# wattnow

AUTOMATION

# Serving Since 1909

Formed in 1909, The South African Institute of Electrical Engineers sports ± 6000 engineering professionals.

## Why Join Us

Our members are professionally engaged in various engineering activities, including academic research, manufacturing, electronics, telecommunications, measurement and control, mining, and power infra-structural services. Members make meaningful contributions to the quality of life in communities and the steady advancement of technology. Their efforts are acknowledged in many countries worldwide.

## Training Academy

We offer CPD training courses, a powerful learning tool to improve skills, ensuring that academic qualifications do not become outdated.

## Skills Development

One of our core objectives is to harness and foster the growth of Education in the Engineering sector, which has been faced with a debilitating shortage of skills.

## Corporate Forums

Corporates are invited to monthly forum meetings to discuss and brainstorm critical issues in South Africa and find solutions.

## Our Purpose

To enhance the practice of electrical engineering in South Africa and the stature of our members through knowledge, networking, influence, education and communication.

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## FEATURES

## GENERAL

SAIEE     @SAIEE     SAIEE

Dear **watt**now reader

According to Business Insider, Automation is about more than mitigating disasters like outages caused by pandemics, and it's not just for large manufacturing companies. Instead, it's now a necessary consideration for any business interested in enhancing safety, increasing efficiency, improving productivity, and growing profits.
In this issue, we examine how Automation changes the work and digital landscape.

Our first feature article, on page 20, written by Siyanda Biyela, "Augmenting Drones and Artificial Intelligence for Overhead Line Inspections", discusses how drones have become an essential tool in inspecting overhead powerlines.

Our second feature article on page 30 - "Technical Feasibility Study of Hydrogen Fuel Cell and Battery Freight Locomotive", investigates the applicability of fuel cell and battery technology to freight railway lines on the pit-to-port manganese line between Hotazel and Port of Ngqurha in South Africa.

Keith Katyora takes us through the strategic approach to green mobility in South Africa in his article "Sustainable Transport Technologies" on page 36.

The **watt**now magazine will be coming to you from February to November 2024. I am going back to the drawing board to bring you a new, fresh look. Herewith is the 2024 features list.

The February issue of **watt**now features Lighting Systems, and the deadline is 15 January 2024. Please send your articles/papers to minx@saiee.org.za. You earn 0.1 CPD* credit when your article is published in wattnow magazine.

Here's wishing all my readers a fabulous festive season, and may 2024 bring us many success stories.

Herewith the November issue; enjoy the read!

*Minx*

*\* - T's and C's apply*
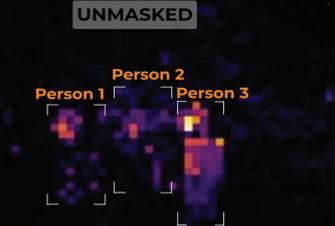
# INDUSTRYAFFAIRS

## ACTOM turns 120 and remains upbeat about African prospects and opportunities



*From left: Andries Mthethwa, Chairman at ACTOM; Sivuyile Ngodwana, Mayor of Ekurhuleni; Mervyn Naidoo, CEO at ACTOM, Dr Robert Nkuna, Director-General at Department of Monitoring and Evaluation within the Presidency.*



*From left: Prof Jan de Kock, SAIEE President and Terrence Moothusamy, MHI Risk Engineers.*



*From left: Leanetse Matutoane, SAIEE CEO; Andries Mthethwa, ACTOM Chairman, Uncel Mhelembe, SAIMechE CEO and Phillip Dukashe.*

ACTOM, a leading electro-mechanical manufacturing company in Africa, recently celebrated its 120th anniversary with a ceremony held at the Royal Johannesburg Golf Club, which was attended by Dr Robert Nkuna (Director General in The Presidency) and several other dignitaries.

Since its inception in 1903, ACTOM has become a major supplier of electrical equipment and services to a wide range of industries, including energy, mining, and utilities. The company is a major contender in the renewable energy sector and has played a pivotal role in advancing the development of solar and wind power projects in South Africa. "This event was a celebration of a legacy company that is over a century old, and the fact that we have managed to navigate multiple industrial revolutions, technology changes, a pandemic, economic cycles, and survive by way of reinventing the company, is testimony to our strength. This event aimed to celebrate what we've achieved, as well as the people who have been involved in helping us reach this achievement," Mervyn Naidoo, Group Chief Executive Officer at ACTOM.

"ACTOM has maintained its leadership position in the electro-mechanical sector for 120 years due to its ability to adapt to the ever-changing market. For example, when Renewable Energy Independent Power Producers (REIPPs) were introduced, we started supplying the balance of plants for those projects, as well as equipment monitoring, specifically for the renewable energy market," says Mamiki Matlawa, Business Development Executive at ACTOM.

"We've been able to adapt by building an end-to-end company in terms of electro-mechanical equipment where we manufacture, repair, and replace – meeting our customers' full spectrum of needs." **wn**

## SAIEE appointed Fellows

The South African Institute of Electrical Engineers, at their 3rd of November council meeting, awarded Robbie van Heerden and Dr Gerhard Botha their Fellowship certificates.

Robbie van Heerden is a senior technical manager at ENERTRAG South Africa and looks after the entire lifecycle of its SA projects, primarily in the development and implementation of solar, wind, and electrical grid projects.

Dr Botha is an ECSA-registered professional engineer with over 20 years of experience centred on research in reliability and supply quality in the utility environment. He became an SAIEE member in 2002. **wn**



*From left: Robbie van Heerden and Prof Jan de Kock (SAIEE President.)*



*From left: Dr Gerhard Botha and Prof Jan de Kock (SAIEE President.)*

## Stan Bridgens receives SAIEE Long Service Membership

Mr Stanley Bridgens, SAIEE's Past President, received a 60-year service membership certificate on Friday, 3 November, at the recent SAIEE Council meeting.

Stanley Charles Bridgens left school due to poor financial circumstances after completing standard eight (grade 10) and was indentured as an apprentice electrician. During the next five years, he completed matric at night school, completed a National Technicians Diploma in Mechanical and Electrical Engineering, and successfully attained, by self-study, the Government Certificate of Competency Electrical Works. At 22 years old, he was employed as an Engineer in the field, and later, he was appointed (the youngest) Distribution Engineer responsible for much of the distribution system of Johannesburg. Later Stan managed the large Metro workshop complex at Reuven as a

stepping stone to being appointed Director of Technical Services for Johannesburg Electricity Department. Stan retired from the Metro after 42 years of service and consulted for three years before accepting the job of CEO of the SAIEE, which he did successfully for 12 years.

Stan is a Professional Engineer after receiving a second bursary to attend Wits University to complete the ECSA requirements for registration.

Stan is a Fellow of the SAIEE and the SA Academy of Engineering (SAAE).

Stan joined the SAIEE as a student in 1962 and received his 50-year certificate of membership in 2012. He was elected president in 1998/1999 and has served as the SAIEE Honorary Treasurer from 2019 - 2021 after retiring as SAIEE CEO. **wn**

# INDUSTRYAFFAIRS

## Mareli Botha from Zutari wins Young Engineer of the Year at CESA Aon Awards 2023



One of the youngest Technical Directors and shareholders at leading consulting engineering and infrastructure advisory firm Zutari, Mareli Botha, was named Young Engineer of the Year at the CESA Aon Engineering Excellence Awards on 16 August at Vodacom World. Now in its 51st year and hosted in partnership with platinum title sponsor Aon South Africa, the awards celebrate innovation, quality, outstanding workmanship and professionalism.

Mareli explains that she decided to study chemical engineering due to its connection to systems thinking. She then did vacation work in the plasma engineering department at the South African Nuclear Energy Corporation (NECSA). Completing a couple of designs for a plasma waste-to-energy project, Mareli says she discovered her passion. "The combination of engineering, creative design, and the concept of making a difference to one of the largest problems internationally, namely the waste crisis and environmental impact, became my inspiration."

This was followed by an internship under Professor Christophe Laux at the Laboratoire EM2C at CentraleSupélec in Paris. Mareli was then invited to complete an international Master's Degree in Project Management, Energy and Environmental Engineering. It opened her eyes to all the other options in environmental engineering and sustainable design. She is currently working in green process engineering and project management at Zutari.

Mareli explains that process engineering is usually the first discipline to start an integrated engineering design in the industrial space. "It is a lot of fun because it typically allows for freedom to conceptualise new designs," she adds. It also typically feeds into the business concept throughout the engineering phases, especially during early project phases.

It means that job creation, operating philosophies, and environmental impact are a basic function of all Zutari's designs. "For green process engineering, it is even more true, since sustainability concepts are embedded into the basis of every design," highlights Mareli.

Within this space, she works on fascinating projects that could fundamentally change South Africa's green economy, such as green hydrogen, biogas to energy,waste to value, etc. "These types of projects enable us to create new businesses, with the potential to generate numerous jobs, while improving the country's sustainability profile."

Mareli comments that there has been a significant increase in women in the process engineering field over the last couple of years, indicating that the industry and people's mindsets are changing. "I believe a number of other engineering fields are seeing a similar change. Having good female role models in this field is important," she stresses.

"As consulting engineers, we work in a constantly changing industry. New technologies, new legislation, new risks and priorities for clients drive the types of projects the market needs," says Mareli. This calls for ongoing self-development and adaptability to industry advances. Lifelong learning is a reality in a field that calls for deep expertise and relevant skills.

"It is both a challenge and a great opportunity. In my case I ensure that I interact with other experts daily to keep learning and adapting. I have never stopped studying and am currently busy with a PhD, which presents a different and fascinating learning experience. Obviously, since the industry is so fast-moving, work-life balance can also become a typical challenge for most engineers. This is something to manage actively," says Mareli.

Mareli is passionate about mentoring and says Zutari has provided access to excellent colleagues and mentors in her chosen field. "Having a mentor is very important and having the right mentor is vital. Young engineers should actively manage their own mentoring opportunities: Find a mentor, secure their buy-in, set up sessions, and follow up. You would not believe how willing people are to spend time to nurture the next generation of engineers," she concludes. **wn**

# Vertiv Launches Energy-Efficient, Scalable UPS for Edge and Mid-Sized Applications in EMEA

Vertiv (NYSE: VRT), a global provider of critical digital infrastructure and continuity solutions, today introduced the Vertiv™ Liebert® APM2, a new energy-efficient and scalable power solution to its uninterruptible power supply (UPS) systems portfolio. The Liebert® APM2 is compatible with lithium-ion (Li-ion) and VRLA batteries and features a compact design that can scale from 30kW to 600 kW in a single unit. It offers significant energy savings as compared to less efficient alternatives, and can also parallel with up to four matching units for additional capacity or redundancy. The Liebert APM2 is a CE certified UPS system available in 400V in Europe, the Middle East and Africa, Latin America, and Asia, including India and China.

To satisfy the increasing power needs of edge computing applications, as well as the constrained space typical of these sites, Liebert APM2 delivers a greater power output in a smaller footprint than similar capacity solutions, with Liebert APM2 models requiring up to 45% less space than the predecessor UPS, Vertiv™ Liebert® APM. The Liebert APM2 can be installed in-row, in-room, against-the-wall, or back-to-back for further application flexibility.

"Vertiv created the Liebert APM2 in response to the need for a compact and efficient product that delivers dependable power quality and availability to the network edge," said Kyle Keeper, senior vice president of global AC power at Vertiv. "The UPS is Vertiv's cutting-edge solution for handling increasing power infrastructure needs without the need for a complete system overhaul."

The Liebert® APM2 operates with high energy efficiency in all modes, up to 97.5% in double-conversion mode; up to 98.8% efficiency when operating in Dynamic online mode, which draws power through the bypass line and uses the inverter for balanced output and as an active filter; and up to 99% when operating in ECO mode, which takes advantage of stable grid input conditions to leverage the bypass line. All modes are automated based on user preferences. The intelligent paralleling feature of the Liebert APM2 facilitates load sharing among multiple power modules, even across multiple units. This enables balanced unit runtime and offers automatic failover for enhanced system availability. Intelligent paralleling has also been shown to contribute to energy efficiency.

"Vertiv has introduced, in Liebert APM2 and other UPS systems, enhancements that improve operational efficiency and can contribute to a reduced data center PUE while also maintaining system availability," said Giovanni Zanei, senior director AC power global offering & EMEA business leader at Vertiv. "In particular, the Dynamic Online feature, built on a robust global platform launched in 2018, enhances the already impressive UPS efficiency and has been adopted by energy- and availability-conscious customers, including many colocators."

The modular architecture of the Liebert APM2 allows for easy front-side access to replaceable components and features hot-swappable building blocks that optimize the mean time to repair (MTTR) to less than 30 minutes. The Vertiv™ Life™ Services program is an available option to remotely monitor and diagnose equipment health, with reporting to track UPS performance.

For more information on the Liebert APM2 and other UPS solutions from Vertiv, visit Vertiv.com. **wn**



*The compact Vertiv™ Liebert® APM2 uninterruptible power supply system is compatible with Li-ion and VRLA batteries*

# INDUSTRYAFFAIRS

A career in data management – DMP SA interns seize opportunities in a skills scarce landscape



Data management skills are highly sought after in the South African Information Technology (IT) industry, as an increasing number of companies are relying on data accessibility to achieve business objectives, streamline their operations and gain agility – all of which can positively impact their bottom line.

To give more young people a chance to enter this exciting and highly competitive field, Data Management Professionals South Africa (DMP SA) offers an annual internship programme that forms part of its scarce skills development and talent acquisition strategy.

The programme actively encourages individuals from diverse backgrounds to apply for available positions at the organisation once they have completed the course.

"As a company, we are serious about developing new talent and giving young people a chance to forge a career in the field of data management. However, the internship programme came about not only to pass on knowledge and skills within the data management field, but to drive work-integrated learning," says Chris de Bruyn, Head of Training, Risk and Compliance at DMP SA.

"Beyond equipping interns with scarce skills that they can take into the industry, the programme also provides them with experience of working within an organisation and interacting with people."

This year's group of interns all successfully completed the programme and 9 were permanently placed with DMP SA to develop their passion for data management into rewarding careers. In the long run, their qualifications will add to the scarce skills talent pool within the IT sector.

## INTEREST IN COMPUTERS
Siyanda Ngobese, who completed this year's internship programme, says he developed an interest in computers from an early age, which prompted his father to buy him his first machine.

"I was always interested in building computers, so the plan was to follow a career in IT all along. However, working in data management, specifically, is the cherry on top. It is fascinating because it involves managing people's data which is not only a challenging task, but also exhilarating due to the vast possibilities that this field has to offer," he says.

Fellow intern Dexter Ndlovu notes that he is particularly passionate about the disaster recovery aspect of data management and helping organisations be ready for any eventuality should an incident occur.

"Whether it is human error or a natural disaster, it is very interesting to be part of a company's plan to secure and protect its data, laying out the strategy to prevent, mitigate and manage the damage that any type of disaster might cause," he explains.

Godisang Sepato describes his journey through the internship programme as a transformative experience that taught him many things beyond just the skills needed for data management, but also how to deal with customers.

## EXPANDING SKILLSET AND BEYOND
"The internship not only expanded my skillset, but also shaped my overall vision of practical knowledge within the workplace and also equipped me with soft skills, which has been an invaluable asset as I continue to advance in my data management career," says Sepato.

Speaking about what advice he would give to the youth who are considering a career in data management, Theunis Kruger says he would strongly encourage them to pursue their journey, as it is a fulfilling and ultimately rewarding career, with long-term prospects.

"I say 'go for it'. Data management is not a field that is likely to disappear any time soon, so it will be a rewarding career. I would also advise those looking to enter this field to make sure that they at least understand the basics of IT - that knowledge can certainly help," he concludes. **wn**

## Smart Energy Solutions for Africa and uYilo e-Mobility Programme commission Alicedale Living Lab

SESA, Smart Energy Solutions for Africa, the European commission-funded 30-partner strong consortium officially commissioned the Alicedale Living Lab yesterday with SESA partner uYilo e-Mobility Programme and the South African implementing partner GREEN Solar Academy. The living lab installation is designed and implemented to provide positive benefits to the Alicedale community, with a strong focus on renewable energy and creating entrepreneurship opportunities.

Alicedale, a quaint village in the Sarah Baartman District Municipality, is located some 100km from the coastal city of Gqeberha (Port Elizabeth) in the Eastern Cape, on the banks of the Bushmans River.

The population numbers around 4,000 people, and Xhosa is the most-used language in the area.

The SESA Living Lab installation includes a shipping container converted to serve as a Solar hub for the centre, solar panels to provide renewable energy, internet access, and two electric vehicles suited for rural conditions to provide local transportation. The centre, with the associated technologies, aims to test and validate a containerized off-grid renewable energy system including second-life electric vehicle batteries for energy storage with the hope that the outcomes and learnings will lead to further replication of these solar hubs across rural Africa.

The uYilo e-Mobility Programme of the Nelson Mandela University is the SESA partner in South Africa facilitating the Alicedale living lab in close coordination with GREEN Solar Academy, a local venture that was selected as part of the first SESA Call for Entrepreneurs in 2022. GREEN Solar was selected for their expertise in solar power training and their mission to make renewable energy accessible to all. "The solar container was designed and installed by the GREEN Solar Academy as a centre for community exchange, training and empowerment. GREEN and uYilo want to further test and validate the financial benefits and improved affordability of solar energy provided by the Solar Hub." says uYilo Programme Manager, Edem Foli. **wn**

# INDUSTRYAFFAIRS

## Schneider Electric Grid Metering Operations – an important step for smart metering rollout



Global leader in the digital transformation of energy management and industrial automation, Schneider Electric is meeting South Africa's advanced metering infrastructure (AMI) requirement head on with the availability of its vendor neutral architecture, EcoStruxure Grid Metering Operations (GMO).

The solution is a meter-agnostic platform and offers advanced deployment, management, and integration of AMI systems. It will enable utilities across the country to make their meters "smarter," a feature that also extends to include prepaid meters. Schneider Electric was recently named one of Global Top 10 Smart Meter Companies by global energy research organisation, Blackridge Research and Consulting. The analyst cited EcoStruxure's "excellent integration capabilities" as a major feature.

"Our EcoStruxure GMO architecture puts our information management services expertise to work to not only achieve effective AMI deployment but also maximise subsequent smart metering returns," explains Dwibin Thomas, Cluster Automation Leader at Schneider Electric.

Smart meters and smart prepaid meters offer real-time data on power consumption via a smart energy management system. This data can be accessed remotely, allowing utilities to accurately gauge usage, obtain billing information and general consumer consumption patterns. EcoStruxure GMO provides effective large-scale deployment, efficient operation and rollout management, improved end-customer services and lower operational costs.

Smart meters also offer important benefits to consumers as it allows them to actively track their power consumption, adjust it according to peak time tariffs. Furthermore, they can also remotely access prepaid meters to monitor top up units.

"This is particularly beneficial to households and businesses that use hybrid solar/grid systems. A common complaint by prepaid users is that when they do switch over to a hybrid system, they don't have real-time insight into the status of their prepaid account i.e., how many units are left," notes Thomas.

Schneider Electric's EcoStruxure GMO offer the following features:

- It manages meters, concentrator, modem, HAN (home area network) device asset information and relationships, device lifecycle and field service logistics.
- Executes remote operations that include configuration, connect/disconnect and on-demand reads.
- Collects and integrates readings and event such as power outage and quality, errors, tampers).
- Monitors and report the status of rollouts and Service Level Agreement (SLA) compliance. **wn**

## SAIEE delegation visited NECSA



*From left: Yoran Mogaladi (NECSA), Prof Pat Naidoo (SAIEE), Athini Pantshwa (ESKOM), Zanele Sibiya (SAIEE), Uncel Mhlelembe (SAIMechE), Leanetse Matutoane (SAIEE), Loyiso Tyabashe (NECSA), Mmeli Fipaza (ESKOM), Qhamkile Boyede (NECSA), Ntebatse Matube (NECSA), Driekus van Der Westhuizen (NECSA), Stephen Mosinki (NECSA), John Nkwana (NECSA) and Nto Rikhotso (NECSA).*



*From left: Zanele Sibiya (SAIEE), Mmeli Fipaza (ESKOM), Athini Pantshwa (ESKOM), Prof Pat Naidoo (SAIEE), Uncel Mhlelembe (SAIMechE) and Leanetse Matutoane (SAIEE).*

The SAIEE delegates recently visited NECSA (South African Nuclear Energy Corporation) with a view to introduce the institute to NECSA and talk matters of mutual concern for the benefit of both organisations. These include professionalising NECSA employees, corporate partnership and collaboration on specific projects. Representing the SAIEE was Leanetse Matutoane (CEO),

Zanele Sibiya (SAIEE Training Manager) and Prof Pat Naidoo (SAIEE Past President and Council Member.

The meeting was a success and culminated with the visit to NECSA's world-class artisan training facility. Watch this space for further outcomes from this visit. **wn**

# Electric Vehicles set to grow in SA

*As the global community celebrated World EV Day in September, South Africa reflected on the structural challenges standing in the way of better uptake of electric vehicles to help reduce carbon emissions. Although the South African EV industry is currently small in comparison to other markets, Justin Manson, Sales Director at Webfleet, Bridgestone's globally trusted fleet management solution, examines the market and predicts that it will expand thanks to government backing and private sector investment.*

The Automotive Business Council (Naamsa) reported that new energy vehicle sales increased by 431,7% from 896 units in 2021 to 4,764 units in 2022.

Although only 502 of those were fully electric (out of 528 963 total vehicles sold), this represented the highest number of pure EVs sold to date and expected to be exceeded in 2023.

However, with limited charging infrastructure of just 78 charging stations across the entire country, growth of EVs, that are still expensive relative to combustion engine cars, remains slow. However, with Naamsa gearing its original equipment manufacturers to begin negotiations with their global headquarters for investments in new manufacturing facilities or the addition of new production lines in existing facilities to include proudly South African EVs.

With more affordable models, people could be more willing to make the shift, considering the potential fuel savings. For vehicle manufacturers, the matter is clear, export markets for South African produced cars, primarily European, are rapidly going electric.

One forecast predicts a 23,8% global compound annual growth rate (CAGR) of new EV sales for the period 2023 to 2030 to 45 million in use by 2030.

The South African EV market still only had around 1,700 units in use by the end of the first quarter of 2023, and the forecast for the Africa EV market is a CAGR of around 10% for the period 2023 to 2028. Beyond that, that growth rate should double, as the EV market becomes more efficient.

## FLEETS TO DRIVE EV GROWTH IN SA

It is most likely that the fleet industry (especially last mile deliveries) will drive the growth of EVs.

South Africa currently has issues with load shedding and a generally unstable electricity grid, which makes EV use difficult, from a planning point of view.

Businesses with vehicles driving short distances could overcome this by installing charging stations at their depots, using solar and inverters for overnight charging, and using by using artificial-intelligence powered fleet management systems, to monitor the charging process, energy usage, charge status and remaining driving distance.

