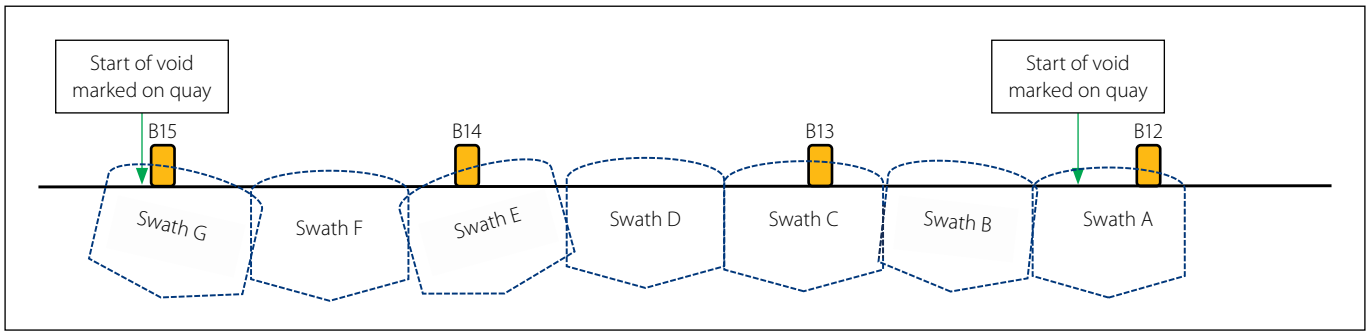

Figure 4 Depiction of the ROV placement in front of the quay (Marine Solutions, 2023)

unsuccessful attempts to conduct the inspection by ROV only, the decision was made to enlist the dive team on site to manoeuvre the ROV into position to take stable measurements without risking loss or damage to the ROV (see Figure 4).

The measurements taken by the ROV closely correlated with the measurements taken by the diving team. The measurements are displayed in Table 1.

Table 1 Summary of ROV measurements

	Horizontal measurement	Width in swath	Vertical measurement	Depth under toe	Seabed depth
Swath A	2.20 m	6.81 m	0.7 m	14.7 m	15.4 m
Swath B	4.85 m	14.31 m	1.4 m	14.8 m	16.2 m
Swath C	4.79 m	13.25 m	1.8 m	14.8 m	16.6 m
Swath D	4.73 m	14.48 m	2.0 m	14.8 m	16.8 m
Swath E	3.33 m	11.73 m	0.7 m	14.8 m	15.5 m
Swath F	2.32 m	7.72 m	0.7 m	14.8 m	15.5 m
Swath G	0.93 m	1.24 m	Less than ROV – 0.22 m	14.7 m	± 14.9 m
Swath H	1.42 m	9.06 m	Less than ROV – 0.22 m	14.2 m	± 14.4 m
Swath I	2.02 m	6.13 m	0.5 m	14.2 m	14.7 m
Swath J	2.33 m	5.46 m	0.4 m	14.2 m	14.6 m
Swath K	NA	2.31 m	Less than ROV – 0.22 m	14.1 m	± 14.3 m

REPAIR METHODS CONSIDERED

Multiple repair methods were considered, taking into account cost, material availability, and effectiveness. Since the discovery of the cavity was an unforeseen event, TNPA and the contractor were under extreme pressure to develop a viable solution that would not significantly jeopardise the project's budget and timeline.

Cement-stabilised geobags and soil infill

One of the proposed solutions was to use cement-stabilised soil geobags to prop up the toe of the structure and then use dredged material or quarry run stone to fill the voids before the geofabric and scour rock was placed (see Figure 5).

Similar repair methods were previously used to repair minor scour pockets close to the toe of the port's quay walls. This repair option was the cheapest, but numerous other factors made it unfeasible.

The cement sandbags could not be placed by mechanical means, which meant that the only viable option was for divers to move and place the approximately

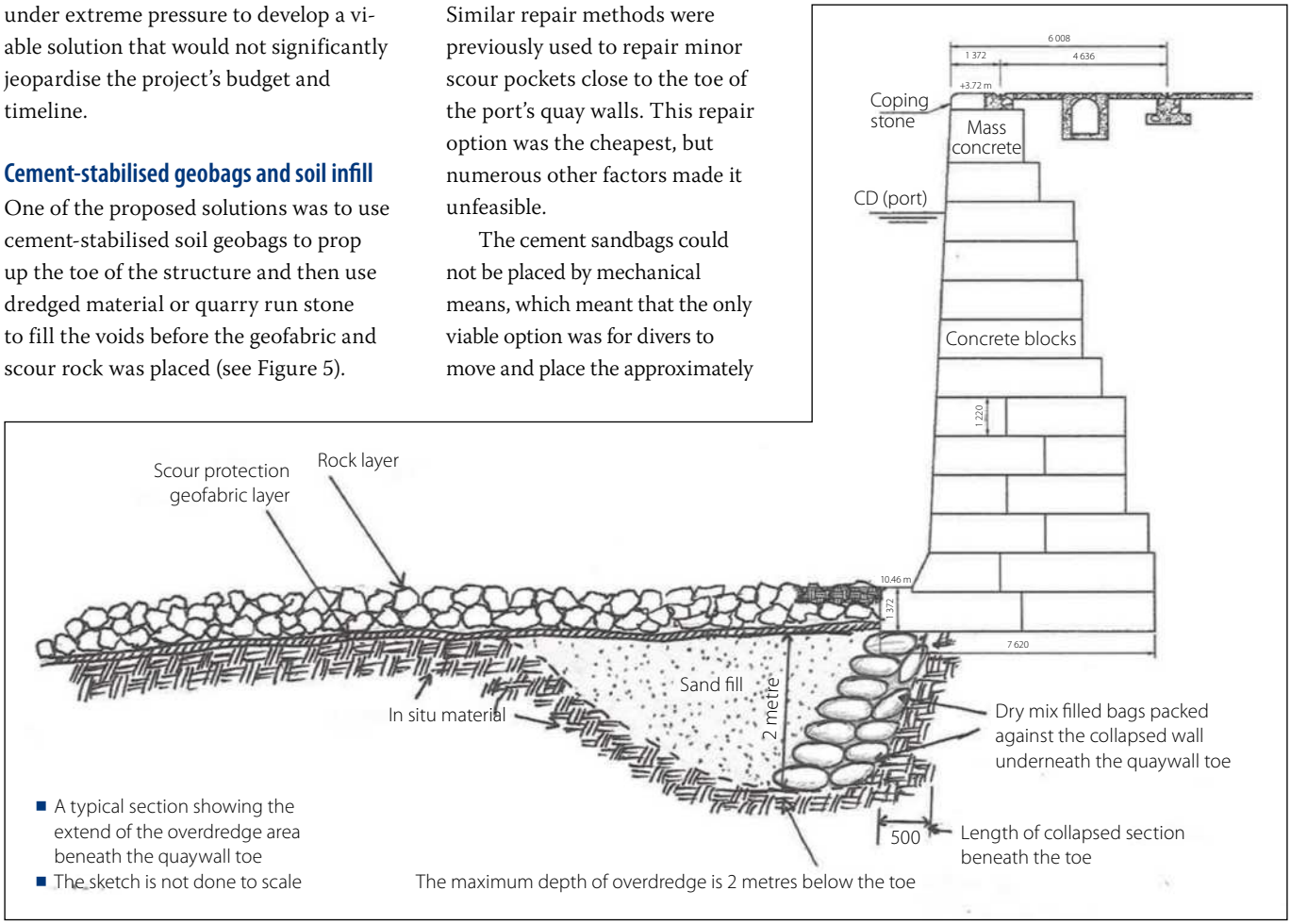

Figure 5 Illustration of the cement stabilised geobag and infill repair option (Illustration by Samukelo Gasa)

40 kg sandbags under the toe of the quay. This would mean exposing the divers to numerous safety hazards in an unstable and confined environment. Furthermore, the extent of scour along the quay was more than 50 m long and would require hundreds of bags to be placed one at a time, which would have been a slow process. There was not sufficient time on the project schedule for this option to be considered further.

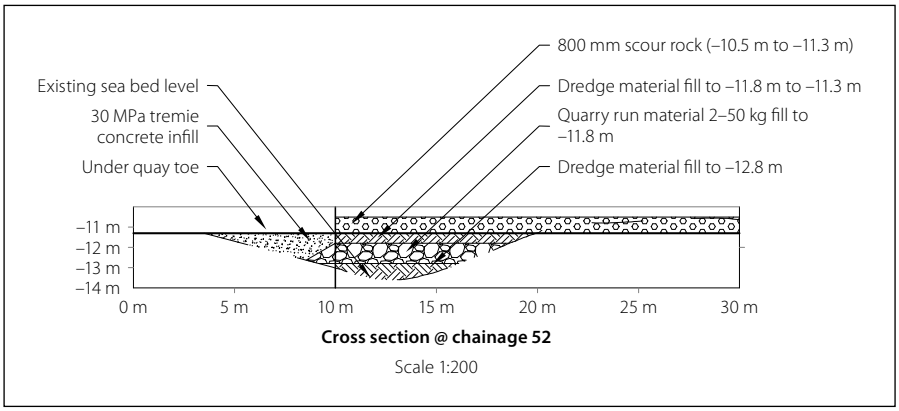

Figure 6 Proposed repair method using quarry run infill and concrete/grout injection under the quay

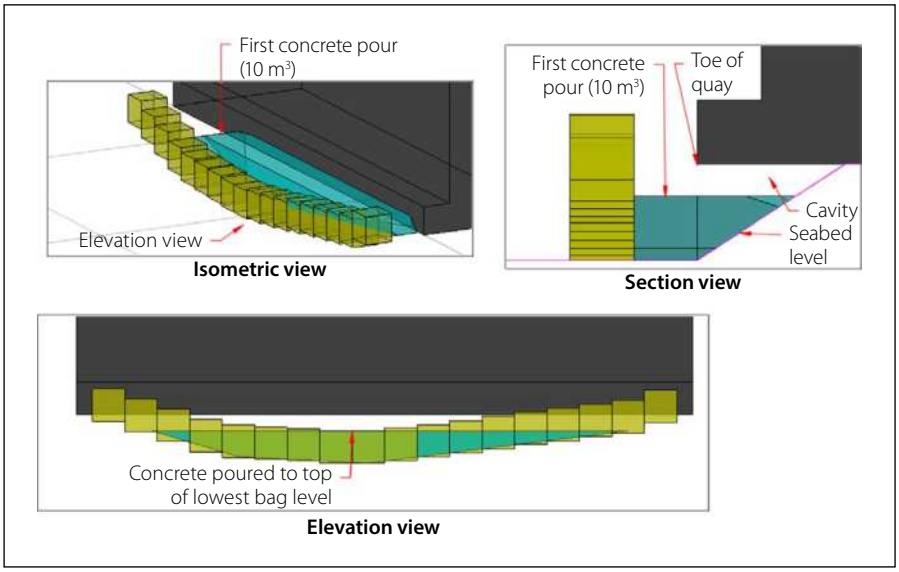

Figure 7 Illustration of the first phase of the construction for the concrete infill repair option

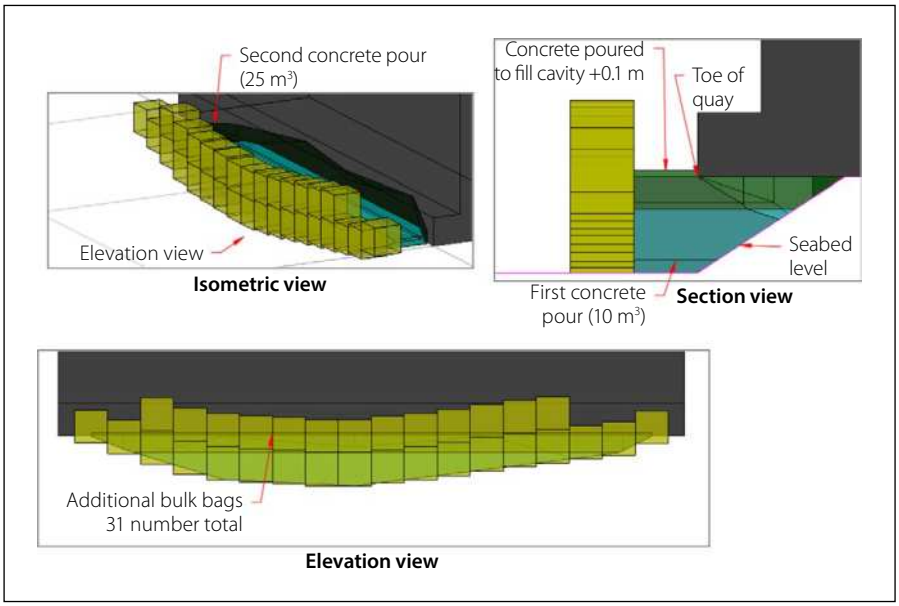

Figure 8 Illustration of the second phase of the construction for the concrete infill repair option

Quarry run stone base with concrete infill

The second repair option explored the use of quarry run rock as an infill instead of dredged material. The rationale was that the rock would provide greater stability than sandy material, and that concrete would be pumped into the void under the quay to further increase stability (see Figure 6). The intent was that the concrete would be able to flow to refusal within the void and close off any voids, thus providing a stable base with the rock infill.

This option relied less on manual labour and divers. The rock infill could be laid using machinery that was already on site and the concrete could be pumped from the quayside. The difficulty in the construction stemmed from the containment of the concrete. Measures would have to be taken to ensure that the cavity was sealed so that concrete could be pumped under the quay.

PREFERRED REPAIR METHOD AND CONSTRUCTION

The preferred repair option of using concrete to fill the cavities under the quay was achieved by using bulk bags filled with sand to act as a temporary shutter for the concrete. This option was chosen with the collaboration of Stefanutti Stocks, Subtech and Transnet. Subtech was appointed as a subcontractor on the project and provided the sandbags and concrete pumping and assisted in the overall construction and design of the preferred solution.

The repair methodology included the following steps:

1. Level the scour area to provide a stable platform to install sandbags.
2. Install the first layer of sandbags from the quay edge with mobile cranes.
3. Pump concrete to the first layer of sandbags under the quay (see Figure 7).
4. Install the second layer of sandbags from the quay edge.
5. Pump concrete to the underside of the quay (see Figure 8).

The preferred option was selected because the required materials were easily attainable and the construction process would be relatively quick in comparison with the other options considered.

6. Remove sandbags to finished dredge or toe level.

The preferred option was selected because the required materials were easily attainable and the construction process would be relatively quick in comparison with the other options considered. The solution centred on providing a solid base under the toe of the quay to provide additional support. 40 MPa concrete was used as the mix design and it was pumped as far back into the cavity as possible to ensure that most of the voids were closed.

The shortfall of this solution is that the engineering team had to rely on the pumping pressure of the concrete and gravity to level out the concrete and fill the voids. The concrete could not be pumped under high pressure to ensure that all voids were filled, and no entrapped air remained under the quay.

CONCLUSION AND RECOMMENDATIONS

The nature of the project and the timelines involved did not provide the engineering team with a large timeframe to design a solution. Many assumptions therefore had to be taken to come to an end product. It was assumed that the in-situ material was stable and compact, and that there would be little settlement due to the load of the concrete. There was insufficient time or budget to conduct any geotechnical studies to determine the engineering parameters of the in-situ material. Another assumption was that the concrete would completely fill the voids and rise to have full contact with the underside of the blockwork quay. This could not be confirmed visually or by testing.

A more accurate means of ensuring that the voids were completely filled was to use grout injection. Pumping grout at a higher pressure would have forced the grout into any remaining small crevasses, however, there was the likely possibility that the grout may continue to move laterally under high pressure, and refusal of the material would not be achieved.

The unplanned nature of the project and the risk it posed to the quay required the engineering and the contracting teams to collaborate extensively throughout the development and implementation of the solution. In developing the solution, the team had to keep in mind the resources available as well as the time constraints. The end solution was deemed to be the easiest and fastest to construct while providing the stability needed to prevent failure of the quay.

A key lesson learned from the project is that better technology should be implemented in monitoring the condition of the berth basins and quay walls. The primary tools for underwater surveys within the port are multibeam or single-beam surveys. These surveys are readily adopted because they can be implemented rapidly over a large area, at a relatively low cost. However, the technology is limited in that the levels detected are purely vertical and there is no indication of possible cavities that may be present under the quay wall. The extent of the cavity detected in the Point quay was large and would have taken years or months to develop, and even with annual surveys taken, the presence of the cavity was unknown until divers were deployed to verify in-situ conditions.

Given the state of ageing infrastructure across the TNPA port system, it is recommended that ports make use of technology such as sonar capable ROVs to supplement the inspection of quays on a regular basis to get a broader range of information on the extent of scour detected. The use of divers to conduct inspections on quays cannot be undervalued, as they were critical in first assessing the problem. However, safety concerns and visibility constraints unfortunately limit diving operations in most ports. ◻

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Marine paving failure highlights the importance of adherence to manufacturing specifications

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The recent failure of a major marine paving installation at the Strand esplanade in the Western Cape was an entirely avoidable occurrence. It prompted this brief commentary which discusses additional measures required when producing concrete block pavers for marine environments. Much of the content here draws on a paper titled "Durability of block paving in a marine environment" prepared by Alex Visser, an Emeritus Professor in the University of Pretoria's Department of Civil Engineering, which he first presented at the 7th International Conference on Concrete Block Paving in September 2003. Twenty-one years later, the paper's content is still just as valid.

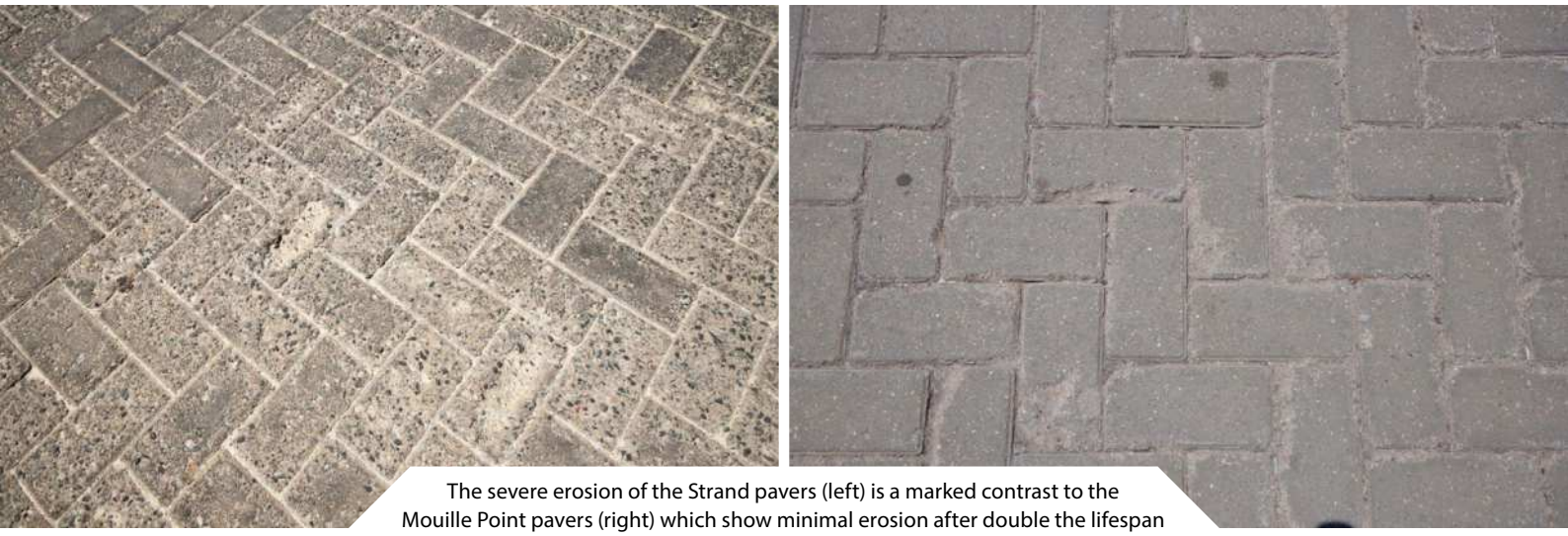
Marine paving installations are exposed to repeated cycles of wetting and drying. If the pavers have not been specifically manufactured for marine environments, it can cause two types of failure: chemical reactions within the pavers resulting in the softening and disruptive expansion of the blocks; and the crystallisation of salts on the surface of the pavers.

In the former, water is drawn up through capillaries in the pavers, and as the moisture evaporates and the blocks dry out, dissolved salts in the form of crystals are left in joints between the blocks and in their pores. To prevent this capillary flow, the blocks should be well compacted and have a low porosity. Furthermore, concrete containing high-alumina cement is recommended since it provides greater resistance to sea water than portland cement.

Seawater sulphate is another paving block enemy. It can destroy the surface of concrete paving blocks and cause a chemical reaction between aggregates and cement or the atmosphere. To improve resistance to sulphate attack, a concrete mix with a low water-cement ratio and a sulphate-resistant cement is required. When the water-to-cement ratio is too high, i.e. insufficient cement, it results in surface erosion of the paving blocks and an excess of air entering the concrete mix.

