Focus on: Water Engineering

Civilution Congress:
Prof Mike Muller on meeting SA’s water needs

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FROM THE CEO’S DESK

I DEDICATE THIS ARTICLE to Sam Amod Pr Eng and Peter Kleynhans Pr Eng, who in the past three weeks, while working on a sensitive project of national importance, impressed upon me the meaning of Civil Engineer.

I have had the pleasant experience of meeting the late Eric Hall – former City Engineer of Johannesburg, Honorary Fellow of SAICE, recipient of SAICE’s prestigious Gold Medal, and SAICE President in 1973. A famous story of Eric Hall’s is, when asked what he would have been had he not been a civil engineer, he responded, “... ashamed of myself!”

In my mind’s eye, I have a vision of what civil engineering professionals and civil engineering should be for the 21st century. It emanates from a combination of things, wrapped in roots of history and heritage, sprouting in new, aspirational legacy – perhaps a new definition of our profession. And since Civilization is an introspective conversion, where we abandon pessimism and distrust, and then regenerate ourselves to become a creative and intelligent part of the solution again, I venture:

“Civil Engineering is the art of directing and collaborating with the great sources of power in nature for the use and convenience of human society and for the sustainability and protection of our natural heritage.”

This because I have always been of the conviction that a civil engineering professional is in the redemption strategy to restore fairness, order and balance in and between nature and society; that the sweet burden of a civil engineer is that of being servant of the people, and custodian of the natural environment and collaborator with its processes.

There is evidence that civil engineering has been around for more than 9 000 years. But the word “engineer” was first used around the 17th century in Italy and France. Engineers were actually military engineers working for the armed forces of a sovereign monarchy – building roads, bridges and weaponry for the advancement of the militia.

In times of peace, however, the king would instruct his engineers to return from the battle frontiers and use their skill to construct infrastructure to benefit his constituencies. Until this time they were still referred to as “military engineers”, but doing civil work. With the notion of developing civil infrastructure like roads, bridges and buildings for civil society and enhancing civil-isation, the name “civil engineer” surfaced as an independent profession for the first time in England in the 18th century.

These men were respected as skilled intellectuals and philosophers who dined at the king’s table and had access to the signet of the highest authority of the land. Throughout this history, the role of the civil engineering professional was to provide the king with honest and impartial advice. Serving king, country and society – I truly cannot imagine a more rewarding, honourable and gratifying profession than to be a civil engineer serving my government and my people.

I am concerned, however, that modern civil engineering is suffering from an identity crisis. We have, in my opinion, detracted from our purpose and calling, and rejected the manual that governs our existence.

In his book Captain in the Cauldron, John Smit tells how, in the first week of his Springbok captancy, the team shrunk got the Bok players to sit down in a circle around a Springbok jersey. Each player was asked to share what the jersey meant – what it had done for them in the past, and what it could do for them in the future. After Smit and another player articulated their beliefs and aspirations, it was Os Durandt’s turn – that legend of a loosehead prop. The giant “… grabbed the jersey, bent his head and then remained quiet for some time. Nobody knew what was going on, and then we realised that the colossal man was crying. Os, the epitome of Springbok rugby, was overcome with emotion. We were profoundly moved.”

If I had to gather the civil engineering professionals into a circle and lay civil engineering out on a carpet, spread out like a Springbok jersey, and ask what civil engineering meant to you – I wonder how you would inspire me.

Ain’t about the ch-ch-ching ch-ch-ching
Ain’t about the bl-bling-bl-bling ...
We need to take it back in time,
When music made us all unite!
And it wasn’t low blows and video hoers,
Am I the only one getting tired?
(Lyrics from Price Tag by Jessie J, 2011)
ON THE COVER

Afrisam is supplying the cement for the rehabilitation of the N1 section from Sydenham to Glen Lyon near Bloemfontein. The project, done on behalf of SANRAL, is a showcase of innovative design characteristics and outstanding labour-intensive workmanship. The other key players are Raubex Construction, Roadmac Surfacing and WorleyParsons.

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ON THE COVER

Spreading quality on
SANRAL road overhaul

INTRODUCTION
The South African National Roads Agency SOC Limited (SANRAL) is known for demanding only the best from the country’s road-building fraternity.

This is exactly the case with the rehabilitation of the N1 section from Sydenham (km 28.8) to Glen Lyon (km 62.4) near Bloemfontein in the Free State. When completed in May 2017, this road will have a life of up to 20 years, mirroring innovative design characteristics and outstanding workmanship.

Johan Acron, project manager at Raubex Construction, Africa’s largest road builder, says the high-level design specifications for this road makes it one of South Africa’s many flagship projects in terms of road rehabilitation works.

Designed by consulting engineering firm, WorleyParsons, the road is made up of 350 mm G4-stabilised subbase, 120 mm bitumen-treated base (BTB) course and 20 mm ultra-thin friction course (UTFC).

TEAM APPROACH
Joining Raubex on the project is Roadmac Surfacing, which is tasked with the BTB and the surfacing components, while Raubex handles the subbase.

Raubex arrived on site in late February 2015 to commence with the R538 million project. The project includes the rehabilitation of bridges and culverts (which together are valued at about R2 million), as well as a host of ancillary works.

By mid-March 2016, the contractor was making steady progress on the project, being 22 days ahead of schedule, with about 68.8% of the subbase completed on the just more than 67 km long works package.

Acron attributes the stellar performance of the contractor to the proactive approach taken by the client, consulting engineer and various subcontractors. However, he also gives credit to the outstanding performance of the participants in the very critical supply chain of this project, including AfriSam and Raubex’s sister companies, Tosas and Petra Quarry. Tosas and Petra Quarry are both part of Raumix, the materials division of the Raubex Group.
He says the project has been divided into 16 sections, each about four kilometres in length. Work starts with the measurement of the natural ground levels, followed by the milling of 50 mm of the base of the existing pavement. This milled material is being used to produce the 20% of recycled asphalt used in the BTB that is being batched by Much Asphalt as part of SANRAL’s ongoing focus on sustainable road construction.

The construction team then surveys the area and places a quality G4 material, which it imports from Petra Quarry in Bloemfontein, and pre-shapes the subbase layers before stabilising them to a depth of 350 mm with 2% CEM II cement from AfriSam.

An interesting aspect of the spreading on this road construction programme is that it is being done by hand, as opposed to using mechanical methods. This labour-based approach is helping the contractor adhere to SANRAL’s strict protocols of ensuring that all its road works create numerous jobs during construction. Shortly after the project peaked, 227 people were working on site.

AFRISAM WELL POSITIONED

A significant competitive edge for AfriSam in the Free State is that it has a depot in Bloemfontein, which receives cement directly by rail from its Ulco clinkering and grinding operation in the Northern Cape. The depot is strategically situated a mere five kilometres from the construction site. This is one of the reasons why AfriSam’s cement features so prominently on all of Raubex’s recent road-building projects in the province. As AfriSam’s Stefan Roos notes, should an emergency arise, the company guarantees that it will have cement on site within an hour.

This project alone will consume 20,000 tons of the company’s Roadstab 32.5N CEM II B-L cement.

Apart from the high quality of AfriSam’s cement, Acron is most impressed by the company’s strict delivery schedule, which helps Raubex keep to its tight construction programme, of which the subbase work is a critical component.

After both Raubex and AfriSam had drafted and agreed on an optimal delivery schedule, weekly contact has been maintained between both companies to ensure an uninterrupted supply of cement. Two loads of cement, each comprising 1,440 bags, are delivered to the site every day, with the first loads arriving at 04:00 in the morning.

Small, medium and micro enterprises are then tasked with offloading the cement from the trucks and spreading the cement manually before stabilisation starts.

LABOUR-INTENSIVE OPERATION

While Acron is very familiar with both mechanical and labour-based spreading, he is impressed by the accuracy and optimal productivity levels achieved by the subcontractors using manual techniques, and he believes this can be attributed to the team of professionals’ proactive approach to managing the project.

Once recycling is completed on the various sections, Raubex primes the subbase with the invert bitumen emulsion that it sources from Tosas. When the surface has dried, Roadmac Surfacing applies two layers of BTB, each 60 mm thick, whereafter the company places the 20 mm thick layer of UTFC.

Acron says there were few challenges on this aspect of the project, describing it as a straightforward, heavy-road rehabilita-
tion project to which the contractor has become accustomed over the years. “Raubex always strives to produce the best possible riding quality, enabling it to hand a high-quality product back to its client and the public.”

USE OF GEOTEXTILES

However, there is a section of the works that is keeping the entire construction team on their toes.

Special geotextiles – geogrid and glassgrid supplied by Fibertex Geotextiles – have to be placed on a portion of the northern section of the road to counter the anticipated ground movements due to the high clay content.

Acron says this process requires skill, is highly time- and labour-intensive, and needs to be managed carefully to ensure that work progresses according to schedule. He explains that Raubex removes the existing base course by milling and stockpiling the surplus material. Then a selected gravel layer, comprising 95% G6 material compacted to a thickness of 150 mm, is hauled from a local borrow area and compacted as prescribed. Geogrid is then placed on the selected gravel layer for soil stabilisation and covered with a neat 50 mm layer of G4 material obtained from Petra Quarry in Bloemfontein. This operation necessitates skill when end-tipping to ensure that there is no damage to the geotextile product.

The entire layer is saturated with water and compacted using a 12 ton smooth drum roller to ensure a rideable area for the delivery of the required 250 mm commercially obtained G4 material. The neat, unstabilised 30 mm G4 layer is then compacted to 97% modified AASHTO density. This compacted layer is left to dry for approximately seven days, after which the final level is cut and secured. The layer is then primed at 0.7 litres per square metre.

Approximately three days are allowed for the prime to dry, after which time SS60, supplied by TOSAS, is applied at 1 litre per square metre as an adhesive for the glassgrid, which is then rolled open over the entire subbase area. This is a very labour-intensive operation and requires diligence from all parties involved to ensure a quality product.

CONCLUSION

This is yet another project that Raubex will be able to add to its impressive portfolio of successful road construction contracts. Furthermore, it is proving to be an excellent learning experience for Raubex’s young and enterprising team of pad-makers. Their capabilities and creativity point to the ongoing success and future of this powerhouse in the African road construction industry.

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What can engineers do to ensure that South Africa meets its 21st century water needs?

WATER SECURITY
What do we mean by water security? Internationally the key words defining water security are reliable, available and acceptable quantities and quality of water necessary for health, livelihoods, ecosystems and production. We also have to make sure that the way we provide water comes at an acceptable level of risk. These risks include flooding and droughts. In addition we have to worry about risks to the environment and to the economy. This then is the mandate of those who are involved in water provision and management. Engineers necessarily have a very important role to play here.

In this challenge of trying to ensure water security for the whole country, and in fact throughout the whole region, what is it that the engineers can do?

COMMUNICATION
Water is a very important political issue. Quite often, though, we find it hard to get to talking to the people who make political decisions. I still maintain that one of the important roles for engineers is to engage with the politicians, who are, in the end, responsible for making decisions that affect water security. And we should use the media as a channel of communication to engage with them. We also have to engage directly with the communities concerned, whether these are large mining companies or poor people in rural Limpopo, to try and understand what their water issues are. In doing so, we must use what we don't talk about as often as we should – our professional values, our training, our technical knowledge – to try and help people to understand what is necessary and what is right, and to encourage them to do it at the right time.

Procurement discussions are also very important to ensure that things are done efficiently, effectively, sustainably

At the second Civilution Congress, held on 9 and 10 May 2016 at the Gallagher Convention Centre in Midrand, leaders from across the engineering spectrum engaged in thought-provoking discussions in line with the congress theme of accountability, which included matters such as ethics and delivering value for money. We will be sharing some of these presentations with our readers over the next few editions of Civil Engineering, commencing with a lightly edited version of Prof Mike Muller’s address. (Prof Muller was Director-General of the Department of Water Affairs and Forestry from 1997 to 2005 and, while serving on the National Planning Commission, was part of the team who prepared the National Development Plan 2030.)
and ethically. If not done ethically, the other three concepts are easily forgotten.

**WATER LEAKS AND WATER LOSSES**
To put matters into perspective for municipal managers it sometimes helps to talk about water leaks and water losses in terms of, for example, how many Mercedes cars you could buy every year if the leaks were just fixed. Fixing only ten leaks a year is worth about R350 000, so you could get a C200 Merc for not much more than fixing around ten of these leaks per year!

When we look at the challenges of reliable water supply in municipalities and reliable household supply, some recent figures from Stats SA are important. In 2008 the proportion of households nationally who paid for water was about 30%. Currently 55% of households felt confident enough to tell the interviewer that they don’t pay for water.

In the same survey 25% of people responded that frequently their water supply is off for more than two days. In many communities it’s two weeks or two months.

We must try and make sure that everyone has water security, i.e. available, reliable, safe water. This is being undermined because some municipalities are trying to provide very high levels of supply for free. The trouble is that people who are not paying for water often use too much. The consequence is that many people who once had a reliable water supply (that 25% of households mentioned earlier, more than 10 million people) no longer have water security. Reliability has gone down and if we do not do something urgently and take serious action we are going to find that the situation continues to worsen. It is a serious issue that we need to consider and it is a major challenge for municipal water services.

I recently saw a taxi full of young trainee plumbers, and I was very pleased to note that it displayed all the slogans about saving water, etc, and that we’re putting young people to work. However, I wonder whether the Department of Water and Sanitation has thought about who’s going to employ and supervise the 15 000 youngsters who are being trained to fix leaks and encourage water conservation. We need to have professionals in charge in municipal water supply who can deal with these things. Those professionals will sometimes say that we cannot afford to build and put in such high levels of services, because we just will not be able to afford to manage the systems, i.e. the systems will break down because we’ve put in more services than we’re able to manage. This has been a recurring theme throughout the Civiliation Congress so far – how do we persuade the political level to put qualified people in charge of technical services, and what local government regulations could help? Current new procurement regulations will help, but until we put professionals in charge, we can look forward to a continuing decline in water availability and water security in many of our poor communities. We shouldn’t have to.