## THE ENVIRONMENTAL IMPACT OF EVS

Part of the reason behind the slow uptake of electric cars has been the recurring energy issues in South Africa. Most EVs still rely on charging from a predominantly carbon-based power source.

However, despite load shedding lasting longer than anticipated, it has brought a silver lining with it. South African homes are increasingly installing substantial solar and high-volume power storage (battery) systems. Not only can drivers cut their driving emissions, but they can also now personally ensure their vehicles are running on sun power.

Additionally, the environmental impact of EVs is generally more favourable than that of internal combustion engines, especially when powered by clean energy sources. EVs have emerged as significantly better and are the future of mobility. They offer reduced greenhouse gas emissions, a lower carbon footprint, and decreased noise pollution.

## GOVERNMENT SUPPORT AND THE FUTURE OF EVS

The government should consider supporting an EV strategy with lower taxes on imports and production, subsidising charging stations, and stimulating consumer demand. Such measures would encourage local manufacturers to invest in new production lines, consequently reducing emissions from imports.

With this in place, the forecasted growth up to 2030 could double within the period leading up to 2040, both locally and globally. Webfleet has made significant investments over the last few years, in line with its sustainability strategy.

Fleet management services launched for EVs are continuously improving as both EV and telematics technology evolve. Webfleet will continue to invest in EV technology as part of a comprehensive sustainability strategy and because the EV market is here to stay and grow, technology and real time reporting will play an important role in the success of the EV market in the future. wn

# 5 Things Your Business Should Consider When Using AI

## - INSIGHTS AND PRINCIPLES FOR ANY ORGANISATION THINKING ABOUT IMPLEMENTING AN AI SOLUTION

At the MMA Impact Forum in September, Helm CEO Dawood Patel shared some valuable insights into the world of AI, and how businesses can harness its power to shape a better future.

Having built a suite of AI-powered products as far back as 2017, Helm has been in the AI game for a relatively long time, and that experience has taught them that before implementing AI solutions for their customers, certain principles need to be considered.

Patel says it's essential to look at your business critically first. "When asking yourself if your business could incorporate AI, it's important to do an analysis of your existing systems and processes to determine where implementing AI is technically feasible.

Some businesses are far ahead of others in terms of digitalisation, and if you're still playing in the analog space, chances are that implementing AI is going to cause more problems than it'll solve. "Next, ask yourself if your business should incorporate AI. You don't want to be making major changes to your business just because everybody else is doing it."

As AI continues to change the game across entire industries at an unprecedented pace, Patel outlined five principles that the team at Helm encourage companies to consider when incorporating AI into their operations.

### 1. TIMING IS EVERYTHING

When it comes to adopting new technology, timing is crucial, and the right timing varies from one business to another and from one industry to the next. Generative AI remains largely unregulated, making it suitable for certain industries like fashion labels looking to boost marketing efficiency, for example. However, heavily regulated industries like banking must exercise caution due to stricter privacy and security regulations. The best approach is to evaluate your needs against the potential risks and benefits presented by AI in its current life cycle.

### 2. BUILD A SUPPORTIVE ECOSYSTEM

Implementing AI isn't a solo endeavor. It's important to have a team that is willing to take risks and push boundaries. Surround yourself with individuals who are enthusiastic about embracing AI technologies, as their support and collaboration will be essential for success. Failing to provide support may force these AI implementations into the shadows which will create significant risks.

### 3. CULTIVATE A CULTURE OF TOLERANCE FOR FAILURE

"A person who never made a mistake never tried anything new." – Einstein's famous quote resonates deeply in the world of AI and tech innovation. Mistakes are part of the learning process. Companies venturing into AI should acknowledge that it's an emerging technology, and hiccups will occur. Fostering a culture that accepts and learns from failure is crucial for sustained innovation.

### 4. UNDERSTAND YOUR CUSTOMERS

Putting humans first is a core principle at Helm, and it should be for any business. Before adopting new tech, understand your customers' needs, challenges and pain points. AI should serve as a tool to assist and enhance the human experience, not replace it. Thorough user research is invaluable in ensuring that the technology you implement genuinely benefits your customers, leading to a successful integration.

### 5. PLAN TO FAIL

(And plan to recover.) Failure is inevitable, but it doesn't have to be catastrophic. Businesses should plan for failure, anticipating where things might go wrong and creating contingency plans to adapt and move forward when they do. Planning for recovery is as crucial as planning for success.

In closing, it is important to remember that AI is still in its infancy, and the rules governing its use are not set in stone. "Companies have the unique opportunity and responsibility to shape the future of their industries. Embrace the challenge and seize the opportunity to lead rather than follow." Patel said. **wn**

# Hydrogen Safety & Hazardous Areas Conference

4th & 5th December, 2023
CedarWoods of Sandton
Sandton, South Africa

IDC Technologies

CPD Validated Conference: Validated by IPET & SACNASP

INSTITUTE OF PROFESSIONAL ENGINEERING TECHNOLOGISTS

Following on from the resounding success of the SOLD-OUT Hydrogen Safety & Hazardous Areas Conferences in Australia, this conference comes to South Africa. Don't miss this opportunity to attend a technical conference like no other. Gain practical insights, hear case studies, attend a masterclass, and learn from industry experts. Be part of the movement toward renewable energies. Connect with industry, forge new partnerships, and build your knowledge.

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SAIEE

# Unlock the future of clean energy and safety at IDC Technologies Hydrogen Safety and Hazardous Areas Conference

## – WHERE INNOVATION MEETS SECURITY!

*As South Africa strives to transition to more sustainable and dependable energy sources, hydrogen has emerged as a promising alternative.*

The safe utilization of hydrogen in various applications is a paramount concern. In this context, the Hydrogen Safety & Hazardous Areas Conference in South Africa takes center stage, providing a valuable platform for industry experts, stakeholders, and professionals to dive into the latest developments in hydrogen-based energy and the associated safety considerations.

The Hydrogen Safety and Hazardous Areas Conference will take place in Sandton, South Africa from the 4th to the 5th of December 2023.

### HYDROGEN AS AN ENERGY SOLUTION
Hydrogen is increasingly recognized as a clean and versatile energy carrier with the potential to revolutionize multiple sectors, including transportation, industry, and power generation.

As South Africa grapples with power supply challenges, the need for more resilient and decentralized energy solutions becomes evident. Hydrogen holds the promise of addressing these challenges while contributing to a sustainable and greener future.

### ENSURING HYDROGEN SAFETY
Although a clean energy source, hydrogen presents specific safety challenges due to its flammable nature. As South Africa embarks on its hydrogen journey, it is vital to ensure the safety of hydrogen production, storage, and utilization. The Hydrogen Safety & Hazardous Areas Conference is dedicated to addressing these safety concerns comprehensively.

A speaker, Blen Teshome says, "Due to the inherent properties of hydrogen, safety during production, transportation, storage, and utilization is an important issue. Further, the safety and reliability of Hydrogen energy are necessary enabling conditions for public acceptance and hence, for faster sustainable energy transition."

### CONFERENCE HIGHLIGHTS
The conference's agenda encompasses an array of crucial topics related to hydrogen safety and hazardous areas, including:

**RISK ASSESSMENT:** Experts will share insights into assessing and mitigating the risks associated with hydrogen-based systems. This knowledge is vital for ensuring the safety of hydrogen infrastructure.

**SAFETY MANAGEMENT:** The conference will explore best practices in safety management, emphasizing the need for robust safety protocols in hydrogen-related operations.

**HAZARD MITIGATION:** Attendees will gain an understanding of hazard mitigation strategies specific to hydrogen systems, contributing to safer industrial practices.

**INDUSTRY INSIGHTS:** The conference program includes sessions that explore the latest developments in hydrogen technology and renewable energy. Participants can expect to learn about cutting-edge technologies and research in the field.

"Conference participants will depart with a comprehensive understanding of the offerings in this burgeoning market, equipped with valuable insights to drive the advancement of this technology in South Africa", says Rahner.

### KEYNOTE SPEAKERS
The conference boasts distinguished keynote speakers who bring extensive experience and expertise to the table.

**MICHAEL MARRINGTON,** Operations Manager at IndEx - Hazardous Area Ex Professionals, is a recognized expert in hazardous areas, specializing in the application of hydrogen systems for industrial processes. His experience spans various sectors, including the implementation of innovative hydrogen technologies.

**MARCO RAHNER,** Smart Infrastructure Sales Director at Siemens Pty Ltd, offers a wealth of professional experience in energy automation and smart infrastructure. He specializes in substation automation, power quality, and distribution automation, making him a key player in the field of renewable energy and smart grids.

# Hydrogen Safety & Hazardous Areas Conference: South Africa

**KEYNOTE SPEAKER**
**Michael Marrington**
*IndEx - Hazardous Area Ex Professionals*

**KEYNOTE SPEAKER**
**Marco Rahner**
*Siemens Pty Ltd*

**Blen Teshome**
*APCON Enterprises Limited*

**Ebrahim Takolia**
*Green Hydrogen Solutions*

**Nirasha Sewpersad**
*Sasol*

**Shantelle Alberts**
*Integrated Fire Technology*

**Dr. Nelson Solan Chipangamate**
*Wits Mining Institute*

**Pieter Colyn**
*ENS*

**Schalk J.P. Kruger 3rd**
*ExHACT - Expert Hazardous Area Consultation and Training (Pty) Ltd*

**Paul Meanwell**
*Komatsu Mining Corporation*

Other speakers include:

- Blen Teshome, Chief Operation Manager, APCON Enterprises Ltd
- Ebrahim Takolia, CEO, Green Hydrogen Solutions
- Dr. Nelson Solan Chipangamate, Postdoc Fellow - Wits MI
- Nirasha Sewpersad, Senior Manager: Solutions, Sasol
- Paul Meanwell, Manager - Engineering Governance, Komatsu Mining Corporation
- Schalk J.P. Kruger 3rd, Managing Director - ExHACT - Expert Hazardous Area Consultation and Training (Pty) Ltd
- Shantelle Alberts, Operations Manager - Integrated Fire Technology
- Pieter Colyn, Executive and Head of the Mine and Occupational Health and Safety Department

## CPD VALIDATED

The Hydrogen Safety and Hazardous Areas Conference is CPD-validated by IPET and SACNASP and is a valuable opportunity for professional development. Participants can earn CPD points by attending and engaging with the conference.

## ºWHO SHOULD ATTEND?

The conference is uniquely tailored to cater to a diverse spectrum of professionals engaged in hydrogen safety and hazardous areas, making it an invaluable event for attendees.

Additionally, safety facilitators and design engineers will find this conference highly beneficial. The advantages of attending this event are multifaceted, including the opportunity to gain insights, share knowledge, and network with experts in the field, making it an essential experience for professionals involved in hydrogen safety and hazardous areas.

"The responsibility for hydrogen safety and explosion prevention is upon everybody. It is a complete life cycle way of thinking that we cannot just think of capital expenditure (capex) and operational expenditure (opex), it's a complete lifecycle, they all go together", says Marrington.

By participating in the Hydrogen Safety & Hazardous Areas Conference, attendees can:

- Gain insights into innovative approaches to hydrogen safety.
- Develop a comprehensive understanding of the hydrogen industry within South Africa.
- Stay informed about the latest technologies and research related to renewable energy.
- Learn about current standards and regulations in the industry.
- Hear from industry experts on the latest technology and information surrounding hazardous areas.
- Connect with innovative presenters and stay updated on emerging trends in the hydrogen and hazardous industries.

As South Africa and the world look to transition to more sustainable and reliable energy sources, the Hydrogen Safety & Hazardous Areas Conference in South Africa plays a pivotal role in promoting safety and innovation in the hydrogen sector. By facilitating knowledge sharing and collaboration, the conference aims to accelerate the adoption of safe and sustainable energy solutions, making a significant contribution to a greener and more resilient energy future.

Register now to attend the Hydrogen Safety and Hazardous Areas Conference. **wn**

# Augmenting Drones and Artificial Intelligence for Overhead Line Inspections

*The emergence of new Remotely Piloted Aircraft Systems (RPAS) technology, commonly known as drones, which is envisioned to be an essential tool in powerline maintenance, has sparked an interest in many utilities globally to research the possibilities of using this technology and quantify all the benefits that could be realised by using it.*

*By: Siyanda Biyela*
*Eskom Holdings SOC Ltd*

Ensuring the maximum efficiency of electricity networks is a vital concern for power utilities. To this end, the increased frequency of plant and line inspections and proactive maintenance of network assets has become increasingly significant. The issue of high operational cost and inadequate asset situational awareness within the organisation is a considerable concern.

The adoption and introduction of drones or RPAS-based solutions can improve the situational awareness of the organisation's assets, which will assist decision-makers in making informed operational and strategic decisions. Currently, there are standard practices for creating situational awareness of transmission and distribution powerlines. However, these practices are limited due to the availability of resources. The emerging drone technology provides many capabilities for organisations to leverage to maximise the opportune benefits, which include optimisation of business operations that will yield cost savings and assist with improving the reliability of transmission and distribution networks. The application of drones for the Powerline Inspection project in Eskom Holdings SOC Ltd, which is the largest power utility in Southern Africa, helped the business to understand how to adopt by comparing various operating models to implement drones as well as quantifying the benefits, including cost savings that will be acquired throughout the evolution stages of this solution.

This paper focuses on the research and proof of concept of using drones for powerline inspections in Eskom's Transmission and Distribution business units. Field trials and a case study were conducted to quantify the benefits

and understand the implications of adopting this technology. The research also examined the cost-effectiveness and viability of in-house capabilities vs. contracting external services. Hence, a service provider with a drone operator license was contracted to inspect powerlines and analyse data. The project team and line division experts shadowed the service provider personnel to ensure safe and efficient operations, which are crucial for realising the benefits of drones.

In conclusion, the proof of concept demonstrated that implementing drones for powerline inspections can significantly reduce costs for both transmission and distribution powerlines. The financial benefit analysis showed a reduction of 30% and 27% for transmission and distribution lines, respectively. While the economic analysis did not include

the costs associated with unserved energy during power outages, the implementation of drones is expected to improve the reliability of the power grid and reduce the number of line failures. This will be beneficial in retaining customers and reducing the likelihood of customers switching to alternative energy sources due to unreliable power supply. Therefore, implementing drones for powerline inspections has the potential to bring significant cost savings and improve customer satisfaction.

## INTRODUCTION

Due to ageing electricity infrastructure and networks, the emphasis and focus of power utility companies have shifted to increasing the reliability of the power delivery system while minimising costs and extending the life of existing facilities. With ageing power plants and powerlines already operating at

maximum capacity, difficulties in building new power plants and transmission lines, and the ever-increasing requirement to meet increasing demands for reliable power, utilities must keep existing electricity networks operating at maximum efficiency. However, this requires stepping up plant and line inspection and proactive maintenance of all assets in the network. Standards constituting designing, planning, and operating a transmission line to address safety matters, lessen risks, and ensure the reliability of transmission lines during operation enable transmission engineers to plan economically in terms of cost and dispatch system and ensure efficient maintenance [1]. It is vital to analyse the ageing process of the conductor as well as its supporting structures and components, which helps to offer guidelines for maintenance, replacement schedule, operational planning, and

safety margins for security systems and steadfastness [1]. This concept would provide suitable replacements to evade financial losses caused by the failure of ageing infrastructure [2].

Power utilities conduct routine inspections and maintenance of powerlines using ground patrol teams and inspectors and operate helicopters with inspectors on board. Helicopters are an appropriate alternative for work under problematic natural conditions in terms of environmental and economic sustainability [3]. The inspectors are trained to identify defects on lines using binoculars and cameras, and identified powerline defects are manually recorded in a logbook. Lately, manned helicopters fitted with enhanced camera systems with picture analysis and databases capable of producing a defects report are used to conduct more transmission powerline inspections safely and effectively. The helicopter-based assessment involves substantial capital and operation costs [4]. As a result, it necessitates innovative solutions that can be more cost-effective. Remotely Piloted Aircraft Systems (RPAS) and robotics-based utility solutions can assist with asset management, equipment condition monitoring and vegetation management. Power utilities worldwide are now considering drones to reduce maintenance costs, improve safety, increase reliability, and reduce response times.

## LITERATURE REVIEW
Power utilities conduct a routine inspections to identify defects that could lead to line failures, which could sometimes be catastrophic. The two most common defects encountered on aluminium conductor steel reinforced conductors are corrosion of aluminium strands and mechanical damage [5]. Therefore, inspections are carried out by ground patrol inspectors and through a manned helicopter with inspectors on-board to detect any powerline defects. The ground inspectors are trained to identify defects on lines using binoculars and cameras, and identified line defects are manually recorded in a logbook and, more recently, onto an inspection laptop connected to the transmission database. The challenge with this inspection method is that it is labour-intensive and prolonged, and it may not be possible in harsh terrains with extreme weather conditions and after extreme events such as hurricanes, floods, storms, and snow [6]. The ground (conventional) inspections are inadequate because there is no aerial visual of the structure, and climbing to view the structure at the top is an unsafe and time-consuming exercise.

This inherently led to the adoption of manned helicopters fitted with enhanced camera systems, increasing the amount of transmission line inspections and proving to be more efficient and accurate than ground inspections. However, they are still constrained due to aerial inspection resource limitations. Through a combined airborne camera, photoelectric observation system, anti-shake telescope, and other related inspection sensors fitted in a helicopter, it is possible to achieve long-time and large-scale powerline inspection [7]. Though this assessment method enables access to hard-to-reach locations and intensifies inspection speed, it comes with many challenges, such as high cost, low accuracy due to high speeds, and the dependence on human visual observation skills. There is always a risk of touching live lines, which could result in a loss of life [6]. While the manned helicopter system is technically feasible, it is, in some cases, not economically viable for short lines, resulting in a minimal number of inspections per cycle. According to the standard, all lines are to be inspected every year.

Having sufficient or frequent inspections would require the power utility to invest more in helicopter purchases, which would invariably need high capital and operational costs. The lack of adequate inspections often results in line failures that could have been avoided.

Instead of investing too much money in older technology, it is wiser to invest in emerging technologies such as drones, flying/climbing robots, and unmanned aerial vehicles (UAVs). This robot is equipped with many sensors and cameras (e.g., visual cameras, thermal cameras) for navigating along powerlines, crossing obstacles on the lines, and inspecting the lines and power components, whilst UAVs are equipped with multiple sensors and cameras for navigating along power lines, performing online inspection to detect apparent faults, and collecting data for later offline inspections [6].

## APPLICATION OF RPAS IN POWER UTILITIES
Drones have significant potential benefits in the power utility industry. For instance, drones offer a flexible and cost-effective solution for inspections, monitoring, physical security, measurements, emergency assessment and response, and surveying. They can be equipped with sensors and cameras, including infrared (IR) and ultraviolet (UV) imaging cameras and Light Detection and Ranging (LiDAR) technology [8-11], to provide a comprehensive view of power infrastructure. This enables utilities to accurately assess the condition of their assets and identify potential maintenance needs. The use of drones in conjunction with digital systems can also help to reduce maintenance costs [12,13] and improve the overall efficiency of power utilities. For example, drones can be used for predictive maintenance, real-time monitoring of power infrastructure, and

for providing access to new data and insights. Navigant Research [14] predicts that power utilities will spend over $13 billion annually on drones and robotics globally by 2026. This is an emphasis on the value of benefits that the drones incorporated with digitalisation will add to the industry.

Case studies and pilot projects have shown the potential of drones to drive digital transformation and innovation in the power utility industry. For example, a study by the European Network of Transmission System Operators for Electricity [15] found that using drones for powerline inspections improved the efficiency and accuracy of maintenance procedures, reducing costs and improving safety. Another study by Pacific Gas and Electric (PG&E) in the United States found that using drones for powerline inspections reduced the time required for inspections by 75% and improved the accuracy and detail of the data collected [16]. Precision Hawk [17] details the methodology and results of the inspection pilot project conducted for Dominion Energy, Inc. in the USA using drone-based inspection technology. Yue [11] states that power utilities and renewable energy companies have widely accepted drone solutions in many countries, such as Australia, Canada, China, Spain, the United Kingdom, and the United States of America. In the UK, 11 588 km of overhead lines have been inspected using drones for England and Wales [18]. Duke Energy of North Carolina in the USA uses drones to inspect infra-red equipment, survey storm damage, and inspect tall structures [19]. Airbus Aerial partnered with a power utility, Southern Company, to demonstrate the usability of aerial technologies, including drones, to inspect powerlines [9]. European utilities such as RTE in France and Energinet in Denmark have embarked on a journey to digital transformation

by incorporating drone solutions for transmission network inspections. China Southern Power Grid Company is utilising hundreds of drones to inspect transmission lines, and in 2019, over 500,000 km of transmission lines were inspected. Many studies have been conducted where drones are merged with digital solutions, for example, to detect conductors [20-22].

The literature has clearly articulated what drones can offer to the power utility industry. However, the impact of drones on digital transformation and innovation in the industry must be understood. Using drones in the power utility industry is still in its early stages. Still, there is growing evidence to suggest that they have the potential to play a significant role in the industry's digital transformation and innovation [23-25]. For example, drones can help drive advanced analytics innovation [8], providing access to new data and insights and enabling utilities to make data-driven strategic and operational decisions.

Additionally, drones can help digitise power utilities by requiring them to manage flight operations and compliance efficiently, process and analyse drone data, and enable autonomous flight to improve efficiencies and reduce costs. According to the World Economic Forum (WEF) [26], the power utility sector will realise a value of over $1.3 trillion from digitalisation. The future of power utility equipment monitoring and optimisation lies in developing high-definition digital twins [27]. To perform such activities about electricity grid operations, digital platforms that allow efficient monitoring of the operation conditions are developed using high-definition images of equipment and structures captured by drones. Moreover, digital transformation is a necessity for autonomous drone flights and navigation, where image

recognition algorithms could support self-flying, vision-based autonomous navigations as well as for advanced inspection images and videos. This is a method that is entirely reliant on digital solutions, and it enables drones to identify and detect objects or obstacles using computer vision to navigate and avoid them.

## EVOLUTION OF ARTIFICIAL INTELLIGENCE IN POWERLINE INSPECTION

Artificial Intelligence (AI) has emerged as a transformative force in powerline component inspection and drone-assisted autonomous operation. In this context, AI-driven technologies play a pivotal role in identifying defects in powerline components and the seamless, automated flight of drones. The integration of AI commences with image pre-processing and enhancement to optimise the quality and consistency of data acquired through drones. Convolutional Neural Networks (CNNs), exemplified by Faster R-CNN, are harnessed for object detection and classification, enabling the precise localisation and categorisation of defects on powerline components. In parallel, anomaly detection models, constructed using unsupervised learning techniques, allow for identifying known defects and unexpected anomalies, contributing to comprehensive defect assessment. Additionally, AI facilitates data fusion from various sensors and real-time monitoring, supporting predictive maintenance models to reduce downtime and avert critical failures.