And as stated above, paving blocks must be fully compacted to reduce permeability so that water absorption is less than 4%. Moreover, to minimise the chemical reaction between aggregates

A large section of the paved esplanade at the Strand (top) exhibiting severe erosion only five years after installation, whereas the paved section at Mouille Point (bottom) exhibits minimal wear after 10 years



The severe erosion of the Strand pavers (left) is a marked contrast to the Mouille Point pavers (right) which show minimal erosion after double the lifespan

and cement, the use of inferior aggregates should be avoided.

STRAND ESPLANADE COLLAPSE

The Strand esplanade runs adjacent to the town's beach for a considerable distance. The paving was installed a mere five years ago, and large sections now exhibit severe surface erosion. It is quite obvious, even to the untrained eye, that the paving block supplier omitted one or more of the crucial steps required to produce marine-class paving blocks.

Engineers include detailed specifications in their tender documents for a reason, namely, what will work given specific environmental conditions. In the case of the Strand, the pavers were correctly specified by the engineer, but the specifications were not followed correctly during manufacture. If they had been, the pavers would have withstood the corrosive effects induced by their proximity to the sea. In this instance the company procuring the pavers might not have supplied the paving producer with all the engineer's specifications. Notwithstanding, whether the proper specifications were included or not, the pavers should have undergone proper testing procedures in an independent laboratory prior to site delivery, especially for abrasion resistance and water absorption.

A marine paving installation which offers a stark contrast to the Strand is Cape Town's Sea Point/Mouille Point esplanade, which provides a noteworthy example of paving block durability in a marine environment. Its construction dates back to 2010, and took place after nine concrete block types had been tested in an experiment conducted by Prof. Alex Visser in collaboration with civil engineer Bob Smith of Ingerop.

Specimens used in the initial laboratory tests were selected from the following block types:

- 20-year-old blocks without a capping layer that were removed from a coastal footpath which had not deteriorated.
- New blocks which had deteriorated or were still intact (without a capping layer) after having been in service for only three years.
- Blocks manufactured in Gauteng do not perform well in marine environments. To confirm this blocks with a 10 mm capping layer in a different concrete mix were tested.

These test results were compared with the reported performance of some installed pavers. However, to evaluate the appropriateness of the laboratory test protocol, nine panels were constructed at Mouille Point for a field test in the area where the problem which initiated the study initially occurred. Paving blocks of varying strengths and compositions were sourced from different producers and were exposed to regular sea splash. Anticipated performance was predicted before the experiment began, and after one year the results were compared with the predicted results.

The experiment was conducted on the basis of five performance tests:

These images demonstrate the effect of salt water on pavers. Salt water has seeped into the pavers at the Strand esplanade (left), causing severe erosion. At Mouille Point (right), the salt has settled and crystalised on the surface of the pavers thanks to the use of a water-proofing admixture, leaving the pavers undamaged and intact

Over the past 10 years, the C.E.L. marine-grade pavers at Mouille Point have withstood regular dousing from wave action and sea spray

- Cement content
- Salt resistance
- Water absorption
- Porosity
- Abrasion resistance.

On completion of the experiment the best-performing paving block was specified for the Mouille Point esplanade. They were manufactured by C.E.L. Paving Products, which went to extraordinary lengths to produce a paver to Visser's specifications. Its efforts have yielded positive results: after 15 years of constant sea spray and wave exposure, the pavers exhibit minimal signs of sea-borne erosion.

RECOMMENDATIONS FOR MARINE PAVING INSTALLATIONS

Visser's paper concluded by recommending that the primary requirement for resistance to paving block degradation in a marine environment is a cement content greater that 14% and preferably greater than 18%. Laboratory tests that provide an indication of potential paving block vulnerability are the cement content test and 15 cycles of soaking and drying in a sodium chloride solution. The Mouille Point experiment demonstrated that variability in the materials used to produce the paving blocks played a major role in their durability.

This was noticed in the cement content determination as well as in the field where some blocks were found to degrade while others in the immediate vicinity remained in good condition. It was felt that block location in the production process could play an important role and should be controlled for in future experiments.

Additionally, it was observed that pigmented blocks performed better than un-tinted blocks made with the same mix to the same strength. It is also well known that fly ash improves the durability of concrete in a marine environment. Visser hypothesised that pigment functions in the same manner as fly ash, reducing pore size and resulting in improved durability. He recommends that fly ash be used as a cement extender for marine paving blocks, especially for un-tinted blocks.

The full results of the laboratory tests and the Mouille Point experiments are presented in Visser's paper which can be viewed at **https://www.cma.org.za/Portals/0/Docs/paving/blockpav03.pdf?ver=2024-04-07-095357-270**.

The main lesson to be drawn here is that material specifications in tender documents are critical to the anticipated lifespan of paving products. As the Mouille Point experiment has shown, variability in paving block materials plays a crucial role in durability.

And, finally, a word of caution: whenever pavers are priced at levels considerably lower than competing tender submissions, alarm bells should ring. To ensure that pavers are fit for purpose, paving procurers and/or contractors should ***always*** batch test pavers in an approved laboratory prior to installation. While not foolproof, it will go a long way to avoid premature paving degradation. ☐

Excavating the shipwreck of *Haarlem* (1647): A multi-disciplinary effort to reveal a national treasure

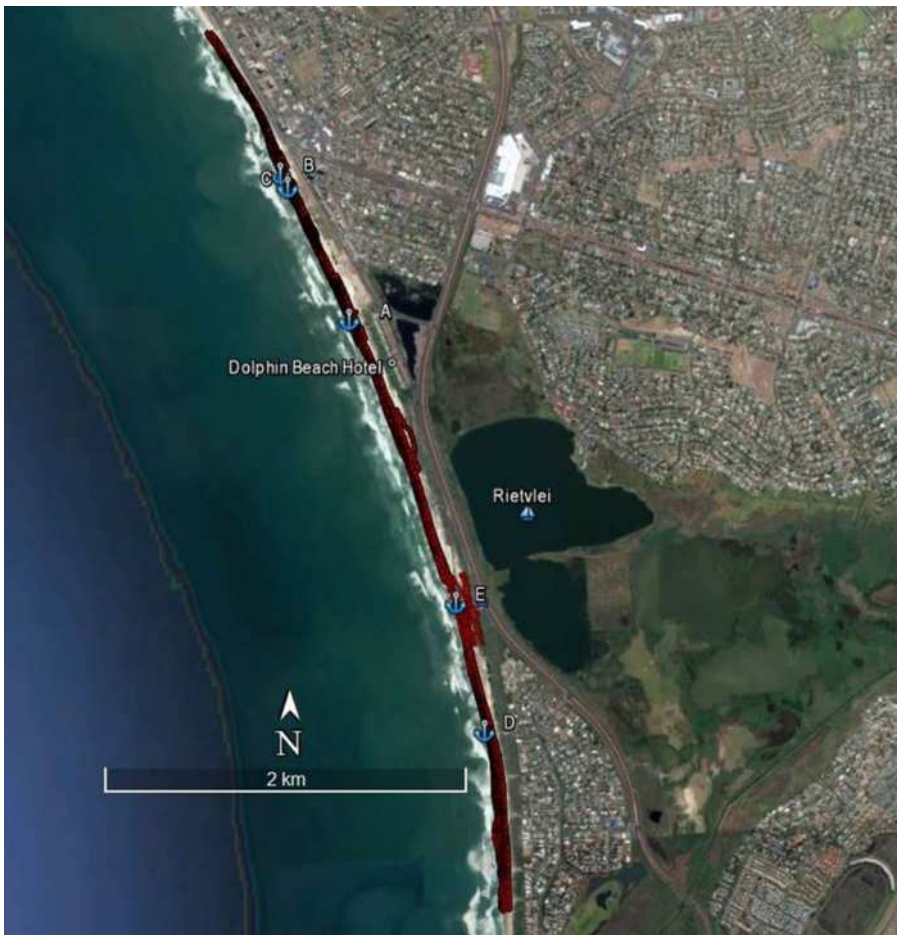


Figure 1 Haarlem Project test excavation locations A to E between Table View to the north and Milnerton (Source: Billy Steenkamp ©AIMURE)

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No shipping disaster in the world ever had such an impact on the history of a whole nation as the demise of *Haarlem*. This United Dutch East India Company (VOC) ship touched ground in Table Bay on Monday 25 March 1647 and became a total wreck. 62 of the crew were left behind, finding refuge in a makeshift camp where they lived for over one year. During their stay, the men established contacts with indigenous people and reported favourably on their experiences upon their return to Europe in August 1648. As a result, VOC management established a stopover for their ships. In time, this station developed into the City of Cape Town. The wrecking of *Haarlem* thus represents one of the major roots of South African society as we know it today.

Since 1989, a multidisciplinary research project has been underway to obtain information on this historic event. It includes archival studies, aerial, geophysical, and geological surveys, as well as archaeological sampling, test excavations, and material analyses of recovered artefacts. These different approaches have provided strong indicators for the location of the wreck and survivor camp.

This article discusses some options from an engineering perspective to excavate the shipwreck of *Haarlem*.

BACKGROUND

The historical significance of the wrecking of *Haarlem* and what followed from it led to the decision to research the event in more detail in October 1988. The first phase consisted of a heuristic survey, aimed at identifying available literature about the incident. The next phase focused on archival research in the Western Cape Archives and Records Service and the Nationaal Archief in the Netherlands. As a result, several relevant historical documents, maps, and charts of Table Bay were traced (Werz, 1999, 2011, 2017a, 2017b, 2017c). Modern studies, such as assessments of seasonal variations in beach morphology of the eastern shore

of the bay and the geology of the nearby Rietvlei area, were also incorporated (Malepe, 2016; Master, 2012; McLachlan, 1991). This combined information allowed for the demarcation of an area between Table View and Milnerton as the place where *Haarlem* had met its demise.

The historical documentation indicates that the wreck was deposited in shallow water, with a depth of about -1 m to -1.5 m, at the foot of a beach slightly to the southeast of Robben Island. The distance to the 'dry' beach was indicated as <60 m and, in time, the ship disappeared under the sand. The location is indicated as being opposite salt pans in the Rietvlei area, whereas the approximate distance to the old VOC landing place near the current Golden Acre shopping centre is slightly more than 11 km (Werz, 2017a).

Further information was provided by comparing the stratigraphy of a well that was dug in the adjacent dunes in 1647 with the current situation (Malepe, 2016; Master, 2012). Based on these leads, a general search area was demarcated for a geophysical survey. This was undertaken during 2017 to 2018 and revealed a number of magnetic anomalies that were checked by test excavations that started in January 2018.

In area A1-A2, a historical wreck was located but was provisionally dated to the late 18th or 19th century based on its appearance. Areas B-C, further to the north, revealed a pipeline and a modern engine block. The southernmost area, D, contains a wreck that was partly exposed in 2003 but, based on the presence of copper hull sheathing, could be dated as post-1780s. The same applies to a wreck that was uncovered in 1996, between areas A and C and about 100 m north of the Dolphin Beach Hotel. This wreck was excavated in that same year by Bruno Werz and was therefore not included in the 2018 test excavations. Area E, between A and D, revealed modern materials such as fence poles that are probably associated with sand dredging activities in the Rietvlei undertaken during the 1970s (Steenkamp, 2017; Werz, 2017a, 2019; Werz, Steenkamp & Prowse, 2017).

Interesting artefacts were, however, found in areas F1-F5 and H1-H2, just west-southwest of the Dolphin Beach Hotel on 8 and 9 September 2018. Although the results of material analyses that can possibly reveal more of their provenance are still outstanding, the items resemble those from VOC wrecks. They include lead patches and sheets, fishing line sinkers as well as hand-forged nails in varying sizes and made from iron, brass, and copper. A composite metal plate fragment, consisting of a copper sheet with lead lining, was found in F1.

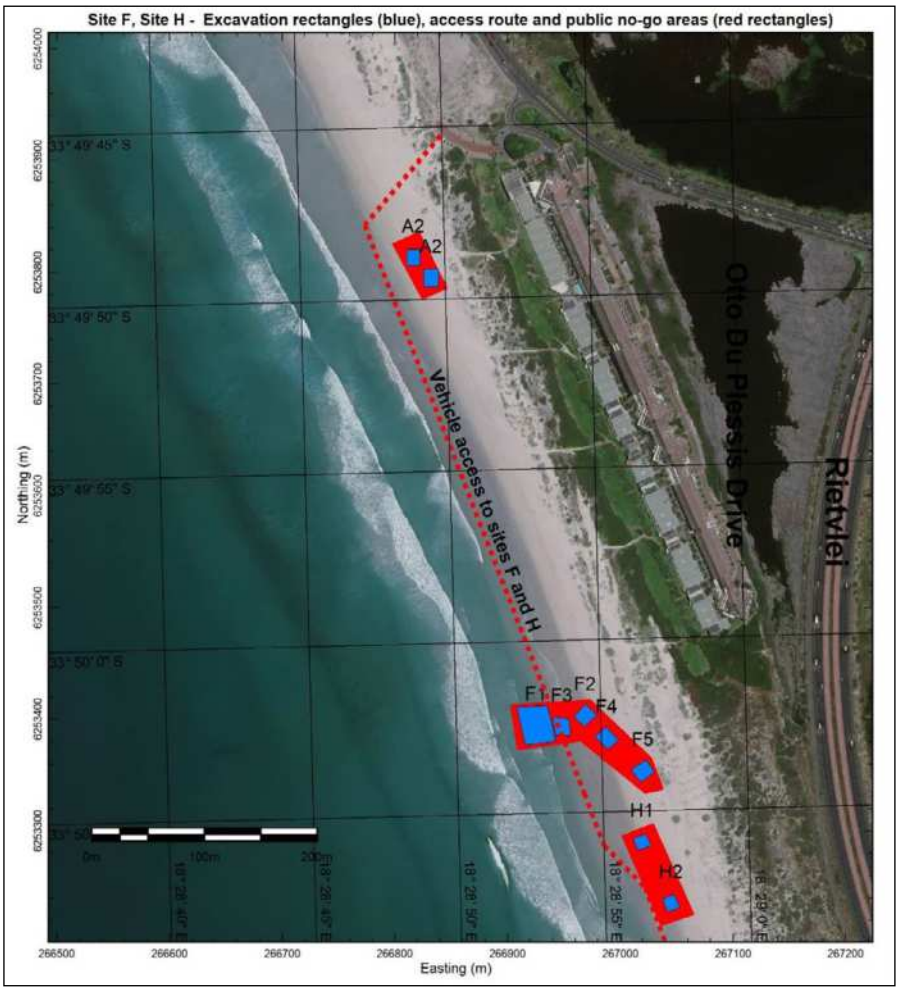

Figure 2 Sites A, F and H in relation to the Dolphin Beach Hotel in Table View (Source: Billy Steenkamp ©AIMURE)

Historical sources indicate that the stern and rudder of VOC vessels were sheeted with lead-lined copper plates. The greater part of the hull was, however, covered with iron nails that, once corroded, created a protective ferrous layer against marine borers (Van Duivenvoorde, 2015). Furthermore, the fact that no copper hull sheeting was found resembling the plates that were applied to ships' hulls from about the 1780s onwards – as proven by the sheeting that was found previously in area D and the wreck that was located in 1996 between A and C – makes areas F-H of special interest.

One object that stands out was found in area F2 on 8 September 2018. It is most likely a necklace made from a hand-drawn copper wire. It has been recorded that the men from *Haarlem* and VOC personnel that arrived at a later stage bartered copper with indigenous people. The journals of the first Commander of the Cape, Jan van Riebeeck, are full of references to this practice and state that locals fashioned jewellery from copper obtained in lieu of livestock. This seemingly inconspicuous object may thus symbolise interaction between indigenes and those from overseas (Thom ed., 1952, 1958; Werz, 2019).

THE CURRENT STATE OF AFFAIRS

At present, it seems highly likely that the shipwreck of *Haarlem* is situated in or near areas F1-F5 and H1-H2. Both the historical, geological, and geophysical data sets, as well as the results of test excavations, point to this location. Analyses of artefacts found on site will hopefully confirm this assumption.

But what are the options once the wreck has been identified beyond a reasonable doubt? The first may be obvious and that is: do nothing and leave the site as is. From an archaeological perspective, this is quite acceptable, following the principle

Figure 3 Proposed location of the sheet pile excavation facility

that archaeological sites contain remnants of the past that are limited, fragile, often unique and that cannot be regenerated. Nevertheless, due to the unique role that *Haarlem* played in South African history, further study is warranted. For that purpose, the wreck may possibly be excavated, ideally under relatively dry circumstances. Two options exist that will be further discussed hereafter.

PREVIOUS HISTORICAL SHIPWRECK EXCAVATIONS

Most historical shipwreck excavations to date were undertaken underwater. Those wrecks that were excavated under relatively dry circumstances include numerous sites in the Dutch IJsselmeer polders, as well as various locations on beaches all over the world (Van der Heide, 1974).

A prime example in the southern African region is the excavation of the wreck of *Bom Jesus* (1533). This Portuguese merchantman was discovered in 2008 in a Namdeb diamond mine in Oranjemund, Namibia, and was excavated that same year. The area where the wreck was found is known as U60 and forms part of Mining Area 1 situated within the 'Sperrgebiet' or 'Forbidden Zone'. Its geographical coordinates are 28°28'29" 849S and 16°15'11" 181E (WGS84). The shipwreck was originally deposited on the seabed. In 2008, this area was temporarily reclaimed from the sea and protected by a massive sand wall. The distance of the wreck offshore from the previous (circa 1980) shoreline was approximately 30 m and the depth in between 7 m and 8 m below mean sea level (Werz, 2009, 2011, 2014).

Construction of this sand wall involved massive bulldozers, sand trucks, and pumps that were operated continuously over a period of approximately one year to keep the area dry. Huge quantities of sand were displaced in the process until the area had been cleared of diamondiferous deposits and the wreck could be excavated and removed. Exact figures for the costs of this operation are not available but the impact it had financially, as well as from the viewpoint of environmental aspects, was considerable. For these reasons, a better alternative at this stage seems to be excavation within a coffer dam.

A good example of a historical shipwreck excavation within a coffer dam is *La Belle*. This French vessel formed part of a fleet of four ships under the command of Robert Cavalier, Sieur de la Salle (*1643 †1687), that was tasked to establish a French colony on the coast of the Gulf of Mexico. The ship sank in 1686 in Matagorda Bay, Texas, and was discovered in 1995 at a depth of -3.6 m. The ship of the *barque-longue* type had three masts, a length of 16.56 m, a beam of 4.5 m, and a draft of 2.4 m. During the period 1996 to 1997, a coffer dam consisting of an inner wall measuring 24.6 m × 15.9 m surrounded by an outer wall with compacted sand between the two walls was constructed around the wreck. After pumping out the water inside, the remains were excavated under relatively dry circumstances. The costs of constructing the dam wall were estimated at about US$1.5 million at the time, or approximately US$3 million in today's terms, based on the USA dollar inflation rate (Bruseth & Turner).

A similar approach is now being suggested to excavate the wreck of *Haarlem*. However, the cost to establish a watertight seal may prove excessive. Apart from the challenges of creating a wave-resistant and watertight seal at the sides of the wreck, a more severe challenge would be to manage seepage from below. Cobble layers were

Apart from the challenges of creating a wave-resistant and watertight seal at the sides of the wreck, a more severe challenge would be to manage seepage from below.

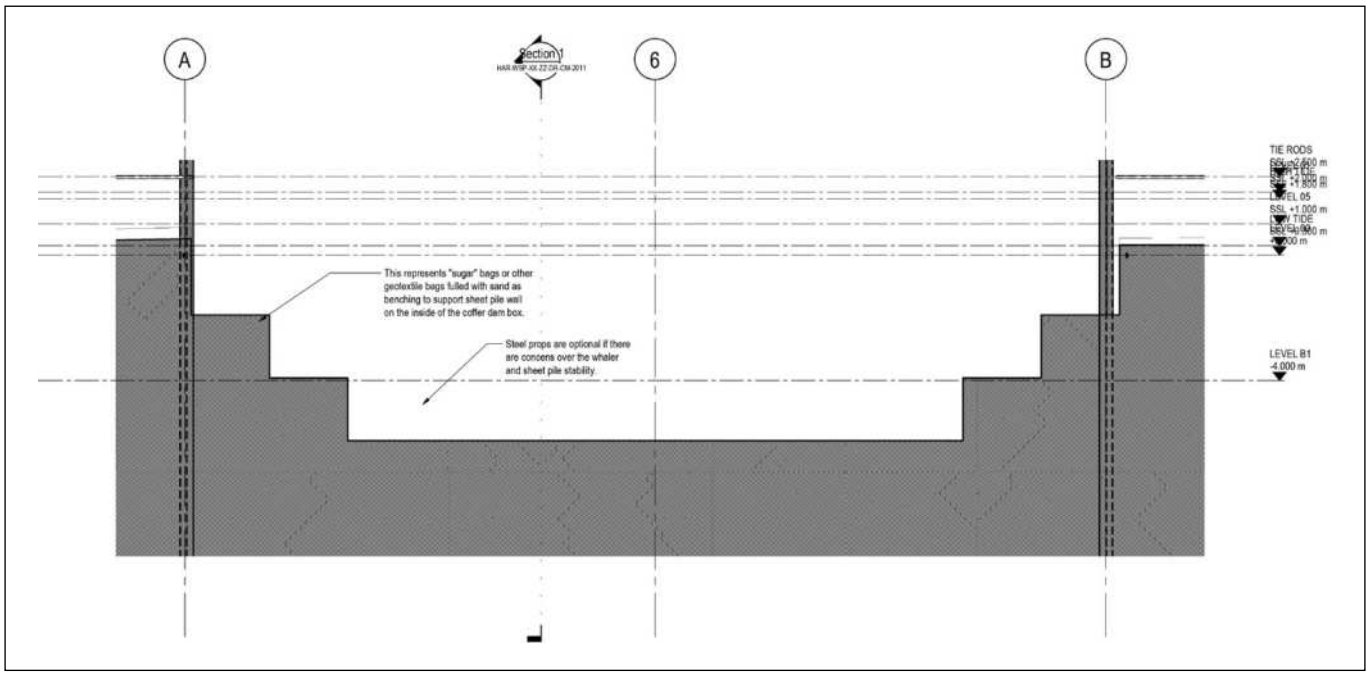

Figure 4 Section A-B across the width of the excavation facility (refer to Figure 3)

evident on the beach during investigations and seepage through such layers would be rapid and difficult to maintain by pumping. For this reason, it is proposed to erect a structure that provides calm conditions for excavation but will not allow for de-watering and excavation in the dry.