**WATER SUPPLY**
To provide an available, reliable supply of water in each household, we have to make sure that there are water resources somewhere to feed the municipal systems.

I recently visited the Sterkfontein Dam and saw that, although the dam has water, it is about 10% down on what it should be. The Sterkfontein Dam – South Africa’s third largest dam by volume – is Gauteng’s strategic reserve. This is what we put there to make sure that if there is a really bad drought we still have water.

So it was discouraging to find that in November/December 2015, 10% of our strategic reserve was released downstream. It is not clear why it was released, but should we experience another year of drought, that 10% is two months’ lost emergency supply for Rand Water. We have effectively taken away two months of our reserve for no particular reason. Although the Minister of Water and Sanitation promised at the time that this was going to be replaced quite rapidly, five/six months later no pumping has been done. This is water that does not come from its own river, but is pumped up from KwaZulu-Natal. Pump-storage is an excellent scheme which pumps water up the hill when Eskom has some spare power so that we can have a strategic reserve of water in Gauteng when we need it. Over the summer Eskom did have spare power, but the water has not been restored yet. We have had utter silence from the Department on what they’re doing and why they’re doing it. It is not even clear if the Department knows by how much they have reduced the water security of Gauteng. This is the kind of question which I believe engineers should be raising, because if we are not aware of it, then no one is. I have
been trying to raise the issue in various media circles, and I encourage all of you to ask why we are reducing Gauteng’s water security at a time when we are not yet sure that the drought is over.

I wish this was the only example of these kinds of issues, but we can talk about Lesotho and the Katse Phase II Lesotho Highlands Water Project. It is six years late – it should have been ready by 2018. The design of the dam and tunnel has not even been started yet. This is our water security. This is what we should be worrying about, what we should all be talking about and jumping up and down and banging on the table about. What are we doing to put the entire economy of Gauteng at risk like this? Gauteng represents 40% to 50% of South Africa’s economy, so why are we allowing this to happen?

Five months ago Cabinet approved that the tenders could be issued. They still have not been issued. On this project a six months’ delay costs about R500 million. So we have already spent R500 million that we did not need to spend. More importantly, we are reducing our water security. What is the reason for this delay? Lesotho is ready and waiting for the South African go-ahead. Why is this procurement process taking so long? What has happened to Mama Action, as Minister Mokonyane used to be known? We need to ask these questions. What we do not want is a repeat of what happened in Phase 1A with corruption on the Lesotho side. We certainly do not want to find that what is holding up this project is a question of who’s going to benefit from it. Gauteng needs to benefit from it, because that way the whole country benefits.

These are the kinds of questions which I believe engineers should be talking about and raising publically, because if we don’t, we mustn’t be surprised if no one else does.

**ACID MINE DRAINAGE**

I do not want to be all doom and gloom, because some things are actually working quite well. You may not believe it, but acid mine drainage (AMD) is an area in which we are doing quite well. What I find interesting in the AMD discussion is how, because of the involvement of engineers, we have largely managed to capture a sensible process and do sensible things.

We are all worried about this water that is going to come out of the ground and how we are going to have to pump it, treat it and look after it, yet very few people are asking how that water gets into the ground in the first place. What is interesting is that, in quite a few cases, the water goes into the ground because it is allowed to flow in somewhere else. There have even been cases where water is pumped out, flows downstream and then goes back down underground – in reality it is just being pumped round and around, gathering pollution as it goes.

There is a pleasant nature conservation area on the East Rand with a pretty little lake, at the bottom of which is a sinkhole. The water from the lake goes down the sinkhole and is then pumped out as acid mine drainage. However, because engineers were involved, someone raised the intelligent possibility that instead of running straight into pumping and treating all the water that is coming out, why don’t they stop some of the water going into that system, reducing the amount needed to be pumped, thereby reducing costs and pollution.

We now have ingress control firmly on the agenda, which will save money. It only happened because there was a properly engineered scoping process to deal with this question, rather than rushing into pumping and treating because someone was going to make money out of it. Engineers were needed here so that everyone could stand back and think about what the problem was and not just throw money at it.

Engineers and SAICE members are already engaging successfully in many of these difficult problems – doing the right thing at the right time quite efficiently. We have plenty of opportunities to do more in the future.

**DESALINATION**

There is talk about desalination, but here is a real case where we have to make sure we do the right thing in the right way at the right time. Only after proper planning and announcement of how desalination is going to help us to meet our water security needs, can we consider it.

There are three reasons why people build desalination plants:

- Panic. For six years Australians listened to environmentalists who said no more dams or water infrastructure were needed, and that by conserving water there would be enough. Then there were six years of drought. Towards about year 4.5 they began to panic and they threw billions of Australian dollars into building lots of desalination plants. Apart from Perth and South Australia, most of those plants are now sitting idle. They should and could have built physical infrastructure, additional dams and surface water systems, but they panicked and built the wrong thing.
We talk about acid mine drainage as a major pollution problem. We waste huge amounts of time talking about the pollution that might come from fracking if we ever do a test hole. We look at the pollution problems related to fracking, and even the pollution problems related to acid mine drainage on the old gold mines of the reef. We look at what is being done on the Mpumalanga Highveld, and we think about what is going to happen when the owners of these mines walk away, go bankrupt or forget to deposit the money in the environmental accounts, or use it for something else, as has been happening already in Grootvlei. We then have to ask ourselves whether we are in fact concentrating on the right water quality problems.

**WATER QUALITY**

Acid mine drainage and desalination remind us that water quality is going to be the growing challenge in South Africa. Quantity is already tough, but when you pollute water you have less available to use, or you need to spend more using it.

We talk about acid mine drainage as a major pollution problem. We waste huge amounts of time talking about the pollution that might come from fracking if we ever do a test hole. We look at the pollution problems related to fracking, and even the pollution problems related to acid mine drainage on the old gold mines of the reef. We look at what is being done on the Mpumalanga Highveld, and we think about what is going to happen when the owners of these mines walk away, go bankrupt or forget to deposit the money in the environmental accounts, or use it for something else, as has been happening already in Grootvlei. We then have to ask ourselves whether we are in fact concentrating on the right water quality problems.

**Personal monetary gains.** These are very big contracts with ample opportunities for corruption. During the drought in Nelson Mandela Bay, instead of finishing the pipeline which would have brought Orange River water (which was available) down to the city, the city supported its politicians who were promoting a desalination plant. They tried to get National Treasury to pay for it, but National Treasury declined – why pay for desalination when you have Orange River water? That desalination project was promoted for personal accumulation; it didn’t have any sense behind it.

**The logical thing to do.** The real reason to promote desalination is where an analysis shows that it is the right and logical fit in the system. It is interesting to see that Cape Town and eThekwini are both now seriously considering using desalination as part of their supply mix. They are doing their analyses to determine whether desalination is indeed the most efficient way to meet their water needs. The challenge for the engineers involved is not only going to be getting the energy inputs right, but also dealing with environmentalists’ concerns about the amount of energy needed. It becomes very difficult to get a sensible decision out of public debate unless that debate is well informed – that is the job of the engineers.

**THE ADMINISTRATION OF WATER**

Government, and the Department of Water and Sanitation in particular, are under huge pressure to take quick decisions and to allocate water speedily – licences must be issued within 90 days of application. That is very worrying, as...
wrong decisions can be made if there is pressure to do things so fast. This could result in the Department issuing ‘dry licences’, i.e. licences to abstract water where the supplies are already fully utilised.

There is no point in issuing dry licences for a commodity as important as water. Are officials encouraged to occasionally say no in instances where there is not enough water?

It is not just water abstraction that requires licences. Mines, for example, require licences for water quality. Coal miners who want to open a mine often demand a water use licence within 90 days, but fail to fully explain how they will ensure running the mine for 20 years, how they plan to close it down, rehabilitate it, and treat any remaining wastewater so that it will not have an impact on the environment.

Are we actually asking reasonable questions and putting reasonable demands on government? Is the Department being allowed to set realistic conditions for water use licences or is there just pressure to issue dry licences and not to bother about what the content is of water quality licences or discharge licences? These are the kind of issues we need to be able to explain.

We also have to say to the Department that it was supposed to have initiated the process of water allocation reforms, so that if there is not enough water in an area, an analysis should be done so that water can be allocated differently. The law provides for that, but we are not seeing those processes happening. I do, however, have a lot of sympathy for the Department, because those are complicated processes.

We must not think that we are alone in trying to do difficult things through water allocation reform, but if we do not start we will never get there. That is another of the areas in which we engineers, because we have the technical understanding and knowledge, need to get involved and need to help people understand what the challenges are.

CONCLUSION
We have many challenges as engineers, and experience much pressures from society. The National Planning Commission calls for the engagement of engineers to achieve the National Development Goals by 2030.

But how do we as engineers engage?

We need to recognise that engineers have jobs, bosses and clients, and this fact often prevents them from freely voicing their concerns. How then can we as a profession engage effectively, but also safely?

Here I would suggest that the professional institutions – the South African Institution of Civil Engineering (SAICE), the Water Institute of Southern Africa (WISA), the South African Academy of Engineering (SAAE) and the Engineering Council of South Africa (ECSA) – all have a role to play in creating a climate and safe spaces (such as the Civilution Congress) where professionals can come together and deliberate on the existing problems and their solutions.

In conclusion, we also need to make sure that we have competent professionals in government. The National Planning Commission was very clear that we are not going to have a developmental state unless we have a capable state. I want to take that one step further – we will not have a capable state unless we have sufficient professionals in the right places in government who can help us take these decisions. It will not be easy, but it is necessary and I hope you will take part in it.
Accountability, the theme for this year’s Civilution Congress, is a good one, as it allows us to:
■ point fingers
■ do introspection, and
■ deal with the real issues affecting us as young graduate engineers and upcoming professionals.

The most important real issue that I would like to bring to your attention concerns engineering skills.

Some time ago a few of my young colleagues and I were talking about the fact that very often we work till late at night with the aim of educating ourselves, because it is not easy to find mentors who have enough time to show us the ropes. The only way for us to gain a better understanding of what we are doing seems to be to put in extra time.

We find it quite depressing then to constantly hear on TV news and in the media in general that engineering skills are in short supply, and that engineering is on our country’s critical skills list, while we as young qualified engineers (employed and unemployed) are so desperately trying to hone the very skills that our country needs.

It makes matters even worse when groups of engineers with foreign nationalities are sought to carry out major projects when there are many South Africans who are eligible to carry out these jobs. In addition, these projects offer many opportunities for us young engineers to be mentored.

The term skills shortage not only paints an unnecessarily bleak picture, but it is also a little insulting to us who are suitably qualified and who are working our hearts out to acquire the necessary post-graduate skills.

In our view the problem is more of a skills transfer issue than a skills shortage one.

In our quest to bridge the gap between ourselves and the industry veterans from whom we so desperately need to learn, we as young engineers have created forums such as SAICE’s Young Members Panel and CESA’s Young Professionals Forum to serve as platforms from where to voice our concerns. Data collected by these young engineers’ forums confirms to what extent the lack of adequate skills transfer has become a stumbling block on young engineers’ road to professional registration.

Mentorship and one-on-one skills transfer are processes that candidate engineers expect and look forward to in the work environment, and rightly so. Mentorship and skills transfer in the workplace helps employers to obtain the detailed information and knowledge they need to eventually move individuals into key positions.

When we as young engineers gain skills through mentoring, we feel developed, competent and confident to carry out engineering projects. And this makes us happy. The happier people are, the easier it is to retain them in the company for a longer period, and the easier it also becomes to develop skills transfer systems that actually work. This approach in turn impacts positively on the success of the company.

Yet, so many companies and managers still do not invest enough time in this issue. They leave it to the HR personnel to sort out, but unfortunately HR staff often only have theoretical understanding of the importance of skills transfer. The result is that young engineers start wondering whether they would not have been better off had they followed a different career. There are many emerging (non-engineering) industries which present significant opportunities for young engineers, and they might very well jump ship.

If there is indeed an engineering skills shortage in our country, it’s a little baby compared to the mother-problem of skills transfer. Without proper skills transfer to all young engineers, the National Development Plan and its objectives will never materialise, the South African engineering legacy will not be sustainable, and our door will open even wider to more groups of engineers with foreign nationalities.

To those managers who are supporting the philosophy and energy of Civilution, we salute and thank you – you have indeed taken the right step in the right direction, and hence we know we can trust on you to mentor us.

To those young professionals who are moving into key positions, I strongly urge you to pay attention to this issue of skills transfer, as I believe it is at the root of our country’s skills shortage problem.

In her capacity as current chairperson of the SAICE Young Members Panel, Phuti’s plea below was delivered to delegates attending the recent Civilution Congress.

Phuti Seopa
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INTRODUCTION

The electrification of urban areas in South Africa, including many informal settlements, reached its culmination during recent years. However, the electrification of rural areas still has a long way to go before most of the rural communities will be provided with a reliable and sustainable electricity supply. The national electricity grid, managed by the parastatal ESKOM, has been experiencing problems due to various reasons, particularly since 2008. The further development of rural electrification is currently on the backburner, mainly due to the shortage in the generation capacity available to ESKOM, which needs to be made available to the users already connected to the national grid. The increases in the price of electricity are starting to be felt by urban and rural communities alike. The primary electricity infrastructure (coal-fired power stations, major supply lines and distribution of electricity within urban areas) is rapidly becoming insufficient and cannot sustain a supply against the demand for electricity from the existing and future users connected to the national grid.

The potential electricity users in the rural areas of primarily the Eastern Cape and KwaZulu-Natal will have to wait until ESKOM, as the national utility, is able to increase its margin between the supply and demand generation capacities, and satisfy delayed electrification expansion development of those users already connected.

Small hydropower schemes can play a critical role in providing energy access to remote areas in South Africa as stand-alone, isolated mini grids (Van Dijk et al 2014). Internationally, small hydro is considered to be the best proven renewable energy technology, ideal for the electrification of remote communities (Loots et al 2014).