In the realm of autonomous drone operation for powerline inspection, AI empowers drones with sensory perception, allowing them to process data from cameras, LiDAR, and GPS to navigate and recognise powerline structures and environmental obstacles. AI algorithms aid in path planning and obstacle avoidance, generating

optimal flight routes while ensuring the safety and precision of inspections. Moreover, AI-driven navigation systems enable autonomous drone operation, with real-time data processing on board to perform preliminary defect identification. This not only streamlines the inspection process but also reduces the need for extensive post-flight data analysis. Overall, the symbiotic use of AI for defect identification and autonomous drone operation is revolutionising the inspection and maintenance of powerline components, promoting enhanced safety, efficiency, and cost-effectiveness while minimising human intervention and operational risks in critical power transmission systems.

## ESKOM'S EFFORTS TO AUGMENT DRONES WITH AI FOR EFFICIENT OPERATIONS

Substantial progress has been made in model development in Eskom Research, Testing and Development (RT&D). A comprehensive dataset of power line component images encompassing various defect types and conditions has been collected and annotated. Training and validation of the Faster R-CNN model using Detectron2 are ongoing, and initial results are promising, with a notable improvement in defect identification accuracy compared to traditional methods.

Eskom RT&D is committed to further improving the accuracy and real-world applicability of the defect identification model. The research team plans to conduct extensive field testing and validation to ensure the model's robustness and reliability under different environmental and operational scenarios. Additionally, the team aim to explore the integration of real-time monitoring systems and automated repair scheduling, ultimately enhancing the efficiency of power line maintenance.

The ongoing research aligns with the global advancements in deep learning solutions for power line component defect identification, contributing to the field's growth and practical implementation. This research has been conducted to prove the concept of one such technology that plays a crucial role in the digital transformation of the power utility industry.

## RESEARCH METHODOLOGY

To fully understand all the implications of adopting this technology and utilise it optimally, it was essential to prove the concept by conducting field trials on powerline inspections by an internal research team and a contracted service provider. To prepare for the PoC or pilot project, a research scan was undertaken to obtain a better understanding of available technologies, their capabilities and limitations, as well as the aviation regulations applicable to the use of this technology in South Africa.

Once the research scan was completed, the preparatory work for field trials was executed. This involved:
- Purchasing and testing the drones (aircraft and payloads) in the high-voltage laboratory by simulating the electrical conditions they will be exposed to when inspecting powerlines.
- Training some Eskom project team members to be drone pilots so that they can partake in the operations. The initial group was trained and endorsed for flying within the visual line of sight (VLOS), and then later, two of the pilots in RT&D were trained and approved to pass beyond the visual line of sight (BVLOS).
- Documenting business requirements for developing IT systems for drone data analysis.
- The project team, in collaboration with inspectors from Transmission and Distribution, conducted field trials to prove the concept of inspecting live transmission and distribution powerlines. The team operated under a third-party drone operator licence and was responsible for all the operations and procedures following South African civil aviation regulations. Technical data and economic data were gathered to assess both the technical and economic feasibility of the solution.
- Afterwards, a service provider was contracted to conduct further inspections using drones for transmission and distribution powerlines. The service provider had to be fully licensed and authorised to operate around critical infrastructure and have all the necessary resources.

## DISCUSSION AND RECOMMENDATIONS

The first research question in this project was to determine if it is technically and economically feasible to roll out drones to inspect power lines. The results of testing three (3) selected aircraft in the high-voltage laboratory demonstrated that the drones could withstand high levels of electric fields, magnetism, and ion discharge (corona). After the success of a series of laboratory tests, field trials were commenced, where high-quality images (HD, IR, UV) and videos were recorded. This was evidence that drones are technically feasible for power line inspection. An economic analysis was performed to determine the feasibility of using drones for powerline inspections. The study incorporated all the financial data recorded during the inspection using helicopters, ground-based inspections and during the PoC of drones.

A business case was developed for the executives to make informed decisions about drones—the analysis for the business case involved examining several scenarios for both transmission and distribution power lines. As part of PoC, several field trials were conducted

Figures 1 & 2: tTese images were analysed by the algorithm that the author developed for the inspection of overhead power lines.

| | HELICOPTER | DRONES |
|---|---|---|
| # of Crews | 1 | 2 |
| # of Crew Members | 3 | 4 |
| # of Days | 1 | 4 |
| Flight time (hrs) | 5 | 29:52 |
| Inspection Cost/km ($) | 110.86 | 295.75 |

Table 1: Inspections by a helicopter vs. by RPAS

| | ROI | IRR | NPV |
|---|---|---|---|
| Scenario 1 | -313.97% | -19% | -$2 127 901 |
| Scenario 2 | -210.41% | 10% | -$1 733 304 |
| Scenario 3 | 49.10% | +cashflows | $4 958 213 |

Table 2: Financial Indicators for each scenario

on various transmission and distribution powerlines, first by internal staff and then later by a service provider, to practice, optimise the operations, and develop drone inspection methodologies for optimal processes. Once the optimal inspection methodology was developed and understood, a case study was performed on one selected 257 kV transmission 53 km powerline.

The case study included inspections by a helicopter and by a ground-based crew. The details of the case study are tabulated in Table I, where helicopter operations are compared to drones. See Table 1.



Figure 3: The daily RPAS operation showing flight time and distance covered

The daily progress of drone crews, who have optimised their operations through previous field trials, has been mentioned, as shown in Figure 3.

Three scenarios assessing the economic feasibility of operating drones were developed from the outcome of the case study. Scenario 1 assumes that the

current helicopter fleet is to be operated for more than five years, and only the gimbal systems for the two helicopters are to be replaced within this period. The study shows that, while drones are a more cost-effective option per hour, they are still more expensive due to the longer time it takes to complete the same task that a helicopter can perform in significantly fewer hours. The ROI, IRR, and NPV calculations for drones replacing helicopters for inspection are negative (Table II).

Scenario 2 investigates a longer project lifetime cycle, and the comparison is on procuring two new helicopters or 24 drones. The study shows that acquiring 24 drones to substitute the addition of 2 new helicopters is not cost-effective, as indicated by an unfavourable ROI and NPV in Table II.

Scenario 3 assumes that the cost of driving to the site and searching for access points is insignificant and is

disregarded in the calculations. It shows that the ROI, IRR, and NPV (Table II) calculations for drones and helicopters are optimistic, and drones are very attractive because of the significant amount of savings they provide. However, the present reality shows that it is still expensive to completely replace helicopter-based inspections with drone-based inspections, given the current conditions. This scenario can only become a reality with the maturity of digitalisation and the successful merging of drones and digital systems that will enable autonomous flights.

Table II summarises the results in terms of the financial indicators of all three scenarios examined (see Table 2).

The other research question that needed to be answered was if it is more feasible to insource or outsource the inspection service of powerlines by drones.

This was approached by conducting the proof of concept in two (2) phases, by internal staff and by a contracted service provider. The inspection cost rates obtained from these operations were $98.71 per hour and $47.4 per hour for outsourcing and insourcing, respectively. Financial modelling was performed for five years, and the results are illustrated in Figure 4.

Based on the analysis of ROI accumulated over five years, the findings strongly suggest that insourcing the drone operations service for Eskom is more cost-effective than outsourcing.
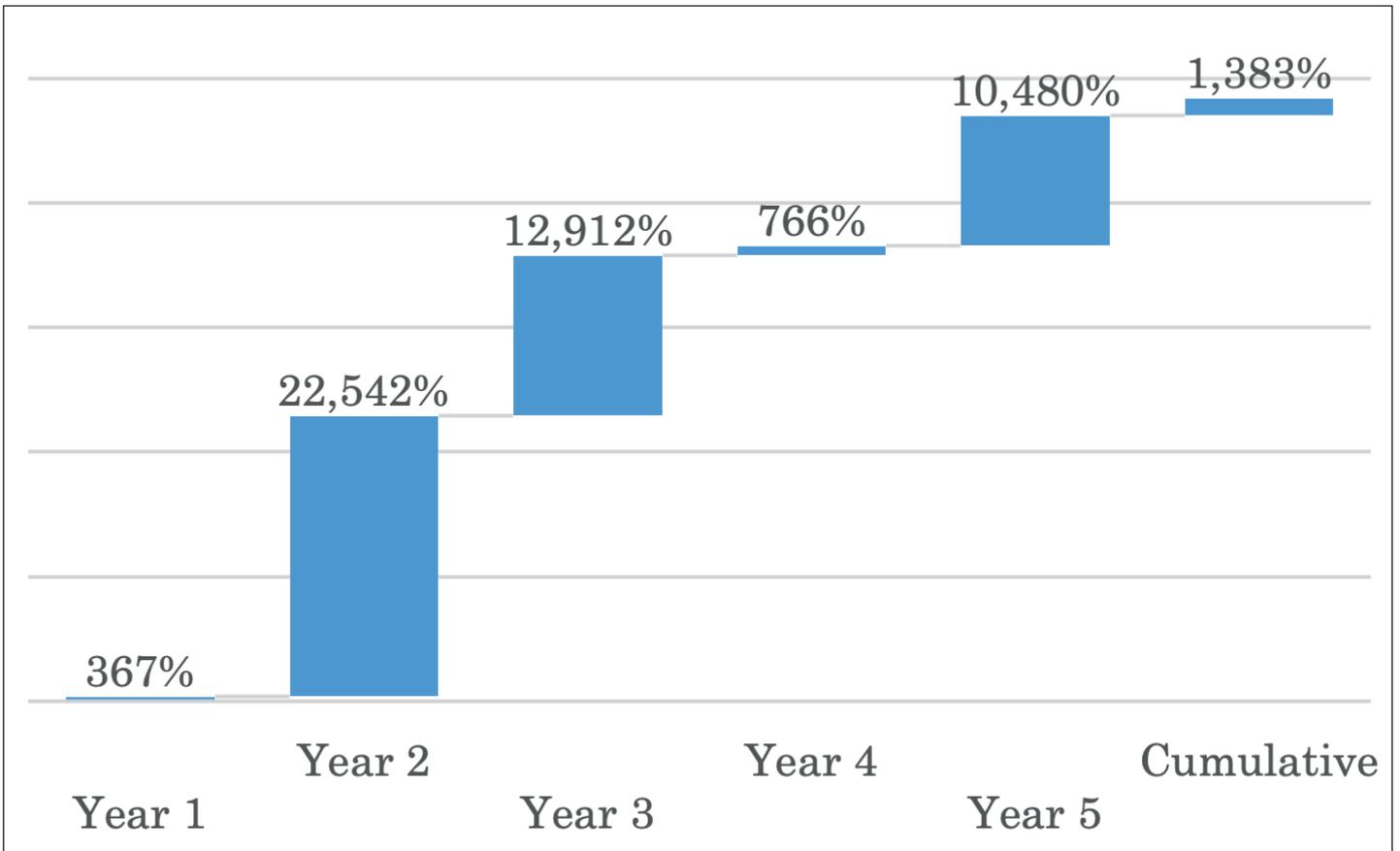
*Figure 4: ROI chart for Insourcing vs. Outsourcing*
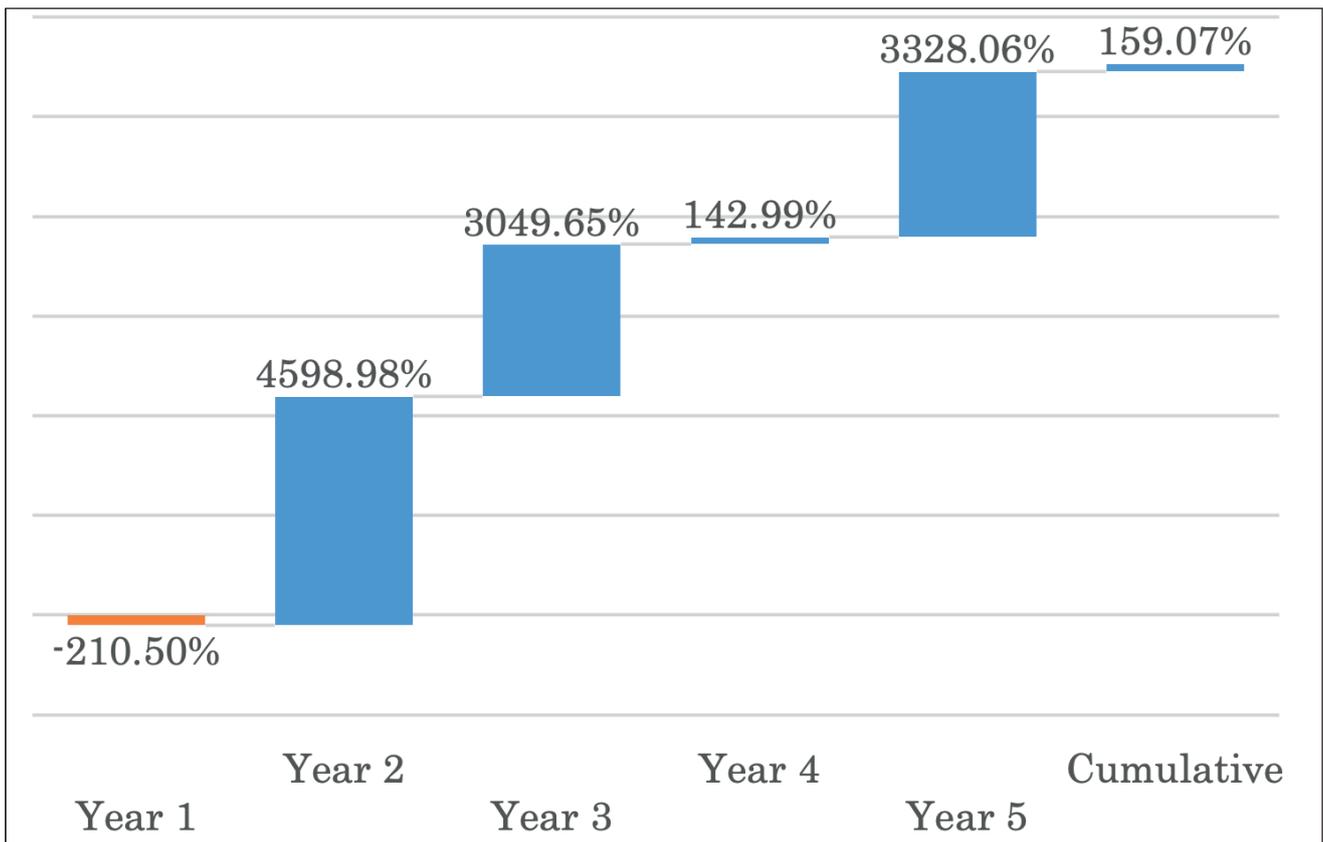


*Figure 5: ROI chart for hybrid approach for MV lines*

The ROI indicator provides compelling evidence that the financial benefits of handling drone operations internally outweigh the costs associated with outsourcing. By bringing the operations in-house, Eskom can maximise its returns and allocate resources more efficiently, leading to long-term cost savings and increased profitability.

## DISTRIBUTION POWER LINES HYBRID OPERATION APPROACH

The nature of the distribution powerlines, especially the medium voltage (MV) network, necessitates a physical assessment of components by a human. Thus, the ground-based inspections cannot yet be replaced. The business case study constituted of hybrid operation economic analysis to ascertain if it will be feasible to implement a hybrid (drones incorporated with ground-based) approach for the distribution of MV powerlines.

The hybrid operation assessment was executed by comparing the ground-based inspections, currently the standard practice for distribution powerlines, with the proposed hybrid operation. The inspection cost rate increased from R410 for ground-based to R634 for hybrid inspection. The results of this analysis are shown in Figure 5.

Figure 5 demonstrates that the hybrid inspection operations for distribution MV lines are economically feasible. The return on investment of over 150% in five years and the internal rate of return of 27% indicate that this approach is financially attractive. The net present value indicates that the project will generate positive cash flows over its lifetime. The benefit-to-cost ratio of 2.6 to 1 indicates that the project's benefits significantly outweigh the costs.

## RECOMMENDATIONS

Based on the results obtained from testing the drones in laboratory and field trials, it is technically feasible to roll out drones for powerline inspections. However, the economic analysis shows that completely replacing helicopter-based inspections with drone-based inspections is still not feasible.

This paper recommends that drones complement helicopters, with drones targeted for shorter lines or inspection of smaller areas, and where a helicopter is not permitted lower for powerline inspections. Drones can be used in scenarios where the cost and time of driving long distances are eliminated with thorough operational strategies, skilled BVLOS pilots, and automation integration. The paper highlights that for drones to be a viable alternative to helicopters, technological advancements must be implemented entirely within power utilities.

The findings suggest that the distribution utilities should implement a hybrid approach to inspect distribution MV lines using drones and ground-based inspections. This approach will require a review of business processes, work procedures, and organisational structure to cater to new roles in drone operations.

## CONCLUSION

This paper summarised an in-depth analysis of the feasibility of using drones for powerline inspections, focusing on the power utility industry. The paper highlights various case studies and pilot projects that have shown the potential of drones to be fully implemented and drive digital transformation and innovation in this industry. The economic feasibility of using drones for powerline inspections is evaluated through a detailed analysis incorporating financial data from helicopter and ground-based inspections. The cost-benefit analysis indicated that drones are not yet feasible to replace or compete with helicopters for long-line inspections.

It is beneficial to utilise drones for short-line inspections, spot inspections and in the zones where helicopters are restricted. This finding necessitates the digitisation of utility systems so that automation and a certain level of autonomy on drones can be implemented to cut the cost of operation, increase efficiencies, and yield more value from drones and robotics. The paper also investigated the feasibility of insourcing or outsourcing the inspection of powerlines by drone service.

The hybrid approach for generating MV lines is proposed as a feasible solution. The paper recommended that drones should complement helicopters, with drones targeted for specific types of inspections where they can provide better efficiency, accuracy and cost savings.

The hybrid inspection operations for distribution MV lines are financially attractive, providing a benefit-to-cost ratio of 2.6 to 1 and an internal rate of return of 27%. This paper provides valuable insights for decision-makers in the power utility industry who are considering the use of drones for powerline inspections. **wn**

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# PowerLogic™ P5

## Protection and Control Relay

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se.com/za
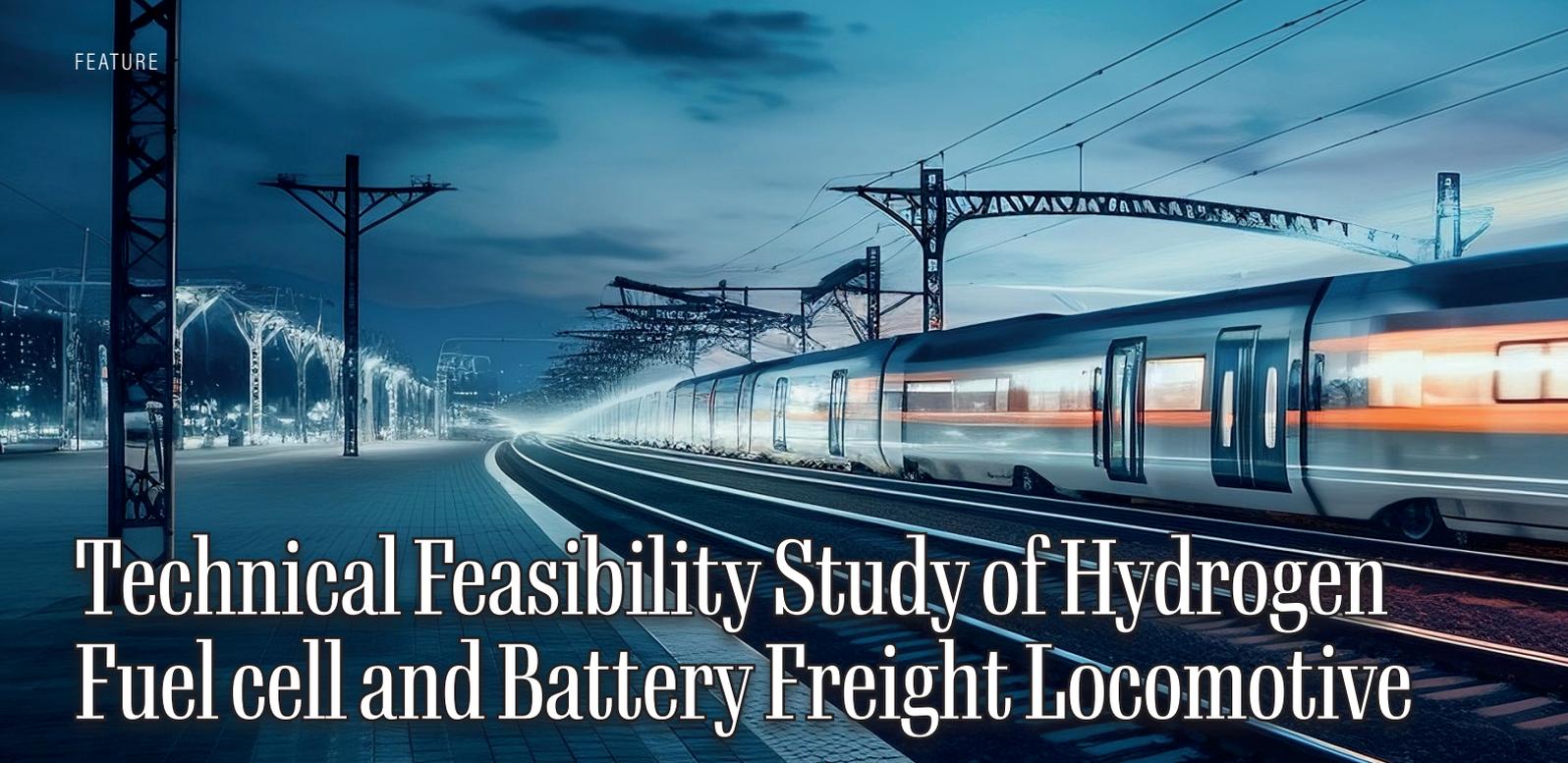
# Technical Feasibility Study of Hydrogen Fuel cell and Battery Freight Locomotive

*Currently, initiatives are made to implement zero-carbon technologies and replace trains that use fossil fuels. Transportation is one of the significant sources of carbon emissions. This work investigates the applicability of fuel cell and battery technology to freight railway lines on the pit-to-port manganese line between Hotazel and Port of Ngqurha in South Africa. Energetic macroscopic representation (EMR) and MATLAB/Simulink are used to control, represent, and simulate interactions and power transfer of the system.*

By: Celimpilo S. Shoba [1,2] & Andre Van Der Walt [2,3]

The sizing of onboard sources (fuel cells and batteries) is done such that, the retrofit space constraint is respected. The results show the required traction energy peak of 89 MWh are reduced to 65 MWh due to regenerated energy.

The battery is charged to 74% at the end of the one-way downhill trip. However, due to constraints on battery capacity, a substantial amount of the regenerated energy is dissipated as heat. Furthermore, it was found that the size constrained sources are feasible to deliver the required payload.

## INTRODUCTION

It is common knowledge that the world is moving away from fossil fuels, due to the challenge of global warming and depletion of fossil fuels which leads to a continuous rising cost of energy. All economic sectors are affected, including the transportation sector. However, in the South African case, especially the railway sector there are further pressing issues such as, cable theft, vandalism, high maintenance cost of railway lines as well as the unreliable power supply from the national grid.