Figure 3 illustrates the location of a sheet pile protection facility. The proposed dimensions of 65 m × 30 m should be adequate to accommodate the *Haarlem* dimensions of 44.8 m in length and 11.08 m in width. The facility will be constructed from sheet piles embedded in the sand within the shallow surf zone using a hydraulically driven pile rig. The piles should be approximately 13 m deep and installed in a systematic manner, starting from the shallow end, and moving inwards towards the sea. Bulk bags will be employed on the inside of the structure as the excavation progresses to stabilise the sides (benching support) of the wet excavation as this progresses (see Figure 4). The seaward wall should be 3 m above the sand level to prevent waves from washing over and to allow work to commence safely during calm periods.

The sides of the facility will be further stabilised by waling beams – steel

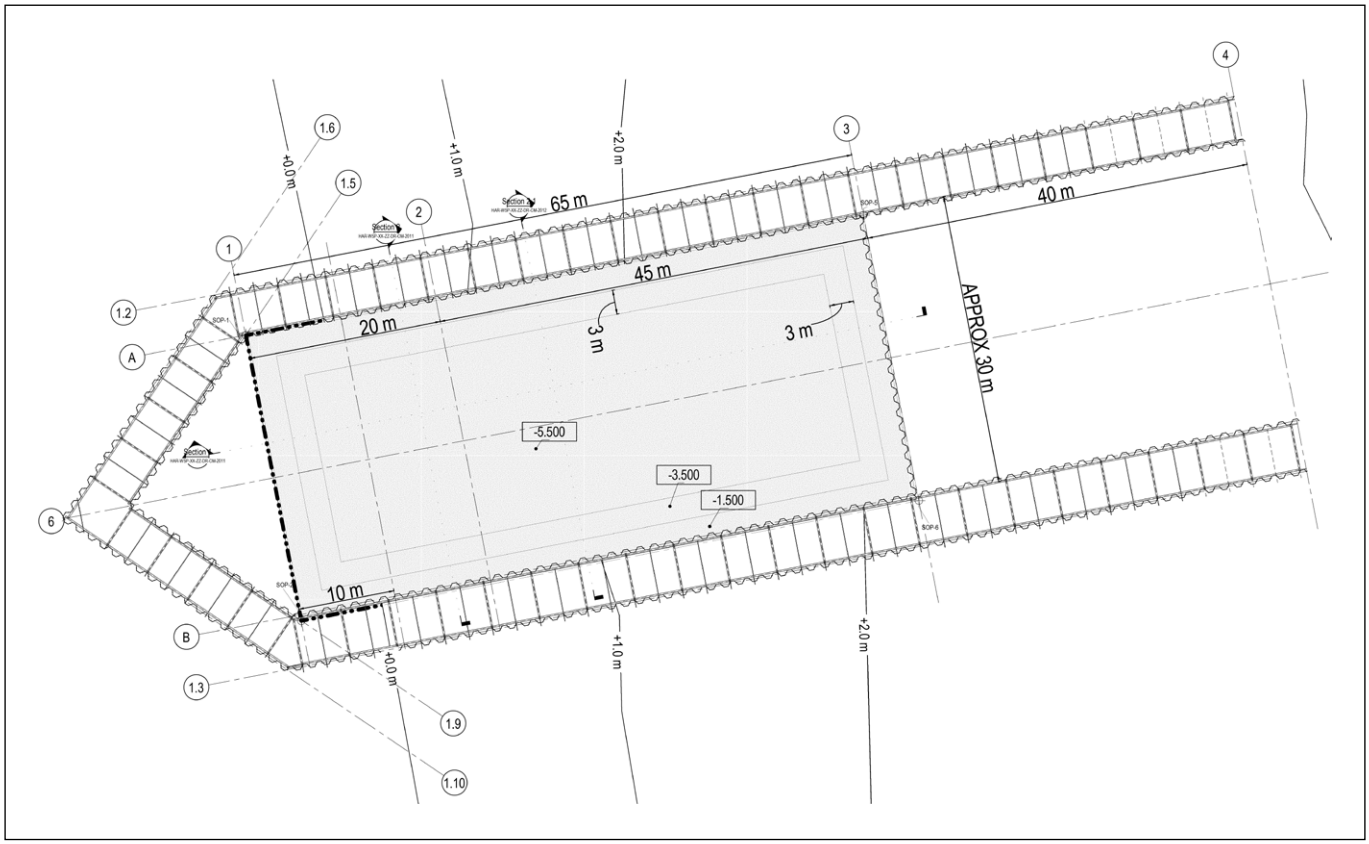

Figure 5 Plan view of the excavation facility (contours are relative to MSL)

supports across the corners of the sheet pile facility, and also positioned as props at an angle from the seabed to the side walls (see Figures 3 and 4). Once the cofferdam is constructed, a dredging operation will then clear sand inside the cofferdam. Seawater may need to be pumped to replenish the water being pumped out while dredging and to maintain the water levels inside the facility. Ongoing maintenance dredging would be required. Pumps would run constantly to maintain water levels inside the cofferdam.

The equipment required to construct such a cofferdam would include:

- 220 m of sheet piling
- Excavators for opening excavations, carrying equipment, and piling
- Hydraulicly-driven piling rig on tracks
- Crane for lifting and placing components and perhaps dismantling the wreck
- Dredge pumps to clean sand and maintain a sand-free environment
- Diving equipment to work in the flooded environment
- Compressors for air tools.

Construction of the cofferdam facility will take around 20 days, with another three to five days for the removal of sand within the facility. The cofferdam structure will be constructed to ensure a safe working environment and to preserve the timber remains of the wreck.

Once exposed, the wreck can be accessed by the scientists, and the crane, with a supporting rigging team, would be able to lift and dismantle it as required. The operation, which is largely plant-driven in an environmentally sensitive area, would require good quality machines that can move easily in the sand and sea environment and would need to be free of any potential pollution risks such as oil and fuel leaks. With the amount of plant moving and considerable public interest, the area would need to be cordoned off to prevent public access. The cofferdam would require multiple quick evacuation stair points that would enhance safety in the event of flooding or damage to the cofferdam.

Once the exploration of the wreck is complete and all artefacts have been collected and recorded, the cofferdam would be removed. The process would include removing the sandbags while backfilling the excavation on the inside of the cofferdam. Machinery would then

Once the cofferdam is constructed, a dredging operation will then clear sand inside the cofferdam.

remove the sheet piles from the seaward side, working back towards the land side. When all the steel sheet piles are removed and all whaling and bracing are removed from the site, wave action will return the beach to its natural state.

An operation such as this does have significant challenges with weather and sea conditions and would benefit largely from being done in the summer when the sea is most calm. Constant monitoring of the sea conditions and forecasts will be made throughout the operation. Only personnel familiar with ocean work will be employed and the work will be undertaken with intensive day-to-day and logistical planning.

CONCLUSIONS

Due to the historical significance of *Haarlem*, this specific shipwreck may possibly be scientifically excavated according to the best practices available to archaeology. The only feasible option at this moment in time is the construction of a coffer dam to allow access to the wreck. Once this goal is achieved, a full archaeological study can be set in motion.

Besides excavation and retrieval of artefacts, this must include extensive and continuous recording by applying standard surveying methods, but also hand tracing of constructional details, photogrammetry, video recording, and laser scanning. This is to be followed by casting of parts of the wreck, where applicable, and reburial of the physical remains. An alternative is to recover the wreck completely and conserve it.

Whatever the outcome, a display in virtual space, as cast, or in the original state, is feasible. Although there are several examples of the latter option in a world context, such as *Mary Rose* (1545) in the UK, *Vasa* (1628) in Sweden, *La Belle* (1686) in the USA, and the Viking period Skuldelev ships in Denmark, this option does not seem viable in a South African context at this time (Bruseth & Turner; Jones, 2003; Marsden, 2003; Rule, 1982; Van der Heide, 1974).

The only feasible option at this moment in time is the construction of a coffer dam to allow access to the wreck. Once this goal is achieved, a full archaeological study can be set in motion.

The main reason for this is economic pressure. Excavating and studying the wreck of *Haarlem,* together with costs for academic and public education, reporting, exhibitions, displays, documentaries, and publications, will cost millions of Rands. A very rough current estimate is R50 million or €2.5 million. Of this, costs for the coffer dam will already be in the region of R35 million to R40 million, or €1.75 million to €2 million. But how does that compare to the average cost of constructing 1 km of single carriage high traffic road (estimated R40 million or €2 million, or the salary, without additional benefits, of a Springbok rugby player of between R20 million and R30 million per year)? When looking at further studying the wreck of *Haarlem* from that perspective, the envisaged costs should not be a major deterrent. Its historical significance as a major event which resulted in the multiracial and multicultural society in which we live today, is sufficient reason to pursue this project.

ACKNOWLEDGMENTS

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Enhancing the Port of Durban with smart technologies

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Ports play a crucial role in global trade, serving as vital gateways for the movement of goods and commodities. However, the increasing demands and complexities of global logistics and supply chains have presented ports with new challenges that require them to adapt and innovate. One solution to these challenges is to implement smart technology.

The Port of Durban, located on the eastern coast of South Africa, stands as a pivotal gateway for trade and serves as a vital economic hub for the region and the continent. As globalisation continues to drive the demand for efficient and secure transportation of goods, there is a growing imperative to embrace smart technologies in port operations.

In line with this, Transnet National Ports Authority (TNPA) is embarking on a journey to create a digitally smart, safe and secure port system with the infrastructure to promote economic growth, transformation and sustainable benefits for ports. This will be implemented through the introduction of the Smart People's Ports Programme, which is an integrated solution that seeks to create a single view of port logistics, operations, infrastructure, assets, traffic and trade flows using the latest digital technology.

INTRODUCTION

Ports are critical nodes in global trade, handling vast amounts of cargo and facilitating the movement of goods and commodities (Karaś, 2020). However, the increasing demands and complexities of global logistics and supply chains pose significant challenges for ports. These challenges include efficient flow management, safety and security measures, environmental sustainability, and ensuring seamless connectivity with other stakeholders in the supply chain. To address these challenges, ports around the world are turning to smart technology solutions (Kosiek *et al*, 2021).

Smart technology such as the Internet of Things (IoT), sensors, cloud computing platforms, big data analytics, and artificial intelligence (AI), have the potential to revolutionise port operations by collecting, processing, monitoring, and analysing data and information concerning various aspects of port operations, including economic, environmental, social, and technological factors (D'Amico *et al*, 2021). By leveraging these technologies, ports can optimise the management of flows, improve efficiency, enhance safety and security measures, reduce environmental impacts, and provide a seamless and integrated experience for all stakeholders involved in the port ecosystem.

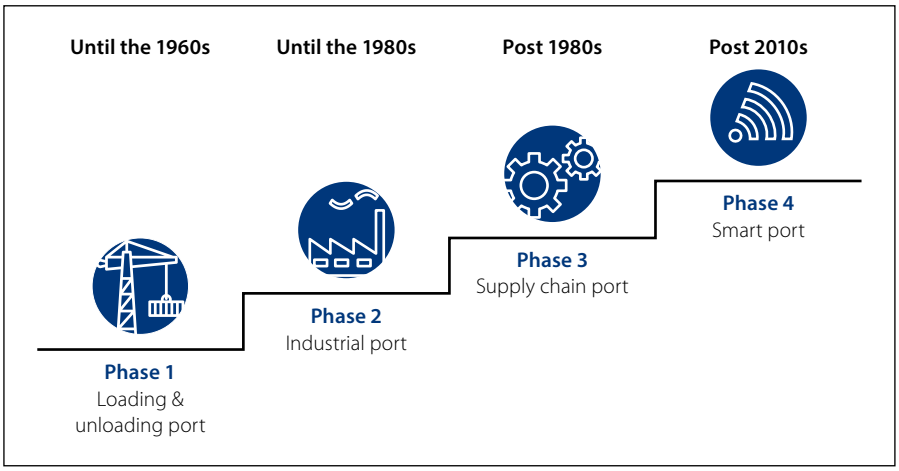

Figure 1 The four generations of port development

The Port of Durban has been a cornerstone of South Africa's maritime trade for decades. With a strategic location and advanced infrastructure, the port handles a substantial volume of cargo, contributing significantly to the country's economy.

Ports have gone through a structural and functional evolution over the last few decades. Simply put, there are four generations in port development, shown in Figure 1. Each generation comes with a new function and focus. What one sees today with the increased need for digital integration is that a port is increasing its focus as a service provider. Ports have a wide variety of smart port technologies to choose from, but the key strategic issues they face should guide the selection process. Major city-based ports like the Port of Durban need to operate sustainably to minimise their environmental impact.

CURRENT STATE OF THE PORT OF DURBAN

The Port of Durban has been a cornerstone of South Africa's maritime trade for decades. With a strategic location

Figure 2 The Port of Durban (Source: TNPA)

and advanced infrastructure, the port handles a substantial volume of cargo, contributing significantly to the country's economy. However, like many ports worldwide, Durban faces challenges such as congestion, operational inefficiencies, and environmental concerns.

Becoming a smart port means developing solutions to address the current and future challenges faced by seaports, including spatial constraints, pressure on productivity, fiscal limitations, safety and security risks and sustainability. However, determining which technologies to implement, how to implement them, and the way in which they can support the overall digital strategy of the port, remains a main challenge.

To assess the readiness and maturity of ports in embracing smart initiatives, the concept of 'smart port maturity' can be used. This categorises ports into the following four distinct levels:

1. **Level 1 – the foundation stage:** Ports initiating basic automation and data collection processes.
2. **Level 2 – the enhanced stage:** Ports utilising advanced technologies like IoT devices and data analytics for optimisation.
3. **Level 3 – the integrated stage:** Ports achieving high interoperability and collaboration across systems and stakeholders.
4. **Level 4 – the intelligent stage:** Ports with fully autonomous operations driven by AI and robotics.

Currently, the Port of Durban stands at Level 2, demonstrating commendable progress with IoT adoption, digital platforms for cargo tracking, and advanced data analytics. However, there is still room for growth towards achieving higher levels of smart port maturity.

The implementation of a truck appointment system (TAS) in the Port of Durban serves as a strategic solution to alleviate congestion and enhance the overall efficiency of trucking operations within the port. The primary objective of a TAS is to distribute truck traffic more evenly throughout the day, minimising bottlenecks, reducing waiting times, and optimising the overall flow of cargo.

The TNPA has developed a pavement management system app that serves as a comprehensive tool designed to address and manage issues related to the port's pavements. It aims to improve accountability, transparency, communication, and decision making while optimising the efficiency of pavement maintenance processes. TNPA is also in the process of acquiring drones to facilitate port infrastructure inspections. The integration of drones enhances operational efficiency, safety, environmental monitoring, and emergency response capabilities.

This technology facilitates a proactive and data-driven approach to port management, supporting the port's goals of sustainability, security, and optimal performance. TNPA is also working on integrating a geographical information system (GIS) into the overall port system to enhance spatial understanding, support infrastructure planning, optimise logistics and aid in environmental monitoring within the port management framework.

The port's traffic management programme, currently in its infancy, is a forward-looking initiative aimed at

TNPA is also in the process of acquiring drones to facilitate port infrastructure inspections. The integration of drones enhances operational efficiency, safety, environmental monitoring, and emergency response capabilities.

revolutionising the way truck-related operations are handled. The primary focus of this project is to introduce automation to key aspects of truck management within the port, addressing existing manual processes and enhancing overall efficiency.

TNPA is currently engaged in developing port simulation software aimed at enhancing efficiency in capturing, calculating, validating, and forecasting various port scenarios across all Transnet port operations. This initiative is geared towards proactively creating capacity to meet future demand, with the software equipped to pinpoint bottlenecks within the system.

Like many ports, TNPA is also moving toward using renewable energy to satisfy operational energy needs within port limits, and is researching renewable energy sources such as synthetic fuels (e.g. hydrogen and ammonia) as an alternative energy source.

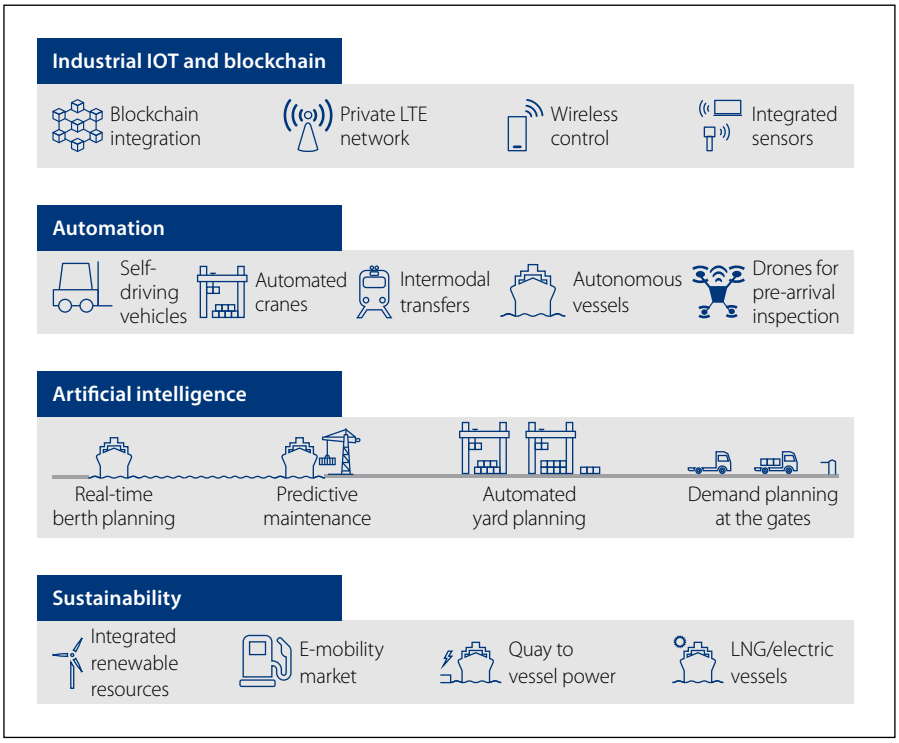

Figure 3 Fourth Industrial Revolution technologies for smart ports

COMPONENTS OF AN INTELLIGENT PORT TERMINAL

Transitioning the Port of Durban into an intelligent port involves several strategic steps, namely:

1. Invest in smart technologies to optimise port operations and enhance efficiency.
2. Foster collaboration among port stakeholders to create an interconnected port ecosystem.
3. Implement predictive maintenance strategies and sustainable practices to minimise environmental impact and ensure long-term viability.

The components of a smart port encompass a wide range of interconnected elements. These components create a holistic and interconnected ecosystem, leveraging advanced technologies to optimise operations, improve sustainability, and enhance overall port management. Figure 3 shows the Fourth Industrial Revolution technologies that are also common modern smart port technologies.

IoT and real-time monitoring

Implementing IoT devices in the Port of Durban will provide real-time data on various aspects of port operations. Smart sensors on containers, cranes, and vehicles can enable efficient monitoring of cargo movement, reducing delays and optimising the use of resources. This data can be utilised for predictive maintenance, minimising downtime and enhancing overall operational reliability.

AI for predictive analytics

AI can play a crucial role in predictive analytics, helping the port anticipate and mitigate potential issues. By analysing historical data, AI algorithms can predict equipment failures, optimise route planning for vessels, and improve overall logistics. This predictive capability enhances decision-making processes, leading to more efficient and cost-effective operations.