Rural electrification is the provision of long-term, reliable and satisfactory electricity service to households in remote rural communities via grid or decentralised/centralised, renewable/non-renewable energy resource. Many consider electrification as a fundamental strategy for poverty alleviation in terms of financial, energy and sustainable developments (Bagdadee 2014), and rural electrification has the potential to improve the standard of living of people in a developing country such as South Africa. However, universal access to
modern forms of energy is still far from being a reality in many parts of South Africa, due to their remoteness, sparse population and relatively low average energy demands. With 80% of the urban areas and 45% of the rural areas electrified, the emphasis of the South African electrification programme is shifting from the urban to the rural areas of South Africa. Where feasible, grid electricity will be extended as far as possible into the rural areas, but large numbers of households and communities will not be connected to the national electricity grid for the foreseeable future.

Alternative, energy technologies would need to be developed and implemented to ensure that the South African government’s objective of universal access to energy and electricity for all its citizens is achieved (Szewczuk et al 2000).

BACKGROUND
In July 2011 the South African Cabinet unveiled 12 implementation plans for immediate action by government. Action Plan 6 called for “scaling up rural development programmes, including investment in rural areas and the revitalisation of smaller towns”. Responsibility for implementing Action Plan 6 was given to the Department of Rural Development and Land Reform (DRDLR) in conjunction with the Presidency. The DRDLR took immediate action and by September 2011 had initiated a programme which focused on people living in 23 distressed municipal districts. These areas are home to almost 18 million of South Africa’s rural residents, many of whom are living in poverty (DRDLR 2013).

The Department of Science and Technology (DST) aims at piloting a range of innovative technology solutions to enhance service delivery through an initiative called the Innovation Partnership for Rural Development (IPRD) programme. The IPRD programme is an initiative of the DST aimed at value addition to the targeted 23 district municipalities in response to some of their prioritised needs (DST 2013).

The DST is the lead agency steering the IPRD initiative in close cooperation with local municipalities, the Department of Cooperative Governance and Traditional Affairs, and the Department of Rural Development and Land Reform. The DST has contracted two implementation agencies, one of which is the Water Research Commission (WRC), to showcase and test a suite of water, sanitation, micro-hydroelectric power and smart geyser technology solutions at municipal demonstration sites.

The WRC contracted the Water Division of the Civil Engineering Department at the University of Pretoria to conduct research within the IPRD Programme on building capacity for the implementation of small-scale hydropower (SSHP) development for rural electrification in South Africa.

One of the study areas within the targeted 23 district municipalities is the OR Tambo District Municipality (DM) in the Eastern Cape. For the initial identification of potential sites for SSHP generation within the OR Tambo DM, a desktop study was done. The focus of the desktop study was to preliminarily identify sites based solely on potential head and flow.

The different rivers and river sections within the OR Tambo DM were investigated to find height differences which would be suitable for SSHP generation. Height differences were verified by site investigations and physical measurements. Sites with a higher potential head difference initially gained preference over sites with higher flows, due to the increase in cost of larger equipment necessary to convey the larger flows.

The geometrical layout of the Thina Falls in the Thina River (Figure 1) within the Mhlontlo Local Municipality, as well as the relatively high perennial flows within the Thina River, offers a feasible opportunity for SSHP development. The total theoretical hydropower generation at the Thina Falls, utilising all the flow present in the river 95% of the time, and incorporating the total height difference between the upstream and downstream levels of the Thina Falls, amounts to 350 kW. This potential reaches mega-watts when higher flows are utilised within higher flow periods.

PROPOSED HYDROPOWER PLANT
The Kwa-Madiba SSHP scheme was designed as a run-of-river scheme on the Thina River, which, as mentioned above, falls within the Mhlontlo Local Municipality in the OR Tambo District Municipality of the Eastern Cape. The intake is located at the top of the Thina Falls, and the turbine room and tailrace at the bottom of the Thina Falls. The intake and the turbine room are connected by a 42 m x 355 mm diameter intake pipeline.
and a 116 m x 355 mm diameter penstock constructed through directional drilling. Table 1 summarises the technical data of the Kwa-Madiba SSHP scheme.

The infrastructure components of the Kwa-Madiba SSHP scheme are categorised into three sections, which can be summarised as follows:

- **Civil components**
  - Intake with primary screen and cleaning rack
  - 42 m x 355 mm Class 6 HDPE intake pipeline
  - 116 m x 355 mm Class 6 HDPE penstock
  - 6 m containerised turbine room
  - Tailrace

- **Electro-mechanical components**
  - IREM ECOWATT micro hydroelectric power plant type TBS 3-0.5
  - BANKI turbine horizontal axis in AISI 304 stainless steel mod.3-0.5 (Figure 2)
  - three-phase synchronous 4-pole generator-type AS60

- **Electrical components**
  - 1 140 m transmission lines
  - 1 000 m distribution lines

A similar Banki turbine was installed at Bloemwater’s Brandkop Reservoir, where 350 ℓ/s of water supplied to the Brandkop Reservoir via the Caledon–Bloemfontein pipeline are diverted through the turbine to generate 96 kW of electricity (Van Dijk et al 2015). Figure 3 shows the installation of the Banki turbine at Brandkop, while Figure 4 shows the planned layout of the Kwa-Madiba SSHP plant from intake to turbine room.

The 2011 Census showed that there are 117 households within the Kwa-Madiba rural settlement, although the actual number of households, according to observations during the site visit, were only approximately 39. The Kwa-Madiba/Thina Falls potential hydropower site will have minimal impact on the environment, due to the fact that (a) only small amounts of flow will be rerouted through the directionally-drilled penstock for hydropower generation, (b) the technology is for non-consumptive use of water, and (c) no scouring will occur due to the operation of the plant. Small amounts of flow are sufficient due to the high available head difference at the Thina Falls.

The introduction of electricity to these 39 households will impact positively on the community, particularly with the added possibility of having a pump connected to the electrical supply for pumping raw water to this community of subsistence farmers to irrigate their crops. To date four undergraduate and three postgraduate students were employed part-time on the project, and approximately thirty part-time jobs will be created by the construction of the project. In addition, two community members will be trained as full-time operators of the Kwa-Madiba SSHP plant. Figure 5 shows a few members of the Kwa-Madiba community with the investigating team at the downstream side of the Thina Falls.

The designs of the Kwa-Madiba SSHP plant have been given the green light by the funders, as well as the Local and District Municipalities, and a Water Use Licence Application (WULA) has been submitted. Upon approval of the WULA, construction of the Kwa-Madiba SSHP plant will commence.
**CHALLENGES**

Some of the major challenges which the project team will have to face include:

- Obtaining planned future electricity grid information from the electricity service providers (ESPs)
- The identification of land ownership and development rights
- The initial identification of potential sites to be developed.

Furthermore, a lack of historical flow data for several rivers within the study focus area necessitates the extensive capturing of flow data over a sufficient period of time in order to predict the power-generating potential at certain sites. Due to time and budget constraints, only rivers with sufficient historical flow data records were included in the initial desktop study. However, this approach could result in identifying and developing sites with technically and economically less potential than possible better sites which were unable to be identified due to historical data constraints.

The accessibility of potential SSHP sites within the study focus area was a challenge, not only to be able to visit identified sites and verify desktop study calculations with physical measurements, but also to find sites which would be sufficiently accessible to allow the physical construction of SSHPs.

On the financial side of matters, the continued poor performance of the South African currency, combined with a shortage of local turbine manufacturers and taxation on imported turbines (mainly from Europe), impacts negatively on project costs, resulting in a 30% increase in the envisaged cost of electro-mechanical equipment at certain sites. In addition, the long lead times for obtaining approvals, and the immense number of role-players and stakeholders involved, further complicate matters and add to the financial difficulties.

A lack of procedural and regulatory legislation pertaining specifically to small-scale hydropower causes the project to be subject to the same basic regulations as other electricity and water resource ventures, i.e. Water Use Licence Applications (WULAs). This could prolong the project completion time, as well as further increase project costs.

**OUTCOMES**

The following outcomes and results were obtained from the research on the project thus far:

- Figure 2: Banki turbine and synchronous generator (IREM)
- Figure 3: Banki turbine installation at Bloemwater’s Brandkop Reservoir
- Figure 4: Google Earth view of the Kwa-Madiba SSHP plant layout
- Figure 5: Kwa-Madiba site visit downstream of the Thina Falls
Small-scale hydropower is a feasible alternative for rural electrification.

The levelised cost of SSHP projects for low-energy generation is high compared to the levelised cost of grid-connected electricity supply. However, consideration of the infrastructure costs associated with connecting remote communities to the local or national electricity grid renders SSHP for rural electrification feasible.

Standard containerised turbine room units, similar to the design of the Kwa-Madiba SSHP plant, should be developed for certain configurations of SSHPs and rolled out for rural electrification in South Africa.

The Department of Water and Sanitation has been approached to review and amend the current applicable General Authorisation, GA1199, to include the construction of small-scale hydropower projects towards non-grid electrification in the rural areas of South Africa.

ACKNOWLEDGEMENTS
This research project was funded by the Department of Science and Technology and the Water Research Commission whose support is acknowledged with gratitude.

REFERENCES

DRDLR (Department of Rural Development and Land Reform) 2013. Priority Districts Analyses for Economic Transformation: High impact (catalytic) infrastructure intervention areas.


Small-scale hydropower is a feasible alternative for rural electrification. Although the accessibility of potential SSHP sites within the study focus area was a challenge, the introduction of electricity to these 39 households will impact positively on the community.
Nooitgedagt Water Treatment Works - Phase 2

BACKGROUND

The Nooitgedagt Water Treatment Works (WTW) is at the heart of the Nooitgedagt/Coega Water Supply Scheme that provides potable water to the Nelson Mandela Bay Metropolitan (NMBM) area (Port Elizabeth, Motherwell, Uitenhage and Despatch) and the Coega IDZ. The scheme comprises high- and low-level systems with an approximately 90 m elevation difference between the two.
The WTW is situated on the right bank of the Sundays River and is supplied with raw water from the Scheepersvlakte Balancing Dam on the left bank. This balancing dam is operated by the Sundays River Irrigation Board, which obtains water from the Orange River Development Project with Gariep Dam as the main source.

The WTW is now being extended from the present average capacity of 70 Mℓ/d to an average capacity of 160 Mℓ/d (peak 210 Mℓ/d) in two phases of 70 Mℓ/d each.

During 1993 the first phase (now known as the High Level Scheme) of the Nooitgedagt WTW was completed with a capacity of 70 Mℓ/day (peak capacity 84 Mℓ/day).

The high-level final water pump station had three 1 000 kW pumping units installed, with provision for a fourth unit. Originally the pump station had an output of some 68 Mℓ/day, with two pumps operating and one standing by. Subsequently a fourth pump was added, boosting the pumping output to some 92 Mℓ/day, with three pumps operating and one standing by. During 2008 two additional pulsator clarifiers were built, which increased the treatment capacity of the WTW to a peak of some 100 Mℓ/day. At this flow the existing six filters are operated on overload.

WATER DEMAND

The Metro’s water demand is increasing at a rate in excess of 3% per annum. To satisfy this ever increasing water demand, the National Department of Water and Sanitation initiated a study to evaluate and prioritise all available water resources to the Algoa Bay region. This study identified the Nooitgedagt Coega Low Level Scheme (NCLLS) as the next water augmentation project available to the Metro.

The NCLLS has a low-lift pump station with four 800 kW pumps at the WTW, bulkwater balancing reservoirs on the farm Olifantskop, a rising main (1.2 m diameter x 19.1 km) sized for 120 Mℓ/day to the balancing reservoirs, a gravity main (1.3 m and 1.5 m diameter x 24 km) from the reservoir to the existing Motherwell Reservoir, with an off-take line (1.0 m diameter) to the Coega IDZ boundary, up to the main future off-take point into the IDZ reticulation.

The NCLLS, which has a pumping height of 90 m less than the existing High Level Scheme, will bring about an energy saving of some 18 000 kWh/day. In financial terms this equates to approximately R1.32 million annually in electricity cost savings for the NMBM once completed. This is due to low-level scheme pumps using almost 20% less power than high-level scheme pumps.

PROJECT STATUS

To date the low-level rising and gravity mains have been constructed and commissioned, as has a 10 Mℓ reservoir at Olifantskop. The scheme is currently partly in use through a temporary cross-connection between the high-level and low-level rising mains at the high-lift pump station.

Construction of Phase Two of the Nooitgedagt WTW commenced in March 2015, with completion scheduled for March 2017. Phase 2 will be followed by Phase 3 and a further 45 Mℓ reservoir at Olifantskop. Phase 2 will also provide the new low-lift pump station to complete the NCLLS to Port Elizabeth.

To date good progress has been made on the new filter block and the low-lift pump station. The filter underdrains and UV reactors have been delivered and are in storage at the NMBM facility provided specifically for the project.

The new WTW extension makes use of dual lateral filter underdrain technology and ultra violet (UV) light for better quality and increased volumes of water supply to Nelson Mandela Bay, a water-stressed area.
The filters to be constructed under Phase 3 will use the same dual-lateral system. Under this phase the original six filters will also be converted to use the dual-lateral system.

The dual-lateral underdrain system is more efficient than the older false-floor and nozzle system used in the past, allowing more water to be filtered over longer periods, with less frequent backwashing and cleaning of the filters needed. This in turn will lead to operational cost savings for the metro and ultimately for the ratepayers.

The use of UV light as part of the disinfection process is a first for the NMBM. The decision to make use of UV was based on a number of factors, including better water quality and reduced consumption of chlorine gas. Chlorine will still be used for final disinfection.

UV light is 100% effective in destroying harmful organisms such as cryptosporidium and giardia species which can cause gastrointestinal tract infections. The presence of these has not been detected in the raw water supplied to the Nooitgedagt WTW to date. Considering the distance raw water travels from the Gariep Dam to the treatment works and the increasing levels of pollution experienced in our rivers, the possibility of them being encountered in the future cannot be ruled out.