Many railway studies focus only on passenger trains and shunting operations (switchers). This lack of research is caused by the assumption that there are rigorous limitations on axle loading and clearances in the freight environment. While the freight train consists are subjected to limitations because of axle loading, the batteries and hydrogen contributes to this challenge because of their high bulk density and limited area for high power density. The Sporie research group has embarked on an investigation of the technical applicability of fuel cell and battery technology in the freight railway environment.

The challenge of adding the batteries and fuel cells are the physical size and weight of these components. Since the battery's state of charge (SoC) ranges between 20 and 80%, the battery size must be 1.67 times more than the amount of storage required. Hydrogen has the highest energy density by mass of any element. However, it has very low energy density by volume, which necessitates compression at high pressures, liquefaction at low temperatures, or other storage methods

such as metal hydrides. The studied locomotive respected the space, mass and volume constraints as it considered a retrofit approach.

## STUDIED LOCOMOTIVE

This study is based on a simulated hypothetical retrofitted locomotive. The train consists of 6 locomotives configured for head-end power with a 1.2 MN force limit on couplers. The standard track load is 104 wagons. It is assumed that the train will fit in the moving structure gauge. The weight of the train is within limits, and the rail and adhesion will not be impacted as the total train mass is kept below the rated tonnage of the current locomotives. Train parameters are given in Table 1. The locomotive and train design were led by Trevor Downward.

The retrofit limits are guided by literature and sizes used on other railway prototypes. The Proton exchange membrane fuel cell (PEMFC) used is based on a Canadian Pacific prototype that uses six 200 kW fuel cells per locomotive. The hydrogen tanks are sized for 94kg at 350 kPa. The battery is based on a previous retrofit which

| LOCOMOTIVE OPERATIONAL DATA | | | |
|---|---|---|---|
| **Description** | **Qty** | **Arrangement** | **Total/Units** |
| Locomotive number and configuration | 6 x (85t) | Head end | 510 tonne |
| Wagon number | 104 x (80t) | 4 x 20t | 8320 tonne |
| Train mass | 8830 | | tonne |
| Track length | 1078 | | km |
| Ruling gradient | 1:80 | | 1.25% |
| ROLLING STOCK DATA | | | |
| Tractive effort | | 205kN@ 34km/h | |
| Braking effort | | 170kN@ 5 to 40km/h | |
| Speed limit | | 0 - 60km/h | |
| Power rating | | 1.94 MW at wheels | |

*Table 1. Locomotive data*

| ONBOARD SOURCES PER LOCOMOTIVE | | | |
|---|---|---|---|
| **Type** | **Description** | **Rating** | **Total/Units** |
| PEMFC | Fuel cells | 200kW x6 | 1.2 MW |
| Gas | H2 Storage tanks | 94kg @350 bar x6 | 564kg |
| LiFePO4 | Batteries | 1800 kWh | 1.8 MWh |
| | SoC for Batteries | 20% - 80% | |

*Table 2. Onboard sources per locomotive*

concluded that if the space for the engine, alternator, radiator and fuel tank is replaced with battery cells only a maximum of 2.3 MWh-3.3 MWh is achievable. The capacity of the battery used in this Sporie research group locomotive is 1.8MWh and details of both hydrogen fuel cells and batteries are summarised in Table 2. The total power rating of each locomotive is 1.94 MW.

## STUDIED TRACK ENVIRONMENT

The rail alignment of the Manganese corridor between Hotazel and Port of Ngqurha with its geometrical profile is shown in Fig.1. The track is 1078km long with several stations in between. Operationally the train is required to stop for 3 minutes at several points to allow other trains to pass and 30 minutes for

a crew change at Beaconsfield station. The data containing route parameters, such as ruling gradient, speed limits, travelling time between stations, and holding times in each station were

provided by key members within the Sporie research group.
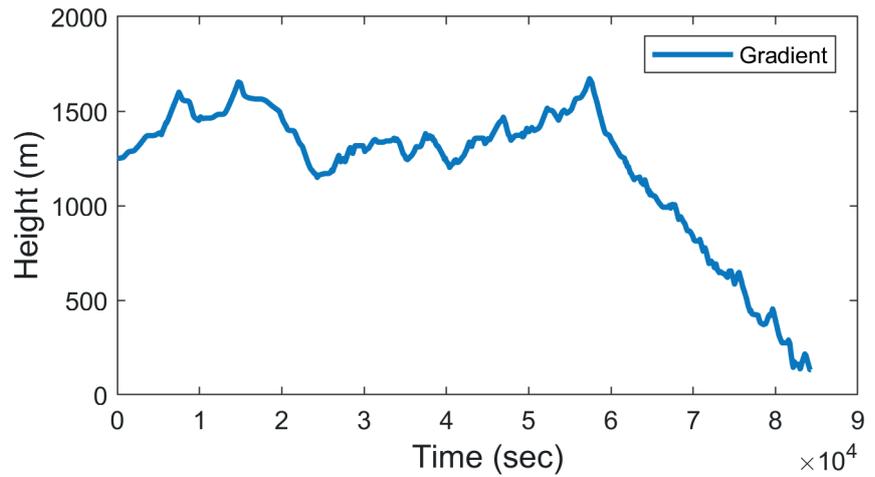


*Figure 1: Track topology from Hotazel to Port of Ngqurha*
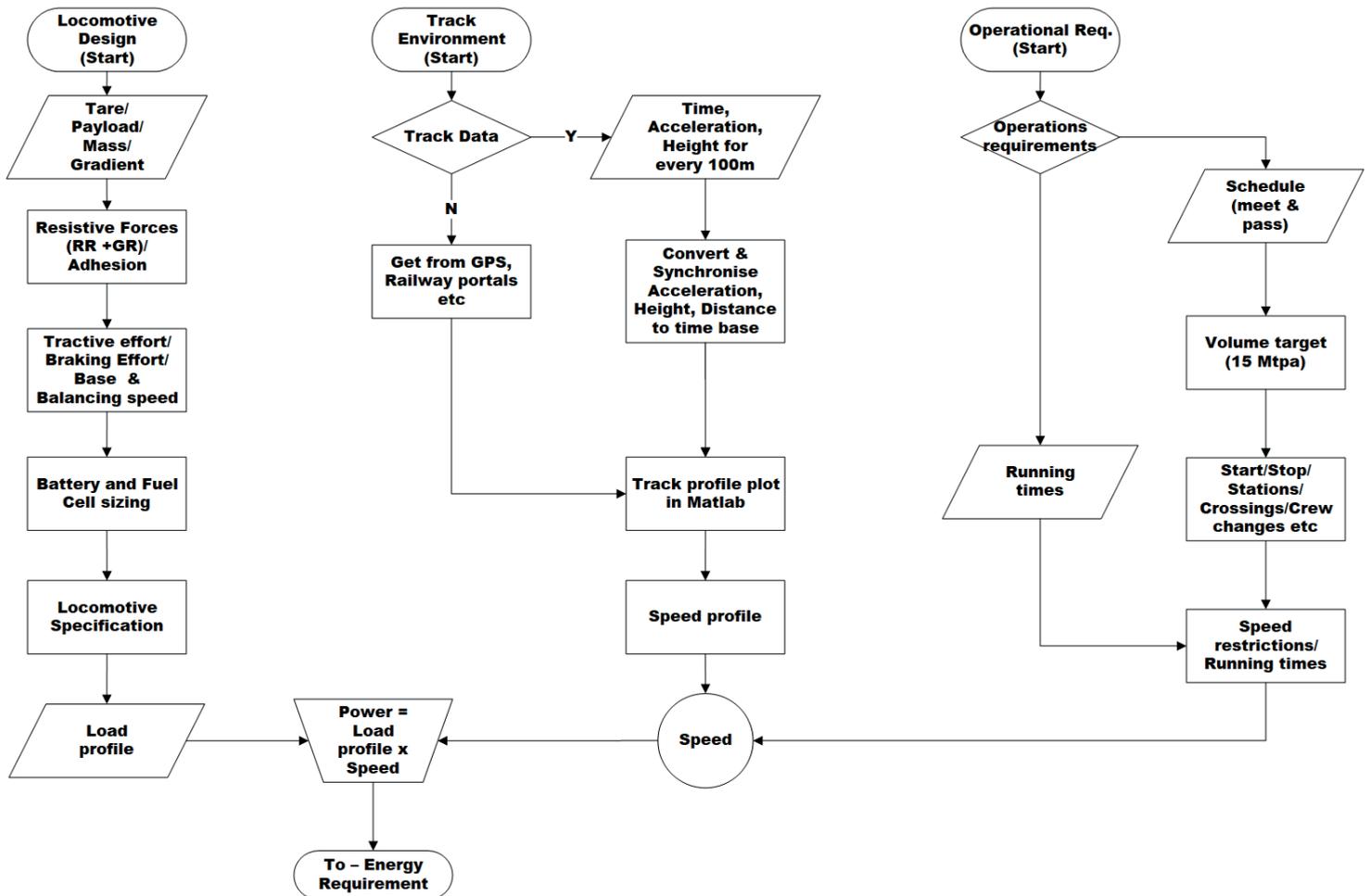


*Figure 2: Methodology Flow chart*
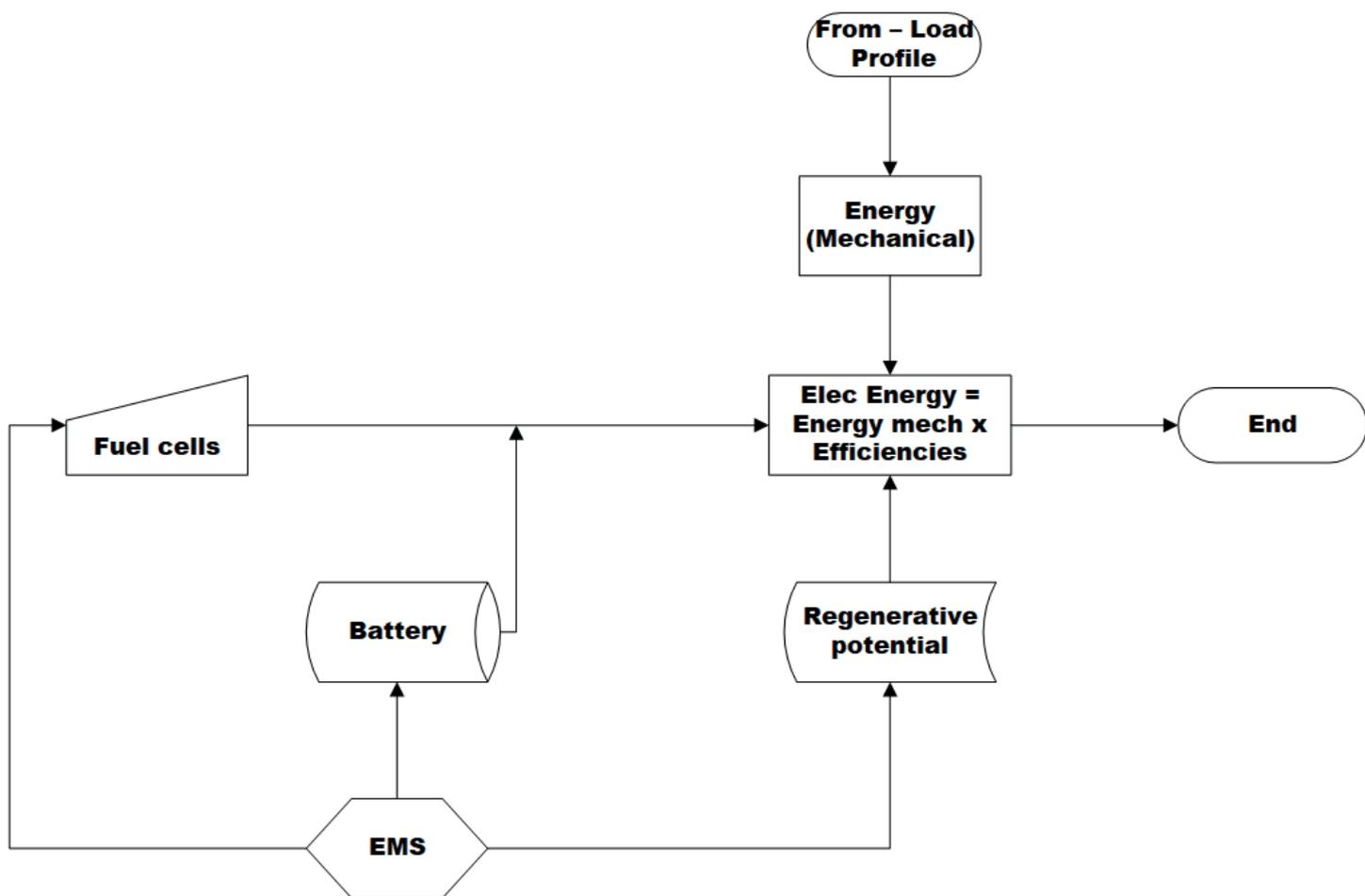
*Figure 2: Methodology Flow chart continues*

## METHODOLOGY

The operational requirements and track environment such as running time, speed restrictions were considered to design the hypothetical train specification. The simulation was conducted using energetic macroscopic representation (EMR) and MATLAB/ Simulink for simulation and validation of the calculations. Using train simulation, the power and energy needs of a train operating on a specific route may be calculated. The track requirements and train inputs are considered to determine the energy required from departure and determine if the sized onboard sources are suitable to supply the required. The energy management system (EMS) design is a frequency-based control system: the low pass filter favours the use of the fuel cell as source and the high pass filter will favour the battery as source.

The method used was governed by retrofit constraints, although using a hypothetical train which will be restricted by the known limitations, such space, volume and weight for the onboard sources. The sizes of the selected onboard sources are based on other prototypes that are currently tested by others, such as Coradia iLint and Canadian Pacific. The methodology is depicted on the flow chart shown in Figure 2.

## RESULTS AND DISCUSSION

Fig. 3 shows the combined energy distribution which includes the required energy from the departure, energy from fuel cell and battery energy spent over the trip. It also shows the feasibility of the retrofitted power sources to deliver the required power from the stored energy. The energy demand is shown to peak at 89 151 kWh and reduce to 65 129 kWh due to the regenerative energy produced as the train descends. The fuel cell delivers more than the required base load energy of 71 243 kWh at the end of the journey. The simulation found that the fuel cell's ability to supply at a fast rate of power demand is limited but augmented by the battery characteristics and controlled by the energy management system (EMS).

Fig. 4 shows the battery's SoC at the start and end of the one-way trip. It can be noted that the battery is 74% charged at the end of the trip because of the regenerative energy. However, it must be stated that batteries are not charged by
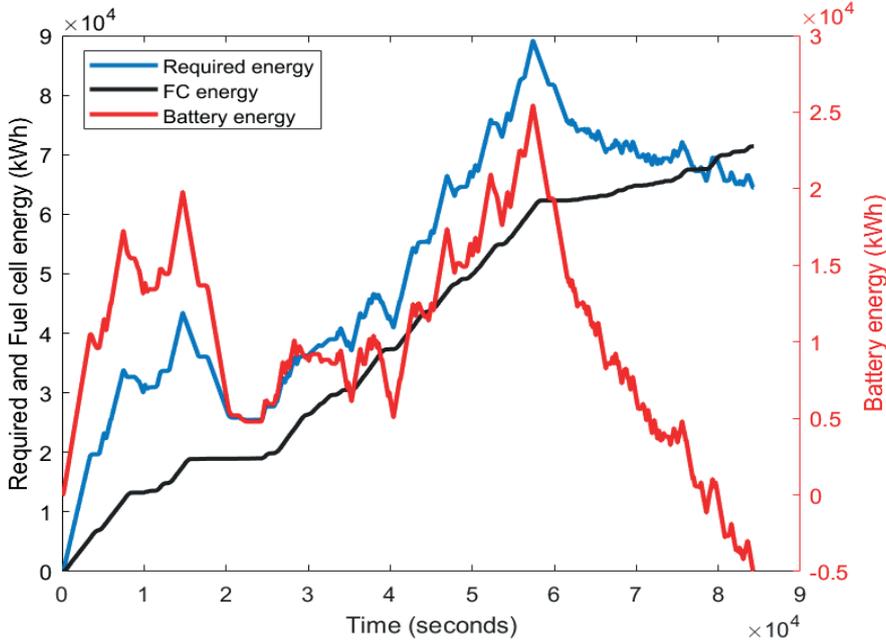
*Fig.3 Energy distribution*
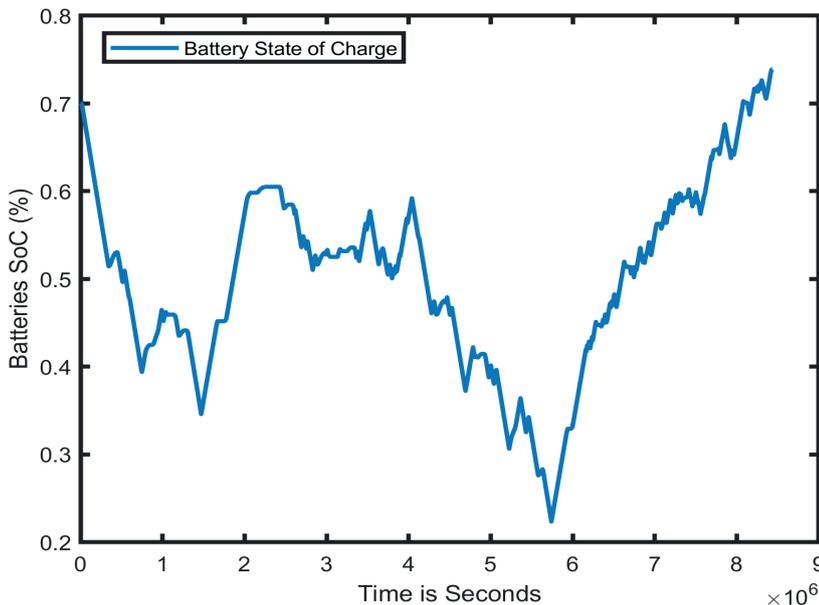


*Fig 4 Battery State of Charge*
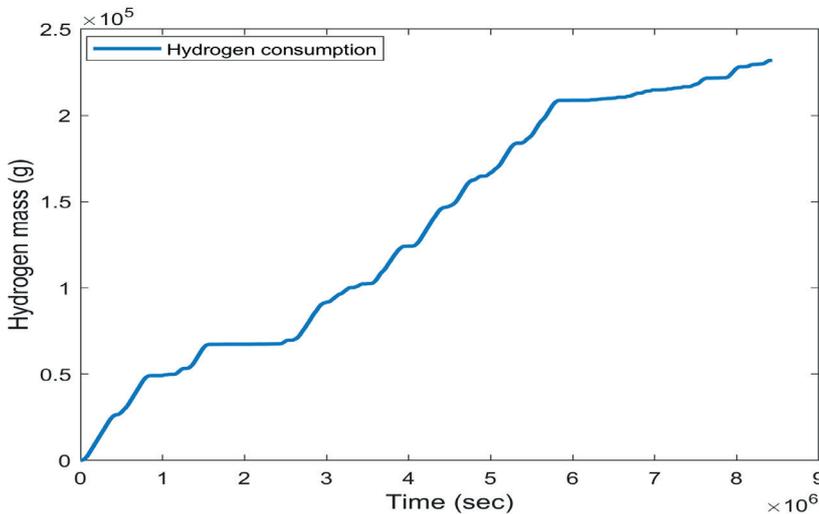


*Fig 5 Hydrogen consumption*

regenerated energy only but also by the fuel cells when required. The batteries could not capture all the regenerated energy, the balance is wasted during the application of braking resistors and brakes. It was noted that a substantial amount of this energy is wasted into the braking resistors. This work did not focus on the total regenerated energy but highlights the achieved benefits of the use of regenerated energy.

One of the determining factors for proofing the technical feasibility of using fuel cell technology in railways is the rate of consumption of hydrogen. If the consumption is too high, it compromises the feasibility of using this application. Fig. 5 shows the consumption results for one locomotive to be approximately 274 kg. The Coradia iLint locomotive has an installed capacity of 94 kg tank of hydrogen for one 200 kW fuel cell which indicates that this studied train consist would use 50% of this capacity.

## CONCLUSION

In this work, the applicability of fuel cells and battery technology in freight applications is investigated for 6 locomotives hauling 104 wagons loaded with Manganese. The sizing of the sources (fuel cells and battery) is carried out considering the capacity restrictions of the locomotive. It is found that the appropriately sized sources can deliver the required energy. Additionally, the regenerative capability of the locomotives gives an additional buffer for the power supply. However, due to storage limitations, it was necessary to dissipate some of the regenerated energy.

It is noted that this hybrid applications calls for more locomotives compared to the currently used three electric locomotives (class 23E) or four diesel locomotives (class D43). This is due the limitation of the available space to fit

the energy sources onboard. With a special designed body that can accommodate more energy sources, such as in the Wabtec design then fewer locomotives could be used. Due to lack of an hydrogen infrastructure it is not possible to conduct an economic feasibility at this stage[1, 2, 3, 4]. **wn**

## ACKNOWLEDGMENTS

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# Sustainable Transport Technologies

## - A STRATEGIC APPROACH TO GREEN MOBILITY IN SOUTH AFRICA

*South Africa, one of the larger African economies, stands at a critical juncture where urbanization and environmental responsibility converge. Rapid urban expansion has given rise to challenges such as traffic congestion and environmental sustainability. In response, South Africa is steering towards green mobility solutions. In this feature, we delve into the strategic implications of adopting sustainable transport technologies, offering insight into South Africa's journey towards an eco-friendly, efficient, and accessible transportation system.*

*By Keith Katyora*
*Pr.Eng | PMP® | CEM®*

## A CRUCIAL IMPERATIVE

As South Africa's urban centres, including Johannesburg, Cape Town, and Durban, continue to expand, they grapple with pressing challenges:

- **Choked roads:** Rapid urbanization has led to increased traffic congestion, longer commutes, and economic inefficiencies[1].
- **Polluted air:** The surge in vehicle numbers has escalated air pollution, impacting public health and well-being.
- **Energy Consumption Levels:** The urban appetite for energy strains the power grid. Traditional vehicles, reliant on non-renewable sources, exacerbate energy challenges[2].

## THE GREEN MOBILITY REVOLUTION

In the midst of these challenges, South Africa is on the brink of a Green Mobility Revolution, where innovation and sustainability redefine urban mobility:

- **Electric Buses:** Silent electric buses, powered by renewable energy sources, offer clean, efficient urban transportation. They reduce emissions and noise pollution, providing respite from urban congestion.
- **Clean Energy Infrastructure:** A comprehensive clean energy infrastructure, featuring strategically placed charging stations and a smart grid, ensures efficient energy management. This enhances sustainability and optimizes energy consumption.
- **Innovative Green Mobility Solutions:** Ride-sharing platforms, multimodal systems, and smart mobility apps empower commuters with efficient choices, reducing private vehicle ownership and alleviating congestion. The Green Mobility revolution is not just about reducing emissions; it's about reimagining the urban landscape. South Africa's cities are becoming cleaner, quieter, and more efficient. They are embracing a future where transportation is not a source of problems but a catalyst for solutions.