Big data analytics for optimisation

The sheer volume of data generated in port operations can be overwhelming, but leveraging big data analytics can turn this data into valuable insights. Analysing patterns and trends can help optimise supply chain processes, reduce bottlenecks, and enhance overall efficiency. Additionally, it can aid in resource allocation, ensuring that the port operates at its maximum capacity without unnecessary congestion.

Drone services for real-time data

Drone services have emerged as indispensable tools in the maritime industry, offering a spectrum of capabilities that significantly enhance port operations. By conducting thorough inspections above and beneath the water, it can enable a comprehensive assessment of quay walls and port infrastructure. The application extends to dredging level management, where drones provide real-time data for precise monitoring and control.

Communication networks

The implementation of robust communication networks, particularly leveraging 5G technology, is a strategic investment in elevating the connectivity and operational efficiency of our smart ports.

Cybersecurity measures

In an era of digital integration, safeguarding the integrity and security of the port's digital ecosystem is paramount. Robust cybersecurity measures are diligently implemented to shield port systems from evolving cyber threats and ensure the continuity of secure port operations. This is to create a secure digital environment that safeguards the integrity of our port operations and protects the interests of all stakeholders.

Digital twins

Digital twin technology offers a transformative approach in various industries by creating virtual replicas of physical entities, systems, or processes such as virtual models of vessels, ports, and logistical processes. This virtual representation utilises real-time data and advanced analytics to mirror the behaviours and characteristics of the original entity, enabling

operators to monitor, test, and analyse its performance for optimisation.

THE CASE FOR SMART PORT EVOLUTION

The implementation of smart technology in the Port of Durban can lead to increased customer satisfaction, as it enables effective decision support and real-time data analysis. Additionally, it fosters collaboration and connectivity among stakeholders in the supply chain, enabling seamless coordination and streamlining of operations. Overall, the implementation of smart technology in ports is crucial for staying competitive and meeting the demands of the modern global trade landscape (Karaś, 2020). These smart technology solutions are not only transforming the way ports operate but also contributing to the development of sustainable and environmentally friendly practices (D'Amico *et al*, 2021).

Looking at the current status of the Port of Durban, the actual performance of the port versus the target performance supports the need for converting the port into a smart port. Quicker turnaround of vessels is imperative to ensure reduced operational costs, decreased delays in delivery lead times and an overall increased level of competitive service to importers, exporters and foreign investors.

TNPA needs to increase the attractiveness of South African ports by employing smart port technologies to avoid congestion at our terminals, following in the footsteps of European smart ports like the ports of Hamburg, Rotterdam and Valencia that have installed black boxes to ensure accurate recording of data for reporting.

The implementation of smart technology in ports is an irreversible trend that is shaping the development of modern seaports (Karaś, 2020). Enhancing the Port of Durban with smart technologies is not just a necessity but a strategic imperative. The integration of IoT, AI, big data analytics, and blockchain can transform port operations, making them more efficient, sustainable, and resilient. As South Africa aims to strengthen its position in the global trade network, investing in smart port technologies at the Port of Durban is a forward-looking approach that will yield long-term benefits for the economy and the environment. It is crucial for South African ports to adapt and employ smart technology to enhance global competitiveness and remain the preferred choice of port for shippers. ◻

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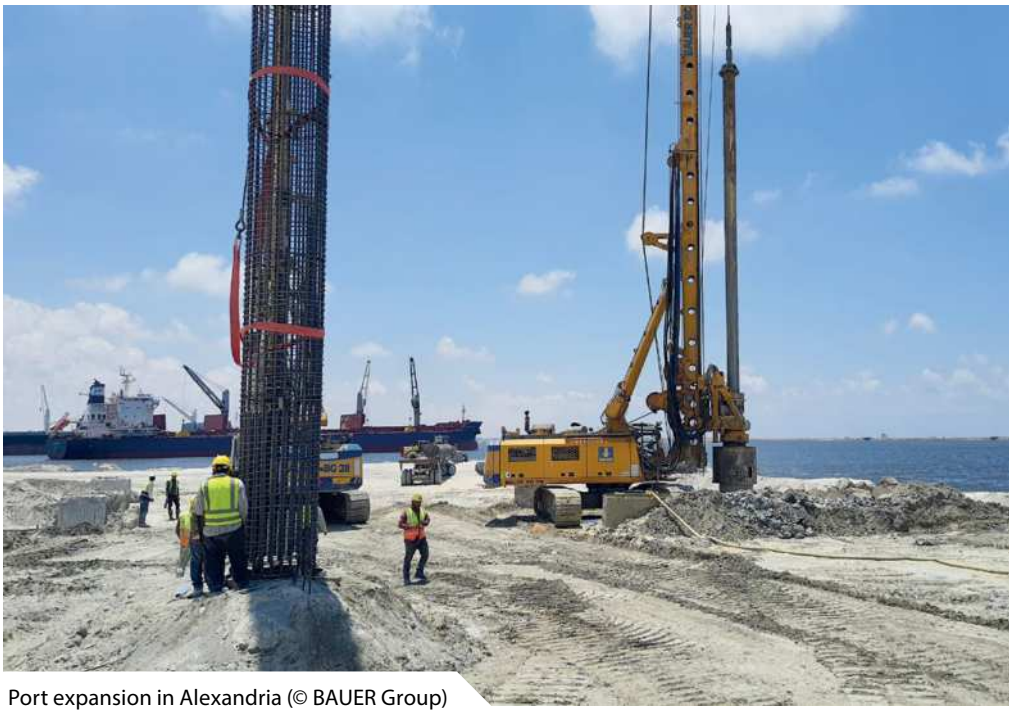
The protection and sustainable development of coastal regions are of crucial importance for the preservation of habitats, the expansion of tourism and the economic development of individual regions worldwide. The expansion of ports plays a central role in this. They are hubs for the transportation of goods. By expanding them, ports can become more efficient, accommodate larger ships and thus boost trade and the economy. The Port of Alexandria in Egypt recently underwent one such crucial expansion.

For the new multi-purpose terminal 55/62 at the Port of Alexandria, Bauer Egypt employed four cutters and two powerful BAUER BG 28 drilling rigs for the work carried out on a semi-rectangular quay wall covering 225 897 m^3 in 2020/21. The project consisted of a front diaphragm wall, two rows of central piles and a rear row of barrettes.



Port expansion in Alexandria (© BAUER Group)

In addition to their efficiency on land, Bauer machines have also proven themselves on water. An example of this is in the foundation work for the impressive Hong Kong-Zhuhai-Macao Bridge – both the longest sea crossing and the longest bridge in the world. Bauer drilling rigs were used to install a total of 230 offshore piles with lengths of up to 115 m.

Installation of offshore piles on the Red Sea (© BAUER Group)

In addition, a completely different, but no less spectacular, project is taking shape around 500 km north of the city of Jeddah in Saudi Arabia. Here too, Bauer technology is playing a key role as part of the Red Sea Islands Project – a spectacular recreational area that is being created on the Red Sea that will combine nature, culture and adventure. Several bridge structures are required for this. For the central bridge, which connects the main island of Shurayrah with the mainland, Bauer Saudi installed 124 piles off the coast using a BAUER BG 28.

These and many other projects demonstrate that by using proven and innovative technologies made by Bauer, as well as a great deal of expertise in execution, onshore and offshore projects can be realised that set standards in the world of specialist foundation engineering. ◻

Feasibility study brings major Ethiopia-Sudan project closer to implementation

The Ethiopia-Sudan Standard Gauge Railway (SGR) project, for which AECOM recently completed a feasibility study, will link Addis Ababa in Ethiopia to Port Sudan on Sudan's Red Sea coast. The goal is to contribute towards socio-economic development by providing an efficient and effective transport system in Ethiopia and Sudan.

The generally accepted route for the project is Addis Ababa-Awash-Kombolcha-Weldiya, on to Wereta, Gonder, Metema, Galabat to Gadarif, Kassala, Haiya and to the port at Port Sudan, a total estimated distance of 1 522 km.

"This ambitious SGR project has significant implications for regional connectivity and trade," says James Anafi, Market Sector Lead: Rail, Africa at AECOM. "The main aim is to enhance transportation links between Ethiopia and Sudan and to facilitate efficient movement of goods, people and services."

The feasibility study became necessary because of Ethiopia's rapid economic growth. Ethiopia is a vast landlocked country, and obtaining access to seaports – which are important for economic growth – requires extensive railway infrastructure.

The study assessed whether the railway line is technically, financially, economically, socially and environmentally viable. It considered factors such as terrain, engineering challenges, economic benefits and environmental impact.

It provides a sound basis for decision-making for investing in the project. In addition, due diligence from the study can attract funding from various sources, including development partners and the private sector. The African Development Bank approved a US$1.2 million grant to finance the feasibility study, which was completed in December 2022.

ACCESSIBILITY CHALLENGES

A major obstacle is that the route extends across Ethiopia and Sudan to reach Port Sudan. Balancing the strategic interests of the two different countries, which were not always aligned, was a challenge. While the project was driven mainly by Ethiopia, the bulk of the route is actually through Sudan. "It starts from the middle of Ethiopia but has to cross Sudan to reach the port. Hence, Sudan was a significant stakeholder and there were different requirements that had to be balanced," notes Anafi.

"The vast scope of the project required a lot of resources and ingenuity to have the feasibility study completed successfully," he explains. AECOM's strategy was predicated on being as collaborative, fair and inclusive as possible to all stakeholders. "Everyone had to feel they were adequately catered for in the project to ensure its ultimate success or there would be pushback." This major consideration had to be balanced against various technical and situational challenges.

The feasibility study commenced during the Covid-19 pandemic, imposing immediate travel restrictions. The team therefore had to come up with innovative ways to obtain site information from the required project locations to be able to carry out the feasibility study. AECOM collaborated closely with in-country partners that could obtain the necessary information. "We had to work with them in such a way that we could still verify and monitor the accuracy and usefulness of the information we were provided with," notes Anafi. Digital technology and tools were used to overcome the challenges posed by the inability to travel, remoteness and to ensure accuracy of information from site.

The problem of restricted site accessibility and limited information persisted even after the Covid-19 lockdowns were lifted due to political instability in Ethiopia. "Once the political situation in Ethiopia had settled down, then Sudan flared up. It presented a challenging environment to work in," says Anafi.

The study assessed whether the railway line is technically, financially, economically, socially and environmentally viable. It considered factors such as terrain, engineering challenges, economic benefits and environmental impact.

ENVIRONMENTAL, SOCIAL AND GOVERNANCE

Part of AECOM's strategy was to ensure its client expanded its own rail capability and skills base as the project proceeded. AECOM provided training for the client's technical staff at its Centurion Africa head office to upskill them and upgrade their knowledge. "It was not even possible for us to travel there, but we were able to bring them to our offices and successfully provide them with the necessary training," says Anafi.

The consultancy's technical capabilities are complemented by advisory services

during the design and planning stages and incorporate important aspects like environmental, social and governance (ESG) considerations. AECOM is particular about sustainability, with its Sustainable Legacies strategy guiding its ESG approach to all projects. "We try to maintain a low carbon footprint on all projects, even to the point of curtailing our own travel where it can be avoided. For example, on this project we achieved a lot of the requirements without having to travel to the country and the site itself," explains Anafi.

AECOM also deployed its remote site reconnaissance technology for remote site monitoring on this project. It combines mobile app data acquisition, real-time reporting and data access globally using cloud storage to enhance safety, efficiency and decision-making in design and construction of infrastructure projects. "That made it very effective for us to work with our local partners. We could still collaborate with them closely enough to achieve a successful outcome," says Anafi.

Environmental considerations were key, as Ethiopia is mountainous and forested, whereas Sudan is mainly desert and flat. "We had to come up with ways to deal with the particular conditions encountered on both sides of the border. We looked at less resource-intensive solutions in terms of sustainability," says Anafi. For example, AECOM made use of a track design solution that operates effectively in a desert environment without having to put in additional infrastructure to control sand blowing onto the track.

In the mountainous sections of Ethiopia that had to be traversed, AECOM also had to consider the ecological impact of any proposed solution. This meant the size and extent of embankments had to be carefully considered so that the natural migration patterns of animals in the region were not unduly impeded. Instead, bridges or tunnels that would have much less of an environmental impact in this regard were proposed, with due regard to cost implications. This means the infrastructure that will be put in place will not have a major impact on local fauna and flora.

The social impact of any project is another critical consideration. Local companies from both Ethiopia and Sudan were included in the project and afforded the opportunity to contribute and build up their own skills base.

GLOBAL EXPERTISE

"A defining capability of AECOM's global footprint is that we have access to global expertise and knowledge. That gives us good exposure to typical problems encountered in railway projects," says Anafi.

"Wherever we are based, or projects located in the world, we have access to that knowledge, which enhances our own capability and efficiency." AECOM's global footprint also means it makes extensive use of digital tools to collaborate on projects across the world and engage seamlessly with clients and partners, as was the case in this project. ☐

Wild Coast N2 Highway Project taking shape

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The Wild Coast N2 Highway Project includes the construction of a 17.3 km greenfields portion of the new N2 highway. This portion of the new N2, known as Package 5, is located near Flagstaff in the Ingquza Hill Local Municipality in the Eastern Cape Province. It is being constructed in the form of a single carriageway road between the two new major bridges – Msikaba Bridge and Mtentu Bridge – which are both also currently under construction.

Knight Piésold Consulting is appointed by SANRAL for the engineering services for all project phases for Package 5, while WBHO-H&I Joint Venture is appointed as the main contractor. The project commenced in February 2023 and is progressing well.

Ongoing works include the exhumation and reburial of 188 existing graves along the new alignment and construction of 20 new houses to relocate affected families. Knight Piesold and WBHO-H&I JV work closely with the local chiefs and families to ensure all the needs of those effected are met. Also underway are the relocation of existing services, bulk earthworks, construction of several concrete culverts, and construction of the largest concrete structure along the Package 5 alignment, the 100 m long Kwadlambu River Bridge.

Package 5 will also cover the upgrading of existing divisional roads, rural tracks and the provision of new access roads (totaling 41 km), new underpass and overpass structures for pedestrian, cattle, and vehicle crossings as well as two new major interchanges.

The estimated construction cost of the project is R3.3 billion and the construction period is 54 months, with completion due in August 2027. The project will provide approximately 118 targeted enterprise subcontract packages for local subcontractors (CIDB gradings 1 to 6), and 300 work opportunities for the local community. □

Construction of rockfill to Fill 23 on the N2, km 49 900 (Credit: Andre Wesson)

Kwadlambu River Bridge Pier 4 under construction (Credit: Stephan Potgieter)

Quality of paratransit/minibus taxi sector service in South Africa

The significant contribution of the minibus taxi industry to the transportation system of South Africa cannot be overstated, and cities are beginning to recognise this. However, while minibus taxis offer benefits to commuters, the industry also faces many quality challenges, including safety, high fares, poor facilities at taxi ranks, road worthiness of vehicles, and bad driver behaviour.

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It is estimated that the paratransit service, also known as the minibus taxi (MBT) service, carries out 66% of all public transport trips in South Africa's metropolitan areas. This is an informal sector that has proven to be effective and efficient in providing public transport services over shorter routes where the advantages of benefitting from government subsidies are insignificant. This is a largely fragmented, cash-based system that is characterised by its demand-responsiveness, unscheduled services, individual ownership of vehicles with few contracts in place, no operating subsidies, and a wide variety of management styles.

Although some authors attribute the taxi industry's quality problems to the unfair competition it faces from other subsidised modes of transportation, others point to the industry's structure and business model as the primary causes of these problems (Ryneveld, 2018). The whole industry operates in the informal economy, does not pay taxes, and does not strictly abide by labour laws, safety or regulatory norms (Woolf & Joubert, 2013).

This paper will discuss the underlying factors that lead to the inferior quality of the service provided by minibus taxis, the interventions that can be implemented to improve the service, and the role the public sector can play towards improving the quality of services provided by this industry.

POOR QUALITY SERVICE ATTRIBUTES AND THEIR UNDERLYING CAUSES

Sharma, Pandit and Bose (2019) outline the importance of user perception in

determining the quality of the service with the objective of identifying the strengths and weaknesses of the service rendered. Regular customers' perceptions contribute to the improvement of service quality, as customers bear the repercussions of receiving substandard service. According to Sharma, Pandit and Bose (2019), the paratransit system's features that users deem significant should serve as the foundation for measuring service quality. Enhancing these attributes is likely to boost the system's current patronage.

Over the years, several researchers have created instruments for the identification and categorisation of these qualities. Eboli and Mazzulla (2007), for instance, distinguish between basic and non-basic characteristics that affect the level of service in the transportation industry. Basic attributes represent service performances that can compromise the service quality when their level is low, while non-basic attributes are secondary characteristics that have a direct influence on service quality if present, but do not compromise it if absent. Basic attributes include crowding, service frequency, service reliability, fare and walking distance to access the service, among others. Facilities, cleanliness of vehicles, information and transit personnel attitude are some of the attributes that are categorised as non-basic (Eboli & Mazzulla, 2007).

Safety and security

According to the 2020 National Household Travel Survey (NHTS), 33.3% of commuters are dissatisfied with security while walking from home to a minibus taxi rank and 29.9% are dissatisfied with the security at taxi rank facilities. The same survey shows that 56.3% of minibus taxi commuters are dissatisfied with the condition of the facilities at taxi ranks. While some of the safety and security statistics, like the security while walking from home to the taxi rank, reflect the broader societal and general security challenges South Africa is faced with, security at taxi rank facilities, and safety concerns while boarding a minibus taxi, are some of the challenges the minibus taxi industry is grappling with.

Section 11 of the National Land Transportation Act (5 of 2009) outlines the responsibilities of the three spheres of government in the provision of land transport in South Africa. In terms of this act, the bulk of public transport responsibilities are allocated to local municipalities, with the provincial and national governments taking a more strategic and oversight role. Very few municipalities have the financial and institutional capacity to design, implement and manage this public transport mandate.

For the effective delivery of public transport responsibilities, local municipalities must first understand the level of capacity that is required to carry out that mandate (Esson & von der Heyden, 2014). Maleka (2023) talks of resource constraints faced by the public sector that hinder the implementation of strategic plans. These constraints can be attributed to a range of factors including economic challenges, budgetary pressures, human resource capacity and competing priorities. The provision of safe and efficient rank infrastructure is the function of the local municipalities, and with the constraints faced by the local municipalities, the successful implementation of this mandate will remain a pipe dream.

According to the 2020 NHTS, 36.5% of commuters using minibus taxis do not feel safe from road accidents while on board minibus taxis. This fear is justified given that South Africa's roads rate among the most dangerous in the world, with accidents claiming the lives of no fewer than 10 000 people every year. Minibus taxis account for 4.5% of the total vehicle population on South Africa's roads but are involved in 8.6% of all crashes reported. This indicates that taxis account for double the rate of crashes compared to any other mode of transport in South Africa (NDoT).

Some studies identify the business model and the industry structure as the root cause of most of the quality problems the MBT industry is engulfed in. Most minibus taxis operate on the target model, where the driver is given a daily target in exchange for use of the vehicle, pays for fuel, and keeps any fares collected over and above all these expenses. This target model leads to reckless driving and total disregard of the traffic laws by the drivers in pursuance of these daily targets. Coupled with this is the inadequate enforcement of the traffic laws by law enforcement authorities.

Minibus taxi drivers operate in a framework similar to self-employment, as they rent the taxi from the owner and pay them around 30% of the daily revenues. They are therefore incentivised to maximise passenger turnover and hence the number of trips made (Jan Schlüter *et al*, 2020). The informal nature of this industry also makes the task of traffic law enforcement unattainable.

Fourie and Pretorius (2016) bemoan the destructive competition that is prevalent among minibus taxi operators as another aspect that compromises the safety and security of commuters. Poor regulation of the industry is at the root of this unhealthy competition and leads to the operators competing on the high-demand corridors operated by busses and trains in their quest for cost recovery.

According to Shaw (1998), "competition among operators reduces the potential for sustained cost recovery by individual operators, reduces the economy of scale benefits of higher order modes and leads to the provision of poor and inconsistent service level to users." This in turn leads to violence because of the competition in the highly contested routes, which in turn leads to reduced service and safety levels due to low profitability (Fourie & Pretorius, 2016).

Comfort

Sharma, Pandit and Bose (2019) identify the following user perception-based quality service sub-attributes that define comfort in the paratransit service:

- Air quality and temperature inside the vehicle, including vehicle noise
- Cleanliness inside the vehicle
- Quality and condition of material inside the vehicle
- Design and arrangement of stop, the ease to move, and length of queue and seating position
- Number of seats, which influences crowdedness

According to the 2020 National Household Travel Survey (NHTS), 33.3% of commuters are dissatisfied with security while walking from home to a minibus taxi rank and 29.9% are dissatisfied with the security at taxi rank facilities. The same survey shows that 56.3% of minibus taxi commuters are dissatisfied with the condition of the facilities at taxi ranks.

- Comfort during trip from start until stop
- Guaranteed seat or location for wheelchair
- Smoothness of the ride
- Seats at waiting areas for pickups
- Shade at waiting areas for pickups away from home.