Studies are currently being conducted into the use of ultrasound in the existing pulsator clarifiers and filters as a means of controlling algae growth. Results to date are inconclusive, but studies are continuing.

Once this Phase 2 extension is completed it will supply approximately 100 Mℓ/d through the Low Level Scheme, relieving pressure on the supply from the western dams system and reducing pumping costs.

Once all phases are completed the Nooitgedagt WTW will reach its full design capacity of 160 Mℓ/day (210 Mℓ/d peak capacity), making it the largest water treatment works serving Port Elizabeth.

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**PROJECT TEAM**

**Client:** Nelson Mandela Bay Municipality  
**Lead consultant and consultant for WTW process, civil and structural work:** AfriCoast Consulting Engineers (Pty) Ltd  
**Electrical sub-consultant for WTW:** CA du Toit Consulting Engineers (Eastern Cape) (Pty) Ltd  
**Architect and quantity surveyor:** Brinkman Ndayi McCall Architects and Quantity Surveyors  
**Mechanical and electrical consultant for low-lift PS:** WorleyParsons RSA (Pty) Ltd  
**Environmental consultant:** SRK Consulting  
**Health and safety agent:** Clare Deacon & Associates  
**Civil works contractor:** Ruwacon (Pty) Ltd  
**M&E contractor for WTW:** PCISA  
**M&E contractor for low-lift PS:** Hidro-Tech Systems (Pty) Ltd  
**Project cost for Phase 2:** R127 600 308 (excluding VAT)
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River rehabilitation and management

BACKGROUND
Many of South Africa’s rivers, especially those flowing through urban areas, have been rendered unstable by ongoing – and often accelerating – development in their catchment areas. Under these conditions, careful rehabilitation and management of river systems is now vital to safeguard lives, property and public assets. In one such intervention, the City of Johannesburg (in conjunction with the implementing agent, the Johannesburg Roads Agency) has commissioned a study on the state of the city’s longest river – the Braamfontein Spruit – to establish what needs to be done to improve the natural habitat and surrounding infrastructure. SRK Consulting Africa, who has applied its river engineering expertise to such projects in several water courses over the past decade, is conducting the study. Its practice and methodology is discussed here as a contribution to enhancing knowledge and building a more sustainable society.

PROBLEMS TO ADDRESS
To reduce the risk to life and property from flooding and erosion along rivers, a broad and integrated approach must be adopted to address the degradation of the water course. This generally involves a two-pronged focus: firstly, within the river catchment, and secondly, on the river system itself.

Development in the catchment area of a river results in more roadways, buildings, parking lots and hard (concrete or brick) surfaces, and hence smaller areas of permeable ground. This in turn results in greater amounts of stormwater run-off into the river during rainstorms.

This introduces higher levels of energy into the river – levels that exceed its natural capacity – causing erosion and instability of the banks, excessive loss of soil, and the deposition of this soil at man-made structures and at bends in the river. The effect is a silting-up of the river bed, choking the river flow capacity and raising the flood level as the river morphology changes. Debris from the river banks and within the catchment then exacerbates the situation by blocking the river – mainly at river crossings – which further clogs up the water flow and creates even more siltation.

Other aggravating factors could be road crossings and drainage structures that have been under-designed, thereby unduly restricting flow. Even where these structures were designed to an appropriate specification at their time of construction, the growing instability of the river system will often render them inadequate in the face of higher flood peaks.

The steady rise of flood levels inevitably leads to the flooding of houses and other developments close to the river banks, causing substantial damage to property and even loss of life. The
flooding of river crossings like road bridges or weirs is particularly dangerous, especially in cities where high volumes of traffic raise the possibility of moving vehicles being washed off these crossings by a river in flood.

Uncontrolled changes to the run-off levels in the catchment also lead to a general environmental degradation of the river ecosystem through the loss of soil cover and vegetation. Biodiversity in rivers is also undermined when water quality levels are affected by human settlements and related development, including sewage treatment plants that are not fully functional or are poorly maintained.

Wastewater remains an issue in many parts of South Africa where the Department of Water and Sanitation’s (DWS) Green Drop certification programme has been trying to raise the standard of wastewater treatment by municipalities. Data from the DWS indicates that in only one out of three municipalities is the quality of discharged water from wastewater treatment plants of an acceptable quality.

It should be mentioned that river system instability is not limited to urban environments; in rural areas, the natural base flow of many rivers has been affected by other changes in their catchments, such as dam construction and water transfer schemes. Water quality in rural rivers is also at risk of nutrient enrichment from chemical fertilisers on farmlands, or run-off from cattle feed-lots.

**INNOVATIVE AND INTEGRATED SOLUTIONS**

To meet the challenge of intense urbanisation – which has given rise to more frequent flooding, erosion and siltation, as well as health hazards in rivers – a Best Management Practices (BMP) approach has been developed and applied in the USA, Australia and Europe. This multi-disciplinary approach governs SRK’s strategy and can be described as the application of appropriate technology to preserve the environment, enhance living standards and improve the quality of life.

The BMPs have two main focal areas of alternative technology: low impact development (LID) and sustainable urban drainage systems (SUDS). These best practices also overcome the traditional limitations of conducting town planning and stormwater
planning as two separate activities, as the new approach integrates these two areas in pursuit of the best solutions.

Re-establishing the water course’s natural environment involves integrated interventions in both the catchment area and in the river system. In conceptualising and implementing these interventions, SRK employs a ‘bio-engineering’ approach that uses alternative technologies wherever possible.

In the catchment it is vital to start reducing the flow rates of stormwater run-off and dissipate water energy through flood attenuation measures, such as ponds, dams and wetlands. Installing larger areas of permeable surfaces will enhance groundwater recharge within the catchment and will also help reduce run-off. These interventions have the effect of limiting future impacts and counteracting decades of urban development.

Working with experts in various fields, such as Prof Gerrit Basson of Stellenbosch University, SRK devises rehabilitation measures matched to its scientific studies of the problem areas. By developing a hydro-dynamic river model, current and future river instability and erosion issues can be determined while also predicting long-term changes in the river morphology. The modelling is able to assist engineers to quantify the problems and also to identify possible sustainable interventions which will reduce flood risks and public hazards, as well as potential liability claims on municipalities, and even loss of life.

These predictions guide SRK in the recommendation of solutions. Using SUDS, the interventions to stabilise rivers could range from the use of natural materials like rocks and gabions, to naturally vegetated banks and weirs designed specially to dissipate energy. Water quality can be enhanced by preserving, extending or creating urban wetland areas.

Among the innovations pursued by SRK is the application of 3-D visualisation models to the field of river rehabilitation and management. Traditionally used in architecture and visual impact assessments, 3-D visualisation can be used in this new context to assist stakeholders like municipal managers and members of the public to understand how river rehabilitation will happen, and what its end result will be.

It will therefore be an important communication and learning tool in the public engagement phase that must comprise part of the environmental permitting process.

CONCLUSION

The key to river rehabilitation is to create a foundation of sound scientific studies of, firstly, the river catchment, and secondly, the river system itself, and then to build solutions that integrate these two elements. Strategically, the response needs to incorporate bio-engineering – that is, ‘hard engineering’ on the one hand, and sustainable green technologies on the other, for best effect in terms of cost and longevity.

SRK’s past work – such as the rehabilitation study conducted recently on the Schoenmakers River project near Port Elizabeth – demonstrates the effectiveness of this approach, and it is hoped that urban and rural rivers alike will benefit from its application. As a water-scarce country, South Africa can lose no time in regaining the health of our distressed water courses.

Using SUDS, the interventions to stabilise rivers could range from the use of natural materials like rocks and gabions, to naturally vegetated banks and weirs designed specially to dissipate energy. Water quality can be enhanced by preserving, extending or creating urban wetland areas. Among the innovations pursued by SRK is the application of 3-D visualisation models to the field of river rehabilitation and management. Traditionally used in architecture and visual impact assessments, 3-D visualisation can be used in this new context to assist stakeholders like municipal managers and members of the public to understand how river rehabilitation will happen, and what its end result will be.
Modelling pore pressures in a tailings dam under construction

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INTRODUCTION
Tailings dams store large volumes of mine tailings. It is generally assumed that strength gain in tailings is due to dissipation of excess pore pressures, although column experiments have shown that this process occurs very rapidly and that, after dissipation, the tailings are still weak. It is still not entirely understood how pore pressures change during normal deposition on a tailings dam.

RESEARCH PROJECT
The aim of this study was to monitor pore water suctions in two layers of gold tailings, using tensiometers. The first layer was allowed to dry before placing the next layer on top, all the while monitoring the pore pressure behaviour in the tailings. The shear strength of the tailings was measured qualitatively throughout these drying-out tests to give an indication of how the pore suctions affected the strength of the tailings. The moisture content of the tailings was measured to monitor how quickly the tailings were drying out.

An attempt was made to determine if the length of time that the tailings was left to dry would have a significant effect on the pore pressures and the shear strength of the tailings. The experiment was therefore carried out for tailings which were not allowed to dry out completely, and for tailings that were allowed to dry out completely.

It was hypothesised that, as the tailings dried, pore water suctions would develop in the tailings. These suctions were expected to decrease when the next layer was placed, because the moisture from the wet layer would seep into the dry layer and destroy the menisci which had formed between the particles. It was also expected that the shear strength would increase as the suctions increased, because the higher suctions would hold the particles more firmly together. When the next layer was placed, the shear strength was expected to decrease along with the suctions.

It was expected that the tailings that were allowed to dry out completely would generate greater suctions than the tailings that were not allowed to dry out completely. Therefore, the completely dry tailings would also be stronger, and should have been less affected by the placement of the next layer.

Eight tensiometers were constructed for the purpose of this study (Figure 1). The tensiometers consisted of a ceramic filter element and a pressure sensor, both surrounded with an epoxy adhesive. The tensiometers measured suction directly when placed in the soil. As the soil dried, the pore water suction between the particles was transmitted through the saturated filter element allowing the tensiometers to measure the suctions directly.

The tensiometers were saturated, calibrated and then placed into two containers, each holding 150 mm thick layers of wet tailings. Three tensiometers were placed into each layer to monitor the suctions at different levels in the layer (Figure 2).

The entire experimental setup was placed under lights in the laboratory in order to speed up the drying process (Figure 3). The tensiometers were connected to a data logger which continuously recorded the results.

The shear strength was measured qualitatively using a vane shear appa-
This apparatus is normally used to measure undrained shear strength. Undrained conditions are generally not applicable in drying tailings, as unsaturated conditions soon develop. However, as the strength of the tailings increased during drying out in response to the generation of negative pore pressures, the moment resistance of the vane to rotation would increase, thereby reflecting the increase in shear strength.

Box 1 was left to dry for seven days before the next layer was placed, while Box 2 was left to dry for 14 days. In Box 1 the suctions increased as the tailings dried out. As expected, all suctions were destroyed when the new layer was placed (Figure 4). The second layer was also 150 mm thick.

The shear strength steadily increased as the tailings dried. Interestingly, the shear strength did not reduce appreciably by the placement of the second layer, and continued to rise after the tailings were placed. This result was somewhat against expectation, as it was expected that the shear strength would reduce due to the reduction of suctions when the second layer was placed.

In Box 2 the suction pressures and shear strength both increased as the tailings dried out, although there was a point where the shear strength no longer increased with suction pressure (Figure 5). This was because, as the tailings dried out, the menisci reduced so that the contact area between the pore water and the particles reduced to such an extent that, despite increased suction, the increase in suction was no longer able to increase the shear strength.

It is believed that the higher suctions generated in especially tensiometer F in Box 2 (left to dry for longer) resulted from the tensiometers eventually starting...
to dry out. Therefore, the relatively large recorded suctions were not the actual suctions in the tailings, but rather suctions due to the drying tensiometer.

The suctions were destroyed when the second layer was placed, but the shear strength continued to increase as soon as the second drying cycle commenced. The additional effective stress from the weight of the second layer, and the renewed application of suction pressures during the second drying cycle resulted in the shear strength increasing significantly as the newly placed material was allowed to dry out.

CONCLUSIONS
In this study the pore water suctions generated in tailings drying out was observed. These suctions caused the shear strength to increase. However, at a point the tailings became too dry and the suctions could no longer affect the strength of the tailings. The tailings layer reached maximum strength and then eventually became weaker as the contact area between pore water and tailings particles reduced.

The suctions were all destroyed when the next layer of tailings was placed. However, the shear strength was unaffected by this change in suction and increased instead. This was somewhat unexpected and showed that the over-consolidation from the first drying out cycle, as well as the additional effective stress from the weight of the new layer, plus the renewed application of suctions all contributed to the tailings’ strength, rather than pore pressure dissipation, as is commonly believed.

It is planned to repeat this experiment by investigating multiple layers of tailings and different rates of construction. An interesting option would be to install tensiometers into a real tailings dam and monitor pore pressures during deposition cycles.

If a broader understanding of strength gain in tailings is obtained, then tailings dams could potentially be constructed at higher rates of rise, while still maintaining safety.

This article is based on Li-Bonné Swart’s final-year research project in the Department of Civil Engineering at the University of Pretoria (carried out under the supervision of Prof SW Jacobsz). She now works for SLR Consulting where she serves on their Mine Waste Engineering team.
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Ensuring competent geomembrane installations

Fifty years or so ago, the geosynthetic installation industry was in its infancy, and people were experimenting with materials and ways to join them. Just about anybody with a roll of plastic and a welding system could line a dam or toxic waste facility. How things have changed! Innovation upon innovation occurred, and it soon became evident that the highly engineered materials and installation demands required a significant degree of experience and expertise, combined with strict quality control.