## STRATEGIC SIGNIFICANCE

The shift towards green mobility extends beyond environmental concerns. It holds profound strategic implications:

- **Economic Advantages:** Green mobility offers reduced operating costs for businesses, job creation, and economic growth. Electric vehicles, requiring less maintenance, enhance financial viability.
- **Societal Well-Being and Quality of Life:** Cleaner air and enhanced urban living improve public health and

1. Traffic in South Africa's most congested cities is getting worse (mybroadband.co.za)
2. South Africa: primary energy consumption 2022 | Statista

quality of life. Quieter electric vehicles reduce noise pollution, fostering community and connectivity.

- **Strategic Preparedness:** Embracing green mobility aligns with global sustainability goals. It enhances reputation and competitiveness, positioning businesses and governments as forward-thinking entities.

## CHALLENGES AND OPPORTUNITIES

While the allure of green mobility is undeniable, it presents challenges:

- **Substantial Investment in Infrastructure:** Developing charging networks and sustainable energy sources demands significant initial capital investment.
- **Regulatory Frameworks:** Adapting regulations to address electric vehicles and innovative mobility solutions requires collaboration and reform.
- **Innovation:** South Africa's talent pool and tech ecosystem drive innovation in green transport, offering export opportunities and job creation.
- **Collaboration:** Partnerships across sectors are crucial for knowledge sharing and resource pooling.
- **Sustainable Practices:** Sustainable urban planning and mobility options reduce congestion and emissions.

## GLOBAL TRENDS AND EXPORT OPPORTUNITIES: SOUTH AFRICA'S ROLE AS A GREEN TECHNOLOGY HUB

In the midst of South Africa's Green Mobility Revolution, the country has a unique opportunity to not only address pressing domestic challenges but also to position itself as a global leader in green technology development and export. This endeavour is not just a strategic aspiration; it's a pathway to economic growth, technological innovation, and international recognition.

### EMERGING GLOBAL TRENDS

Across the world, the demand for sustainable and eco-friendly transportation solutions is on the rise. As countries grapple with the imperative of mitigating climate change and reducing carbon footprints, green mobility technologies are becoming a central focus. Electric vehicles, renewable energy integration, and innovative mobility platforms are at the forefront of these trends.

South Africa's embrace of these technologies aligns perfectly with global movements towards greener transportation. It signifies that South Africa is not merely a passive observer of these trends but an active participant, contributing to the global effort to address climate change and promote sustainable living.

### OPPORTUNITIES FOR EXPORT

The development and deployment of green mobility solutions create significant export opportunities for South Africa. Here's how the country can capitalize on this:

- **Electric Vehicles (EVs):** South Africa can establish itself as a manufacturing hub for electric vehicles, producing not only for domestic consumption but also for export. By developing a robust EV manufacturing ecosystem, the country can tap into the growing global demand for emission-free transportation.
- **Clean Energy Infrastructure:** As the world transitions to clean energy, South Africa can export its expertise in developing clean energy infrastructure. This includes knowledge in building charging networks, renewable energy installations, and smart grid technologies, all of which are vital components of sustainable transport systems.
- **Innovative Mobility Solutions:** South Africa can export its innovative mobility solutions, such as ride-sharing platforms, integrated multimodal systems, and smart mobility apps. These technologies

have the potential to address urban transportation challenges worldwide, making South Africa a valuable contributor to the global mobility revolution.

- **Knowledge and Expertise:** The country can export its expertise in sustainable urban planning and transportation management. By sharing its experiences and knowledge in transitioning to green mobility, South Africa can assist other countries in their efforts to create more sustainable and efficient transportation systems.

- **Job Creation:** Exporting green technology and expertise not only generates revenue but also fosters job creation within the renewable energy and transportation sectors. This provides a boost to South Africa's economy and helps address unemployment issues.

- **Strengthening Diplomatic and Economic Ties:** Becoming a hub for green technology export can enhance South Africa's diplomatic and economic ties with other countries. Collaborative efforts in green technology development can lead to partnerships and alliances, further strengthening the countries' global standing.

South Africa has the potential to position itself as a hub for green technology development and export, riding the wave of emerging global trends in sustainable transportation. By leveraging its commitment to green mobility and investing in technology and innovation, the country can not only address its domestic challenges but also become a significant player in the global green technology market. This endeavour promises economic growth, job creation, and international recognition, solidifying South Africa's role as a leader in the green mobility revolution.

In conclusion, South Africa stands poised for a greener, more sustainable transportation future. Electric buses, clean energy infrastructure, and innovative green mobility solutions pave the way for a future where sustainability meets efficiency. As South Africa navigates the urbanization-environmental dilemma and the transition to sustainable cities, green mobility is the strategic area which could have huge impact. This strategic shift not only reduces the carbon footprint but also positions South Africa for a future defined by innovation, resilience, and a higher quality of life for its citizens and stakeholders. More than just playing a role in the transportation sector, the significance of green mobility shapes South Africa's communities and economy holistically. **wn**

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# Automation - Trends & Spends Report

*Newton's third law of motion dictates, "what goes up, must come down." With this in mind, the Intelligent Automation Network have speculated whether or not, after two years of unprecedented growth brought on by the COVID-19 pandemic, the global market for intelligent automation, robotic process automation (RPA) and other business process automation solutions would eventually contract.*

At least when it comes to 2023, the answer seems to be no.

Based on our survey of over 400 intelligent automation, RPA and digital transformation leaders, the race towards building the autonomous enterprise has only just begun.

Customers as well as employees and investors now expect companies to be agile, capable of rolling out new services and capabilities as the market demands.

Rather than deterring organizations from investing, increasing inflation, supply chain disruptions and fears surrounding a potential global recession are pushing organizations to embrace intelligent automation.

Meanwhile, organizations are scrambling to retain talent. Rather than replacing humans with robots as many have feared, organizations are now using intelligent automation to close pervasive talent gaps and enhance the employee experience. With the emergence of low code solutions, citizen developers are increasingly taking digital transformation into their own hands and leveraging these tools in ways that best align with their individual workplace needs.

What this all this means is that companies are not slowing down when it comes to RPA, intelligent automation and DX investments. In fact, we expect to see unprecedented levels of innovation in the year ahead as organizations continue to expand and evolve their digital footprints.

That being said, some challenges do remain. Some organizations are still struggling to make the most of their existing business process automation investments while those who have yet to adopt these technologies fall further and further behind the curve. In addition, organizations that may be especially impacted by recent geopolitical and economic uncertainty have been forced to cut their technology budgets in some areas.

Over the next several pages, we'll examine what key enabling technologies our membership base is investing in over the next year as well as which top vendors they're most eager to partner with and the top industry trends that will dominate the market in 2023.
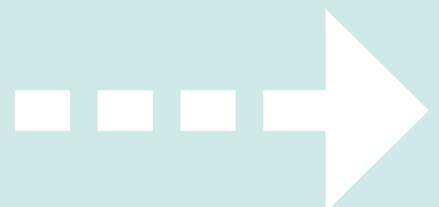
# Digital Transformation 2.0

**CHART 1**

**Is your organization currently undergoing a digital transformation?**

- Yes
- No, but plan to within the next year
- No, no plans to undergo a digital transformation



3%
13%
84%

**CHART 2**

**Do you expect your budget for digital transformation to increase or decrease over the next year?**

- Increase
- Decrease
- Stay the same
- No budget
- I don't know



2%
1%
21%
21%
55%
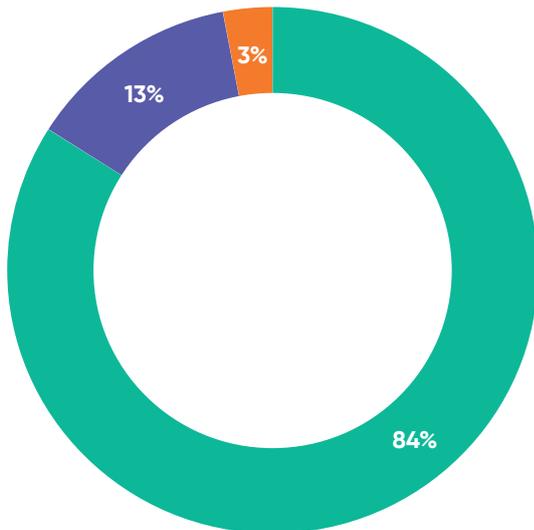
If anything, fears of economic uncertainty have pushed organizations to double down on their digital transformation ambitions. Case in point, 84% of our respondents confirm they are already investing in digital transformation with and additional 13% saying they plan to in the next year. These figures are right in line with our **2021 results** wherein 56% of our respondents said they were currently undergoing a digital transformation and 33% said they planned to do so in the next year.

In addition, our respondents expressed interest in a wide range of emerging technologies. Artificial intelligence (AI), especially in the form of computer vision is becoming especially popular as is digital twin technology, process mining and supply chain analytics. Those these technologies were

once just the stuff of science fiction, 70% of our respondents are investing in at least one of the technologies listed in chart 3.

However, that does not mean that budgets are necessarily increasing at the same rate. While only 3% of 2021 respondents expected their DX budgets to decrease, 21% of 2022 respondents due (chart 2). Furthermore, only 55% of 2022 respondents expect their budgets to increase vs. 63% in 2021.

In terms of functional focus, not surprisingly, information technology (IT) and finance are the two most popular areas to transform (chart 4). Given the plethora of routine, repeatable processes and high-quality transactional data in these functions, they are often both the easiest and perhaps most rewarding departments to transform.

# Digital Transformation 2.0

**CHART 3**

**Are you currently or considering leveraging any of the following technologies and solutions?**

● Currently leveraging   ● Plan to implement within 12 months

| Technology | Currently leveraging | Plan to implement within 12 months |
|---|---|---|
| AI – Computer Vision | 46% | 22% |
| AI – NLP/Conversational AI | 33% | 36% |
| AI – Machine Learning | 40% | 30% |
| Analytics Automation | 35% | 35% |
| Augmented/Virtual Reality | 36% | 30% |
| Cloud Integration (iPaas) | 36% | 32% |
| Digital Twin Technology | 39% | 28% |
| Advisory Services | 34% | 31% |
| Edge Computing | 34% | 30% |
| Internet of Things (IoT) | 38% | 29% |
| Physical robots | 32% | 34% |
| Process Analytics | 37% | 31% |
| Process Mining | 39% | 30% |
| Security Tech | 38% | 28% |
| Self-Service Analytics | 36% | 30% |
| Supply Chain Analytics | 40% | 26% |
| Supply Chain Automation | 36% | 29% |

0%   50%

# Digital Transformation 2.0

CHART 4

**What functional areas are currently undergoing digital transformation?**

| Actively transforming | | Plan to in the next 12 months |
|---|---|---|
| 74% | Finance | 23% |
| 48% | Human Resources | 47% |
| 52% | Customer Service | 44% |
| 51% | Supply Chain & Procurement | 43% |
| 57% | Inventory Management & Warehousing | 36% |
| 52% | Sales & Marketing | 41% |
| 60% | IT | 35% |
| 50% | Entire Enterprise (all of the above) | 39% |

75% — 0%    0% — 75%

One interesting area we saw increased interest in was inventory management and warehousing. In between supply chain disruptions, inflation, and evolving customer expectations, its vital for retailers and manufacturers to invest in automated inventory management and warehousing solutions.

While many people associate these solutions with physical robots, that only accounts for a small percentage of automated warehousing and inventory management solutions. Most are multifaceted, using RPA and intelligent automation to automate spreadsheet entry, reordering, document validation and demand forecasting.

Last but not least, 50% of respondents said they were undergoing an enterprise-wide digital transformation. While in the past many organizations opted to automate or transform one function or even process at a time, that approach is not as risk-avoidant as many believed it to be. Increasingly, organizations are recognizing the benefits of developing an enterprise-wide strategy such as reduced complexity, increased interoperability and enhanced data sharing, amongst other synergies.

In terms of what's next, 47% of respondents say they plan to transform Human Resources (HR) in 2023. HR has long been on the agenda for DX, though many organizations have only automated select HR tasks such as payroll automation, onboarding and select recruitment workflows. HR teams are also increasingly deploying chatbots and self-service applications to enable employees to easily ask questions and make minor changes to their employee profiles.

However, as other back-office transformation come to successful fruitions, many organizations will turn their attention to HR next. With companies now enhancing their remote work options and starting to invest in performance management tools in earnest, **recent research** indicates that the global HR technology market will grow at a 5.7% CAGR to $ 8.36 billion by 2030.

# Intelligent Automation and RPA

2022 was an exciting and eventful year for the RPA and intelligent automation (IA) sector, especially when it came to mergers and acquisitions. As documented on our **website**, over 17 M&A deals took place during the first 8 months of 2022 on top of at least 5 major ones that took place in 2021. This M&A activity has irrevocably changed the RPA vendor landscape, maturing a diverse, start-up rich market into one dominated by 5 five "mega-vendors."

One factor driving these transactions are IA and RPA's soaring adoption rates despite some of the skepticism surrounding these solutions, especially when it comes to scalability. In fact, experts predict the RPA market will grow to $20.1 billion by 2030 and our findings more or less confirm these projection.

While in 2021, only 30% of respondents were actively investing in IA and RPA, 64% of our respondents said they had already invested in intelligent automation (chart 5)

and 42% said they are currently investing in RPA (chart 6). Looking forward to 2023, an additional 35% said they planned to adopt intelligent automation with 54% saying they planned to invest in RPA.



**CHART 5**

## Are you currently leveraging intelligent automation?

● Currently Leveraging    ● Plan to implement within the next year

36%

64%
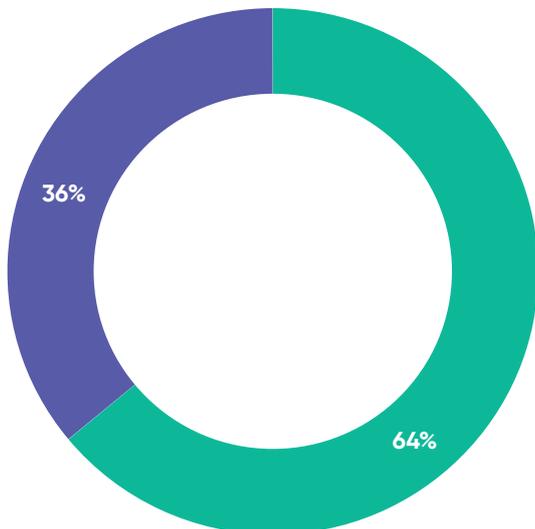
**CHART 6**

## Are you currently leveraging RPA/ Rules-Based Tools?

● Currently Leveraging    ● Plan to implement within the next year

42%

58%
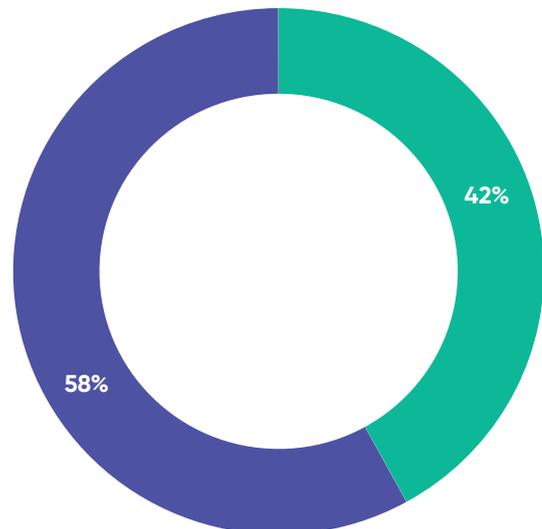
# Intelligent Automation and RPA

CHART 7

**Do you expect your budget for intelligent automation to increase over the next year?**

- ● Increase
- ● Decrease
- ● Same
- ● Don't know



5%
22%
49%
23%
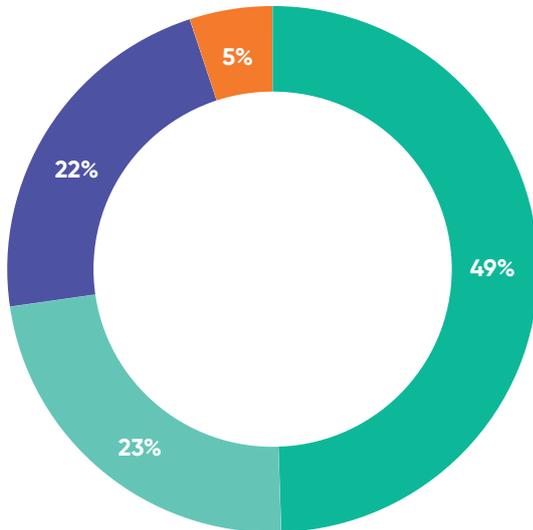
CHART 8

**Do you expect your budget for RPA/Rules-Based Tools to increase over the next year?**

- ● Increase
- ● Decrease
- ● Same
- ● Don't know



5%
24%
40%
28%
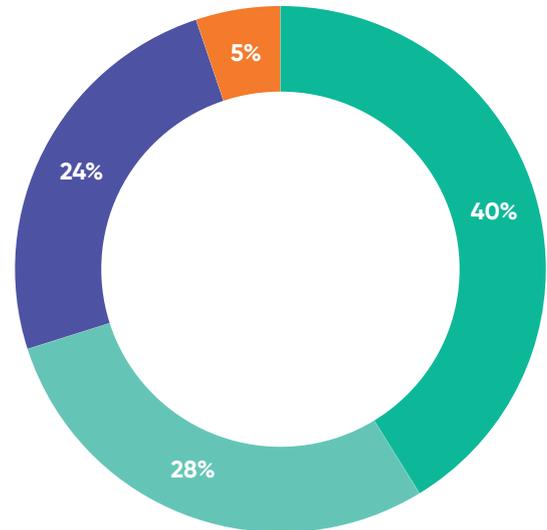
Though more people may be adopting and reaping the rewards of RPA and intelligent automation, that does not necessarily mean that everyone's budgets are increasing. In fact, budgets seem to have plateaued, probably in response to ongoing economic uncertainty.

In addition, while recent advancements in enabling technology such as AI, process discovery and low code make RPA success more achievable than ever, the technology is not without its limitations. As mentioned before, RPA can be difficult to scale as well as expensive and brittle, requiring ongoing maintenance.

As such, only 49% of respondents expect their intelligent automation budgets to increase in 2023 vs. 53% heading into 2022. At 40%, the percent of respondents who expect their RPA budgets has remained entirely the same over the past year.

As for execution, we also saw a rather dramatic increase in the implementation of automation center of excellences (CoEs). While in 2021, only 54% of respondents had implemented an automation CoE, this year 72% of respondents said they already had one in place (chart 9). This proves that organizations are getting serious about business process automation and building out the organizational infrastructure in order to support these objectives.

# Intelligent Automation and RPA

## CHART 9
## Does your organization have an Automation Center of Excellence?

Plan to in the next 2 years

Yes

| 72% | 16% | 12% |

No

## CHART 10
## Are you currently or considering working with any of the following intelligent automation and RPA vendors?

**Current partner**

**Considering partnership**

| Current partner | Vendor | Considering partnership |
|---|---|---|
| 39% | Appian | 48% |
| 44% | Automation Anywhere | 47% |
| 47% | AutomationEdge | 39% |
| 50% | Blue Prism | 40% |
| 46% | Datamatics | 42% |
| 52% | EdgeVerve Systems | 36% |
| 48% | HelpSystems | 39% |
| 49% | IBM | 41% |
| 51% | Intellibot | 37% |
| 47% | Kofax | 39% |
| 48% | Kryon | 39% |
| 43% | Laiye | 45% |
| 44% | NICE | 42% |
| 45% | Nintex | 44% |
| 45% | Pega | 42% |
| 47% | Rocketbot | 40% |
| 48% | SAP | 41% |
| 48% | Skan AI | 39% |
| 44% | Techforce.ai | 43% |
| 46% | UiPath | 43% |
| 46% | WorkFusion | 41% |

55%      0%      0%      55%

# Hyperautomation

CHART 11
**Are you currently investing in hyperautomation?**

**45%**  **46%**  **9%**

50%

- ● Current investment
- ● Plan to invest within the next year
- ● No, no plans to invest

0%
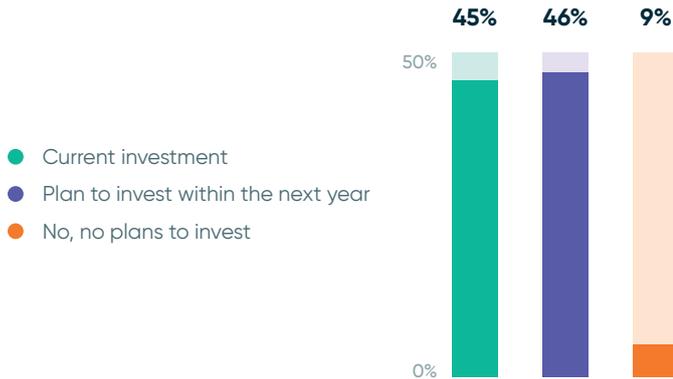
CHART 12
**Do you expect your hyperautomation budget to increase over the next year?**

**44%**  **22%**  **22%**  **8%**  **4%**

50%

- ● Increase
- ● Decrease
- ● Stay the same
- ● No budget
- ● I don't know

0%
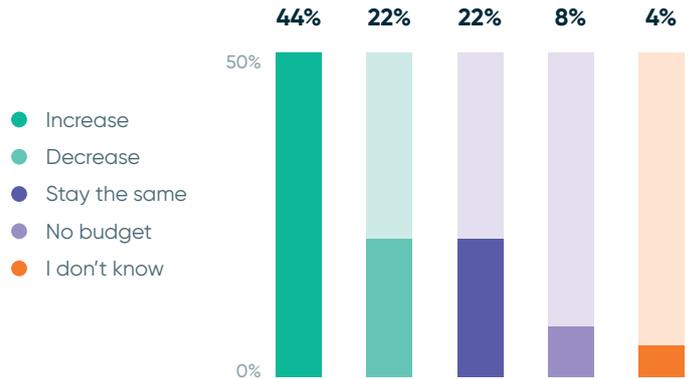
In addition to intelligent automation, people are also increasingly investing in hyperautomation rather than RPA alone. In fact, 91% of respondents say they either currently are or plan to invest in hyperautomation in 2023 (chart 11). Furthermore, 66% of those surveyed stated that they expect their budgets for hyperautomation enabling technology to either increase or stay the same over the next year.

These findings align with recent research conducted by **Salesforce and Vanson Bourne** which predicts that 80% of organizations will include hyperautomation on their technology roadmap by 2025.

Rather than any technology in particular, hyperautomation encompasses multiple digital transformation technologies and techniques including: RPA, AI, process mining, workflow automation, advanced analytics, automated process discovery, iPaaS and machine learning. The term also implies a holistic, studied and mature approach to automation.