According to Business Tech (2022), there are approximately 250 000 minibus taxis on South Africa's roads and approximately 170 000 of these are encumbered and aged while 80 000 are financed and insured. According to the National Department of Transport, the average age of the taxis on the road in South Africa is 13 years. In 1999, the government announced the introduction of the Taxi Recapitalisation Programme to regulate and control the minibus taxi industry, implement training and capacity building, and establish conditions of economic survival, prosperity and empowerment. The programme entailed the scrapping of the current 9 to 16-seater vehicles and their replacement with the more spacious and comfortable 18 to 35-seater vehicles. Central to this phasing out of the old vehicles was the compliance with regulations, reduction of the number of vehicles and accidents, improvement of the quality of the transport service and reduction of the cost of travel.

Unfortunately, the progress in the implementation of the programme has been held back by the lack of political will, with some political leaders accused of being minibus taxi owners themselves (Browning, 2018). Between the years 2006 and 2018, 72 690 vehicles were scrapped against a government target of 100 000 vehicles, leaving a balance of 63 241 vehicles still to be scrapped. This balance excludes the vehicles that operate without licences, as the possession of an operating licence is a prerequisite for scrapping (Fobosi, 2023).

Minibus taxi fares

The following user perception-based quality service sub-attributes define comfort in the paratransit service (Sharma, Pandit & Bose, 2019):

- Suitability of fare structure for the mode
- Total expenses required to use the service
- Ease of payment
- Advantages in using the mode compared to the expenses.

Although minibus taxis score very well on accessibility and travel time, the industry scores poorly on safety from accidents, fares, facilities at ranks, roadworthiness of vehicles and the behaviour of drivers towards passengers (van Reyneveld, 2018). The 2020 NHTS shows an increase in the number of households whose choice of travel mode is influenced by the cost, from 26% in 2013 to 31% in 2020. The same survey showed a decrease in the number of households whose travel mode choice is influenced by travel time, from 33% in 2013 to 23% in 2020.

Evidence shows that although transport costs as a share of household expenditure varies greatly across space and time, overall transport expenditure increases strongly with income, but tends to be regressive as

costs consume a larger share of income among poor households. Studies show that poor households pay more for public transport trips than their richer counterparts do. The location of many low-income households on the urban periphery and their high dependence on informal transport with unsubsidised fares are the main contributors to this situation (Venter, 2011).

Most minibus taxis in South Africa are cash-only enterprises, with drivers keeping the remaining fare after fuel and vehicle rental payments are made. Minibus taxi owners almost never factor in the cost of depreciation when figuring out how much their vehicles will cost to operate. In addition to the careless driving that results from using this technique, carrying cash on board exposes drivers and commuters to criminal activity (Schalekamp, Mclaren & Behrens, 2017).

INTERVENTIONS REQUIRED TO IMPROVE QUALITY OF SERVICES IN THE MINIBUS TAXI IDUSTRY

South Africa, like many cities in Africa and other developing countries around the world, has embraced the Bus Rapid Transit (BRT) system as a means of transforming its transport system. In South Africa, the BRT systems are now operational in Cape Town, Johannesburg and Tshwane and are still under development in other cities in the country. Cities have, however, come to realise the importance and relevance of the MBT service in their transportation system.

This realisation mainly stems from the challenges that face the BRT system, whose causality is traceable to the apartheid spatial sprawling form, which produces tidal travel patterns. Regrettably, this urban spatial sprawl has continued unabated beyond the apartheid era, as the current government continues to build houses for the poor on the periphery of urban areas, something which exacerbates the unaffordability of travel for the poor.

The need for a policy level shift to support integrated public transport networks and hybrid systems, where scheduled services and MBT service operations complement each other, is becoming increasingly acknowledged by city planners. Cities have come to realise the need for embracing the complimentary role of the MBT service, rather than replacing it with BRTs (Schalekamp & Klopp, 2018). As an example, the City of Cape Town, in its Integrated Transport Plan (ITP), talks of a hybrid system in which minibus taxis operate along the formal scheduled transport modes as feeders or distributors to these modes. For the cities to realise the benefits of integrating MBT services into the BRT and other transport modes, government needs to put focus and resources towards addressing the quality challenges the MBT industry faces.

South Africa, like many cities in Africa and other developing countries around the world, has embraced the Bus Rapid Transit (BRT) system as a means of transforming its transport system. In South Africa, the BRT systems are now operational in Cape Town, Johannesburg and Tshwane and are still under development in other cities in the country. Cities have, however, come to realise the importance and relevance of the MBT service in their transportation system.

The Blue Dot taxi pilot project, introduced in 2021 by the Western Cape provincial Department of Transport and Public Works, whose objective was to encourage, monitor and reward behavioural change in the MBT industry through an incentive programme for compliant participants, was one of the brilliant interventions from the government. Unfortunately, the project collapsed due to lack of financial support from the National Department of Transport and could not proceed beyond its pilot phase that ended in November 2022 (Hendricks *et al*, 2023). This was a widely hailed project that is admired not only by the commuters but also the MBT industry as it made an immense contribution towards addressing the quality issues faced by the industry. The National Department of Transport needs to resuscitate this project and roll it out in all nine provinces.

Regulation of the MBT industry

The taxi industry in South Africa originates from the informal economy, operating predominantly outside the legal, commercial and fiscal spheres of the economy. Despite its challenges, the industry has become the preferred mode of transport. The regulation of the industry should therefore not summarily be taken as a superior alternative (Fourie & Pretorius, 2016). UN-Habitat has emphasised how crucial it is for developing nations to allocate funds towards creating policies and initiatives that guarantee road safety issues, and the need for prioritising MBT regulations in pursuit of the Sustainable Development Goals. Thus, it is believed that improving regulation and road safety, especially in the MBT industry, represents a vital first step towards lowering the number of people killed and injured in road accidents (van Reyneveld, 2018).

The National Land Transport Act (5 of 2009) is the primary legislation that governs the operation of road transport services in South Africa. The act requires the establishment of transport regulatory authorities that are responsible for managing the economic and safety elements of the public transport system. The provincial government, through the Transport Operating Licensing Administration Board (TOLAB) is responsible for ensuring transparency in the determination and approval of formation or amalgamation of associations, routes, permits and operating licences for passenger transport services in the country. TOLAB, in collaboration with the Provincial Regulatory Entity, is empowered by the Act to approve or reject a prospective operator from entering the MBT industry after seeking concurrence with the affected municipality and stakeholders (Mtsi, 2021).

The White Paper on National Transport Policy (1996) and Moving South Africa (1998) strategy gave birth to the Taxi Recapitalisation Programme in 1999. In 2018 the scrapping component of the programme was ended after the scrapping of 72 690 out of the 135 000 vehicles that were scheduled for scrapping. The government is currently in talks with the South African National Taxi Council (SANTACO), which claims to be the taxi industry's democratically elected structure, for the revival of the programme. The MBT industry is currently decentralised, and MBT drivers operate as free agents. The programme is therefore bound to collapse as the operators view SANTACO as a national body that does not represent them at regional and local levels.

The programme currently faces a myriad of challenges that range from the disjointed taxi industry, to corruption in the issuing of operating licences and permits, need for the rationalisation of the transport

agencies at provincial and national government levels (permit boards, registrar's offices, cross border roads agencies), collapse of the cooperatives concept, bad image of the industry from the public and commuter's point of view, and public sector capacity deficiencies (Chiloane-Tsoka, 2018).

Therefore, the intervention of the government in terms of policy development and the regulation of agreements becomes critical for ensuring that the bottom-up approach in the appointment of a democratically elected body that represents all the operators in the taxi industry is adopted (Mtsi, 2021). Without this single point of accountability for the MBT industry, none of the reform interventions will ever materialise.

Subsidisation of the MBT industry

The South African public transport system consists of rail and bus services, which are subsidised by government, and MBT services, which are unsubsidised. Ironically, this is the transport mode that is most preferred, particularly by the poor sectors of the community (Mamabolo & Sebola, 2018).

Ryneveld (2018) points out the existence of significant variations in the profitability among operators of the minibus taxi industry. The level of profitability is influenced by the route the taxi runs, and the nature and effectiveness of the authority exercised by the taxi association controlling the route. As an example, studies conducted in Cape Town show that some of the routes record profit margins in excess of R20 000 per vehicle per month, while some routes operate at deficits in excess of R2 000 per vehicle per month. The need for the government's intervention in the industry in the form of operational subsidies over and above the Taxi Recapitalisation Programme cannot be over emphasised. The government can attain higher safety standards, improve working conditions for drivers, and control operator competition by formalising and regulating the market through subsidisation (Ryneveld, 2018).

Gotz *et al* (2014) talk of the phenomenon of transport poverty that is prevalent among poor urban residents of South African cities and define it as an inability of people to seek work and access community and social services, and which constrains them in participating in urban life. Some may lose jobs or resign from their jobs due to severe transport difficulties. At the core of transport poverty is people paying more for travel costs than they can afford. Poor households spend more on transport as they mostly rely on the informal unsubsidised minibus taxis for their commuting needs. In South Africa, the contributing factors leading to transport poverty are low access to private and public transport services, affordability issues connected to over-reliance on minibus taxis, the legacy of apartheid planning and contemporary housing developments, and over-reliance on walking (Lucas, 2011).

Studies show that "affordable public transport can provide a significant boost to the poor's mobility" (Bryceson *et al*, 2003). There is a direct link between transport affordability and non-existence of government subsidy in MBT operations in South Africa. The responsibility to turn around this status quo rests on the shoulders of policy makers, namely government.

CONCLUSION

There is a strong affirmation that the BRT system, in its current form, is unaffordable to municipalities, and that the capital costs of the infrastructure that is required for its implementation are unaffordable to the government. The accessibility and flexibility of the minibus taxi service is what attracts commuters to it, and other transport modes are unable to offer those attributes to commuters.

The regulation of this industry is the first step government needs to embark on in pursuit of its formalisation and the ultimate improvement of the quality of service that is rendered by the industry. Regulations should also come with the minimum quality standards that need to be adhered to by the minibus taxi industry. A more inclusive, cost-effective approach that accommodates the different transport modes in a regulated and formalised manner is needed for addressing the transport challenges facing South Africa.

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Why SA should be developing smart road pavements and materials

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Today we enjoy a plethora of "smart" technologies, from smartphones to smart cars and cities. However, our road pavements have yet to embrace these advancements, lacking in smart technology integration. To position South Africa as a global leader in intelligent transportation, it is essential to invest in research focusing on data-driven smart pavements and materials engineering.

Over the past 250 years, the world has undergone three industrial revolutions, with the fourth currently underway. The South African Presidential Commission on the Fourth Industrial Revolution (4IR) defines Industry 4.0 as "an era where people are using smart, connected, and converged cyber, physical, and biological systems and smart business models to define and reshape the social, economic, and political spheres".

Smart road pavements and materials pave the way for a more connected, sustainable, and efficient transportation system, benefiting both citizens and the environment. It is a field with the potential to transform and uplift road transport infrastructure in a safe, sustainable, and efficient manner.

Pavement deterioration is a common challenge in South Africa, and sustainable and resilient pavement infrastructure is therefore crucial for solving the country's current socio-economic and

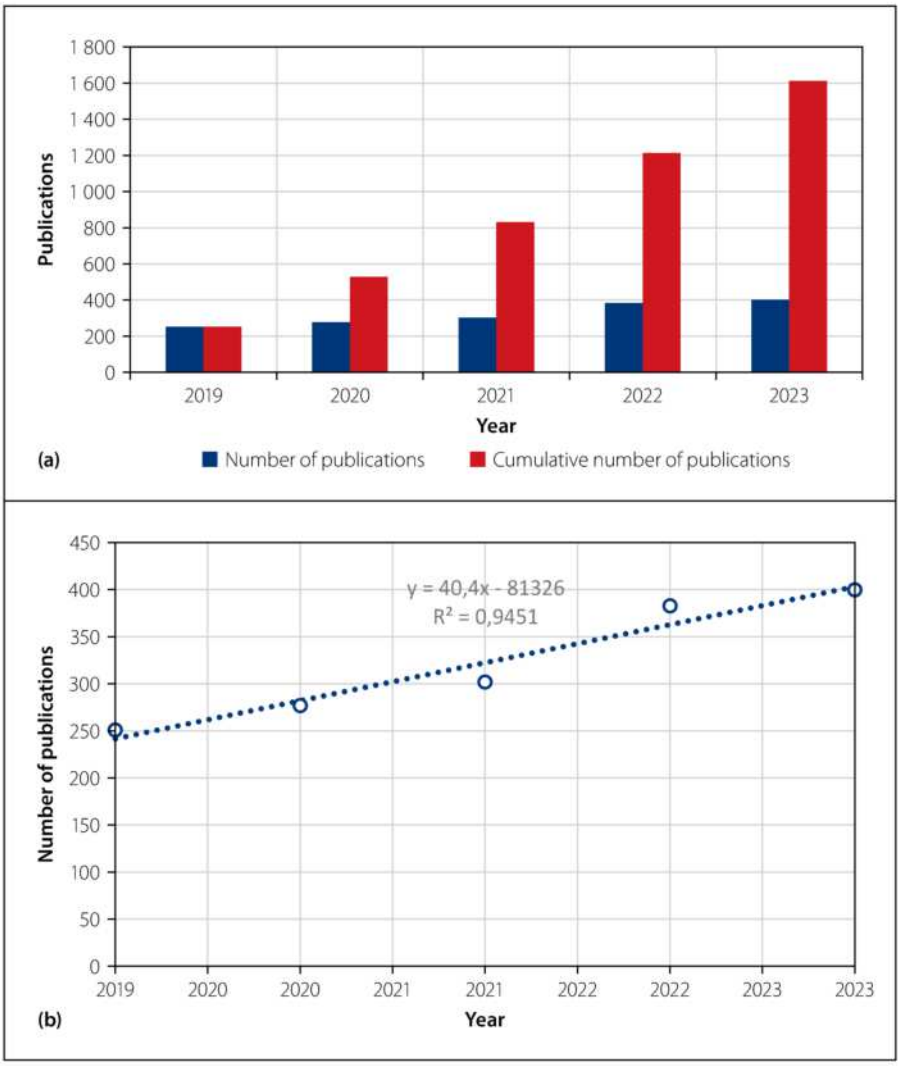

Figure 1 Yearly publication trend

Pavement deterioration is a common challenge in South Africa, and sustainable and resilient pavement infrastructure is therefore crucial for solving the country's current socio-economic and environmental challenges.

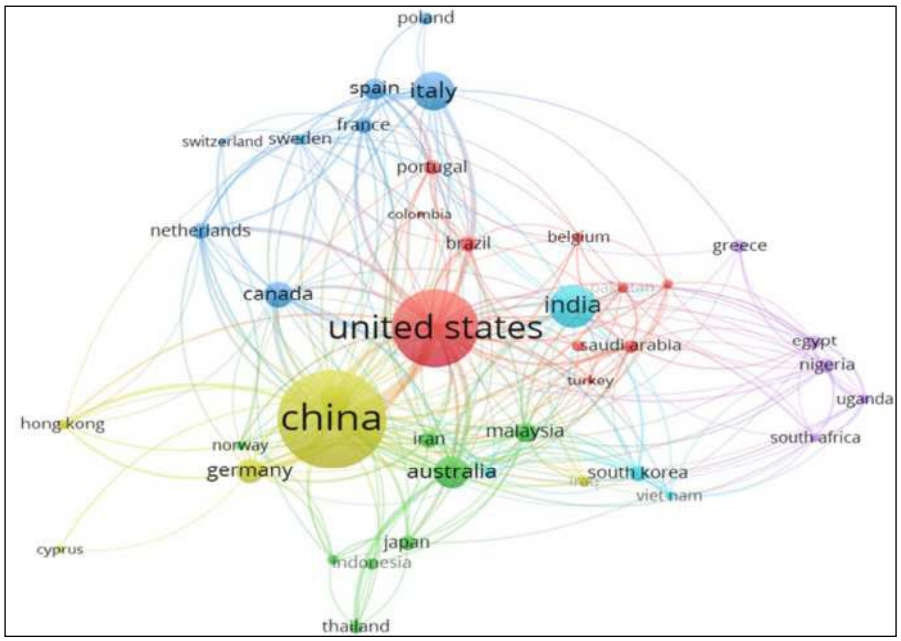

Figure 2 Network visualisation of countries leading in smart pavements and materials research

environmental challenges. The research and development of smart road pavements and materials in South Africa has the potential to promote intelligent and sustainable transport infrastructure, advance the performance of pavement materials, reduce CO_2 emissions and energy costs, and create endless economic possibilities in line with the National Development Plan 2030, circular economy, and Sustainable Development Goals 9 (Industry, Innovation, and Infrastructure), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), and 13 (Climate Action).

RESEARCH EFFORTS

Figure 1(a) shows the global yearly publication trend of smart pavements and materials research from 2019 to 2023. Figure 1(b) shows a linear growth pattern with a coefficient of determination (R^2) of 0.9451, implying a positive trend in smart pavements and materials research globally. Figure 2 shows that the research on smart pavements and materials in South Africa is still emerging and/or lagging at the global scale, as it contributes less than 0.87% of global publications. This implies a need for greater research, funding, and collaboration.

Research on smart road pavements and materials for sustainable transport infrastructural development and/or geotechnical engineering applications is currently being undertaken in the Department of Civil Engineering Science under the Faculty of Engineering and the Built Environment at the University of Johannesburg, and is further supported by the Intra-Africa Mobility Scheme of the European Union in partnership with the African Union under the Africa Sustainable Infrastructure Mobility scheme. The work is part of collaborative research at the Centre of Applied Research and Innovation in the Built Environment.

Research on smart road pavements and materials for sustainable transport infrastructural development and/or geotechnical engineering applications is currently being undertaken in the Department of Civil Engineering Science under the Faculty of Engineering and Built Environment at the University of Johannesburg.

The research is currently in the bibliometric and systematic review stage, which has identified seven research areas (innovation) and impacts, which are outlined in Table 1.

Overall, the yearly publication trend indicates that South Africa must prioritise research in smart road pavements to emerge competitive in the 4IR era and achieve the goals of the National Development Plan 2030. Thereafter, implementing intelligent transportation and smart road pavements and materials in South Africa will require a multidisciplinary approach with collaboration from both the public and private sectors. ◻

Table 1 Quad chart of the expected outcomes of researching and developing smart road pavements and materials in South Africa

Aim To develop integrated smart road pavements and materials.	**Potential stakeholders** i. Department of Science and Innovation ii. Department of Transport iii. South African Civil Aviation Authority iv. Airports Company of South Africa Ltd v. South African National Roads Agency Ltd vi. Eskom vii. United Nations Development Programme viii. Development Bank of Southern Africa ix. African Development Bank x. World Bank xi. European Union xii. Private investors xiii. Local and international universities
Innovation The research, development and implementation of: i. Eco-friendly pavement materials ii. Self-healing pavement materials iii. Traffic load self-sensing pavements iv. Cracking and/or rutting self-detecting pavements v. Solar-powered pavements vi. Electric vehicle self-charging pavements vii. Pavements connecting smart cities.	**Impact** i. Fostering the South Africa National Development Plan 2030, circular economy, and Sustainable Development Goals 9, 11, 12, and 13 to advance smart transport infrastructure. ii. Advancing the South African socio-economic landscape through re-industrialisation to compete and collaborate with the new fast-growing economies. iii. Developing a network of public-private partnerships on smart pavements and materials intellectual property technology commercialisation. iv. Building R&D capacity to facilitate implementation of the smart pavement infrastructure technology. v. Advancing the science, technology, and innovation of smart transportation in this era of 4IR and artificial intelligence.

Tales of political party manifestos in SA's 2024 general elections and implications for the civil engineering profession

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Reading through political party election manifestos requires a good breakfast preceded by very good sleep. Paying attention to these manifestos is important because they provide a hint of what to expect in the executive and legislative branches of the state. Moreover, the manifestos could help prepare civil engineers on how to position themselves as a profession, including in higher education, research and development, institutional building, and communication. I reflect on a dozen of these manifestos.

THE 2024 NATIONAL AND PROVINCIAL ELECTIONS

On 26 March 2024 the Independent Electoral Commission of South Africa reported that some 14 662 candidates had been nominated by their respective political parties to contest 887 seats in the National Assembly and the nine provincial legislatures. For the National Assembly, which has a maximum of 400 seats, some 4 323 candidates had been nominated from what I count as 51 parties, excluding independents. Needless to say, the 2024 elections will be highly contested, with some pundits labelling them a watershed moment due to likely shifts in historical voting patterns, as reflected in various polls.

CIVIL ENGINEERS AND THE POLITICAL DISCOURSE

Civil engineering is arguably the closest of engineering disciplines to political dynamics, with civil engineers continually shaping and being shaped by the political discourse. I had a mentor who carried the South African Constitution booklet with him to every meeting. I only came to appreciate the significance of this act many years later, when I also came to appreciate that a contextless civil engineer becomes a loose cannon.

I believe the preamble of the Constitution of South Africa refers to civil engineers where it says: "We, the people of South Africa… Respect those who have worked to build and develop our country". It is in the past tense because future generations will still be reading this, including in relation to the current cohort of engineers.