A COMMON SET OF STANDARDS
There were many who recognised the importance of creating a common set of standards for the geosynthetic installation industry. The International Association of Geosynthetic Installers (IAGI), which was established 21 years ago, was one of the first organisations to do so. It developed a programme in consultation with its members, outside experts in the containment field and government officials involved in the geomembrane industry, to establish a benchmark of business practices and professionalism for installation contractors. The Approved Installation Contractor (AIC) programme recognises geosynthetic installation companies that meet a minimum level of professionalism and business practices. Those businesses who comply with its standards are recognised as geosynthetic installation companies. Today it is a highly respected professional association representing geosynthetic material installers across the globe.
LOCAL LEGISLATION

South Africa is extremely fortunate in that its Department of Environmental Affairs continues to make a significant contribution to protecting the natural environment, particularly through its promulgation of the National Environmental Management Waste Act Regulations in August 2013. These regulations have at last put an end to the dangerous philosophy of pollution dilution and dispersion, which was advocated previously for a number of facilities that are now the source of significant pollution.

The application in the past of the Minimum Requirements, despite their application being limited to hazardous waste sites and lagoons, and the application of the more recent NEMWA Regulations, have confirmed that higher standards can reduce pollution by many orders of magnitude. The more competent the construction quality controls of the pollution containment barrier, the greater the reduction of pollution.

PROFESSIONALISM IS HERE TO STAY

A worrying trend has appeared over the past two years, however. A significant number of construction companies are undertaking barrier system installations for authorised environmental protection facilities in the water, waste and mining sectors. Some of these installations exceeded modern technology performance predictions, but sadly, some installations are so poor that the intensely engineered, carefully selected and costly geosynthetics within the specified liner systems were rendered dysfunctional.

A significant number of customers report that, despite clearly articulated quality standards, contractors are failing to provide quality workmanship. The frustration and problems that occur as a result of the poor work, result in financial stress and added complications. This is particularly true for large geosynthetic containment projects where poor installation can cause major problems. Installing a geomembrane correctly requires significant experience and expertise. This experience and expertise are found in those companies which have properly trained staff and internal quality processes that are strictly adhered to within the company.

IT’S NOT AS EASY AS IT LOOKS

On the surface, geomembrane installation appears to be relatively easy. You overlap the geomembranes and run the welding machine between the sheets. Sounds simple enough. However, there is much more to installing a containment system than just welding the liner. Unfortunately the geomembrane industry has had its share of welding technicians with some field experience who decide to purchase a geomembrane welding machine or two and start bidding on jobs.

Dr Robert Koerner, Emeritus Professor at Drexel University, has often stated that the weakest link in the installation of geomembranes is the seam. We at the IAGI would like to take that statement a step further: the seams are definitely important, but so is the installation of the appurtenances, connections to and penetrations through the geomembrane. Additionally, many containment systems consist of multiple layers, and the installers need to understand how to be site-specific when installing components such as geomembranes, geotextiles, geogrids, geosynthetic drains and geosynthetic clay liners in conjunction with other components. A professional lining contractor needs to have experience in constructing these complicated systems, fulfilling project plans and instituting substantial quality control
and quality assurance programmes. It is important that the contractor professionally manages and understands the purpose, behaviour and properties of what are often the most carefully selected geosynthetics for a project, while also ensuring that his personnel are properly trained to use extrusion welding and wedge welding equipment and the necessary quality control procedures for the site.

Installation of geomembranes can be adversely influenced by changing weather, soil conditions, diurnal temperature variations and, most importantly, subsequent activities over the installed membrane. An experienced contractor will have quality assurance programmes and controls in place to ensure that the welders are producing seams and applying installation processes that do not leak, despite any challenges they may encounter on site. Skilled welding technicians know how to deploy and adjust the machines to produce a seam or install an appurtenance that will meet the quality requirements for both the company and any regulating body overseeing the job. The testing for a quality installation requires that the contractor invest in the field testing equipment to make sure the work is done correctly. Furthermore, the contractor should provide quality assurance documentation to the owner of the project upon completion.

In the civil engineering market, the contractor will typically be subjected to a standard of quality that is outlined in the plans and specifications for the project. It often happens, though, that an unskilled contractor gets the job because his/her bid for the project was the lowest. Customers are frequently desirous of obtaining the best installation for the least amount of money, only to discover that cheaper is not always better.

WHEN THINGS GO WRONG

There are many instances of an inexperienced contractor finding that he does not have the financial resources to overcome project delays and the kinds of problems that occur on many job sites.

In one instance in the United States (but this kind of problem is not limited to the USA), a reputable contractor lost a bid on a large job to an unknown company by approximately USD10 000. The company that got the job failed to install the system correctly and did not perform the necessary quality assurance procedures. Unfortunately for the owner, the finished project leaked and could not meet the regulatory requirements under the government issued permit. Ultimately it cost the owner USD1.8 million to fix the containment system.

Recently, a liner system consisting of 20 000 m² 2.0 mm HDPE, 1 000 g/m² geotextile with a stone drainage layer on top was found – by means of Dipole Electric Leak Detection (ELD) – to have a cut of 1.5 m long in the membrane, 23 penetrations and many deep scratches, mainly as a result of inexperienced application procedures and workmanship. Excluding the scratches, this equates to one hole per 833 m². The liner was installed by a non-IAGI member.

Compare this to a 130 000 m² (footprint) capped double-composite liner with a drainage layer in-between where three areas of damage were found (Dipole ELD), with all three being
Some of the things that inexperienced contractors have in common are that they do not have sufficient skilled staff, skilled supervision or appropriate site QC knowledge to complete a job in a timely and efficient manner, all of which will increase the costs for the owner and other contractors on the job – costs they may not have budgeted for.

CHOOSING THE RIGHT CONTRACTOR

How does an engineer or owner know whether the company they are considering for a job has the needed resources? There are several ways of doing this. They could begin by conducting a review of the company to determine its track record, experience, personnel training, financial resources and necessary quality control and quality assurance programmes. Another option is to find out whether the installer is a participant in an industry-sponsored verification programme.

The Approved Installation Contractor (AIC) programme sponsored by the IAGI is an example of such a programme. AIC contractors must meet requirements in the following areas: corporate history and business practices, insurance verification, safety training ISO accreditation, and professional competence and experience. Significant work is involved in AIC verification, but the benefits to the owners, engineers and specifiers who use AIC companies on their jobs are enormous. AIC gives the user community a tool to select experienced professionals for their geosynthetic installations. Engineers and owners can require installation companies to have achieved current AIC status by including it in the project specifications.

A portion of the AIC requirement is that the company must employ certified welding technicians. The CWT programme tests welding technicians on their skill in welding geomembranes by wedge and extrusion. The candidates must take a written exam and conduct physical welds of various geomembranes and different thicknesses. The welds are tested at a third party lab to determine whether they pass or not, so it is a rigorous test. Between 20% and 25% of all welders who take the exam fail.

WHY PROFESSIONALISM SHOULD BE TAKEN SERIOUSLY

Ensuring that the geosynthetic installation industry provides professional, best-in-class services, guided by a common set of standards, is not just about reputation, cost-effectiveness or efficiency. At heart it is about protecting people and the environment. If we are to do our part in achieving this to the best of our ability, everyone in the industry must contribute. Perhaps a good place to begin is for owners and engineers to demand experienced geomembrane contractors, and to conduct the diligence necessary to verify that experience.

ACKNOWLEDGEMENT
We thank Aquatan (Pty) Ltd, the only AIC in Africa, for their assistance in preparing this article.
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**MARKET CONTRIBUTION**

**Water provision with off-grid technology**

**INTRODUCTION**

South Africa celebrated National Water Week in March, with the theme *Water for people – Water by people; Water has no substitute*. In the spirit of this theme a South African company has developed a technique that provides a reliable water source by implementing a localised water treatment and supply system.

Prentec (Pty) Ltd are the developers of the Aquastation technology, an off-grid system that provides water to rural communities and eco-tourist lodges which are far from reliable sources of water and power.

Adrian Viljoen, Prentec’s Process Director and developer of the Aquastation technology, explains the background to their project at Boekenhoutshoek, where a much needed supply of water has been provided to the community. “The requirements at the outset of the project were to augment the bulk water supply to the community with underground water so that they have access to water at all times. Prentec partnered with Active Power to deliver an Aquastation-based system to this community, and the project was funded through the Municipal Infrastructure Grant.”

Boekenhoutshoek is a small village situated in the Mpumalanga Province. It falls under the Thembisile Hani Local Municipality (north of Emalahleni/ Witbank and to the west of the Loskop Dam), which is located in the Nkangala District Municipality. The project serves almost 2 000 dwellings under the Free Basic Water Level of 6 000 litres per household per month.

Prentec’s Project Manager, Ryan Stewart, further explains the technology used for this project: “Four solar-powered Aquastations, with integrated transfer pump stations, produce high-quality, safe drinking water for the community. Seven 30 000-litre sectional steel storage reservoirs are provided which, together with 14 kilometres of piping and 61 standpipes, ensure that all members of the widespread community have easy access to clean water.”
ABOUT THE AQUASTATION

The Aquastation is a self-contained water treatment system that is able to produce safe drinking water from ground or surface water sources to satisfy local requirements.

The unit uses the most modern Hydranautics PVDF ultra-filtration membranes as the main means of treatment. These have a pore size of < 0.01 microns, which effectively remove all bacteria, viruses and cysts, leaving the water aesthetically pleasing and safe to drink. The system also automatically doses 0.5 ppm of chlorine in order to preserve the water quality in the storage and distribution system.

The system is fully automated, taking care of backwashing, cleaning and chemical dosing. Key components of the control system are a Mitsubishi mini PLC and rugged VSD. DC power from the solar panels is used by a control board developed specially by LBA to supply power to the system.

The membrane is rugged and dramatically oversized to ensure trouble-free operation with minimal maintenance. The hypochlorite supply must be topped up once per month. In terms of operations and maintenance, the unit at Boekenhouthoek is linked remotely to Prentec (with the assistance of a member of the Boekenhouthoek community) to facilitate the delivery of diagnostic services and technical support.

For Harry Seshabela, the Site Agent, it has been a remarkable and exciting experience to have been involved in the design, installation and commissioning of the Aquastation. “On start-up it took less than an hour for the water to be treated from the borehole through the Aquastation to the storage reservoirs, and finally to the communal standpipe. And it was clean! Since start-up, the plant has produced clean water every day.”

PROJECT CHALLENGES

Prentec engaged with 14 local subcontractors to assist in the execution of the Boekenhouthoek project. “It was thus necessary for us to adapt our usual methodology to this environment, which meant developing support systems and contract management systems to deal efficiently with this type of scenario. Although all parties found themselves on a steep learning curve, we established a good rapport with the contractors, councillors and community liaison officers. We strongly believe this effort by all concerned contributed immeasurably to the success of the project and the ongoing acceptance of the equipment by the community,” says Stewart.

INFO

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From concept ...
... to reality

AQUASTATION DELIVERS

<table>
<thead>
<tr>
<th>Station</th>
<th>Capacity (m³/d)</th>
<th>People served*</th>
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*Free Basic Water Level
TO COUNTER VANDALISM, which robs owners of equipment worth hundreds of thousands of rands, pump stations are increasingly being built like fortresses, complete with thick reinforced concrete walls and roofs, and with small ventilation holes in the walls instead of windows or steel louvres, which are vulnerable to attack by angle grinders and oxy-acetylene torches.

Consistent with these measures, the installation of self-supporting, heavy but easy-sliding 60 MPa concrete doors – SA Patent 2008/06587 – together with extremely robust locking mechanisms, are being specified more and more by consulting engineers. The concrete is completely immune to attack by oxy-acetylene torch, and the steel reinforcing in the doors is too dense for chisels to penetrate.

Other advantages include that such ‘fortress’ pump houses do not require perimeter fencing, nor do they require 24-hour security, accumulating to a very substantial saving over the life of the pump station. The additional expense of installing a concrete sliding door will typically be recovered after the first three to four months of not having to pay for security guards. The cost of replacing vandalised or stolen equipment is in any case several times the cost of the door!

A pump house that is stripped clean takes several months to recommission. In the interim water may have to be brought to the community by tanker at great expense.

If vandalism is a concern, then ‘fortress’ pump stations equipped with concrete sliding doors are a wise investment.

INFO

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The American Society of Civil Engineers (ASCE) has a programme which declares a deserving prominent historic engineering project an International Historic Engineering Landmark. A potential such landmark has to be identified by the engineering institution of the host country, and is then subjected to rigorous examination by an ASCE panel to ascertain whether it meets certain key criteria before it can qualify for the award.

The criteria for this prestigious award are as follows:

1. The nominated project must be of national historic civil engineering significance. Size or technical complexity of design or construction is not sufficient in itself.
2. The project must represent a significant facet of civil engineering history, but does not have to be designed or constructed by a civil engineer.
3. Projects must have some special uniqueness (e.g. a first project constructed); or have made some significant contribution (e.g. the first project designed by a particular method); or utilised a unique or significant construction or engineering technique. The project itself must have contributed to the development of the nation or at least a very large region. Thus a project which did not make a contribution, did not lead to some other development, or was a technical ‘dead end’ may not be of national historic significance, although it was the ‘first’ (or only one) of its kind.
4. Projects should be generally available to the public view, although safety considerations or geographic isolation may restrict access.
5. Nominated projects should be at least 50 years old from substantial completion at the time an ASCE plaque presentation is desired.

In 2008 SAICE applied successfully for the Woodhead Dam on Table Mountain to receive the award. Prior to this the bridge at the Victoria Falls had been the only project in sub-Saharan Africa to be so recognised. With an impending visit to South Africa by the ASCE President, SAICE’s History and Heritage Panel felt it was time for another application, and after some tense debate it was agreed that the lighthouse at Cape Agulhas would best fit the criteria.

In the application the following unique features of the Agulhas lighthouse were emphasised:

1. Built in 1848, it is the first properly designed and engineered lighthouse in southern Africa, and possibly in the southern hemisphere.
2. Construction was the result of a campaign lasting some forty years for the funding of proper measures for safety on the South African coast. The eventual success of the campaign was largely due to the efforts of Colonel Charles Michell, Surveyor-General and Civil Engineer to the Cape Colony.
3. The authority to build this lighthouse was a breakthrough in the policy of the British Government which up till then had denied that it was its responsibility to fund lighthouses. It had steadfastly maintained that lighthouses should be funded by the local community or by the ship owners. This change in policy was influenced by the intense campaign by South
African interests to improve the appalling record of shipwrecks around the tip of Africa. The policy change led to the construction of over thirty more lights on the South African coast and an unknown number in other parts of the British Empire.