As organizations increasingly focus on enterprise and ecosystem transformation is discussed in the first chapter of this report, we expect organizations to increasingly embrace hyperautomation in years to come.

CHART 13
**What percentage of your overall budget is allocated towards RPA, Intelligent Automation and Hyperautomation technology and services?**

1-25%
**18%**

25-50%
**42%**

50-75%
**27%**

Over 75%
**7%**

I don't know
**4%**

No budget
**2%**

0%                                        45%
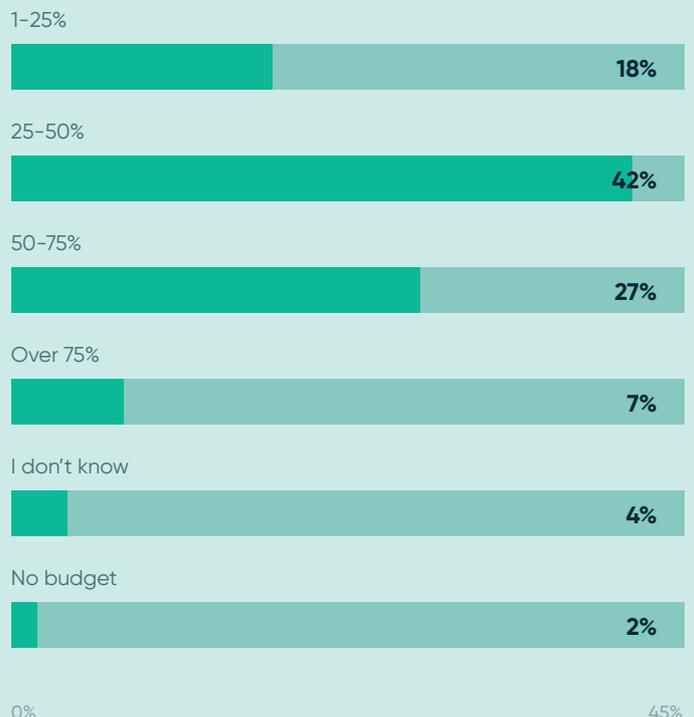
# API Management

**CHART 14**

## Are you currently leveraging API integration management technology?

- ● Currently leveraging
- ● Plan to implement in the next 12 months
- ● No plans to implement

48%
47%
5%
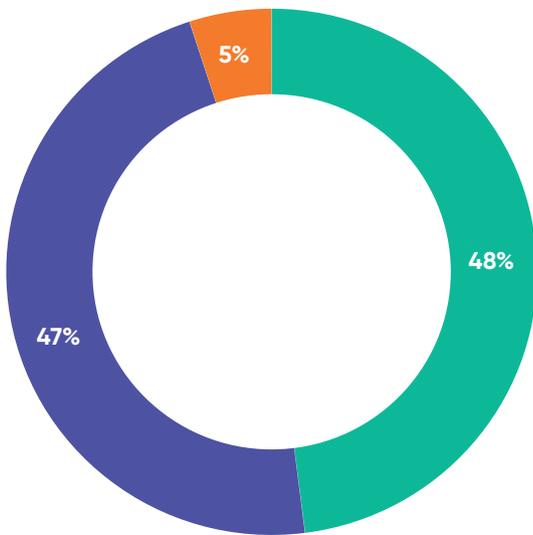
**CHART 15**

## Do you expect your budget for API integration management technology to increase over the next year?

- ● Increase
- ● Decrease
- ● Stay the same
- ● No budget
- ● I don't know

46%
24%
24%
3%
3%
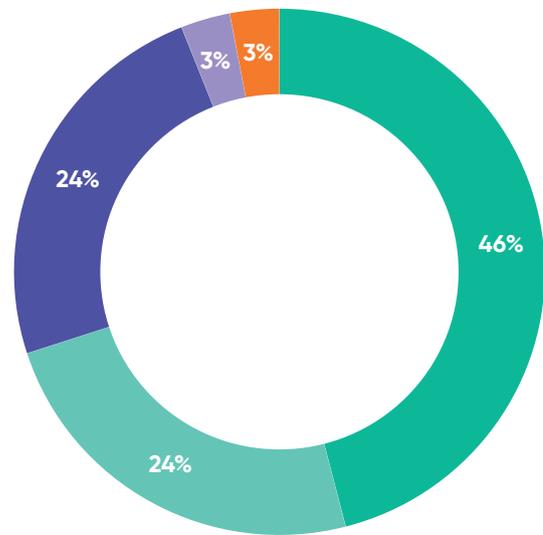
One of the key enabling technologies of hyperautomation and digital transformation are application programming interfaces (APIs), code-based intermediaries that allow two applications to talk to each other. Because they enable data transfer between multiple, disparate systems, APIs can be used to automate back-end processes.

Though APIs have been around for years, organizations are increasingly relying on them to fuel their most business critical applications. As such, the market for API management solutions, centralized platforms that allow enterprises to deploy, monitor, reuse and analyze APIs, has expanded.

In fact, 48% of those surveyed confirmed that are already leveraging API management technology and 47% expect to implement it in the next year. As for 2023 budgets, 46% predict their budgets for API management tools will increase.

# Workflow Automation, Orchestration and Management

CHART 16

**Which of the following workflow solutions are you currently leveraging?**

● Currently leveraging     ● Plan to implement within 12 months

| | |
|---|---|
| Workflow automation | **59%** / **25%** |
| Workflow management platform | **41%** / **42%** |
| Workflow management services | **49%** / **33%** |
| Workflow orchestration | **45%** / **35%** |

0%       60%
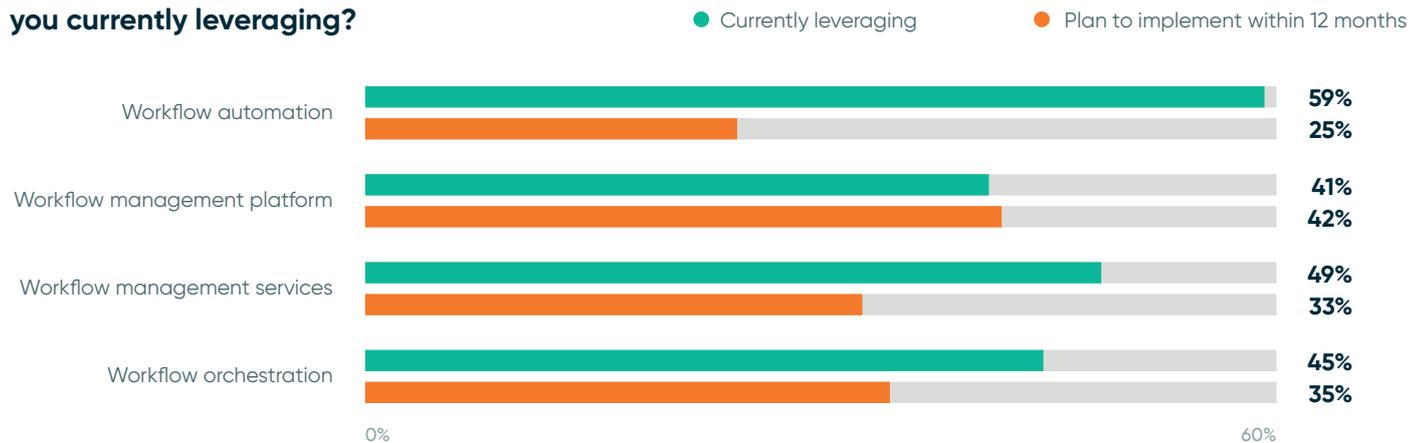
For the second year in a row, we've seen growth across all four workflow solutions we enquired about both in terms of budgets and adoption rates (charts 16 and 17). As workflow automation and orchestration tools are key components of digital transformation, this is hardly a surprise.

In addition, workflow automation and orchestration technology has become increasingly accessible. Not only has there been an explosion of standalone low code workflow automation tools entering the market, enterprise platforms are increasingly offering low code workflow automation features. For example, both Slack and Microsoft offer low/no code workflow automation tools that enable user to automate basic tasks such as onboarding communications, basic PDF creation and email forwarding.

Behind the scenes, workflow automation and orchestration tools continue to drive IT transformation. From microservices orchestration to MLOps to event automation, organizations increasingly rely on workflow engines to harmonize and automate some of their most high value, mission critical processes.

**CHART 17**

**Do you expect your final, approved budget for workflow optimization solutions to increase over the next year?**

● Yes
● No, I expect it to stay the same
● No, I expect it to decrease
● We don't plan on investing in these tools at all
● I don't know

Pie chart values: 70%, 16%, 6%, 4%, 4%
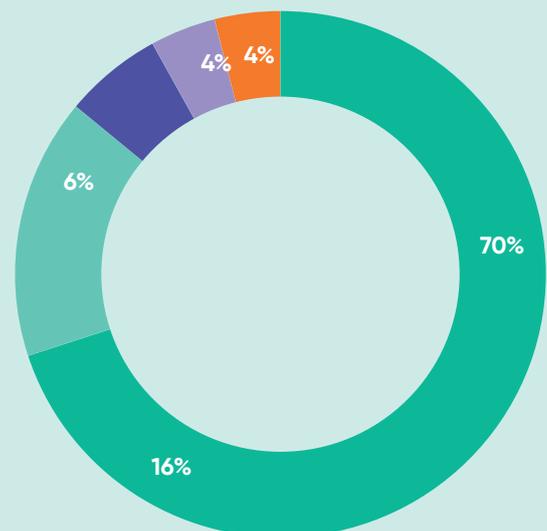
# Workflow Automation, Orchestration and Management

**CHART 18**

**Are you currently or considering partnering with any of the following workflow management solution providers?**

| Current partner | | Considering partnership |
|---|---|---|
| 56% | Automate.io | 21% |
| 36% | BP Logix | 39% |
| 36% | Camunda | 38% |
| 38% | ClickUp | 36% |
| 42% | Comindware Tracker | 33% |
| 39% | Hyland/Alfresco | 35% |
| 42% | IBM | 34% |
| 36% | Integrify | 37% |
| 40% | Kintone | 33% |
| 34% | Kissflow | 37% |
| 38% | Kofax | 35% |
| 41% | M-Files | 34% |
| 37% | Newgen | 35% |
| 39% | Nintex | 35% |
| 40% | OpexTex | 33% |
| 39% | Orchestly | 34% |
| 40% | Pipefy | 33% |
| 37% | ProcessMaker | 35% |
| 39% | ServiceNow | 35% |
| 39% | Workfront | 33% |
| 41% | Zapier | 32% |
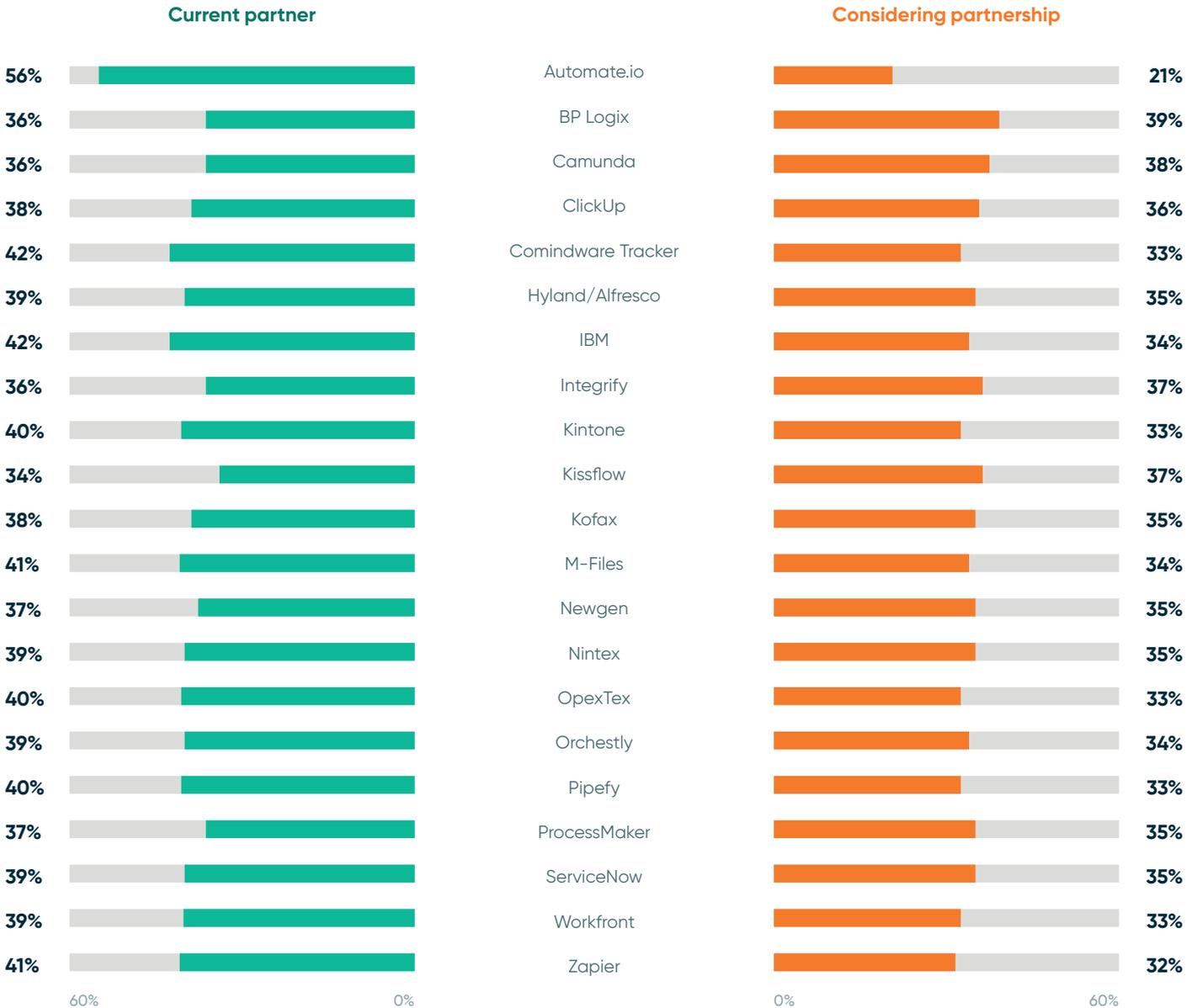
While in 2021, 56% of respondents expected their workflow solutions budgets increase, a striking 70% of this year's participants expect their budgets to increase. Expect an update from us next year on how this widespread adoption is paying off.

# Low and No Code Automation

CHART 19
**Are you currently leveraging low or no code automation tools?**

**70%**  **22%**  **8%**

70%

- ● Yes
- ● No, but plan to within the next year
- ● No, we have no plans to invest in low-code

0%
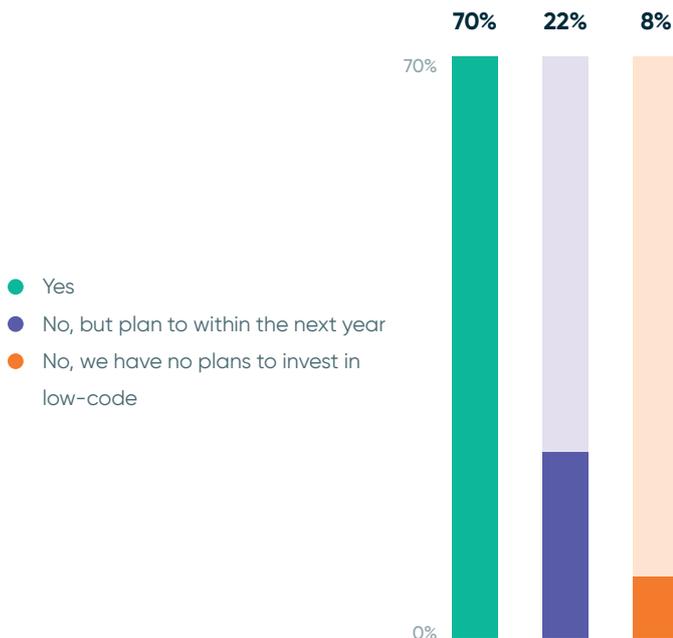
CHART 20
**Do you expect your final, approved budget for low/no code solutions to increase over the next year?**

**46%**  **23%**  **23%**  **5%**  **3%**

70%

- ● Increase
- ● Decrease
- ● Stay the same
- ● No budget
- ● I don't know

0%
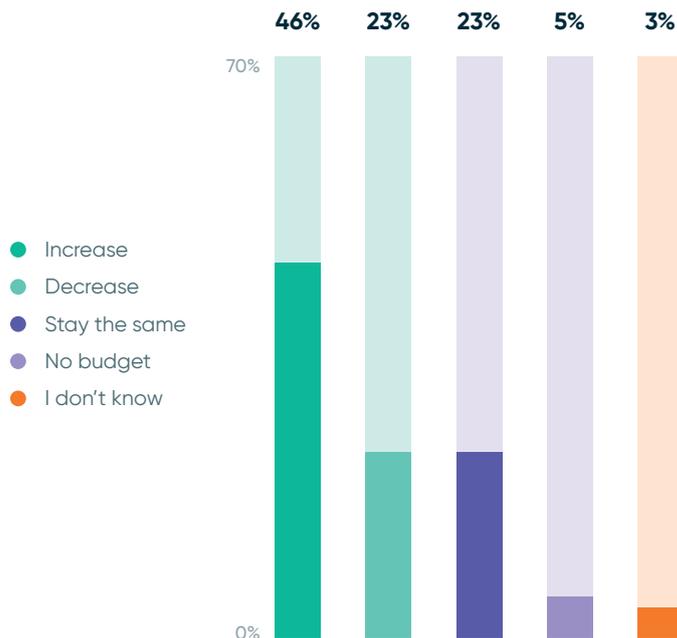
The market for low and code solutions has come a long way since we first started including this vertical in our survey back in 2021. That year, only 38% of our respondents were using low/no code solutions. This year, 70% of our respondents say they are leveraging these tools, representing a considerable increase YOY (chart 19).

In the past, intelligent automation practitioners have expressed a fair amount of skepticism when it come to low code automation, and not without good reason. If improperly implemented, not only can such tools increase technical debt and process complexity, but they can also lead to vendor lock-in.

That being said, in an age where skilled programming talent is becoming increasingly hard to come by, low/

no code tools have helped fill in the gap. In addition to enabling expert software engineers and coders to build automations more efficiently, these tools have also opened the doors to non-IT professionals. Leveraging low/code tools, these "citizen developers" now build simple process automations and applications with minimal help from IT.

Going forward, we expect low code tools to become increasingly ubiquitous and we are far from alone. **Gartner** predicts that by 2025, 70% of new applications developed by enterprises will use low-code or no-code technologies, representing a significant increase from 25% in 2020. Furthermore, **Google's engineering team** predicts that, within the next three years, over half of all business applications will be built by users who do not identify as professional developers.

# Low and No Code Automation

CHART 21

## Are you currently or considering leveraging any of the following low/no code tools?

| Current partner | | Considering partnership |
|---|---|---|
| 55% | Appian | 55% |
| 36% | AppSheet | 36% |
| 37% | Bizagi | 37% |
| 33% | Catalytic | 33% |
| 39% | Creatio | 39% |
| 40% | Google App Maker | 40% |
| 38% | K2/Nintex | 38% |
| 35% | Kissflow | 35% |
| 34% | Lansa | 34% |
| 37% | Mendix | 38% |
| 40% | Microsoft Power Apps | 40% |
| 36% | Newgen | 36% |
| 42% | Oracle APEX | 42% |
| 39% | Outsystems | 39% |
| 38% | Pega Systems | 38% |
| 39% | Pipefy | 39% |
| 38% | QuickBase | 38% |
| 36% | ServiceNow | 36% |
| 35% | Zapier | 35% |
| 40% | Zoho | 40% |

Current partner axis: 60% — 0%
Considering partnership axis: 0% — 60%
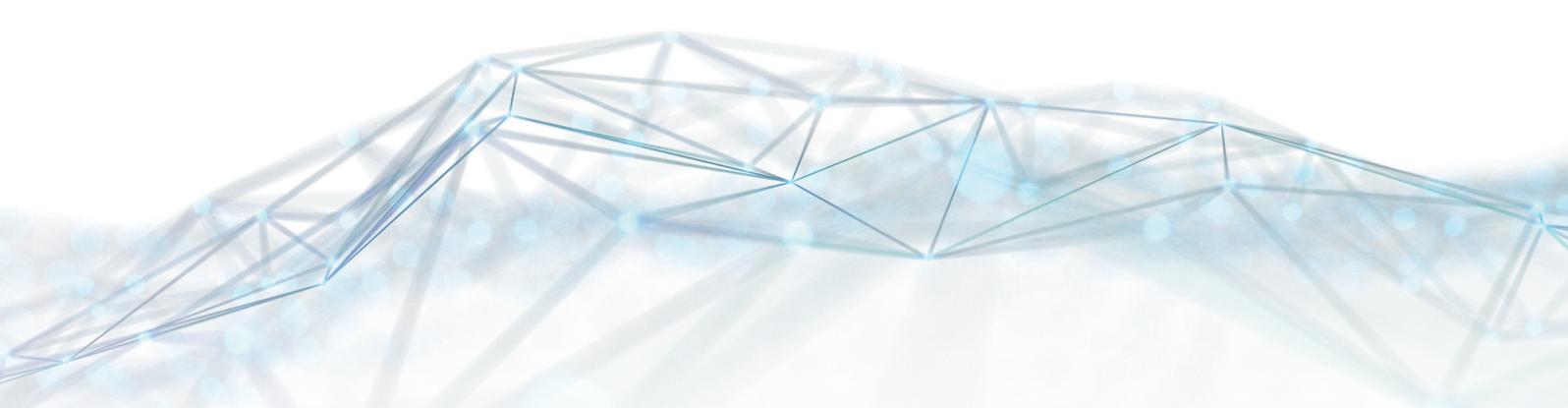
# Intelligent Document Processing

**Are you currently leveraging intelligent document processing (IDP) and automation (IDA) tools?**

- ● Currently leveraging
- ● No, but plan to implement
- ● No, no plans to implement
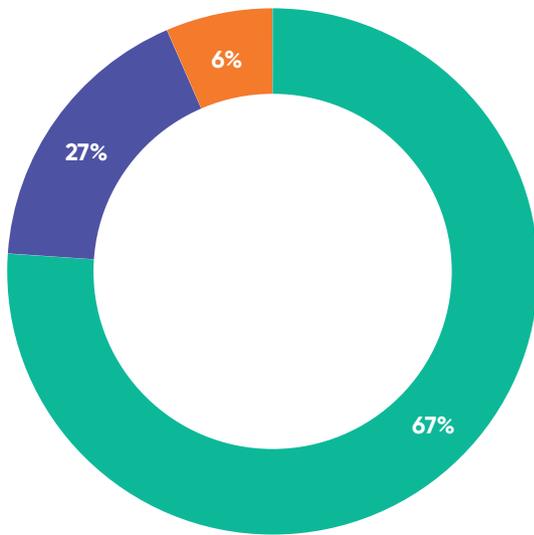
**Do you expect your final, approved budget for IDP/IDA solutions to increase over the next year?**

- ● Increase
- ● Decrease
- ● Stay the same
- ● No budget
- ● I don't know
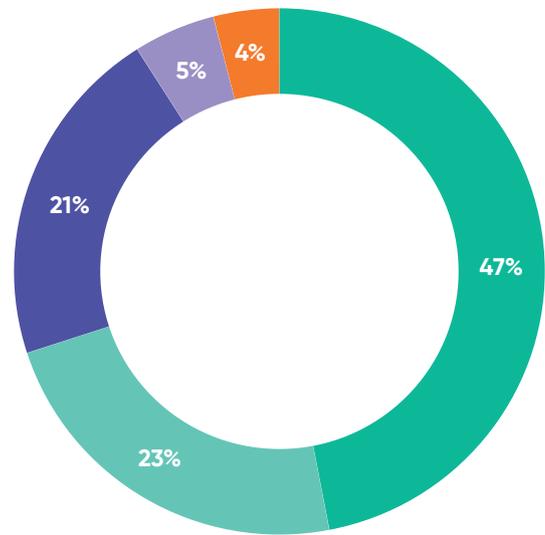


Intelligent document processing (IDP), a.k.a. intelligent document automation, has evolved considerably over the past year, both in terms of technological capabilities and market growth. By combining artificial intelligence techniques such as computer vision and natural language processing (NLP) to traditional IDP technology, organizations can now extract and transform unstructured data from a wide range of documents, not just templated forms.