REFLECTING ON 2024 POLITICAL PARTY ELECTION MANIFESTOS

An election manifesto is as statement of intent by a political party, issued before elections, articulating the party's aims, objectives and priorities should it be elected to govern. For this article, I chose to reflect on manifestos of a sample of 12 political parties based on the ease of availability of their manifestos. The 12 parties selected are not a representative sample of political views because every political party is unique. Rather, the reflection provides a hint of the nature of political conversations that are likely to take place beyond the 2024 elections.

The review takes the form of assessing text in each manifesto against the 17 Sustainable Development Goals (SDGs) in terms of the extent to which each manifesto seeks to address the SDGs. The SDGs are a set of specific measurable actions adopted

Table 1 Assessment of each political party manifesto against SDGs

Sutainable development goal	ACDP	ActionSA	Aljama-ah	ANC	DA	EFF	FF Plus	GOOD	IFP	MK Party	RISE Mzansi	UDM	Total	% out of possible maximum
Goal 1: End poverty in all its forms everywhere	1	3	1	2	3	3	2	3	2	0	2	1	**23**	59%
Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture	2	1	1	2	1	2	2	0	2	0	2	2	**17**	44%
Goal 3: Ensure healthy lives and promote well-being for all at all ages	1	2	1	2	1	2	1	0	2	0	1	1	**14**	36%
Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	1	2	1	2	3	3	2	2	2	1	2	2	**23**	59%
Goal 5: Achieve gender equality and empower all women and girls	1	1	1	2	0	3	1	2	0	0	2	2	**15**	38%
Goal 6: Ensure availability and sustainable management of water and sanitation for all	1	2	1	2	2	3	2	1	2	0	1	1	**18**	46%
Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all	1	2	1	2	2	3	2	2	2	1	3	1	**22**	56%
Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	1	3	1	3	3	3	2	2	3	3	2	2	**28**	72%
Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation	1	3	1	1	3	3	1	1	1	1	2	2	**20**	51%
Goal 10: Reduce inequality within and among countries	0	2	2	2	2	2	1	2	1	0	2	2	**18**	46%
Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable	1	2	1	2	2	3	2	2	2	1	2	2	**22**	56%
Goal 12: Ensure sustainable consumption and production patterns	0	0	0	0	0	0	1	0	1	0	2	2	**6**	15%
Goal 13: Take urgent action to combat climate change and its impacts	0	1	0	1	1	3	2	2	1	0	1	1	**13**	33%
Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development	0	1	0	0	0	2	1	0	1	0	0	1	**6**	15%
Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	0	1	0	0	0	2	1	0	2	0	0	1	**7**	18%
Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	1	2	1	1	2	2	2	2	2	0	2	2	**19**	49%
Goal 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.	0	1	1	2	2	2	1	2	0	1	1	2	**15**	38%
	12	**29**	**14**	**26**	**27**	**41**	**26**	**23**	**26**	**8**	**27**	**27**		

Colour code	
Assertions against a specific SDG = -1	A mention and a clear plan on how aspects of the SDG will be addressed = 2
No direct mention of aspects of the SDG = 0	Both a plan and explicit measurable targets of how aspects of the SDG will be addressed = 3
Mention of intention to address aspect of the SDG = 1	

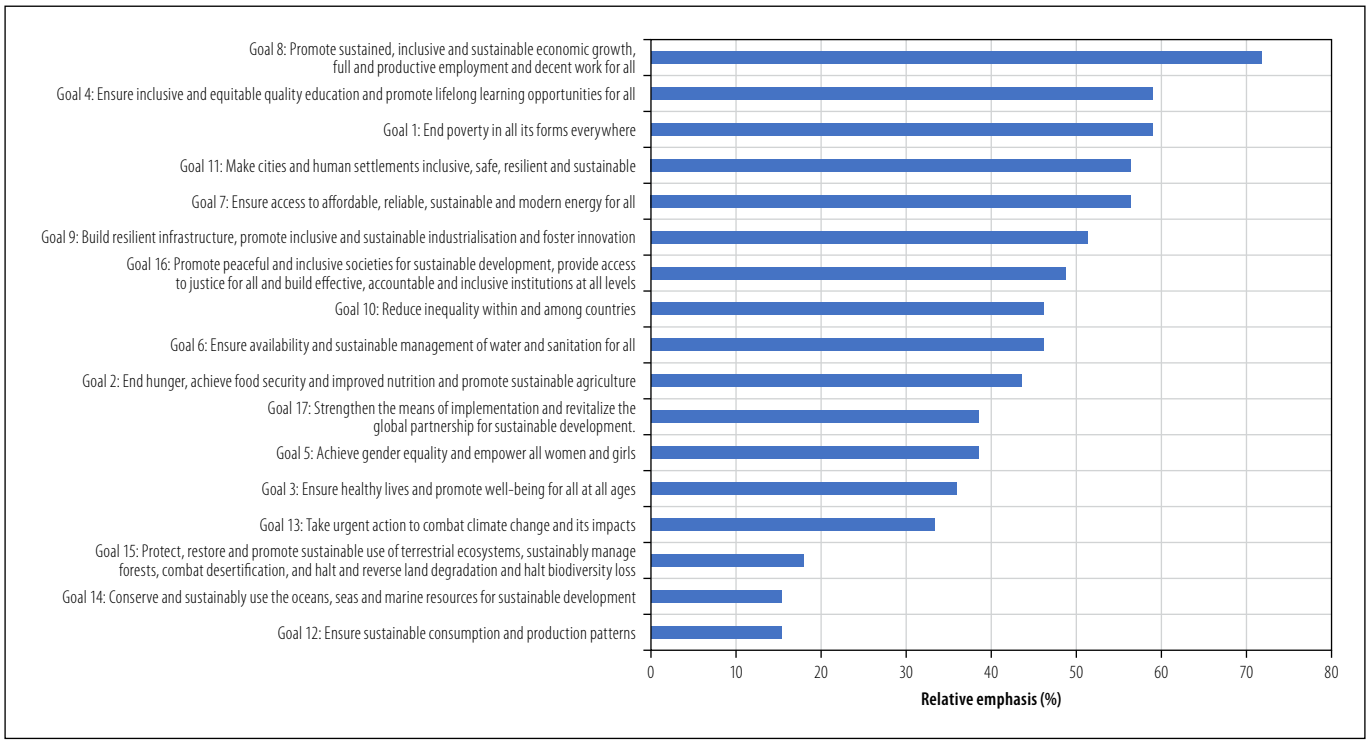

Figure 1 Relative emphasis of SDGs in manifestos

by United Nations member countries in 2015 to help guide and measure developmental progress over a 15-year horizon.

A five-level categorical scale was used for each SDG and manifesto:

- Score of -1 for assertions made against a specific SDG.
- Score of 0 if there is no direct mention of aspects of the SDG.
- Score of 1 if there is direct mention of intention to address aspects of the SDG.
- Score of 2 if there is both direct mention and a clear plan on how aspects of the SDG will be addressed.
- Score of 3 if there is both a plan and explicit measurable targets for how aspects of the SDG will be addressed.

The reflection is by no means an evaluation of the quality of political party offerings or their manifestos. Rather, it reflects the discourse that is likely to ensue after the May 2024 elections. More importantly, the assessment may help the civil engineering profession to position itself in the ensuing political conversation.

ASSESSMENT OUTCOMES

Table 1 summarises the assessment outcomes for each party. Figure 1 depicts the relative emphasis of each SDG by all the 12 parties.

By virtue of emphasis on job creation, most emphasis in the manifestos has been placed on SDG 8, namely "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all". The least emphasis is jointly on SDG 12, "Ensure sustainable consumption and production patterns" and SDG 14, "Conserve and sustainably use the oceans, seas and marine resources for sustainable development".

It appears that more short-term issues affecting the wellbeing of voters tend to have greater emphasis. On the other hand, it appears that political parties tend to regard measures aimed at such actions as sustainable use of marine resources, and adoption of sustainable consumption and production patterns as least likely to resonate with voters. Job creation is seen as the key driver. Overall, scoring across all the SDGs is 43%, possibly implying that SDGs are not considered key decision drivers.

IMPLICATIONS FOR THE CIVIL ENGINEER IN CONVERSATION WITH POLITICIANS

Civil engineers are likely to be required to plan, design and deliver projects that maximise job creation, even if such projects are sometimes to the detriment of the environment and compromise intergenerational equity. It is therefore important to continually remind civil engineers of Section 24 of the Constitution, which states that:

> "Everyone has the right: (a) to an environment that is not harmful to their health or wellbeing; and (b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that: (i) prevent pollution and ecological degradation; (ii) promote conservation; and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development".

Gender equality, and overall societal equality, are some of the lesser emphasised actions. Civil engineers should proactively counter this and engender equality, with clear targets, in institutional designs and projects. Overall, it will be necessary for civil engineers, as engineers of society, to place the interest of society first, current and future, when creating policies, plans, and designs for infrastructure and services. This is because the default political setting is not likely to shift the needle.

CONCLUSION

Civil engineers must earn the respect of society referred to in the preamble of the Constitution. The mere execution of projects because there is a budget to do so is insufficient. Rather, projects must earn civil engineers the respect. Civil engineers should never be mere implementing agents. Over and above, the Constitution demands civil engineers to always reflect on any proposal in the interest of both intra- and inter-generational equity, and to maximise ecological sustainability. ☐

Grain and the train: Preparing for South Africa's grain elevator system

The national grain elevator system of South Africa was put into use in 1924, about 15 years after the first feasibility study highlighted the weaknesses of its then prevailing system of manhandling grain bags. Unless it could be replaced with a mechanised system of bulk grain handling, South African grain would not be economically competitive to European consumers, the targeted export market. We celebrate the centenary of our elevators with a three-part series of articles reviewing the planning, design and implementation of the network of 34 new country elevators, 2000 specialised new grain wagons and two new port elevators. This first paper tells the story from the start at Unification in 1910, up to the point when actual construction started in 1921.

A hundred years ago, the grain elevator system in South Africa came into use, roughly 80 years after the first grain elevators were built in the United States and Canada, which brought great financial benefits to those countries. Why did it take so long to catch up when South Africa was normally much quicker to follow technological advances elsewhere?

The first reason is geographical. The North American continent offered a network of navigable rivers, large inland lakes and man-made canals to make it relatively easy to ship agricultural produce to consumers. In South Africa, animal transport and poor roads made overland transportation slow, difficult and expensive.

The second reason is political. Before 1910, South Africa was a patchwork of different jurisdictions. The main grain producers were in the Republics of the Orange Free State and Transvaal, while the big consumers and export harbours were concentrated along the coasts of the Colonies of the Cape and Natal. Rivalry among these jurisdictions was often fierce and led to continuous strife, ultimately boiling over during the Anglo-Boer War (1899 to 1902). The railway systems, the only practical option for moving grain in large quantities, were similarly fragmented among different railway companies. Moreover, the coverage of the region by the railways was sparse – by 1905 the total length of railways in the Orange Free State and the Transvaal, the main grain producing regions, was only 2 500 km. Only when the likely unification of South Africa appeared on the national agenda in the early 20th century, a national grain elevator system could be considered. The official Union of South Africa formed in 1910, and the consequent amalgamation of the regional railway companies into a single South African Railways (SAR) was an important event that paved the way for an integrated South African grain elevator system.

PREPARING FOR A SOUTH AFRICAN GRAIN ELEVATOR SYSTEM

As soon as the new Union Government was formed, it commissioned Sir Thomas Price to report on the feasibility of a grain elevator system for South Africa. Price's tenure as the General Manager of the Central South African Railways (CSAR) came to an end when the CSAR was subsumed by the SAR. His vast experience as a railwayman made him the ideal person for the job.

He spent a few months in the United States and Canada during 1911 to study the latest elevator developments before producing a comprehensive report with 14 conclusions and 19 recommendations. At the time of Price's visit, there were 6 779 grain elevators in use in North America, demonstrating how far South Africa had fallen behind in this respect. Price was convinced that South Africa had the agricultural potential to vastly increase its grain production; that South African grain was of a type and quality that would be successful in competing on the European market; that the price of South African grain could be competitive, albeit with small initial margins that were likely to improve with scale; and that South Africa had significant natural factors in its favour such as cheaper land, more sunlight and better conditions to attain lower moisture levels by natural drying. However, there were significant South African weaknesses that stood in the way of an efficient elevator system, including:

- The facilities throughout the grain supply chain (collection, handling, storage, transport and port loading) were poor.
- The main mode of grain handling was with bags, while the main benefit of grain elevators was premised on handling grain in bulk. The cost of discharging bagged grain in Europe was said to be between 30% and 50% greater than it was for bulk grain. In 1918, before bulk handling, there were 420 people employed in Durban harbour, assisted by belt conveyors, to load the grain bags onto ships. At the time, it was estimated that only 33 people would have been necessary if the grain was handled in bulk by a properly equipped elevator.
- There was some scepticism among the South African grain producers towards a new elevator system. The Price report was concerned that the "farmer, even though he will gain much, will, at the outset, be doubtful

Figure 1 Thomas Rees Price, General Manager of the CSAR from 1902 to 1910

Figure 2 William Wilson Hoy, General Manager of the SAR&H from 1910 to 1929

whether it is sure that justice will be done to him under the bulk loading and grain elevator system, seeing that his grain will be mixed with that of others of the same grade, until he finds by experience he has nothing to be alarmed about on that account".

- The grading and classification of grain was not nationally consistent, which "affects the good name and character for good faith of South Africa." More consistent grading and accurate weighing practices had to be introduced to get on par with the US and Canada.

Price, in conclusion, had no doubt that elevators would bring much benefit for South Africa and its farmers, but was uncertain whether enough surplus grain was produced at that point to guarantee immediate financial success. However, in anticipation of the eventual adoption of grain elevators, sooner or later, the players in the grain industry had already started to address the weaknesses listed above. A multi-disciplinary conference was held on 18 and 19 January 1910 in Bloemfontein, attended by 36 grain experts representing the railways, chambers of commerce, shipping, departments of agriculture, producers and official grain graders. Price was elected as chairman of the conference and the conference was opened by General Christiaan de Wet, erstwhile hero of the Anglo-Boer War, then Minister of Agriculture of the Orange Free State.

De Wet stated that the conference had "not been called together one moment too early in order to make the best arrangements for the exportation of maize." One of the most important outcomes of the conference was consensus that the grading of grain should be placed under one government authority to enforce uniformity of grading practice and standards. A standing committee was suggested to set standard grain grades for every year and to issue uniform grain certificates for grain passed and rejected. Such a committee was subsequently formed and met on 24 April 1911 for the first time in Cape Town, discussing a broad range of technical grain issues such as the standardisation of bags, forms and certificates, the problems of weevils and moisture during storage, the statistical basis for laying down sampling protocols, etc.

The meeting was also attended by Willliam Hoy, the General Manager of the SAR, who posed a number of practical railway questions, such as the washing of grain wagons, who should pay for it, how many weighing stations should be provided, their required accuracy and calibration, etc. As early as 1912, the grain industry was seemingly well on its way to being ready for the introduction of grain elevators. But in 1914 World War I broke out and all plans had to be put on hold for a few years.

During the war, South African grain production increased quite dramatically. In 1911, when Price published his report, the total agricultural areas under maize was roughly 1 million ha. By 1919, just after the war, the area almost doubled to 1.8 million ha. From 1908 to 1913 the total grain exported was mostly under 0.5 million bags/year; in 1917 more than 2 million bags were exported. In 1918, with the end of the war in sight, the time was obviously opportune to introduce a national grain elevator system.

A Grain Elevator Committee was appointed in February 1918 to "inquire in and report upon the desirability or otherwise of establishing grain elevators in South Africa". Based in Johannesburg, the Committee visited many towns and districts to take evidence, including harbours, mills and private elevators. The Grain Elevator Committee had their report ready by August 1918, which concluded that the elevator system should be implemented as soon as possible. The total capital cost was estimated to be roughly £2 million, a substantial investment. In practical railway terms, this amount could have paid for roughly 1 000 km of new railway. Though admitting that it was difficult to calculate, the anticipated cumulative savings were about £0.5 million a year, suggesting that the capital investment could be recovered in four years.

The report was well received and lauded as an investigation that had been "carried through with a thoroughness and expedition which should serve as an object lesson to other similar bodies" and that the report was "one of the most business-like and heartening publications that have appeared from a Government department for many years".

The SAR&H was tasked to turn the proposals into reality. Some suggested that the Department of Agriculture should have been given the task, but it was obvious that the grain elevators were mostly about engineering and logistics, superimposed on the railway network available at the time – all these matters were at the core of the SAR&H's activities. The SAR&H appointed William Littlejohn Philip, a grain elevator expert from Wiltshire England, to provide a conceptual design of the system, including appropriate design parameters, suggesting the best types of equipment, the most appropriate materials, and the number, capacity and location of the proposed elevators. Littlejohn Philip submitted his report in December 1919. This report, along with covering memoranda from the SAR&H, were presented to Parliament for authorisation of the funds for the construction of the grain elevator system.

The SAR&H Administration was handed a new mandate to control the cleaning, weighing, grading, storing, transportation and loading of the grain at the ports, but its jurisdiction would not extend to trading in grain (in 1913, the control and operation of the major harbours was transferred to the SAR, which then became the SAR&H). The SAR&H was to run the elevator system on a no-profit basis. The intention was that, once the elevator system got underway, private enterprise would step in to extend the network and to take over all the elevators some time in the future.

A critically important aspect of the South African grain elevator system was that grain received into an elevator lost its identity once it had been weighed, graded and transferred to a storage bin. The system worked on the principle that a tonne of grain, at a specified grade, was equivalent anywhere in the system, which relied on a uniform grading of grain throughout the country. This offered a huge financial convenience to farmers, who would get a transferable grain receipt immediately upon delivery to the nearest elevator.

LOCATION AND SIZING OF THE ELEVATORS

The elevator system comprised two types of elevators. The "country elevators" would normally receive the grain by road from the farming areas, and despatch it by rail. The "port elevators" would normally receive the grain by rail from the country elevators and despatch it into shipping vessels. The country elevators would be built in the main grain producing areas, located alongside existing railway lines. There would be two port elevators in Durban and Cape Town where larger quantities of grain could be stored, with mechanical loading facilities to ensure rapid transfer of bulk grain into ships.

To allow for the anticipated transition from using grain bags to the more efficient bulk handling of grain, all the elevators had to be designed to deal with both modes of handling for both incoming and outgoing grain. Littlejohn Philip, in his recommendations, boldly suggested that 71 country elevators should be built at once, which would allow the export of 726 000 tonnes/year, but the SAR&H took a more cautious approach and reduced the export target to 526 000 tonne/year which would require only 34 country elevators.

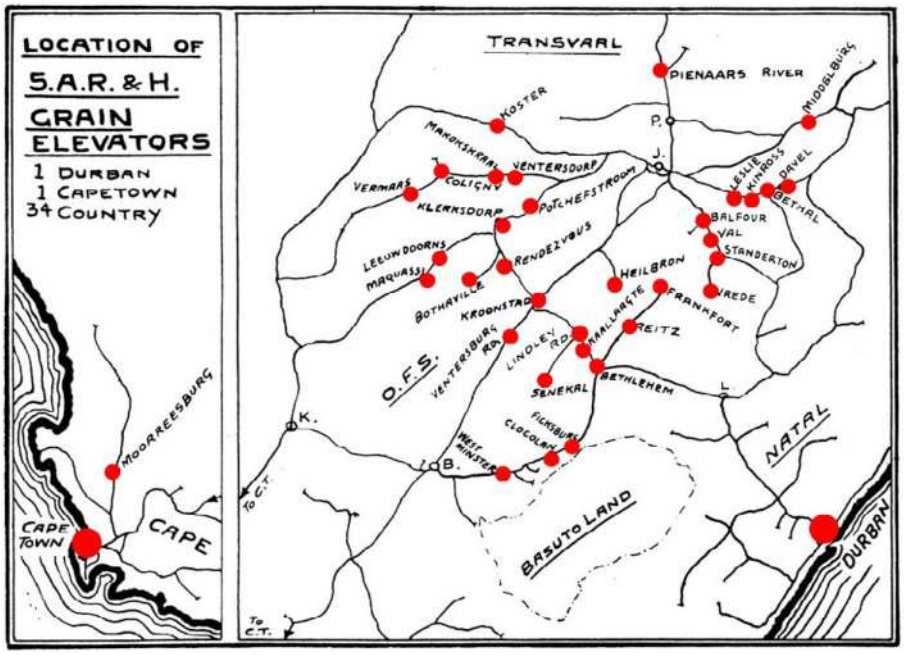

Figure 3 Elevator locations superimposed on the railway network at the time of building the first elevators

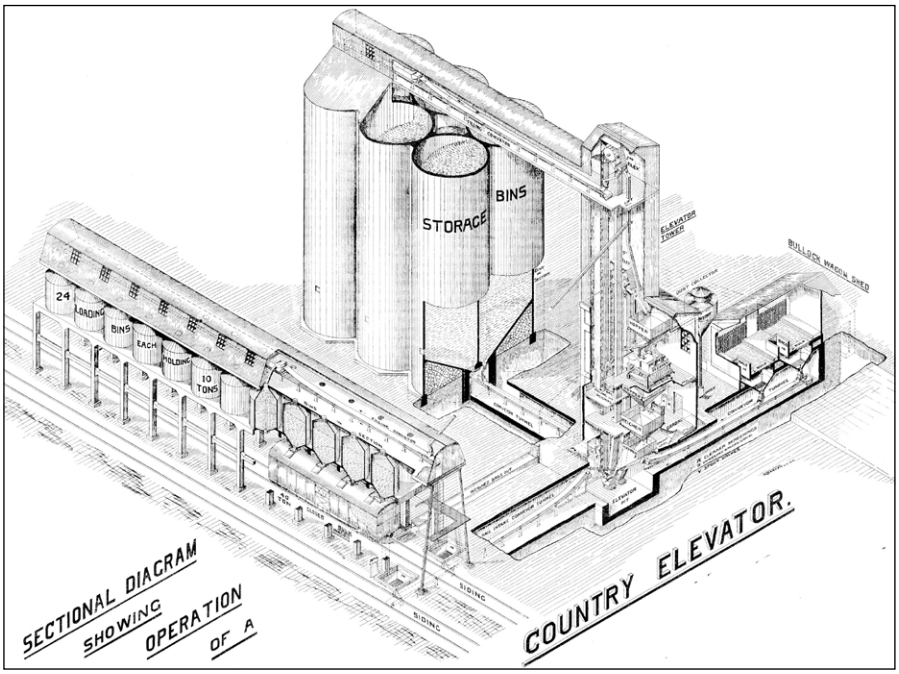

Figure 4 Sectional elevation of a small country elevator

Of the 34 country elevators, 33 were in the northern part of the country, with a single elevator at Moorreesburg in the Western Cape (see Figure 3). It may seem odd to have a large port elevator in Cape Town, so far away from the grain producing areas, but it made sense as the railways between the maize areas and Durban were already overworked. Export facilities for the wheat and oats of the Swartland region were also needed, and ships leaving from Cape Town could reach their destinations in Europe four days quicker than from Durban.