4. It was the last major work of Colonel Michell, who travelled to England and France to study lighthouse design and current practice. The lantern and lens which he specified were the most modern technology available at the time. Michell is regarded as the father of civil engineering in South Africa and the lighthouse is regarded as the most prominent memorial to him in South Africa today.

5. At the time of construction, access to the remote area was difficult, and materials and personnel were brought in by sea. The project was nevertheless completed in just over six months, and within budget.

6. The safety of shipping around the tip of Africa was undoubtedly improved by this light, confidence in coastal trade improved and the passage to India and the Far East became less hazardous.

7. The lighthouse was threatened with demolition in the 1970s, but was saved by the efforts of a group of concerned local residents. It is still in operation, although the equipment has been modernised.

After a furious exchange of e-mails and further information being gathered, developed and despatched within 24 hours, the ASCE committee announced on 7 March 2016 that the project had been accepted. The challenge to find a competent maker for the plaque, and to arrange suitable celebratory functions in the short time available before the arrival of the ASCE delegation was almost as complicated as the construction of the lighthouse itself!

Eventually, on Thursday 12 May, a large group including officials from the Transnet Lighthouse Service, historians, senior SAICE members and media representatives, met in Cape Town to celebrate the award. ASCE President Mark Woodson made a short speech about the significance of the award and then displayed the handsome plaque to the assembly. The function was held at the Cape Peninsula University of Technology’s Hotel School in Granger Bay, where the foundations of the earlier Mouille Point Lighthouse (demolished in 1920) can still be seen on the grounds.

By Saturday 14 May the plaque had been installed in its permanent position on the base of the lighthouse itself. The building and its surroundings were in exemplary condition and the weather was playing along — it was a glorious afternoon. The ASCE delegation arrived in tow with SAICE President Dr Chris Herold, CEO Manglin Pillay and COO Steven Kaplan, guided by former Executive Director Dawie Botha (now a resident of Hermanus) after a whirlwind tour which included the spectacular Clarence Drive, the penguins at Stony Point and a convivial lunch at the southernmost winery (Strandveld Vineyards) where our guests were able to sample and appreciate the quality of the local products.

After addressing a gathering of about 40, including a number of the persons who had saved the lighthouse some 40 years earlier, genial President Mark unveiled the plaque and then climbed the tower for a first-hand inspection of the light installation and a view of the Cape itself. Afterwards all in attendance withdrew to the smart and cozy Agulhas Lodge for superb canapés and an extended resampling of the excellent Strandveld products. From every point of view the ASCE delegation had reason to feel that the Agulhas Lighthouse was well deserving of their commendation.

The events were coordinated by Tony Murray, former chair of SAICE’s History and Heritage Panel, while Keith Mackie, chair of the new SAICE Marine Division, was responsible for sourcing and specifying the plaque.
The story of the lighthouse at Agulhas

The Agulhas Lighthouse was a triumph of the Colonial Engineer in the Cape at the time, Colonel Charles Michell, to provide adequate safety facilities at the perilous southern tip of Africa.

ANCIENT BEGINNINGS

The world’s first lighthouse of any consequence was situated in Africa, but at the opposite end of the continent to the one we are celebrating. It was built on an island called Pharos at the entrance to the port of Alexandria in Egypt in 279 BC for King Ptolemy II. By any standards it was a giant – 140 metres tall on a base 33 metres square. The fire at the top could be seen over 40 km away. Quite rightly it became one of the Seven Wonders of the Ancient World. By comparison the Cape Hatteras Lighthouse on the coast of South Carolina, the tallest in the United States, is 60 metres high; the Skerryvore, pride of the British Isles, 48 metres; and the South African champion, Slangkop, a mere 33 metres.

The designer and builder, Sostratus, must have known his trade. How he lifted the huge limestone blocks into position is a matter for speculation; he then ‘cemented’ them together with molten lead. Two thousand years later the same material was used in building the second Eddystone Lighthouse. The method was obviously successful, because the structure stood for 1 500 years – the

The Cape Agulhas Lighthouse (seafacing side) - now an International Historic Engineering Landmark - was conceived and designed by Charles Michell in the old Egyptian architectural style.
tallest ever built until overtaken by the American skyscrapers in the 1930s. During its existence the fire at the top, which provided the light, must have consumed whole forests of wood. It was destroyed by an earthquake in AD 1302.

According to legend the engineer engraved his name on the finished structure as Sostratus of Gnidon, but realising that his patron would not be pleased with this presumptuousness, he covered it over with lime plaster and wrote in it the name of Ptolemy. In due course, however, the king died and the plaster weathered away to reveal the permanent inscription.

The lighthouse was unique for another reason. It was not built to warn mariners of hazards. Rather, on the featureless coast of Egypt, Ptolemy wanted a beacon to show the position of his new city, and to attract traders to spend their money and buy goods brought overland from the east. It was the world’s first major advertising sign.

At the other end of Africa, however, the coast is rugged, treacherous and subject to violent storms. From the time that the first Europeans rounded the Cape of Good Hope there was an ever-growing list of shipping casualties. But the authorities were indifferent, to the point of callousness, about providing guides and warning lights for the benefit of mariners. Such lights as were around the British Isles were privately owned; the aristocrats who ran the British Government shrugged off shipwrecks as being due to bad seamanship. Besides, there was a very lucrative industry in ‘salvaging’ wrecks, many of which had been deliberately lured to their fate by callous ‘wreckers’. 

The science of lighthouse building showed little development for some 2 000 years. Then in 1759 John Smeaton, the first person to call himself a ‘civil’ engineer, built the third Eddystone Lighthouse to a properly considered design. His system of interlocking blocks...
successfully withstood the fiercest storms and was copied extensively for over a hundred years. Some fifty years later, French inventors produced effective lanterns and compound lenses to concentrate the light. By 1850 Sir James Chance perfected a revolving system for the giant lenses so that the light source appeared to flash, thereby identifying the source by the pattern of the flashes.

THE CAMPAIGN TO PROVIDE LIGHTHOUSES ON THE SOUTH AFRICAN COAST

Around the Cape such navigational aids were virtually non-existent. The Dutch East India Company ignored any efforts to reduce shipping losses, and any temporary measures were undertaken at the initiative and expense of the Governor. So, while Jan van Riebeeck and his successors made sporadic attempts to assist shipping by erecting fire beacons, no effort was made to provide permanent lighthouses. The British Government, when it rather unwillingly took over a backward and cash-strapped colony, was just as apathetic. The powers-that-be had little regard for loss of life, and no appreciation of the cost to the nation of shipwrecks. In their eyes lighthouses and similar measures were not the responsibility of the public purse – such should be funded by the users, and if the navy was not active in the area, this should be the burden of the owners of merchant shipping.

One of several colourful characters who arrived at the Cape in the wake of the British takeover was Admiral Sir Jahleel Brenton, who represented the British Admiralty at the Cape between 1815 and 1824. He was an unusual occupant of flag rank in the British Navy, as he was an American by birth. He was named after an obscure Old Testament character, and appropriately he was a fierce proponent of spreading the Gospel. He also let his voice be heard about the lack of shipping facilities around the Cape coast. He was appalled at the indifference of the British Government towards the provision of lighthouses. The shipping companies and the merchants, both in the Colony and in India, joined in the chorus. Brenton estimated that the cost of losses in Table Bay during his incumbency amounted to £3 400 000. He pressed for lights in False Bay and elsewhere, but the British Government was adamant – lights used purely for local purposes had to be operated and maintained from the local purse, which, in the case of the impoverished and neglected Cape Colony, was usually empty. And so there were more wrecks and loss of life and loss of cargoes while the Government looked away. In the vicinity of Agulhas alone the Arniston was lost in 1815 and 372 souls perished, and there were several other wrecks in the next twenty years. The Cape citizens were incensed, but the cries for assistance fell on deaf ears.

Sir Rufane Donkin, who acted as Governor between 1820 and 1821, had other ideas about the value of lighthouses and pushed ahead with plans for a light at Green Point. He called for tenders without proper authority and awarded a contract for 13 400 rixdollars to Herman Schutte, a German stonemason and architect who later became Inspector of

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Government Buildings to the Colonial authorities. When the appointed Governor, Lord Charles Somerset, returned from leave he had to sort out the paper work, and there was a delay of some three years before the project could go ahead. Eventually, after Admiral Brenton had confirmed that the lighthouse would be of enormous value to merchant shipping, funds were authorised, the job was completed and the light was displayed for the first time in April 1824.

The building was both designed and built by Schutte (he was also involved in the building of the Groote Kerk and the original St Georges Cathedral in Cape Town). But Somerset was not inclined to spend further money on the upkeep of a facility which he had not authorised; within ten years the building had fallen into disrepair and the light was barely visible.

The administration of lighthouses became part of the duties of the Director of Public Works at the Cape, and when Charles Michell assumed this office in 1828 he pursued the improvement of the service with the vigour which marked all his operations. He campaigned relentlessly for permission to build new lights at Mouille Point, Agulhas, Cape Point and Cape Recife, and applied for funds for the proper maintenance and operation of the Green Point light. But Whitehall remained adamant – lighthouses were the responsibility of the mariners and the local population; no money was available for any major public works.

Michell’s understanding of the value of good infrastructure and its positive effect on the economy of the Colony were appreciated by the colonists, but nothing could be done without funds. His other passion was to improve the standard of roads. A new governor, Sir Lowry Cole, was prepared to give the go-ahead, and Michell built the superbly designed Sir Lowry’s Pass which immediately became an economic asset. But the governor had overstepped the limits of his authority and was recalled. All infrastructure construction was cancelled. Michell may have been prevented from actual construction, but he nevertheless went ahead with locating, planning and designing roads, mountain passes and lighthouses, to be implemented when finances, or the attitude of Whitehall, improved. When the super-efficient Colonial Secretary John Montagu arrived in 1844, the Colony’s fortunes took a turn for the better and Michell was gradually able to bring his schemes to fruition.

The Green Point light was restored and upgraded in 1842. Michell had also designed and built a lighthouse at Mouille Point, as the light at Green Point could not be seen by ships leaving the Table Bay anchorage. It was a strange little structure, designed, no doubt, with thrift in mind, and was replaced by a more effective tower in 1865. This in turn became redundant and was taken out of service when a light was installed at the end of the breakwater in 1908. The structure was demolished in the 1920s, but the foundation can still be seen in the grounds of the Hotel School in Granger Bay.

CAPE AGULHAS LIGHTHOUSE

Michell’s plans for a light at the southernmost point of the continent gained enthusiastic local support. The Attorney-General William Porter, various local traders, mariners, merchants as far away as Bombay, and of course the admiral at Simon’s Town all lent their voices to the campaign. In 1837 Michell visited Agulhas to seek out a suitable site, but further progress was then not possible. In 1838 he returned to England on home leave. He took with him persuasive sketches of the dreadful conditions in crossing the mountain chains, and plans for improvements. He nearly succeeded in persuading the Secretary for the Colonies to fund a new pass over the Outeniqua Mountains, but when he went on to push for a lighthouse, he was shown the door. Undeterred, he travelled to France to study the design of French lighthouses, and he met Henri le Paut who manufactured state-of-the-art equipment.

During 1839 three ships were wrecked near Cape Agulhas, but the authorities were still unimpressed. The Cape populace, however, were adamant that a light should be provided. Subscription lists were opened and the local merchants pledged £300, and their counterparts in Bombay 5 400 rupees. The wrecks piled up, agitation continued, and costs grew. In 1846 Michell estimated that the cost of lighthouses at Agulhas and Cape Recife would amount to £25 000. If this was borne entirely by the colony, it would mean that any other public works would have to be put on hold for three years. But the local Legislature felt the matter was so impor-

tant that it voted £12 000 towards the projects. Eventually, in 1847, the London administration came round to accepting that the safety of shipping was a benefit to the Empire, as well as to the Cape itself, and relented to the extent that it agreed to fund half the total cost.

There were further delays while the best site for the light was debated. Michell made several expeditions to the site — it was no doubt a formidable journey by land — and enlisted the services of Thomas Maclear, Her Majesty’s Astronomer at the Cape, to identify the most advantageous position. The Royal Navy despatched three ships to assist with the survey, and eventually a suitable site was agreed upon, and construction commenced.

It was a great day when the foundation stone was laid on 8 January 1848 in the presence of the Governor, Sir Harry Smith, and Admiral Dacres of the South Atlantic squadron. The only dignitary missing was Michell, who was beginning to show signs of his impending heart disease and could not attend, but the assembly raised three cheers for the tenacious engineer.

The competent builder and, in modern terms, project manager, was William Martin of Cape Town. His workforce of some ninety men lived on the site, and equipment and provisions were ferried from the Cape to Struis Bay. Anticipating a policy far into the future, he employed workers from the nearby Elim Mission Station and trained them to become masons. The limestone blocks for the structure were quarried from the hillside behind the site; the walls at the base are three metres thick and the task in quarrying, dressing and laying the considerable number of blocks was no mean feat. Nevertheless, construction progress was excellent and the lighthouse was completed by December of the same year, at a cost of £15 871.

The opportunity to design a lighthouse for the very tip of Africa seems to have reawakened the romantic streak in Michell. Perhaps with a nod to the famous Pharos of Alexandria at the other end of the continent, he produced a plan in the ‘Egyptian Revival’ style, consisting of a central light tower flanked by two lesser turrets linked to the centre by the keepers’ accommodation. Four large windows faced the sea, but at some time in the past these have been covered up.
Architecturally the building may be a gem, a unique example in a universe of utilitarian designs, but the keepers, who had no watchroom in which to spend their hours on duty and were required to observe uncomfortably from the lantern chamber, would no doubt have preferred a more practical layout.