While IDP solutions will likely always be found in transaction and paper heavy departments such as accounts payable, its applications are expanding. IDP can now be found in customer service departments where it is used to extract and analyze data from customer emails, chats and feedback forms. In addition, legal as well as procurement teams are increasingly leveraging IDP to optimize contract management operations.

Due to these recent technological advancements and the ever intensifying need to reduce costs in the face of economic uncertainty, the percentage of respondents currently leveraging IDP has increased from 42% in 2021 to 67% in 2022 (chart 22). Furthermore, 47% or respondents expect their budgets to increase next year compared to 37% last year (chart 23).

Going forward, we expect many IDP vendors to evolve their value proposition to include the entirety of unstructured data processing (UDP). Using more sophisticated applications of AI (i.e. computer vision, NLP, video analytics, etc), UDP solutions are able to structure unstructured data from a variety of sources, not just text-based documents, such as videos, social media posts, photographs, phone calls, etc.

# Intelligent Document Processing

## Are you currently or considering leveraging any of the following IDA, IDP and UDP solutions?

| Current partner | | Considering partnership |
|---|---|---|
| 53% | ABBYY | 20% |
| 33% | Appian | 37% |
| 38% | Automation Anywhere | 34% |
| 39% | Automation Hero | 31% |
| 37% | Blue Prism | 32% |
| 33% | Botminds | 37% |
| 37% | Canoe Intelligence | 34% |
| 33% | Conexiom | 34% |
| 34% | Datamatics | 34% |
| 35% | Edgeverve | 33% |
| 37% | Esker | 31% |
| 35% | Fujitsu | 34% |
| 39% | Hyperscience | 29% |
| 33% | Infrrd | 35% |
| 34% | Kofax | 35% |
| 37% | Newgen | 30% |
| 32% | Nintex | 35% |
| 30% | Pipefy | 37% |
| 37% | Rossum | 31% |
| 36% | ServiceNow | 33% |
| 37% | Singularity Systems | 30% |
| 34% | Super.ai | 34% |
| 35% | TCG Process | 32% |
| 34% | UiPath | 35% |
| 37% | Veritone | 29% |

55%     0%     0%     55%

# 2023 Respondent Demographics

## Respondents by Function

- Customer Service
- Data & Analytics
- Digital Transformation & Strategy
- Finance & Accounting
- HR
- IT
- Manufacturing
- Operations
- Procurement, Supply Chain & Logistics
- Product & Service Development
- Sales & Marketing
- Other

| 14% | 16% | 17% | 9% | 7% | 13% | 7% | 5% | 6% | 4% | 1% | 2% |
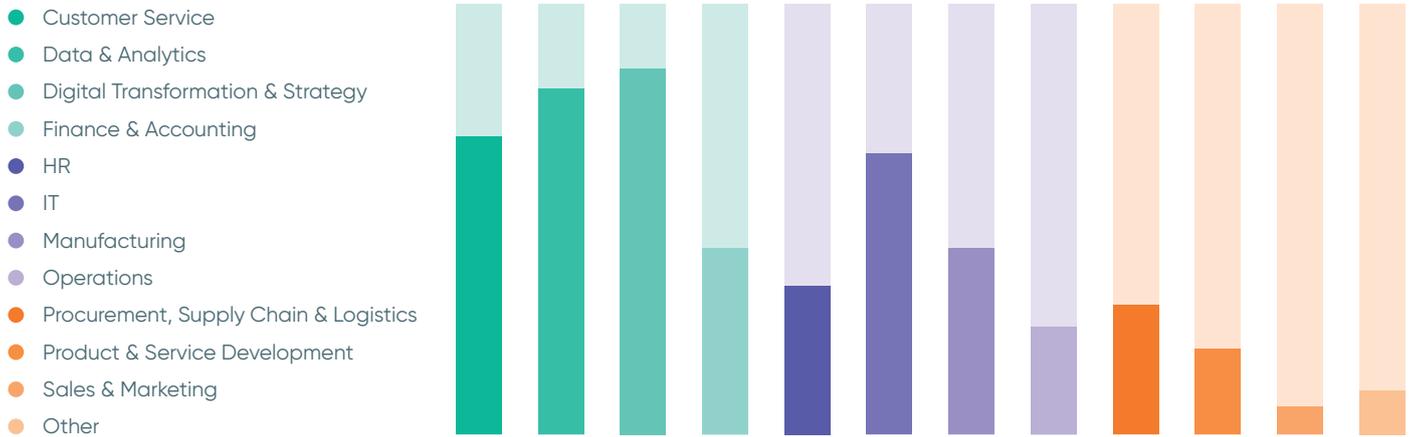
## Respondents by Industry

| Industry | % |
|---|---|
| BFSI | 4% |
| Aerospace & Defense | 10% |
| Agriculture | 6% |
| Construction & Real Estate | 15% |
| Energy & Utilities | 12% |
| Public Sector, Government & Education | 10% |
| Healthcare/Life Sciences | 6% |
| Hospitality & Food Services | 4% |
| Management Consulting or Professional Services | 6% |
| Manufacturing | 9% |
| Media & Entertainment | 3% |
| Mining | 3% |
| Retail | 3% |
| Technology | 6% |
| Telecommunications | 1% |
| Other | 1% |

0% — 20%
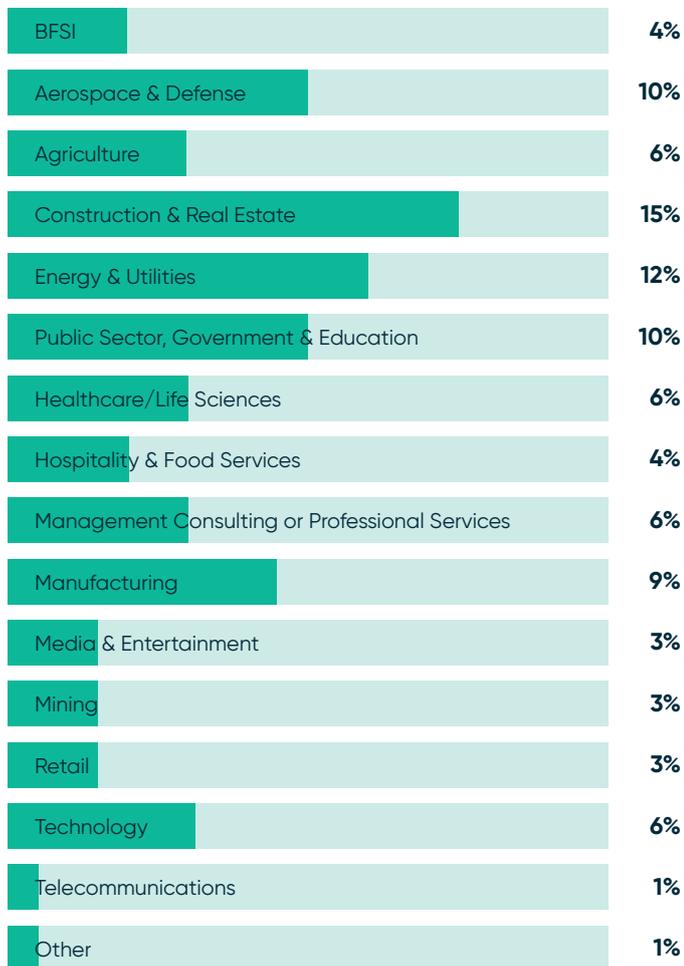
## Respondents by Seniority Level

| Seniority Level | % |
|---|---|
| Chief Executive Officer (CEO) | 6% |
| CEO/CTO/CFO | 20% |
| Department Head | 13% |
| Senior Vice President | 9% |
| Vice President | 8% |
| Assistant Vice President | 7% |
| Senior Director | 8% |
| Assistant/Associate Director | 5% |
| Senior Manager | 6% |
| Manager | 8% |
| Team Lead | 4% |
| Project Manager | 4% |
| Analyst | 2% |
| Other | 2% |
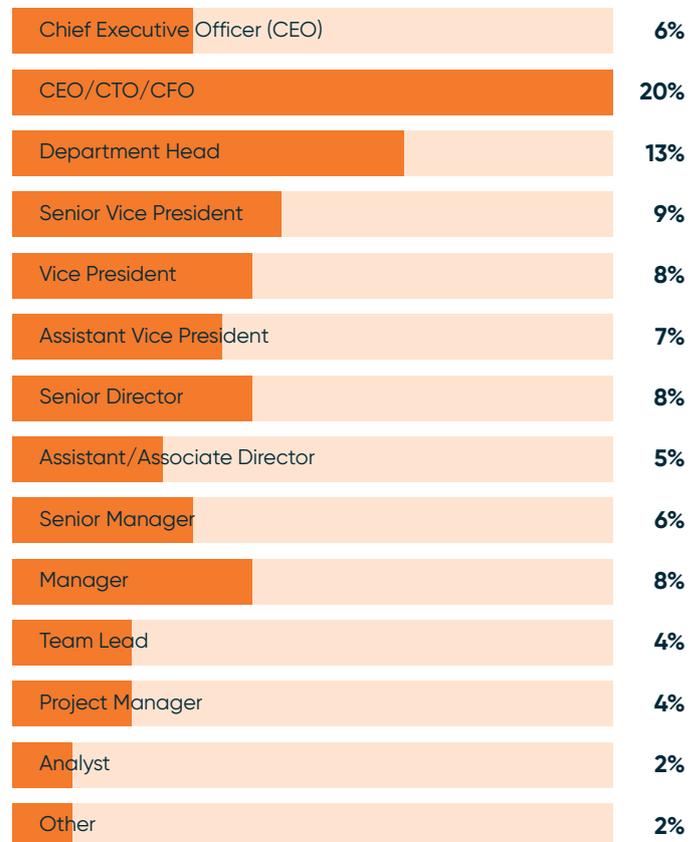
0% — 20%

# The EV Revolution
## HUGE OPPORTUNITIES FOR TECH COMPANIES TO PARTNER WITH THE AUTOMOTIVE INDUSTRY

*The emergence and growing popularity of Electric Vehicles (EVs) is generating exciting opportunities for the Eastern Cape province, which already has a well-established presence in the local vehicle manufacturing sector, as well as for technology companies looking to partner with the automotive industry.*

*By Sy Gourrah*
*ACTOM Smart Technologies*

The region has the potential to expand its manufacturing capabilities to include EVs, which could pave a promising path for the industry's transformation in line with smart technology advancements.

This could bring various benefits to the province such as increased employment opportunities, new technologies and could also encourage the establishment of private-public partnerships. It is also likely to advance smart technologies and solutions that would facilitate infrastructure development with drastically reduced emissions, creating a sustainable transportation sector.

The Eastern Cape province is currently the largest exporter of vehicles and due to the demand for EVs in Europe, the province is well-positioned to manufacture them on its existing production lines. The Automotive Industry Development Centre (AIDC) Eastern Cape has already been aligned to the establishment of local EV-building capabilities and the development of the required skills.

### FACTORS DRIVING ADOPTION
Increasing climate change concerns and the mandatory reduction of carbon emissions in most European countries are driving the adoption of EVs, which will mitigate air pollution and reduce the reliance on fossil fuels. However, the global automotive landscape is currently shifting not only to EVs but also to digitalisation and smart technologies, which are playing a pivotal role in the digital transformation of South Africa's manufacturing space.

As a result, the Eastern Cape needs to keep pace with emerging trends in the automotive sector, especially as the advancement in battery technology has increased the viability and performance of EVs, making them more appealing to customers. It is therefore key for South Africa's major automotive industry hub to keep up with automakers that are currently transitioning to electric mobility and moving away from internal combustion engines.

EV manufacturing is aligned with the advancement of several other smart technologies, such as battery management, performance optimisation, efficiency, and safety systems.

EVs generate a large amount of data that needs to be analysed from sensors, control units and communication modules. Additionally, smart grids and charging infrastructure, along with remote vehicle monitoring systems, would have to be integrated for the large-scale rollout of EVs.

### PARTNERSHIP OPPORTUNITIES
This is likely to create opportunities for companies to partner with the province, as well as automotive industry players for the supply of charging stations and related infrastructure across the country.

Similarly, manufacturers and assemblers of batteries that can provide battery storage in a sustainable and environmentally friendly manner will likely get the opportunity to partner with players in the automotive industry.

The transition to EVs is one of the biggest disruptors of the modern automotive industry and a driver of innovative solutions around electric mobility. One of the ways to accelerate this transition is through the expansion of the charging infrastructure network within the country, but the implementation of these projects will require the appointment of the appropriate technological partners.

Local technology companies that want to partner with the automotive industry must remain innovative with their products to meet the needs of the changing manufacturing environment.

The shift towards EVs not only provides local businesses with the perfect opportunity to partner with EV makers for the provision of services and products, it also enables them to play their part in ensuring the sustainability of the environment. **wn**

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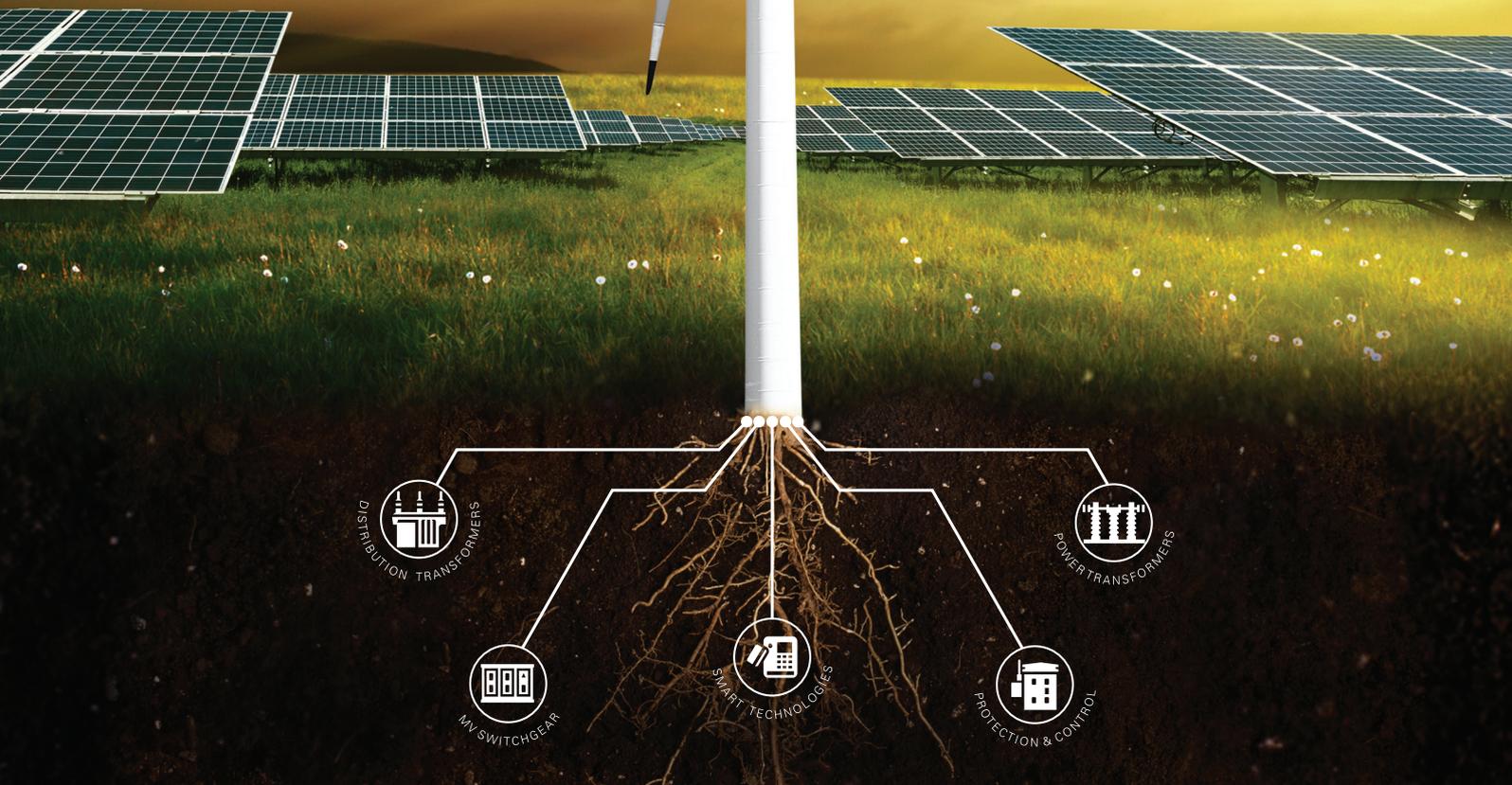
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# The Grid and its Digital Twin

*The benefits of digital twin technology have enjoyed considerable attention in the last year. Transcending multiple industries, it's well-established, and the returns are significant. However, digital twins' role in the power and grid industry is not as well-known, so it's essential to unpack its invaluable benefits and returns.*

*By Dwibin Thomas
Cluster Automation Leader at
Schneider Electric*

A digital twin is a digital representation of a physical asset or system – the bridge between the digital and the physical world. Currently, two versions are pertinent to the power and grid industry:

- Asset digital twins - at the asset level, a digital twin can model the performance of power equipment such as a transformer, generator, or protection device. These assets are designed, built, and operated in heavily digitised environments using the abovementioned technologies.
- System digital twins – it can also be used to model systems such as electrical networks, power plants, cable systems or complete substations.

## DIAGNOSTICS

As a diagnostics tool, digital twins can provide valuable insight into why a power outage occurred, determine the root cause, and build a plan that will mitigate similar future events.

Here, the power management platform – represented by the digital twin - is built on top of a model of the electrical network itself. In turn, this introduces new workflows that find the root cause faster. For example, it allows the engineer to replay an incident step-by-step, inspecting measurements on any part of the network at any time.

Those exact measurements from the real system can also be fed as inputs into the digital twin assets to determine if, for example, a breaker operated, and if not, why.

## THE DIGITAL REPRESENTATION OF THE REAL

Digital twins allow operators to run simulations before deploying it. It is, therefore, a valuable training and maintenance tool. For example, suppose an employee is scheduled to visit a substation to maintain transformers. In that case, they might have to go through a complex set of operations, such as isolating each transformer from the utility and powering the downstream feeder from another transformer.

The above can be fully simulated on the substation digital twin before the employee leaves the office. Also, when on-site, connected to the digital twin, the employee can verify the planned switching actions before executing it.

Designing new electrical networks for extensive facilities is another essential application where digital twins add value. Automation and control schemes, communication architectures, and switchgear and cabling layouts benefit from being tested and validated in a digital twin simulation before investing in costly construction and commissioning.

## A MIRROR BALL

Predictive maintenance is one of the most common uses of digital twins today. For example, a digital twin of a generator can tell you when maintenance is needed by comparing the predicted behaviour to the actual behaviour based on historical activity.

Facility energy use forecasting and validation is another common prediction application. Here, the digital twin of the facility is fed with the process, occupancy,

temperature, or other parameters. The facility's digital twin outputs the expected energy consumption over the next day, week, or season. This data can justify investments, confirm the facility is operating as expected, or validate investments made in the past.

## SUSTAINABILITY

Interestingly, one of the emerging uses of digital twin technology is designing environmentally conscious grid infrastructure. The digital twin model is essential in equipment and systems' decarbonisation as it provides valuable data at all stages of the product and project lifecycle.

During the design stage, digital twins are used to build and update a virtual model. Input simulates each project step on a single platform, such as the equipment's mechanical, electrical, thermal, and environmental properties.

Therefore, digital twins provide a risk-free way to analyse, test, and experiment with different design scenarios, processes, equipment, and operations before making any changes to the physical asset's design.

Digital twin technology has the potential to play an invaluable role in the power and grid industry, be it in daily operations or the sustainable infrastructure of the future. **wn**

# Why collaborating with a BPO partner is the secret to becoming automation-ready and futureproofing your business

*Although technologies such as artificial intelligence, business process automation and machine learning have developed at a rate faster than we could have imagined, we're not yet at a point where we can say with certainty that machines are going to replace all humans in the workplace any time soon. We are still exploring the potential for technology to supplement and augment human capabilities in the workplace to significantly increase efficiencies, reduce wastage and drastically improve safety and working conditions.*

*By Tennille Bell
Programmed Process
Outsourcing (PPO)*

A clear trend is emerging in the business world - those that embrace automation and innovation are the ones that will thrive in the future. It will be necessary for businesses to shift from manual processes to technology-driven workflows to ensure relevance and survival in an increasingly digital world. A Business Process Outsourcing (BPO) partner can play a catalytic role in helping organisations find the right combination of technology and human skills to streamline their operations, reduce costs, and enhance overall productivity, readying them for the next step in the evolution of the workplace.

## THE POWER OF ANTICIPATION: PROACTIVE BUSINESSES AVOID FALLING BEHIND

Transformation is more accessible and less disruptive when businesses are prepared for it. That's where a BPO partner can play an instrumental role in helping organisations ensure a smooth transition to emerging technologies when the time is right. By collaborating with a BPO partner, businesses can seamlessly shift from manual processes to technology-driven, human-assisted workflows, enabling them to stay ahead in an increasingly automated business landscape. The right forward-thinking BPO provider will ensure the organisation

is future-ready by streamlining existing workflows, identifying bottlenecks, and implementing solutions to increase human efficiency. Such a BPO partner will help the company shift from a reactive to a proactive mindset, which allows the business to achieve agility and adapt quickly to changing market dynamics.