The country elevators were sized according to the grain production in their surroundings, assuming that their contents would be turned over five times a year. Their total storage capacity therefore had to be about 526 000/5 ≈ 105 000 tonnes. Their individual storage capacities ranged from 1 600 to 5 300 tonnes in seven standardised sizes. The smallest nine elevators, for example, had storage capacities of 1 600 tonnes distributed over six main bins and two interstitial or "star" bins (which means that the volume between four closely spaced bins would also be used for storage).

The largest four elevators had capacities of 5 300 tonnes each, distributed over twelve main bins and five interstitial bins.

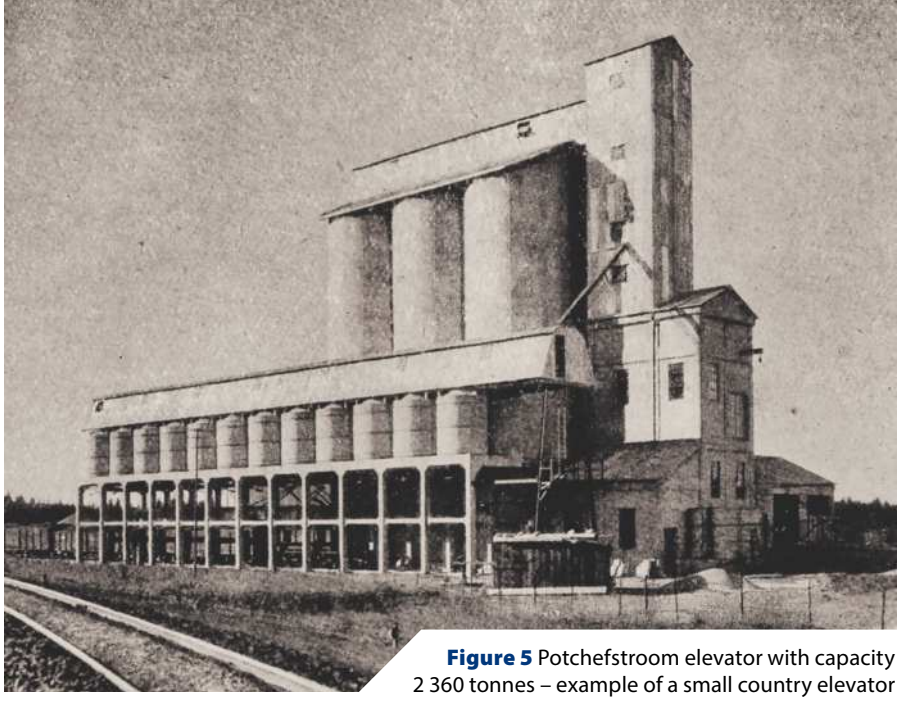

Figure 5 Potchefstroom elevator with capacity 2 360 tonnes – example of a small country elevator

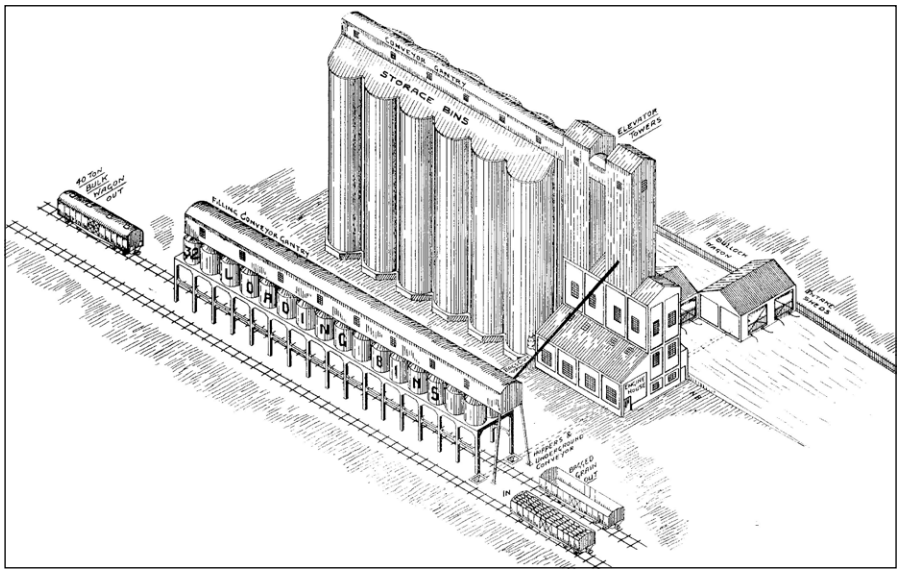

Figure 6 Elevation of a large country elevator

Figure 7 Bethlehem elevator with capacity 4 360 tonnes – example of a large country elevator

As it turned out, the country elevators had a combined capacity of 99 000 tonnes. In all cases, the bins were arranged in two rows. Every elevator would have an intake area, a "working house" to accommodate the lifting gear, the weighing scales and the grain cleaning equipment, the storage bin area and a despatch area. The smaller country elevators would have one working house to accommodate most of the mechanical equipment; the larger ones two working houses (see Figures 4 to 7).

The port elevators in Cape Town and Durban were substantially larger with capacities of 27 200 and 38 100 tonnes respectively. These capacities were based on the assumption that they would have eight stock turns/year. The Cape Town elevator had three receiving and four shipping elevators, along with 42 bins, each 27 m high. The larger Durban elevator had four receiving and five shipping elevators, along with 50 main bins, 28 m high, arranged in five rows and 36 interstitial bins. Besides providing storage, they also had to have sophisticated equipment for loading the grain quickly into the ships. Both port elevators were designed for a maximum grain transfer rate of 907 tonnes/hour. Special precautions were taken to address three problems common to bulk grain storage:

- Grain dust is highly combustible and poses the danger of fire and explosion, the reason why many early wooden elevators were lost to fire. The dust had to be removed before entry into the storage bins.
- If damp grain is taken into bulk storage, natural drying slows down and the grain could start to ferment. The temperature then rises, which increases the risk of combustion and spoiling the grain with a musty smell. For this reason, the grain moisture content had to be lowered by natural or mechanical drying to below a certain threshold before accepting the grain into storage.
- Weevil infestation of grain, however slight, disallowed any grain from entering into bulk storage. This strict rule followed after studies by entomologists from the Department of Agriculture. Farmers were therefore encouraged to send their produce to the country elevators as soon as possible before weevils developed in their own storage facilities.

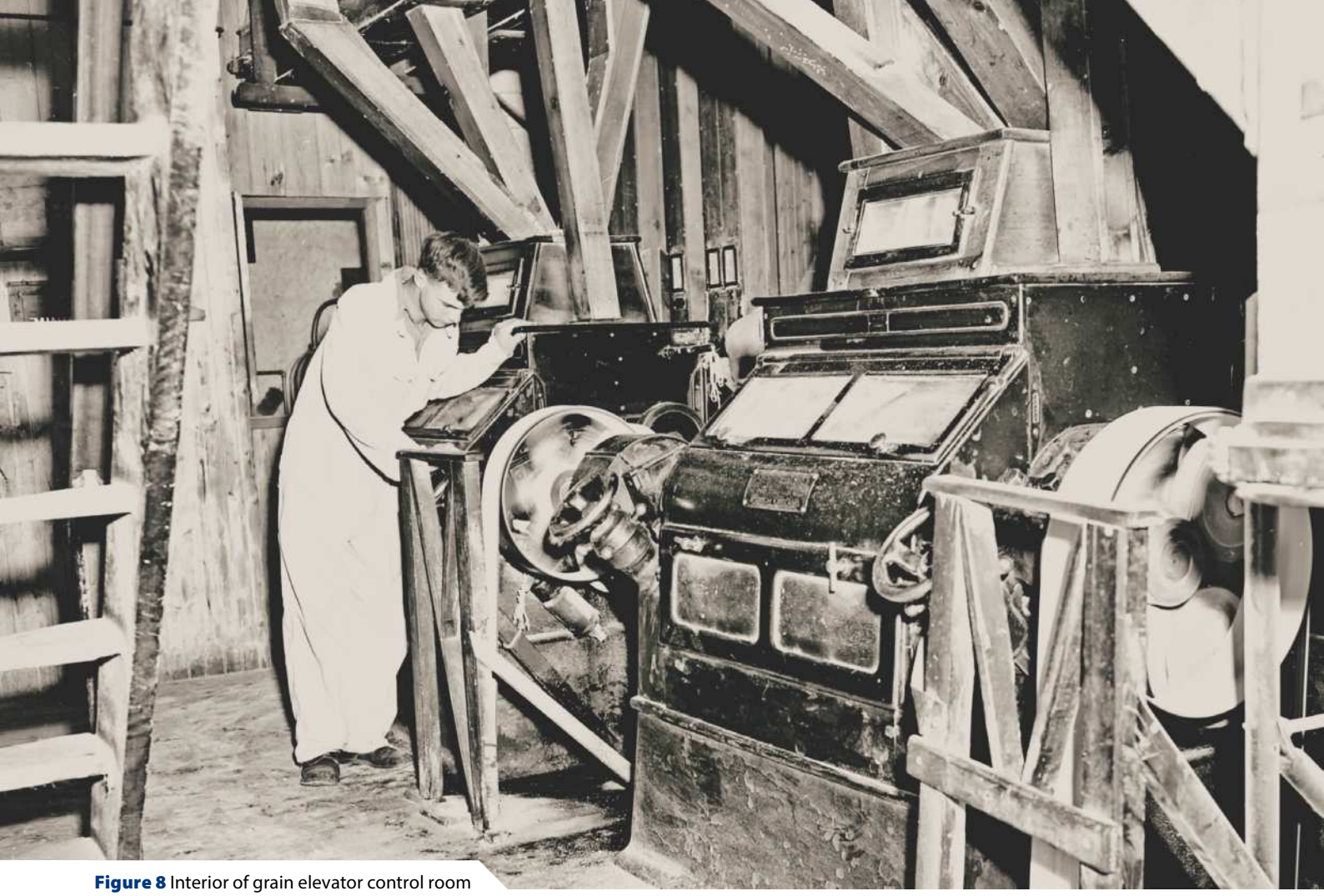

Figure 8 Interior of grain elevator control room

PREPARING FOR CONSTRUCTION

The SAR&H split the civil engineering works into six parts. Each port elevator had two contracts – one for the foundations, and the other for the superstructure. The superstructure contract included the mechanical and electrical work, which were subcontracted to specialised equipment suppliers. The country elevators were lumped into a group of the 17 largest, and another for the 17 smallest elevators.

The two foundation contracts were awarded to local contractors. All the others were awarded to AW Menkins, a Canadian by birth, based in New York. His original tenders conformed to American standards, but not to the specifications laid down by the SAR&H. However, as his tenders were very much cheaper than those of his competitors, Menkins was given the opportunity to adjust his tenders to conform to the SAR&H specifications, but it did not make much difference and his price remained the lowest in all cases. Menkins came with good credentials as a "man of the highest qualifications in regards to elevator construction" who had then just successfully completed a large port elevator at Globe Island in Sydney, Australia. The awarding of the contracts to an American company did not pass without critical comment. The Colonial Government in Britain had shortly before loaned £6 million to the Union Government for investment in infrastructure. The Federation of British Industries complained that it was wrong that the main contracts were going to an American company and lobbied Winston Churchill to take up the cause of the British manufacturers who wanted the contracts. General Smuts, then the South African Prime Minister, responded to Churchill by pointing out that only the main contracts for the building work were going to Menkins; the structural steel and machinery were all being sourced from Britain.

Meanwhile, 60% of the total cost of the elevators would be spent in South Africa, with concrete, reinforcing steel, and labour all being supplied locally. South African interests were not satisfied either, and the local Association of Certified Mechanical and Electrical Engineers wrote to Smuts in 1923 complaining of the limited opportunities for its members since the contracts for the elevators had been "let as one … with the only South African materials used in the whole plant being the reinforcing bars, cement, stone, sand and water for the concrete". The Association argued that all the machinery, with the possible exception of specialised machinery such as the grain weighing scales, could have been made in South Africa at as good a quality and probably as cheaply as that imported from overseas. They pointed out that a private grain elevator had already been built during World War I for the Vereeniging Milling Company at Randfontein – a "grain elevator of the latest design, equipped with

The SAR&H split the civil engineering works into six parts. Each port elevator had two contracts – one for the foundations, and the other for the superstructure. The superstructure contract included the mechanical and electrical work, which were subcontracted to specialised equipment suppliers. The country elevators were lumped into a group of the 17 largest, and another for the 17 smallest elevators.

Figure 9 Grain weighing bin

the very latest conveyors and machinery, and the first of its kind in South Africa".

The subcontracts for the mechanical equipment for the two port elevators were awarded to two British companies, namely Spencer & Co of Melksham for Durban and Henry Simon & Co of Manchester for Cape Town. All structural steelwork went to Furness Shipbuilding Co of Middlesborough in England. Some examples of the mechanical equipment are shown in Figures 8 to 10.

The SAR&H recruited a team of its own engineers to supervise this complex project, scattered widely over 36 construction sites throughout the country. The team was headed by William Henry Clark, the Bridge Engineer of the SAR&H, who had to take on the additional duty of Resident Engineer, Grain Elevator Construction. Clark had three district engineers as his deputies – James Merriman Greathead was in charge of the port elevator in Cape Town, A Reynolds of the port elevator in Durban, and JM Granger in charge of all the country elevators.

Construction of the port elevators started on 24 January 1921 (Cape Town) and 1 March 1921 (Durban). By the end of February 1921, tenders were also accepted for the 34 country elevators. The first national grain elevator system for South Africa was finally underway.

SOURCES

Material for this paper was mostly drawn from SAR&H publications (annual reports, bulletins and magazines) and the dissertation of David Worth, submitted to the University of Cape Town in 2004, available at **https://open.uct.ac.za/handle/11427/30067**. A footnoted version of the paper is available from the author.

COMING UP

The next paper in this series will track the progress and problems at the 34 country elevators and the Cape Town port elevator, as well as the preparations the SAR&H had to make to meet the manpower and rolling stock requirements for commissioning and operating the national grain elevator system.

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Figure 10 Operator on an internal man-lift, pulling up and down on a rope, assisted by a counterweight system

Empowering the future: SAICE STAR and SAICE FLP inspire young engineers

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In the ever-evolving landscape of engineering, nurturing the next generation of professionals is paramount. SAICE stands at the forefront of this endeavour with initiatives like SAICE STAR and SAICE FLP paving the way for aspiring engineers to realise their potential and contribute meaningfully to society.

SAICE STAR (Success Through Academic Readiness), serves as a beacon of inspiration for learners across South Africa. At the heart of this initiative – led by Takalani Netshipale and Simphiwe Zondo, together with 20 esteemed individuals from all parts of South Africa – is a commitment to nurturing STEM talent and instilling crucial skills for academic and professional success.

Retang Maphothoma, a SAICE STAR representative from AECOM, exemplified this mission during a recent World Engineering Day event held on 4 March 2024, organised by the Engineering Council of South Africa. Addressing students from Bokgoni Technical School in Atteridgeville, Pretoria, Retang delivered a compelling talk aimed at empowering grade 10, 11, and 12 learners.

Central to Retang's message was the notion that success is not merely a destination, but a journey marked by perseverance and continuous learning. Drawing from her own experiences, she emphasised the importance of resilience, self-reflection, and motivation in the pursuit of excellence. By sharing personal insights and lessons learned, Retang underscored the transformative potential of education and mentorship in shaping future leaders in engineering.

The impact of the SAICE Future Leaders Panel (FLP), further amplifies the efforts of initiatives like SAICE STAR. Comprising young professionals, graduates, and students in civil engineering and related fields, SAICE FLP catalyses professional development and community engagement. Led by passionate individuals like Dlozi Mnisi (Chairperson) and Victor Chibaya (Vice Chairperson), the panel orchestrates a diverse range of activities aimed at nurturing talent, fostering industry exposure, and promoting STEM education.

Learners were guided through a hands-on activity, constructing bridges from everyday materials like straws and newspaper

At the World Engineering Day celebration, SAICE FLP members, including Dlozi and Victor, joined Retang in guiding learners through a hands-on activity. Together, they facilitated the construction of bridges using everyday materials like straws and newspaper, showcasing the practical applications of engineering principles in a fun and interactive manner. Beyond the technical aspects, this exercise fostered teamwork, creativity, and problem-solving skills among the participants, instilling a sense of confidence and curiosity about the field of engineering.

The collaborative efforts of SAICE STAR and SAICE FLP underscore the importance of mentorship and community engagement in nurturing the next generation of engineers. By providing mentorship, educational resources, and hands-on experiences, these initiatives empower young learners to explore their interests, develop critical skills, and pursue rewarding careers in engineering. Moreover, by actively engaging with schools, universities, and communities, SAICE cultivates a culture of inclusivity and excellence, ensuring that no aspiring engineer is left behind.

As we reflect on the inspiring work of individuals like Retang, Dlozi, Victor, and countless others involved in SAICE STAR and SAICE FLP, it is evident that the future of engineering is bright. Through mentorship, advocacy, and hands-on learning experiences, we have the power to shape a generation of innovative thinkers and problem solvers, poised to tackle the challenges of tomorrow with confidence and resilience. In this spirit, let us continue to invest in the potential of our youth, nurturing their talents and aspirations as they embark on their journey towards a sustainable and prosperous future.

Get involved

To join SAICE FLP or SAICE STAR, contact marketing@saice.co.za.

SAICE Limpopo hosts branch site visit two regional bulk water projects

To continue serving its members, the recently resuscitated SAICE Limpopo Branch invited its branch members to a site visit to the Industrial Wellfield Development and Associated Works and Phase 1 Commissioning: Refurbishment of Mokopane reservoirs and electrical work for the booster pump station at the Dorandraai Water Treatment Works (WTW) on 24 October 2023.

Sipho Nkonka
Mogalakwena Bulk Water Supply DWS Project Manager, Department of Water and Sanitation Limpopo Region
nkonkas@dws.gov.za

Mogalakwena Municipality is a local municipality located within the Waterberg District Municipality in Limpopo, South Africa. The municipality spans roughly 6 166 km^2 and is a home to around 307 684 people. The municipality is one of the five local municipalities within the Waterberg District Municipality that is granted the powers and functions of a Water Service Authority and Water Services Provider. The municipality was appointed by the Department of Water and Sanitation (DWS) as the implementing agent for Regional Bulk Infrastructure Grant projects.

PROJECT DESCRIPTIONS

The Industrial Wellfield Development and Associated Works project (project 1) forms part of phase 2A of the Mogalakwena Bulk Water Scheme. The raw water for the project is sourced from 11 boreholes located within Mokopane and its close surrounds: four boreholes within Mokopane, two in Sekgakgapeng village, two in Phola Park, and three in Moshate. The four boreholes in the Mokopane Zone will abstract approximately 940 kℓ/day, while the other seven boreholes in the Sefakaola Zone (Sekgakgapeng, Phola Park, and Moshate) will abstract approximately 2 739 kℓ/day (2.74 Mℓ/day).

The Sefakaola Zone boreholes will pump water to the to the command reservoir at Sefakaola village while the boreholes in the Mokopane Zone will pump water to the Mokopane high end reservoir to augment water for Mokopane and surrounding areas.