Michell had made arrangements for the lighting equipment while in Europe in 1847, and had ordered a huge dioptric lens from a French maker. The assembly was 19 feet in circumference and 10 feet in height and weighed several tons – it was another major triumph to land it safely and install it in limited time.

The lamp was also of French origin, but for some years it was unique. It was fuelled, not by the usual whale oil, but by oil extracted from the fat tails of the local sheep. This product was not obtainable on a regular basis, and in time the lamp was converted to burn more conventional fuel.

The light was commissioned in 1849 and was reputed to be visible 17 km out to sea.

**THE AGULHAS LIGHTHOUSE SECOND PHASE**

The breakthrough in funding at Agulhas had repercussions around the Empire, and the authorities now appreciated the value of safety measures for shipping. Michell had located sites for lights at Cape Point, Roman Rock and Cape Recife, which were implemented by his successor George Pilkington (Michell never recovered from his illness and died in 1851). In the ensuing years, lights were gradually provided at various spots along the coast, but the pace at which this was implemented did not satisfy the mariners, merchants, lawyers or insurers, and in 1894 a Lighthouse Commission was set up by the Colonial Government. This resulted in William Tregarthen Douglass, a member of a famous family of English lighthouse builders, being appointed as Lighthouse Engineer to the Colony. In due course his protégé Harry Cooper became his local representative, and was eventually appointed Lighthouse Engineer in the South African Railways Administration.

The concerns about the siting of the Agulhas light were not unfounded. Seafarers reported that the Agulhas light was sited too low to be effective and was often obscured by sea mists, and the Commission required this to be investigated as a priority. Douglass proposed to erect a completely new installation on a steel tower alongside Michell’s 1848 lighthouse, but Cooper, on site, preferred a concrete structure, and designed a tower, 180 ft tall, which would meet the mariners’ specifications. Both proposals were abandoned on account of cost, and instead the apparatus in the existing tower was modified. In 1905 Cooper installed a new incandescent burner and followed this up by altering the lamp to consume white rose oil. In 1910 he replaced the old fixed lens with a new rotating optic. As would become the custom, the work was undertaken personally by Cooper, with the assistance of the lighthouse keepers and a handful of others. The new apparatus was installed with considerable ingenuity and human muscle power, which brought fulsome praise from the

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inspecting Civil Commissioner: “New light erected despite many surrounding difficulties, redounding to the credit of the Engineer in charge, supported by a small but efficient staff. The workmanship in this erection is a masterpiece and will serve as a lasting memento of a capable Officer and Engineer ...”

On 1 March 1949 the Cape Agulhas Lighthouse, the oldest artefact in the South African Railways and Harbours service, was 100 years old. A special ceremony was held to mark the occasion.

In 1960, long after Cooper had retired, the lighthouse tower was condemned, as it was believed that the limestone blocks from which it had been constructed were decaying. Demolition plans were opposed by the Bredasdorp Divisional Council on the grounds of the historic significance of the structure, so it was agreed that the lighthouse would be spared and the Council would take over the maintenance. A new aluminium lattice tower was erected behind the old structure to carry the lighting equipment. However after some twenty years – the lighthouse was by now a national monument – the Council found it was unable to finance the upkeep of the old building, and demolition was once again an option. After years of controversy, negotiation and another doughty campaign by concerned citizens, it was finally decided to restore and recommission the old lighthouse as a working unit. The fears of unsound material in the structure proved unfounded. A few weathered blocks of limestone were replaced and the equipment was converted for automatic operation, and in 1988 the light shone once again from Michell’s distinctive Egyptian edifice.

The keepers’ quarters have been converted into a museum. The surrounds are in the care of SANParks, which, in conjunction with the South African Heritage Agency, has been responsible for removing unsightly buildings in the vicinity and promoting the lighthouse as a tourist attraction – for a small fee visitors can climb up the tower and view the equipment. A modern light source ensures that the beacon can be seen some 31 nautical miles out to sea, but the lens is still the giant catadioptric, rotating on a bed of mercury, which was installed over 100 years ago.

Almost thirty years have passed since recommissioning, and the suspect tower is standing as firmly as it was when built over 150 years before, and is once more keeping mariners informed of the position of the southernmost point of Africa.

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Knowledge Swarms and Experiential Hives

BACKGROUND

The much vaunted South African National Development Plan (NDP) represents, without equal, the greatest opportunity for our beleaguered subcontinent’s upliftment and long-term sustainability since the 1994 democratic election in South Africa. However, it could also remain a frustratingly distant and unreachable rolling horizon, or even become an extravagantly costly nightmare if the appropriate scarce and critical skills and knowledge crisis is not addressed effectively and timeously.

The long-cherished traditional and theoretical models of teaching, learning and knowledge sharing, with an increasing focus and reliance on systems-oriented approaches to knowledge identification, gathering, capturing, packaging, sharing and transfer, have proven to be predictably ineffective and unsustainable – both locally and globally. This is true within almost every industry type and size, and it is certainly true within most engineering and construction organisations, which have the added complexity of highly mobile and remotely-situated staff who move nomadically from project to project.

The unacceptably high incidence of increasingly costly, repetitive and predictable mistakes in the general engineering, building, projects and construction sectors indicates that the traditional ways of empowering and enabling our future generations of consultants and contractors is failing us dismally.

‘Knowledge Swarms and Experiential Hives’ represent a social-cohesion supporting philosophy for sustainable nation building, which, in the engineering and construction sector specifically, could mobilise the collaborative capabilities of our nation’s vast academic, institutional and individual intellectual human capital – from the retired or recently retrenched knowledge experts,
through the layers of currently employed managers and technical personnel, to our thousands of unemployed graduates.

This article is a summary of a more extensive paper and presentation titled, “Knowledge Swarms and Experiential Hives – the critical and emergent role of the ageing knowledge experts in the engineering and construction sectors of developing nations” (1) by the same author. This presentation won the Global Knowledge Management Leadership award at the Global Knowledge Management Congress in Mumbai, India, in July 2015.

**INTRODUCTION**

The consistent hallmark of all highly developed and successful civilisations since the dawn of mankind, has always been the ability to teach, share and pass on the collective knowledge gains, academic achievements and experiential wisdom of the current generation to the next.

Indeed, in times gone by, the second most important and prominent individuals in history, next to the various emperors and royalty, were always the engineers, architects, scientists, philosophers and master craftsmen.

Mobilising the entire industry knowledge and experiential wisdom value chain, of a nation in need, towards a common goal of sustainable prosperity and growth, through ubiquitous access to effective knowledge sharing, must surely rank as one of the greatest priorities facing South Africa, and indeed Africa. This is certainly true in the engineering and construction sector (2).

Developing nations in Africa, and more specifically South Africa, have up until now been very dependent on a knowledge-rich, Baby Boomer generation of well-qualified and connected experts and expats, and their consistently dependable expert capabilities and competencies for all major infrastructural and megaprojects (3). This generation of highly experienced people valued length of service in an organisation and the concomitant attainment of increasingly specialised expertise and recognition as a revered personal attribute and much sought-after career development characteristic.

Generationally speaking, local and global experience indicates that the Gen Y graduates (born from the early ‘80s onwards) and the upcoming Gen Z, will not be motivated by long, stable careers and attainment of expert status (8). They will favour instead, globally sought-after and varied multi-skills sets and the quest for greater work-life-play balance, including instant gratification. They are more status-driven and focused on social connectivity, instead of participation in expert Communities of Practice (5) and attaining long-serving career goals.

This has already manifested itself widely in the rapid turnover of young graduates in most organisations, and the reduced number of young candidate engineers striving for and attaining professional registration status in their chosen disciplines. This has had an unfortunate and negative effect on the quality of service delivery and the insidious degradation of national infrastructure (6). This is true across all the professional disciplines.

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[Image: Reducing the Dunning-Kruger Effect]

[Image: 5C Holocratic Contribution Model]

[Image: Knowledge Swarms and Experiential Hives Model]

[Image: Example of a typical knowledge mentoring taxonomy structure]
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forces, stresses and strains involved in the calculations of equilibrium do not sympathise with historical socio-political inequities and the moral imperative.

It is widely accepted that South Africa is now more divided as a nation than it was before the 1994 democratic elections. This creates unnecessary, but highly restrictive, fear-based barriers to sustainable, spontaneous and self-volunteered knowledge sharing amongst the diverse four generation groups currently vying for significance and survival in the active workplace.

**METHODOLOGY AND APPROACH - NATION BUILDING OR NOTHING, THE NEED FOR A UNIFIED APPROACH**

Given the enormously complex, sensitive and potentially volatile nature of the challenge at hand, any solution would need to start with a significant step-change in the potentially chaotic algorithms of cultural belief systems and the drivers of societal needs, norms and values.

Government, education, academia, business, professional bodies and voluntary associations and institutions would need to co-construct a single, compelling vision, wrapped in a harmonising, socially cohesive, nation-building philosophy. This is sorely needed to underpin a more practical framework, focused on mobilising our nation’s industry knowledge and experiential wisdom value chain, and thereby unlock our collective intellectual and experiential horsepower.

One such harmonising and socially cohesive, nation building philosophy could be the **5C Holacratic Contribution Model** — a step-change process in mobilising national consensus towards un-politicised, common knowledge needs and outcomes, using effective and naturally occurring swarming constructs.

The increasing turbulence and changing nature of work is shifting so rapidly that very soon the long-serving matrix structures, and the command and control-like Baby Boomer-led and managed corporations, will have no option but to transform into highly agile, de-materialised and dis-intermediated entities, optimising ubiquitously connected, cross-functional, expert-sharing and quick-response work teams. These will operate with new rules and a survival of the swarm urgency. The ability to rapidly swarm to meet a need, and then just as effectively de-swarm as the need abates, and then again re-swarm, in different formations and configurations, energised and driven by the speed of need, is a critical attribute of knowledge swarms and experiential hives and the future of the intelligent workplace.

Swarms require an activated belief space based on a mutually inclusive drive for both self and societal enhancement (be that survival or enrichment). This underlying philosophical swarming construct, which will be so critically needed to attract full commitment and engagement by our nation’s stakeholders, is embodied in the author’s Knowledge Mentoring™ 5C Holacratic Contribution Model — what do I know, what do I need and what can I share with my colleagues, with my company, with my community ... for my country and for my continent.

As with all swarms, a quorum sensor needs to manifest, which silently and without explicit rules, dictates the collective knowing, direction, speed and urgency of the swarm. It is highly likely that the recent and predictably on-going challenges with our power, water and logistics utilities will act as a sufficient quorum sensor to mobilise an effective step-change in our national belief space. The highly publicised concerns across all political spectrums, are sufficient proof that this critical component of effective swarming is already in place and that a communal quest for more effective, common knowledge sharing would probably be very well accepted.

The next step in the Knowledge Swarms and Experiential Hives model, is the establishment of the multi-stakeholder model itself.

**KNOWLEDGE SWARMS AND EXPERIENTIAL HIVES MODEL**

The Knowledge Swarms and Experiential Hives model consists of multiple stakeholders, bonded by a common societal belief and driven by the speed of need to address pressing national infrastructural needs — and even the mythical National Development Plan.

Essentially, the model works as follows:

- The national urgency for major infrastructural projects (like the 18 Strategic Integrated Projects or SIPs Projects), which will cover multiple national imperatives such as power, water, logistics, science, education, health and many others, cannot continue to be put on hold for political posturing and other potentially more sinister reasons.
- The only currently effective response capability to this massive nation-building need will come from the well-established and highly capable engineering and construction sector. This will include all the players in the built environment space, such as the building and projects sectors as well. This sector unfortunately currently has a more adversarial relationship than a collaborative one with government.
- A critical success factor in the conceptual Knowledge Swarms and Experiential Hives model will be the establishment, development and maintenance of between 100 to 200 Common Knowledge Hives, which contain the most common, predictable and repetitive engineering and construction competencies and capabilities required for the major infrastructural common knowledge Asset Classes (e.g. dams, nuclear, railway, SKA, etc).
- Each Common Knowledge Hive will contain the critical knowledge assets required to safely and cost-effectively engineer, procure, construct and manage a specific common knowledge Asset Class, structured in a predictable pattern recognition model, which drives and supports optimum learning and memory formation. (More about this brain-sensitising learning and memory-enhancing technique in further articles in this series.)
- The key role players and participants in the Common Knowledge Hives are as follows:
  - The *Swarmers* who are made up of the inexperienced, or less experienced, employed and unemployed graduates across the various built environment disciplines.
  - The *Swivers* who are made up of experienced and/or professionally registered middle to senior managers and technical experts across the various sectors.
  - The *Hivers* who are made up of external experts / global experts / recently retired or retrenched local experts and other accessible and volunteering subject matter experts.
  - The *Thrivers* who are made up of the proactive newly empowered Swarmers, who are now able to start their own small Enterprise Development Initiatives and offer their services either to the existing engineering and construction employer base, or alternatively, directly to the project developers and state-owned entities themselves.
The Drivers who are made up of the complex interplay of all other involved organisations and entities, such as government, academia, business, state-owned or controlled entities, professional bodies, voluntary associations, skills development authorities, regulatory authorities, funders and donors, research institutions, occupational authorities, NGOs and PBOs, training and development organisations, and finally, the essential clients and clients’ representatives and agents.

The Sponsors and Suppliers who are made up of all the providers of capital, labour, plant and materials, and who represent a critical source of potential funding and incentivisation for the success and sustainability of the Knowledge Swarms and Experiential Hives model.

The critical roles, responsibilities and expectations of the key role players above will be dealt with in more detail in a subsequent article.