## PREPARE TO INNOVATE OR CONTINUE TO STAGNATE

Contrary to popular belief, business automation does not mean that operations become fully machine-run. While automation is intended to reduce operational costs, it still requires the human touch to be effective. Businesses can spend a great deal of money on automation technology, but without the skilled labour to match machine output, efficiency goals cannot truly be achieved. Here, a BPO provider can ensure that the business reaches its efficiency targets by ensuring that workers have the skills and experience necessary to sync to the production machinery and achieve the outputs required.

## TRANSFORMATION DEMANDS EFFICIENCY FIRST

Businesses must set the foundation for excelling at their core competencies to avoid a situation where they're playing

catch up at a significant cost. A BPO provider can assist with instilling a productivity-focused approach across operations. This is essential to ensure that once processes have been optimised using technology, the human component of the business can embrace the change and match the new pace. This requires a complete mindset shift from complacency to one focused on driving efficiencies.

## EFFICIENCY DRIVES COMPETITIVENESS

Optimisation measures ensure that technology is used to increase outputs, but humans need to be quick enough to assemble, handle or package what's coming off the conveyor belts. The right BPO partner can bridge the gap between machines and humans by ensuring that specific expertise is in place to support the optimisation drive and streamline operations. By increasing efficiency with automated processes supported by the right human skills, business operations are run optimally. This results in reduced operational costs and better turnaround times, resulting in increased quality of outputs and quicker delivery of goods to customers. Once operations are running smoothly, the business has more time to focus on its core functions, which allows it to focus on creating a competitive edge.

## CHOOSING THE RIGHT BPO PARTNER

Being prepared to adapt to change means choosing a forward-thinking BPO partner who becomes invested in the business's success. Such a BPO provider must have the right skills and expertise to achieve the desired productivity outcomes.

Such a partner must provide access to specialised individuals, such as process and industrial engineers, who are essential to ensure the efficiency and effectiveness of automated processes. In making their selection, businesses must establish whether the BPO provider is financially sound, with a track record in increasing performance through a visible productivity-focused approach. Such a BPO provider must have an innovative mindset without losing focus on the importance of regulatory compliance.

## AGILITY ENSURES FUTURE RELEVANCE

Furthermore, efficiency isn't a once-off achievement. It is attained over time. The right BPO partner is focused on continuous, incremental improvement to ensure that people and processes are repeatedly refined for greater results. There is little point in increasing technology capabilities without the ability to maximise investment, and that is precisely where a BPO provider can help businesses gear up in preparation.

By streamlining operations, it becomes easier for companies to integrate with new AI-driven technology as it emerges, which ensures a smoother transition into the workplaces of the future. **wn**

# Why aren't we harnessing the power of hydro as part of a comprehensive energy mix?

*After trudging through almost two decades of the country's long term decline in power production, 2023 has seen some of the worst rolling blackouts to date. Yes, there has been positive progress in the renewable energy sector, but it's simply not enough. We should be including hydro solutions with existing solar projects to get us off the back foot and potentially ahead of the energy crisis, says Nato Oosthuizen, Partner and Renewable Energy Expert at BDO.*

The nation's growing energy demands, coupled with the urgent need to combat climate change, have thrust renewable energy sources into the spotlight. Among these, hydropower has emerged as a financially viable option in the country's renewable energy mix, holding the potential to reshape South Africa's energy landscape and foster economic growth while preserving the environment.

Hydropower, as a renewable energy source, harnesses the energy of flowing water, making it an ideal fit for a country with diverse geography. Although we are classed as a drought prone country, by tapping into rivers, dams, and other water bodies, which are often fuller in the rainy seasons, South Africa can unlock a significant portion of its renewable energy potential.

One of the primary benefits of hydropower lies in its reliability and predictability, if it is installed in the right locations. Unlike solar or wind energy, which are dependent on weather conditions, hydropower offers a stable and consistent energy output if it is built on a river or dam where the overflow of a feeding damn can drive the turbine. This characteristic is particularly crucial in South Africa, where loadshedding has been a recurring issue, impacting industries, households, and overall economic stability. Integrating hydropower into the energy mix can mitigate these challenges by providing a steady supply of electricity, reducing the risk of blackouts and ensuring a reliable power supply for both urban and rural areas.

But as a drought-prone country, is hydropower generation a feasible option?

Critics might raise concerns about the environmental impact of hydropower, especially related to dam construction and alteration of water ecosystems. While these concerns are valid, responsible planning and implementation can mitigate potential adverse effects. To fully realise the potential of hydropower in South Africa's energy mix, we must consider that when combined with solar solutions – for example using solar to pump water which is then stored in smaller dams to be used to flow through hydro turbines – there is potential for a much more economically viable option for peak power generation.

We have seen some evidence of collaboration between government bodies, private sector stakeholders, and local communities but unfortunately, red tape seems to be the bottle neck that is holding back the tide.

A case in point is the Inga 3 hydro project announced in 2013 with World Bank support, a project that was supposed to deliver 11 GW of power, primarily for export to South Africa. However, the World Bank cancelled its involvement in 2016 due to what it called "strategic differences" and since then the project has repeatedly been delayed by red tape. Although President Ramaphosa announced recently that the project is to be revived, we could still have to wait around 18 months to see any movement as new deals with new partners are discussed.

However, solutions don't always have to be on such a grand scale. In April this year, the Department of Water and Sanitation (DWS) initiated the DWS Hydropower Independent Producer Programme (DWS HIPP) in an effort to allow for the available infrastructure and water courses to be used to contribute to the power grid with renewable energy. The types of hydropower technologies that can be applied for include impoundment, river diversion or run-of-river, pumped storage and floating or kinetic turbines (small-scale generating capacity).

Unfortunately, small scale hydro projects are often cast aside in favour of solar or wind solutions that are perceived as more cost effective. However, if the DWS HIPP is successful it could open the door for smaller projects, such as mini hydro plants, that do not require a massive investment for set up to become welcome additions to a comprehensive solution to the energy crisis that takes into account all facets of the resources available to the country. In periods of drought, we can turn to solar and in periods of rainfall, hydro solutions can take the lead.

The outcome we are all looking for at the end of the day is a solution that allows us to generate as much power as possible to keep our county – and economy - running, especially during peak periods.

It is clear that the inclusion of hydro power in South Africa's renewable energy mix is a necessity to truly harness the power of renewables. Unfortunately, as we have seen in the past, necessity certainly does not always equate to action.

The country cannot pin its hopes on the revival of projects that have been in the pipeline since 2013. The severity of the energy crisis in 2023 requires a solution that isn't the topic of discussion for another 10 years, but rather one takes into account all options available.

To reiterate the President's own sentiments at the 2023 SONA address: "Extraordinary circumstances call for extraordinary measures. The energy crisis is an existential threat to our economy and social fabric. We must spare no effort, and we must allow no delay in implementing these measures." Are we really allowing no delays in implementing any measures possible to keep the lights on, Mr President? Will we truly see movement in the hydropower space? Because right now, your words don't hold much water. **wn**

# Inference Engines
## – REAL-LIFE DEPLOYMENT SCENARIOS

*In the Machine Learning space, we often go through a plethora of academic papers touting new methodologies to improve some aspects of model performance, model accuracies, methods of training, dataset augmentations, activation functions, hyperparameter optimisation, and the list goes on. Rarely do we see anything related to deployment strategies in real life for a particular use case. It is understandable from an academic research standpoint that this subject is not of the utmost importance.*

*By Angshu Pradhan*

There is more interest, accolades, and recognition in determining the best way to improve results on given benchmark datasets. Also, there is no need to deploy the new proposal into any real-life systems afterwards.

As a result of this and a not-so-mature deployment domain in ML, we are left with a wide berth to figure this part out on our own. Most research code is typically implemented in popular frameworks such as Pytorch or TensorFlow/Keras. Often, there are simple visualisations or inference codes to run the model and see results. These frameworks also provide inference-specific solutions (torchscript, torchcompile, etc.). However, implementing an engine is left to the user for their unique case. As for custom model architectures that one can build and implement, the fact again remains that we must develop our own inference pipeline. There is no plug-and-play system for models in the language, vision, and other domains. There are also some proprietary frameworks/ plugins, such as the Nvidia Deepstream SDK and TensorRT. However, the steep learning curve and the lack of excellent documentation make it extremely difficult for someone new to tackle this task. Additionally, this would vendor lock someone to Nvidia, for example, and would not accommodate other GPU types in the future.

With these things in mind, it is important to consider a holistic approach to inference engine building. Factors such as the importance of cloud connectivity vs IoT edge devices, interpreted code vs compiled, vendor locked vs hardware agnostic are some of the main things to consider. They play a big role in deciding how to build inference engines for one's particular use case.

As an example of cloud versus IoT, examining the cloud instance first, we see that if the customers are only accessing the model's output, then we have some flexibility in making decisions like compute server capabilities (more VRAM for inference available on the cloud, more scalable on demand etc.),

choices of inference framework (e.g. python vs C++) etc. This situation will be very different when deploying on an IoT device that the customers have direct access to. This may mean that source code needs to be compiled, resources are limited, the framework needs to be implemented in faster lower-level languages, internet connectivity may be scarce, so updates and monitoring must be done differently, etc. This scenario is further complicated if IoT devices vary in nature, such as having Nvidia Jetsons, Raspberry Pi 5s, and others in the mix. In this case, if we used Deepstream SDK for a vision-based pipeline, this would only support the Nvidia line of products and not the others. The inference engine can be implemented in different frameworks in this case, but maintaining the codebase and performance metrics will be a nightmare.

One approach could be looking at frameworks that do not rely on or rather abstract away the ties to the underlying hardware and low-level libraries such as CUDA, ROCm, etc. Custom inference engines can be made that take the best practices from other frameworks but allow for deployments in a various number of device types. This is a particularly beneficial approach if the team building is deeply intimate with the inner workings of the framework, the team has knowledge of GPUs in general, and the device diversity is high.

However, another approach could win in a situation where most devices are a specific type and a few are different. In this case, deploying two various engines in two supported frameworks for the respective hardware will make more sense and be much easier to develop. Thus, the scale, the device type diversity, and the types of inference domains the device must traverse are also important factors when considering engine build strategy.

Based on the recent developments in this space, it does seem that eventually, we may see one or two frameworks surface and take market share, which will allow users to build ubiquitous systems that are entirely hardware agnostic and high-performance in all types of devices with a single codebase to maintain. Until then, we must manage this type of scenario using the strategies mentioned above.

At Hercules, due to the sheer variety of deployment domains, we have inference engines that scale in all types of hardware environments. As of the day of this write-up, Nvidia still rules the ML arena, so several of our inference engines take advantage of CUDA-friendly frameworks. However, it was prudent for us to develop engines with a forward-looking mindset across the board for various types of silicon.

With the silicon arms race in full swing, it is only a matter of time before more competition enters the space and the availability of certain chips becomes an issue because of demands or other factors. As such, we had to build modular and flexible hardware agnostic engines with most types of acceleration chips/platforms in mind. **wn**

# Large Models, Small Machines – What is the impact?

*As the world of LLMs (Large Language Models) permeates our everyday news cycle and online interactions, and as household-named companies like OpenAI and Meta keep pushing the envelope with newer, bigger and better models, there seems to be a budding community where a steady and growing movement is taking place that is noteworthy. It is the community of hobbyists and professionals alike who are dedicating significant time and effort to enabling running these types of large models on self-hosted LLMs on simple household GPUs for local inference with regular PCs and MacBooks.*

**By Angshu Pradhan**

This community-driven initiative has increased in popularity in the last few months and is doing a stellar job of "democratizing" some of the language-based AI.

Some individuals in the community are single-handedly carrying the entire space with their vital contributions, making this inference possible. For example, once the LLM is released from the source, considerable effort is put into pruning the models, quantizing them, and converting the architecture into a C or similar low-level language for performant speeds for use with lower specification commodity hardware. This shared effort amongst individuals and small groups is so critical that even established companies and researchers rely on them to release updates. Online communities and forums are bustling with activity, discussing their respective repository updates almost daily with exciting and usable code. These updates include implementations of the hottest topics in LLM, from Meta's Llama 2 variants, Mistral-7b, and even frameworks such as streamingLLM, which claims to solve the significant context problem by allowing conversations to hold context up to 4 million tokens (meaning that the model would not lose context of the discussion even with extended input tokens, using something called an attention "sink").

Why is all this important? In several ways. The obvious one is the democratization of technology, an essential aspect, as previously mentioned.

While the likes of ChatGPT only allow users to interact with the model's output, and while Meta's models are free and open source, it require large GPUs, this type of work has allowed even laptop users the ability to explore, tweak, and modify and overall gain a much comprehensive background on LLMs without having to have a datacentre at your disposal. The models come with pre-trained weights that took weeks/months and millions of dollars in GPU time to train. This starting point lets the average user assess and finetune various models and their capabilities. It further allows them to build applications and modify the architectures to improve accuracy and realize performance gains. This type of accessibility to the models acts as a very effective feedback loop on the research work, as many users who may or may not be in the academic stream can help evaluate and improve the models, unlike before, where just a small group of researchers could do so. It is analogous to having a mature open-source software community as opposed to proprietary software that requires a dedicated team, and the fact that this team may not be able to improve at the same rate as the open-source software would.

At Hercules, the very day ChatGPT was released, we immediately knew that the need for local inference on LLMs would be in demand in any given industry. Whether for privacy reasons, custom model architecture development, or any other reason people want local inference, companies demand self-hosted LLMs to perform tasks within their organizations. From audits, KPI Generation, documentation, or simply helping with research in different departments, LLMs finetuned locally for an organization will significantly improve efficiencies in their day-to-day processes. As such, we took great interest in this community in its inception stages and learned valuable lessons, having tried the techniques and methods.

Additionally, with Meta releasing models like Llama 2 and perhaps Llama 3 in the future, we can leapfrog our efforts in this field by building atop the pre-trained weights without spending millions of dollars of GPU time on training from scratch for all use cases. This means we could productize the end-user features and offer turnkey LLM solutions in various domains.

Without the early lessons from the open-source movement of miniaturizing LLMs, this endeavour would be much more involved. Even from an inference perspective, deciding on the best engines and methods alone takes significant effort and resources. It is always essential to have an ear to the ground on grassroots movements in tech and not only focus on the big-ticket items. Sometimes, the more significant lessons are where we must look deeper. **wn**

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## Our Purpose

To enhance the practice of electrical engineering in South Africa and the stature of our members through knowledge, networking, influence, education and communication.

## Contact Us

SAIEE House, 18A Gill Street, Observatory, JHB

011 487 3003

www.saiee.org.za

## MEMBERSHIP FEES EFFECTIVE 1 DECEMBER 2023

The Council meeting held on 1 September 2023 approved subscription & entrance fees as from 01 December 2023 as per schedule indicated below.

**PLEASE NOTE:  In terms of Bylaw 3.2 annual subscriptions are due on 1st December 2023**

**MEMBERSHIP FEES CAN BE PAID IN MONTHLY RECURRING PAYMENTS**

Council agreed to a discount for fees paid before 31 March 2024. Members are therefore encouraged to pay promptly to minimize increase impact.

| Grade of Membership | Annual Subscriptions paid before 31 March 2024 | | Annual Subscriptions paid after 31 March 2024 | | New Members FEES * see Notes 1 & 4 below. | |
|---|---|---|---|---|---|---|
| | RSA incl VAT (R) | Outside RSA excl VAT (R) | RSA incl VAT (R) | Outside RSA excl VAT ( R ) | RSA incl VAT (R) | Outside RSA excl VAT (R) |
| Student | 173 | 150 | 208 | 180 | 208 | 180 |
| After 6 yrs study | 1 800 | 1 565 | 2 160 | 1 878 | 2 160 | 1 878 |
| Associate | 1 800 | 1 565 | 2 160 | 1 878 | 2 160 | 1 878 |
| Member | 1 989 | 1 730 | 2 387 | 2 076 | 2 387 | 2 076 |
| after 6 years | 2 325 | 2 021 | 2 789 | 2 426 | 2 789 | 2 426 |
| after 10 years | 2 433 | 2 116 | 2 919 | 2 539 | 2 919 | 2 539 |
| Senior Member | 2 433 | 2 116 | 2 919 | 2 539 | 2 919 | 2 539 |
| after 6yrs/age 40 | 2 637 | 2 293 | 3 164 | 2 751 | 3 164 | 2 751 |
| Fellow | 2 637 | 2 293 | 3 164 | 2 751 | 3 164 | 2 751 |
| Retired Member (By-law B3.7.1) | 1 118 | 972 | 1 342 | 1 167 | n/a | n/a |
| Retired Member (By-law B3.7.3) | nil | nil | nil | nil | n/a | n/a |

1. The fee for all new applications is R3337.00 which includes an entrance fee of R950.00. On election to the applicable grade of membership the new member's account will be adjusted accordingly and refunds/additional payment made on request.  Entrance fee for Students is free and new Student applicants require payment of R208.00.

2. Transfer fee to a higher grade is free for all grades of membership.

3. Members are encouraged to transfer to a higher grade when they qualify. It will be noted that the fees of Member and Senior Member grades after 10 and 6 years respectively are equal to the fees of the next higher grade.

4. Members elected after May 2024 pay a reduced subscription fee.

5. By-law B3.7.1 reads "Where a member in the age group of 55 to 70 years has retired from substantive employment in the engineering profession,  such member may make written application to Council for recognition as a retired person and a reduced membership fee".

6. By-law B3.7.3 reads "any member complying with the conditions of B3.7.1 but who has been a member of the Institute for not less than 25 consecutive years, shall be exempt from the payment of further subscriptions." Members who comply with the requirements of By-Law B3.7.3 may make written application to Council for exemption from paying subscriptions".

7. By-law B3.9 reads "any member in good standing who has been a member for fifty (50) consecutive years shall be exempt from the payment of further subscriptions."

8. Members not in good standing by failing to pay their subscriptions by end of June of each year will, subject to Council decree, be struck-off the SAIEE membership role.

9. Members in good standing and no longer in substantive employment and do not receive payment or salary for work done may apply to Council for a reduction in their annual subscriptions.

10. The members monthly magazine ("wattnow") is available on line and members who require a hard copy may acquire same on request and for a nominal fee subject to minimum uptake numbers.

11. Members who wish to pay their membership fees in recurring payments should activate the payments on their banking portal. Members will receive the early bird discount only if their fees are fully paid by 31 March 2024.

# 2023 SAIEE MEMBER BENEFITS

| STUDENT MEMBER | ASSOCIATE MEMBER | MEMBER | SENIOR MEMBER | FELLOW |
|---|---|---|---|---|
| Jobs portal for WIL | Jobs portal access | Jobs portal access | Jobs portal access | Jobs portal access |
| Mentorship | Mentorship | Mentorship | Services Directory | Services Directory |
| Exclusive Networking Events | Exclusive Networking Events | Exclusive Networking Events | Mentorship | Mentorship |
| CPD training discounts | CPD training discounts | CPD training discounts | Exclusive Networking Events | Exclusive Networking Events |
| Charge Reward Programme earnings | Charge Reward Programme earnings | Charge Reward Programme earnings | CPD training discounts | CPD training discounts |
| Bursary programme | Bursary programme | Long standing member gifts | Charge Reward Programme earnings | Charge Reward Programme earnings |
| Publication access (**watt**now & ARJ) | Publication access (**watt**now & ARJ) | Bursary programme | Long standing member gifts | Long standing member gifts |
| Site visits | Site visits | Publication access (**watt**now & ARJ) | Bursary programme | Bursary programme |
| SAIEE Centres | SAIEE Centres | Site visits | Publication access (**watt**now & ARJ) | Publication access (**watt**now & ARJ) |
|  |  | SAIEE Centres | Site visits | Site visits |
|  |  |  | SAIEE Centres | SAIEE Centres |
|  |  |  | Eligibility for nomination as Center Chair | Eligibility for nomination as Center Chair |
|  |  |  |  | Eligibility for nomination as an Office Bearer |

## MEMBERSHIP UPGRADE DISCOUNT STRUCTURE

| LENGTH OF MEMBERSHIP | DISCOUNT UPON UPGRADE |
|---|---|
| 10 - 19 years | 5% |
| 20 -39 years | 10% |
| 40+ years | 15% |

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### Western Cape Centre
**Chairman** | Heinrich Rudman
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# SAIEE CALENDAR

## NOVEMBER 2023

| 07/11/2023 | Fundamentals of Financial Evaluation for Projects |
|---|---|
| 07/11/2023 | SAIEE Railway Chapter \| Online Monthly Meeting |
| 07/11/2023 | SAIEE Power & Energy Section presents: The Transition to Renewables - lessons from Australia |
| 08/11/2023 | Earthing And Lightning Protection |
| 14/11/2023 | Anatomy of Wind Turbines |
| 14/11/2023 | SAIEE Energy Storage Chapter presents: Overview of the Energy Storage Consortium |
| 22/11/2023 | ACTOM presents: Save the Transformers - a success story |
| 23/22/2023 | SAIEE Western Cape Centre presents: An Investigation of the Integration of Distributed Energy Resources in an Adaptive Energy Market-Based AGC System to Improve Grid Stability in the Southern African Power Pool (SAPP) |
| 27/11/2023 | Gaining an insight, understanding, and application of the Protection of Personal Information Act 4 of 2013 (POPIA) |
| 28/11/2023 | Introduction to 5G Communication Networks |
| 28/11/2023 | Substation Design and Equipment Selection |
| 28/11/2023 | SAIEE Lightning Chapter presents: Lightning Protection of Solar PV Systems - lessons learned |
| 29/11/2023 | SAIEE Eastern Cape Centre ST-Talk: Lightning Protection of Solar PV Systems |
| 30/11/2023 | SAIEE KZN Gala Awards dinner |

## DECEMBER 2023

| 05/12/2023 | Operating Regulations For HV/MV Systems - ORHV |
|---|---|
| 05/12/2023 | Photovoltaic Solar Systems |
| 06/12/2023 | Design Thinking and Innovation for Engineering Professional |
| 12/12/2023 | Incident Investigation and Management (Root Cause Analysis) |
| 13/12/2023 | SAIEE Eastern Cape Centre presents: Strategic Marketing for Electrical Engineers |

## JANUARY 2024

| 24/02/2024 | SAUPEC 2024 |
|---|---|

■ Section & Chapter, Centre Events    ■ SAIEE Academy Online Training    ■ SAIEE Academy Classroom Training

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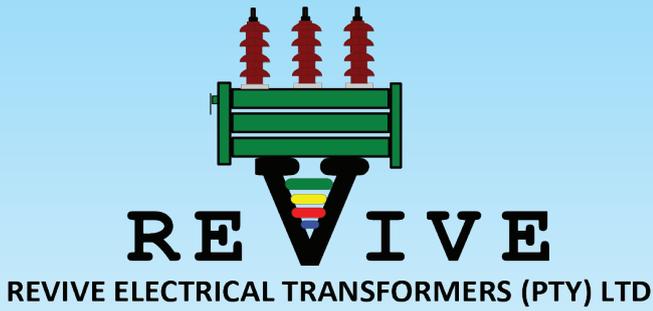
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