The project construction cost is estimated to be R28 884 627.31 for the completed works.

The Phase 1 Commissioning: Refurbishment of Mokopane reservoirs and electrical work for the booster pump station at Dorandraai Water Treatment Works project (project 2) forms part of phase 1A of the Mogalakwena Bulk Water Scheme. The raw water for the project is sourced from four boreholes in the Mokopane area. The project construction costs is estimated to be R41 324 659.94 for the civil and electrical aspects of the project at completion.

PROJECT OVERVIEW

Project 1

This contract provides for the completion of the Industrial Development Wellfield, Pumping Mains and Associated works project. This project could not be completed previously due to several challenges with the former contractor and engineer. The remaining scope of the project includes the following work:

- Completion, testing and commissioning of 13.5 km of pipelines
- Completion of 50 valve chambers
- Installation of the package plant – chlorination (treatment)
- Equipping 11 boreholes
- Road (both national and municipal roads) and rail crossings (Transnet).

Project 2

This contract provides for the phase 1 commissioning of the refurbishment of two high end reservoirs, one level reservoir at Mokopane, and the refurbishment of the electrical works at the booster pump station at the Dorandraai WTW. This project aims to ensure the reliable and sustainable supply of water for the town of Mokopane and surrounding areas.

The scope of the project includes the following work:

- Desludging the concrete reservoir
- Sealing joints, hammer testing
- Pressure cleaning exterior
- Roof waterproofing
- Refurbishing the valve chamber house.

PROJECTS STATUS

Project 1

The project commenced on 3 May 2023 and was initially scheduled for completion within 3 months (3 August 2023). Unfortunately, the project is still under construction due to numerous challenges, namely delays of the railway crossing pipeline work and electrical cable for electrification of some boreholes. The project is currently 94% complete and the contractor is on schedule to meet the revised completion date of 14 December 2023, as per the revised programme of works.

Project 2

The project commenced on 20 April 2023 and was scheduled to be completed within 12 months (20 April 2024). The project is under construction with no challenges and is currently 53% complete and due for completion on the agreed date of 20 April 2024.

SAICE LIMPOPO BRANCH SITE VISIT

The site visit was attended by 21 delegates from various institutions, both public and

private sector, from the Limpopo province and beyond.

The purpose of the site visit was to continue showcasing bulk water infrastructure projects to fellow civil engineering professionals in the province, to highlight challenges faced in the field of project management in Limpopo, to share knowledge and information on the different water treatment technologies on the market, to continue facilitating network opportunities among civil engineering professionals in the province, and to promote the visibility of SAICE Limpopo as a brand to attract new and recall old members.

The site visit was done in three sessions. The formal morning session included three presentations and was followed by two informal sessions in which attendees visited the project sites.

Presenters included Noko Mashita, SAICE Limpopo branch committee member; Sipho Nkonka, DWS Project Manager and SAICE Limpopo branch committee member; Alfred Bwanya from Royal HaskoningDHV; Kgotso Mohlake from Bogolo Waste Management; Elvis Manyelenyele from Mulalo Consulting Engineers; and Ndanganeni Mahangani from Superior Filtration.

Table 1 Local labour employed on project 1

Month	Adult		Youth		Disabled		Total
	Male	Female	Male	Female	Male	Female	
October 2023	12	4	7	6	0	0	29

Table 2 Local labour employed on project 2

Month	Adult		Youth		Disabled		Total
	Male	Female	Male	Female	Male	Female	
October 2023	3	1	5	3	0	0	12

Table 3 Human resources and plant on project 1

Human resources currently on site	Imported	Local	Total
Construction manager	1	0	1
Site foreman	1	0	1
Safety officer	1	0	1
CLO	0	2	2
Safety reps	0	0	0
Security	0	2	2
Operators	3	0	3
Total	**6**	**4**	**10**

Table 4 Human resources and plant on project 2

Human resources currently on site	Imported	Local	Total
Construction manager	1	0	1
Site foreman	1	0	1
Safety officer	1	0	1
CLO	0	0	0
Safety reps	0	1	1
Security	0	0	0
Operators	3	0	3
Total	**6**	**1**	**7**

Table 5 Plant and equipment on site at project 1

Description on plant	Imported	Local	Total
Flat truck	1	0	1
Tractor load backhoe (TLB)	1	0	1
Excavator	1	0	1
Water cart	0	0	0
Roller	0	0	0
Pedestrian roller	2	0	2
Generators	2	0	2
Total	**7**	**0**	**7**

Table 6 Plant and equipment on site at project 2

Description on plant	Imported	Local	Total
Tipper truck	0	1	1
Tractor load backhoe (TLB)	0	0	0
Grader	0	1	1
Water cart	0	1	1
Roller	1	0	1
Pedestrian roller	0	0	0
Generators	2	0	2
Total	**3**	**3**	**6**

Noko Mashita presenting

Delegates during the first session

Delegates at the package plant (project 1)

Delegates at one of the boreholes (project 1)

Presentations covered the project challenges, technical/design information and package plant for chlorination (water treatment).

The second session, where delegates had the opportunity to experience the construction aspect of project 1 firsthand, was jointly presented by George Makina, the contracts manager, and Sbusiso Nsele, the resident engineer. The duo took delegates through the construction phases from the source through to the boreholes and pipeline, as well the Transnet rail crossing that has not yet commenced. Kgotso Mohlake took the delegates through the package plant aspect of the project for chlorination (treatment) purposes.

The third session allowed delegates the opportunity to experience the construction aspect of project 2. The session was jointly presented by Barnabas Mboweni, the construction manager, and Valry Seerane, the resident engineer, who took delegates through the construction phases of the refurbishment work done on the reservoir and valve chamber house.

IN CONCLUSION

The SAICE Limpopo branch site visit was fruitful to all delegates who attended. Delegates interacted throughout the sessions, and the Limpopo Branch Committee is thankful to its branch members and delegates who attended and added significant value by participating meaningfully.

Upon completion, both projects will provide clean drinking water compliant to SANS 241 to the communities within the Sefakaola and Sekgakgapeng villages and surrounding areas. In addition, town residents, businesses, public institutions and other surrounding areas will experience a more reliable and sustainable water supply. Approximately 75 530 people will benefit upon completion of the projects. ☐

Project 1 team	
Stanslous Dondo Pr Tech Eng	Department of Water and Sanitation
Daniel Raseala	
Hangwani Nemudivhiso Pr Sci Nat	
Sipho Nkonka Pr Techni Eng	
Thabang Thobejane	Mogalakwena Municipality
Forget Ntekele	
Alfred Bwanya	Royal HaskoningDHV
Sbusiso Nsele	
George Makina	Within Africa Construction
Henk Venter	
Precious Makgoba	Makwatsa Consulting – OHS consultant (Agent)
Thato Pheme	Seteshe Group – environmental consultant (Agent)
	Seteshe Group – social consultant (Agent)

Project 2 team	
Stanslous Dondo Pr Tech Eng	Department of Water and Sanitation
Daniel Raseala	
Hangwani Nemudivhiso Pr Sci Nat	
Sipho Nkonka Pr Techni Eng	
Thabang Thobejane	Mogalakwena Municipality
Forget Ntekele	
Elvis Manyelenyele Pr Tech Eng, Pr CPM	Mulalo Consulting Engineers
Valry Seerane	
Nkateko Maluleka	MM Star
Barnabas Mboweni	
Obvious Shumba	Rev2Light Safety Health Environment and Quality Solutions – OHS consultant (agent)

Delegates at the Mokopane reservoirs (project 2)

Delegates who attended the site visit

SAICE Training Calendar 2024 (Face-to-Face)

Course name	Course dates	Location	CPD accreditation No	Course presenter	Contact
Elementary Project Management	16–17 July 2024	Cape Town	SAICEproj22/03117/25 Credits: 2 ECSA	Hamish Riddet	Register: **store.saice.org.za/courses** **cheryl-lee@saice.org.za**
	5–6 August 2024	Port Elizabeth			
	5–6 November 2024	Durban			
	26–27 November 2024	Midrand			
Adjudication and Arbitration: How to deal with Challenges to Jurisdiction	10 July 2024	Midrand	SAICEcon21/02927/24 Credits: 1 ECSA	Adv. Hubert Thompson	
	17 July 2024	Cape Town			
Structural Steel Design to SANS 10162-1-2011	18 June 2024	Durban	SAICEstr21/02965/24 Credits: 1 ECSA	Greg Parrott	
	6 August 2024	Cape Town			
	8 October 2024	Midrand			
Reinforced Concrete Design to SANS 10100-1-2000	19 June 2024	Durban	SAICEstr21/02964/24 Credits: 1 ECSA	Greg Parrott	
	7 August 2024	Cape Town			
	9 October 2024	Midrand			
Practical Geometric Design	4–8 November 2024	Midrand	SAICEtr22/03158/25 Credits: 5 ECSA	Tom McKune	
Water law of South Africa	27–28 August 2024	Midrand	SAICEwat22/03102/25 Credits: 2 ECSA	Adv. Hubert Thompson	
	3–4 September 2024	Cape Town			
The Legal Process dealing with Construction Disputes	4–5 June 2024	Port Elizabeth	SAICEcon22/03165/25 Credits: 2 ECSA	Adv. Hubert Thompson	
	6–7 August 2024	Midrand			
Legal Liability Occupational Health and Safety Act (OHSA)	10 June 2024	Port Elizabeth	SAICEcon23/03295/26 Credits: 1 ECSA	Attorney Cecil Naude	
	22 July 2024	Midrand			
	19 August 2024	Bloemfontein			
	9 September 2024	East London			
	7 October 2024	Polokwane			
Construction Regulations from a Legal Perspective	14–15 May 2024	Cape Town	SAICEcon23/03319/26 Credits: 2 ECSA	Attorney Cecil Naude	
	11–12 June 2024	Port Elizabeth			
	23–24 July 2024	Midrand			
	20–21 August 2024	Bloemfontein			
	10–11 September 2024	East London			
	8–9 October 2024	Polokwane			
Legal Liability Mine Health and Safety Act (MHSA) Act 29 of 1996	16–17 May 2024	Cape Town	SAICEcon21/02922/24 Credits: 2 ECSA	Attorney Cecil Naude	
	13–14 June 2024	Port Elizabeth			
	25–26 July 2024	Midrand			
	22–23 August 2024	Bloemfontein			
	12–13 September 2024	East London			
	10–11 October 2024	Polokwane			

SAICE Training Calendar 2024 (Online)

Public Private Partnerships (PPP) Part 1 - What does it take to put a PPP together?	3 September – 12 November 2024 (6 × 2 hour sessions)	Online	SAICEEL22/03166/25 Credits: 1 ECSA	Johan Samuels and Wynand Dreyer	Register: **store.saice.org.za/webinars** **cheryl-lee@saice.org.za**
Elementary Construction Dispute Resolution Procedures	24 July 2024	Online	SAICEEL21/02972/24 Credits: 1 ECSA	Adv. Hubert Thompson	
Design of Vessels, Tanks and Piping	5–6 June 2024	Online	SAIChE 433 Credits: 3 ECSA	John Broli	
	6–7 August 2024				
	4–5 September 2024				
	6–7 November 2024				

Register online: www.saice.org.za | All dates are subject to change

SAICE Training Calendar 2024 (Online)

Course name	Course dates	Location	CPD accreditation No	Course presenter	Contact
Design of Piping Systems	22–23 May 2024 24–25 July 2024 18–19 September 2024 20–21 November 2024	Online	SAIChE 434 Credits: 3 ECSA	John Broli	Register: **store.saice.org.za/webinars** **cheryl-lee@saice.org.za**
Multi-Variable Problems in Engineering (Analysis, Solution, Control)	28–29 August 2024 30–31 August 2024	Online	SAIChE 389 Credits: 2 ECSA	John Broli	
Design of Pumping Systems	19–20 June 2024 21–22 August 2024 23–34 October 2024	Online	SAIChE 435 Credits: 3 ECSA	John Broli	
Design of Optimum Electrical Power Usage (E1)	27–28 May 2024 29–30 July 2024 28–29 October 2024	Online	SAIChE 390 Credits: 2 ECSA	John Broli	
Engineering Report Writing, Presentations, Communication	15–16 May 2024 17–18 July 2024 16–17 October 2024	Online	SAIChE 384 Credits: 2 ECSA	John Broli	
Design of Process Systems	12–13 June 2024	Online	SAIChE 436 Credits: 3 ECSA	John Broli	
Materials in Engineering Design, Important Trends and Innovations	3–4 July 2024 2–3 October 2024	Online	SAIChE 438 Credits: 3 ECSA	John Broli	
Engineering Design as Creativity, Innovation and Value Adding	14–15 August 2024 9–10 October 2024	Online	SAIChE 381 Credits: 2 ECSA	John Broli	
Corrosion, Cracks, Catastrophes	10–11 July 2024 11–12 September 2024 13–14 November 2024	Online	SAIChE 421 Credits: 2 ECSA	John Broli	
Design of Electrical Systems for Plants and Building Services (E2)	24–25 June 2024	Online	SAIChE 424 Credits: 2 ECSA	John Broli	
Managing Risk and Legal Liabilities in Engineering	30–31 May 2024 26–27 June 2024 25–26 September 2024 27–28 November 2024	Online	SAIChE 437 Credits: 3 ECSA	John Broli	
Construction Claims A Practical Approach	7 June 2024	Online	SAICEEL23/03340/26 Credits: 1 ECSA	Theunis van Zyl	

Register online: www.saice.org.za | All dates are subject to change

SAICE Academy Training Calendar 2024 (E-learning)

Course name		Location	CPD accreditation No	Course presenter	Contact
Elementary Accounting for Engineers		Online	SAICEEL22/03088/25 Credits: 1 ECSA	Tanya Thompson	Register: **cpdonline.saice.org.za**
Authentic Leaders Development Program: Module 1 (Leading Self)	7–28 May 2024 6–27 August 2024 8–29 November 2024		SAICEEL21/02926/24 Credits: 1 ECSA	David Ramsay	**https://cpdonline.saice.org.za/courses/authentic-leaders-developement-program/**
Video Editing			No credits	Upskillist	Register: **cpdonline.saice.org.za**
Photoshop			No credits	Upskillist	
Probability and Statistical Analysis					

Register online: www.saice.org.za | All dates are subject to change

SAICE Academy Training Calendar 2024 (E-learning)

Course name	Location	CPD accreditation No	Course presenter	Contact
Project Management	Online	No credits	Upskillist	Register: **cpdonline.saice.org.za**
Financial Planning				
Coaching				
Mindful Practice				
Building Resilience				
How to Start a Business				
Smartphone Photography				
Psychology of Organisations				
Data Analytics				
ECSA Registration Series #1: Background to Registration				
ECSA Registration Series #2: How to Register as a Candidate				
ECSA Registration Series #3: Before you get Started				
ECSA Registration Series #4: Background to ECSA Registration				
ECSA Registration Series #6: Mentorship				
PV24 Module 1 1 Work Sequence		SAICEEL23/03240/26 Credits: 0.2 ECSA	Sualca Enterprise Development | SAICE	Register: **cpdonline.saice.org.za** **saice-cpd@sualca.com**
PV24 Module 1 2 Parties to a Project		SAICEEL23/03241/26 Credits: 0.2 ECSA		
PV24 Module 1 3 Contract Documents		SAICEEL23/03242/26 Credits: 1 ECSA		
PV24 Module 1 4 Project Team		SAICEEL23/03243/26 Credits: 0.4 ECSA		
PV24 Module 2 3 Estimating		SAICEEL23/03246/26 Credits: 1 ECSA		
PV24 Module 2 4 Allowables		SAICEEL23/03247/26 Credits: 0.8 ECSA		
PV24 Module 3 1 Certificates and Measurement		SAICEEL23/03248/26 Credits: 0.9 ECSA		
PV24 Module 3 2 Allowables vs Costs		SAICEEL23/03249/26 Credits: 0.6 ECSA		
PV24 Module 3 3 Forecasting		SAICEEL23/03250/26 Credits: 0.5 ECSA		
PV24 Module 3 4 Contract Reporting		SAICEEL23/03251/26 Credits: 0.5 ECSA		

Register online: www.saice.org.za | All dates are subject to change

SAICE-PDP / Candidate Academy Training Calendar 2024

Course name	Course dates	Location	CPD accreditation No	Course presenter	Contact
Getting Acquainted with Basic Contract Administration	26–27 June 2024 12–13 November 2024	Online	CESA-2076-08/2025 SACPCMP/CPD/21/004 Credits: 2 (12 hours)	Theuns Eloff	Register: **store.saice.org.za/training-courses** **lizelle@saicepdp.org**
Getting Acquainted with Basic Stormwater Design	25–26 July 2024 17–18 October 2024	Online	SAICEwat21/02897/24 SAICEEL21/02898/24 Credits: 2	Andrew Brodie	
Getting Acquainted with being a Resident Engineer on Pipeline Projects	18–19 July 2024 7–8 October 2024	Online	SAICEEL23/03362/26 Credits: 2	John Cato	

Register online: www.saice.org.za | All dates are subject to change

SAICE-PDP / Candidate Academy Training Calendar 2024

Course name	Course dates	Location	CPD accreditation No	Course presenter	Contact
Getting Acquainted with being a Resident Engineer on Roads Projects	23–24 May 2024 22–23 August 2024 24–25 October 2024 2–3 December 2024	Online	SAICEproj21/02957/24 SAICEEL21/02958/24 Credits: 2	Jan Bierman	Register: **store.saice.org.za/training-courses** **lizelle@saicepdp.org**
Getting Acquainted with Estimating, Costing and Pricing of Construction Tenders	3–4 June 2024 16–17 September 2024	Online	CESA-2063-05/2025 SACPCMP/CPD/21/006 Credits: 2 (12 hours)	Theuns Eloff	
Getting Acquainted with General Conditions of Contract for Construction Works (GCC2015) (includes GCC 2015 and yellow GCC guide)	5–6 August 2024	Online	CESA-2075-08/2025 Credits: 2	Theuns Eloff	
Getting Acquainted with Geosynthetics in Soil Reinforcement	30–31 May 2024 18–19 November 2024	Online	SAICEEL23/03394/26 Credits: 2	Edoardo Zannoni	
Getting Acquainted with Planning, Scheduling and Programming for Construction Projects	23–24 July 2024 9–10 October 2024	Online	SAICEcon23/03285/26 SAICEEL23/03286/26 SACPCMP/CPD/21/005 Credits: 2 (12 hours)	Theuns Eloff	
Getting Acquainted with Road Construction and Maintenance	20–21 May 2024 10–11 September 2024	Online	CESA-2064-06/2025 Credits: 2	Theuns Eloff	
Getting Acquainted with Sewer Design	15–16 August 2024	Online	CESA-2065-06/2025 Credits: 2	Andrew Brodie	
Getting Acquainted with Technical Report Writing	5–6 June 2024 2–3 September 2024	Online	SAICEEL22/03151/25 SACPCMP/CPD/23/116 Credits: 2 (11 hours)	Les Wiggill	
Getting Acquainted with Water Resource Management	27–28 August 2024 6–7 November 2024	Midrand Cape Town	SAICEwat21/02986/24 Credits: 2	Stephen Mallory	
Getting Acquainted with Water Reticulation (NEW COURSE)	13–14 June 2024 12–13 September 2024	Online	TBC Credits: 2	Andrew Brodie	
Pressure Pipeline and Pump Station Design and Specification (2-day course)	13 & 15 August 2024	Online	CESA-2066-06/2025 Credits: 2	Dup van Renen	
Road to Registration for Candidate Engineers, Technologists and Technicians	16 May 2024 3 June 2024 22 July 2024 5 September 2024 5 November 2024	Online Midrand Online	CESA-2067-05/2025 Credits: 1	Allyson Lawless	
Road to Registration for Mature Engineers, Technologists and Technicians	12 June 2024 13 August 2024 15 October 2024	Online	CESA-2127-02/2026 Credits: 1	Stewart Gibson	
Road to Registration for Mentors, Supervisors and HR Practitioners	13 May 2024 26 November 2024	Online	CESA-2105-10/2025 Credits: 1	Allyson Lawless	
The direct route to registration as a Construction Project Manager or Construction Manager with SACPCMP	20 August 2024 15 November 2024	Online Online	CESA-2052-12/2024 Credits: 1	Jeff Pipe	
Understanding the 6 Stages of the Project Life Cycle to register as a Construction Project Manager or Construction Manager	20–21 June 2024 19–20 September 2024	Online	CESA-2084-05/2025 Credits: 2	Jeff Pipe	
Understanding the technical implications of developing and operating a landfill	29–30 July 2024 3–4 October 2024	Online	SAICEEL22/03157/25 Credits: 2	Ken Bromfield	

In-house courses are available. To arrange, please contact: Cheryl-Lee Williams (cheryl-lee@saice.org.za) on 011 805 5947.
For SAICE-hosted Candidate Academy in-house courses, please contact: Lizélle du Preez (lizelle@saicepdp.org) on 011 476 4100 or 072 356 5230.

Register online: www.saice.org.za | All dates are subject to change