In conclusion, the underlying theoretical and proven constructs of this Knowledge Swarms and Experiential Hives model is based on both substantial research and extensive practical experience, involving the critical use, application and benefits of the following six essential elements of effective Social Network Analysis and large, distributed group Knowledge Mentoring:

1. Access to a robust and widely accessible Integrated Knowledge Mentoring Framework™ (or similar end-to-end process and proven model), with appropriately structured knowledge assets and the necessary tools, techniques and technologies to enable the optimum exchange of knowledge flows between the engaged participants.
2. The use of an application of the latest neurosciences-based learning and memory-enhancing techniques, which dramatically change the way we have historically approached teaching and learning in the engineering and construction sector – and even the journey to professional registration.
3. Instant access to Distributed Cognition and the ability to act effectively and provide a rapid response mechanism to complex and chaotic conditions – thereby providing a form of common knowledge on tap, for sparsely distributed knowledge sources and seekers in which to communicate, cooperate and collaborate effectively, for the greater common good of our nation.
4. Leveraging the profound and proven benefits of knowledge sharing and collaboration enhancing concepts such as the strength of weak ties, and how little-known experts and other, unknown but potentially willing collaborators in our own individual knowledge networks, can significantly enhance complex decision-making for the greater good. This includes the importance of developing Echo Trust dynamics amongst the collaborating participants of the Common Knowledge Hives, based on a robust and shared commitment to a societal belief space and need – the compelling vision. Effective social network engagement has reduced the historical ‘Six Degrees of Separation’ amongst knowledge seekers and willing collaborators, to no more than
two or three degrees at most. Echo Trust acts as a significant multiplier of value.

5. Establishing a Reward and Recognition-based model, whereby engineering and construction excellence is revered and self-driven, through a technology-enhanced, and sponsor-incentivised, gamification process (214) (215) of published successes and status. This then mobilises the strength of weak ties in a self-perpetuating, distributed cognition framework that is built and sustained on a national common objective of conscious societal evolution and enhancement (28).

6. The development of a socially inclusive, fully integrated socio-skills development model (27), which optimises mandatory BBBEE spend in line with national and sector-specific, scarce and critical skills and knowledge needs, thereby providing a win-win-win for nation building in every sense of the word. The above six points will be dealt with in far more detail in subsequent articles.

CONCLUSIONS AND RECOMMENDATIONS

Africa Ke Nako (Africa Rising) – oxymoron or opportunity?

A troubled and iniquitous past does not have to perpetuate a similar future.

The Knowledge Swarms and Experiential Hives model represents a realistic and pragmatic model for true nation-building on multiple levels, at a scale never seen or attempted before. We have the local skills, knowledge, expertise, relationships, technologies and national will to make it work.

This represents an opportunity for the sectoral professional bodies and voluntary associations and institutions, as well as the major consultancies and contractors, to take a leadership role, engage the multiple government and state-owned enterprise stakeholders, and drive the process forward – in the pursuit of a better future for us all.

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A troubled and iniquitous past does not have to perpetuate a similar future. The Knowledge Swarms and Experiential Hives model represents a realistic and pragmatic model for true nation-building on multiple levels, at a scale never seen or attempted before. We have the local skills, knowledge, expertise, relationships, technologies and national will to make it work.
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The concept “connectivity” implies communication, but basically comes down to the exchange of information. This, however, is not all that is required to guarantee project success. If you are sincere in achieving sustainable results, especially in the project environment, you have to engage together with your team in a programme that enhances metaphysical connectivity. By not having “interpersonal” and “emotional” on your radar screen as a business leader or project manager your project may suffer from high personnel turnover, internal competition, demotivated team members and lack of teamwork. These, inter alia manifest in cost, schedule and quality challenges.

BEHAVIOURAL FACTORS AND MEGAPROJECTS

Megaprojects (MPs) are usually uncertain, complex, and politically sensitive, and involve a large number of partners. The majority of megaprojects are plagued by cost overruns, schedule slippage and failure to deliver on expectations. As a consequence, megaprojects are characterised by conflict, uncertainty and poor cooperation between partners (Van Marrewijk et al 2008).

With most aspects of project management being more behavioural in nature than quantitative, one can assume that this is a blind spot for the engineering discipline – engineers having to be analytical, critical, logical, realistic, reliable and timely. This industry, dominated by the left brain, indulges in ambitious and complex projects that not only attract attention, but that also demand a great degree of right-brain prowess previously ignored.

There exists a viewpoint that, by populating a project team with the most revered engineers the world has to offer, success is a given. With about half of the megaprojects that are attempted worldwide regarded as a failure, the industry calls for visionary leaders bold enough to challenge ignorance regarding the vital role constructive behaviour plays in the current paradigm.

A motto that defines the industry has often been echoed in the hallways: “You get hired for your technical skills, but fired for your behavioural mistakes.” Typical behaviour-related issues that surface during an MP are:

- Insecurity
- Fear
- Threats
- Downsizing
- Incompatibility
- Conflict
- Negative attitudes
- Organisational politics
- Subcultures
- Ineffective communication.

The following trends in the project environment can no longer be ignored:
The above indicators clearly impact human resource strategies as a subset to project management. Megaprojects involve multiple competencies, each of which will be characterised by unique contexts that complicate alignment of decisions and actions. People have markedly different ways in which they perceive and assimilate information, make decisions and solve problems. Appreciation of and attention to these different thinking styles can change the way you do business with your workforce and your customers. As the business world becomes more complex, understanding the thinking styles of your colleagues and expanding the thinking styles of your workforce beyond their regular preferences may not be a luxury, but a necessity.

Engineers are trained to think critically, analytically, technically and logically, and hence they usually know how to solve problems. This is the result of years of training and habitual left-brain thinking. The chances that these modes of thinking will overshadow emotion, interpersonal, holistic, artistic and imaginative modes, etc, are obvious. True to our nature we may always look for external factors to act as scapegoats. Contrary, though, to our physiological "blind spot", the "engineer's blind spot" can be cured, although you may ask why this irregularity is not addressed more by our academic institutions. Effective communication requires metaphysical connection. Experiential learning involves participants physically and emotionally. This methodology optimises metaphysical connectivity by creating a safe environment for participants to foster sound relationships that will stand them in good stead. The University of Pretoria’s Graduate School of Technology Management embarked on a programme about ten years ago to sensitize students to think and act in a more balanced fashion (left and right brain). Feedback from these students (Master’s in Project Management and Master’s in Engineering Management) has been overwhelmingly positive.

In other words, when one has identified one’s project team members, first establish team alignment by exposing the team to teambuilding. As leader of a project team one must facilitate a healthy balance between the team’s cognitive and emotional cultures. One has to find a balance between what we communicate and how our body language amplifies and affirms what is communicated in our mission statement. In other words, if one arrives at work with a frown on one’s face, one contributes to the team displaying a negative emotional culture (fear, uncertainty). Leaders are often not aware of how much influence they have in creating a negative or positive emotional culture.

The case study below is proof of the positive effect that team alignment sessions have on project management.

MEGAPROJECT SUCCESS: A CASE STUDY

Sasol Technology operates as one of the business units of Sasol and inter alia acts as a launching pad for international expansion projects. Aware of a possible blind spot that may jeopardise execution, Sasol contracted TBi (The Team Building Institute) to optimise behaviour-related performance in the Integrated Project Management Team (IPMT) to subsequently create an emotional culture.

First, TBi introduced the IPMT to the HBDI (Herrmann Brain Dominance Instrument) to prove or disprove the assumption that the majority of the IPMT would be grouped as Quadrant A (analytical) thinkers. The thinking style assessment of 110 MP project managers confirmed this.

The high intensity of the IMPT members’ thinking styles grouped in the A-Quadrant suggested that the majority favoured this analytical mode of thinking, i.e. factual, quantitative, critical, rational, mathematical, logical and analytical. This does not imply that they are not able to access the other modes of thinking, but the above-mentioned modes will predominantly be in their foreground.

Project leadership was informed about this finding, highlighting the probability of excellent analytical output by the IPMT, but poor execution of and a total disregard for teamwork.

TBi advised that performance would be negatively affected if IPMT members were not exposed to some kind of intervention that would not only create awareness, but also provide simulation exercises that would afford members the opportunity to apply other modes of thinking experientially.

With the strong preference for analytical and critical thinking taken into account, it is safe to say that positive and constructive feedback amongst team members would not happen spontaneously if some form of awareness campaign were not introduced. A lack of positive feedback would severely impact motivation – when people are not acknowledged their interest in doing the work will dissipate and output will drastically fade.
Constructive feedback on performance should be foremost in the minds of project managers. Research findings by Zenger and Folkman (2013) regarding the effect that positive feedback has on performance indicated that the ideal or optimal ratio to optimise performance requires five positive comments to one negative comment. This may sound quite obvious, but it may not be that obvious when the majority of the IPMT members think critically and analytically as their default mode of thinking. If they are not aware of this fact, project delivery will be compromised. Zenger and Folkman (2013) argue that 62% of above-average performers (55%) improved 24% when frequently exposed to positive feedback.

The IPMT was introduced to the first phases of team alignment, and constructive team behaviour was soon displayed, with participants becoming very aware of their blind spot or their lack of awareness of the importance of behavioural alignment to optimise project success.

Figure 1 represents an overview of the leadership team’s behavioural response to the alignment strategy.

**Observations**
- The IPMT members quickly understood how they had to adapt their behavioural patterns to be less critical, and they quickly gravitated towards a culture of interdependence.
- The difference between the blue (baseline performance) and the red (average) graphs indicates significant improvement on all constructs, before the alignment sessions and after all the workshops. This is positive, but the challenge is to maintain this newly formed behaviour.
- Transfer and longevity of changes brought about by these alignment workshops will be lost after six months without follow-up procedures.

**Findings**
- **Trust amongst colleagues** and **caring for others** are the constructs that measured the highest variance (1.7). This suggests that constructive criticism would be given and accepted in a positive way and, according to Zenger and Folkman (2013), this would have a significant, positive impact on productivity.
- **Empowerment** and **self-discipline** measured the lowest, which suggests that urgent attention is required to address:
  * Bureaucratic practices that disempower members (not trusted to take decisions – too many signatures).
  * Principles that govern work ethic are not aligned – reliable feedback (members do not set each other up to win, but wait for feedback) and self-discipline (members are not equally committed to ‘go the extra mile’).

**CONCLUSION**

The above analysis serves to confirm that a thinking style assessment can act as an important tool to assist engineers in managing behaviour during a megaproject. When the IPMT members realised which aspects of their thinking styles were unknowingly neglected, they actively engaged in constructive and positive behavioural patterns.

**REFERENCES**


If Shaun has a workplace accident, there will be more than one victim.

At Bova, we understand that accidents have widespread consequences. It’s why we believe you can’t put a price on safety. We go beyond compliance through an uncompromising commitment to innovation and technology. We are dedicated to keeping people like Shaun and his staff safe.

http://www.bova.co.za/a-day-in-a-life/warehouse-manager

IT’S A DANGEROUS WORLD, MAKE IT SAFE.
MARKET PERSPECTIVE

Tough economic times ahead for consulting engineering industry

THE LATEST Biannual Economic and Capacity Survey of Consulting Engineers South Africa (CESA), for the period July to December 2015, indicates that times are tough and getting tougher, with industry confidence the lowest in 16 years. The report indicates that the consulting engineering industry will have to adapt to a low-growth environment, as the outlook for infrastructure spending is hampered by poor economic growth, lower than expected revenue by government, international economic instability and price volatility, and low private sector confidence. Over 540 firms employing just over 24,315 staff, who collectively earn a total fee income of R23.4 billion per annum, are members of CESA.

Three key factors continue to influence the global outlook. These are the gradual slowdown and rebalancing of the Chinese economy, lower prices for energy and other commodities, and the gradual tightening of the US monetary policy.

GDP growth in South Africa slowed to 0.6% q-q, from 0.7% q-q in the previous quarter. South Africa’s economic growth slowed from 1.5% y-y in 2014 to 1.3% in 2015. Growth was largely dragged down by a further contraction in the agriculture sector, while construction recorded marginal growth of 1.1% in the fourth quarter (from 0.5% in the previous quarter).

Chris Campbell, CESA CEO, believes that, “Government needs a strong focus on the implementation of more of its strategic infrastructure projects, as detailed in the National Development Plan, in order to mitigate the decline in the economy and improve investor confidence.” He further reiterated that, “Engineers in South Africa stand ready to partner with government in eradicating the leakage from the fiscus, not only through water which does not reach domestic households, but also through poorly spent monies or corrupt practices which have led to payment for poor quality and even non-existent services in the infrastructure space.”

Probably the most critical concern, and most significant downside risk to inflation and economic growth, for the domestic economy is the fear of a further sovereign credit rating downgrade and its effect on the industry. A lower credit rating means the cost of borrowing for the South African government will escalate, which means more of the tax payer’s money will be used to finance debt, with less available to spend on critical economic and social infrastructure. Currently government expects that 3.6% of GDP per annum will be used on interest expenditure, estimated at around R260 bn per year – equal to total public sector infrastructure allocations per year.

FEE EARNINGS - SOFTER GROWTH OUTLOOK

Consulting engineering fee earnings in the last six months of 2015 increased by around 6%, against an expected decrease of between 2% and 3%. Larger firms reported muted growth of 2% on average for the last six months, while stronger growth was reported by medium and smaller firms (up by 31% and 11% respectively). Respondents nevertheless expect earnings to fall by 5% in nominal terms during the first six months of 2016, compared with the second half of 2015. Campbell states, “Although the outlook is concerning, it is encouraging to see that profitability among member firms has increased.” The percentage of fees outstanding for longer than 90 days as a percentage of total estimated income showed some improvement to 23%, from 24.5% and 24.0% in the previous two surveys. It is estimated that a total of around R5.8 bn in earnings is currently outstanding after the 90-day period.

INDUSTRY CONFIDENCE LEVELS - LOWEST IN 16 YEARS

Confidence levels fell to its lowest level in 16 years, and were significantly weaker in the last six months of 2015, compared to expectations in the June 2015 survey. Levels fell from an expected 56.0% satisfaction rate to 39.4%, and although business condi-
tions are expected to improve slightly to a satisfaction rate of 48% (first six months of 2016) and 44% (last six months of 2016), levels are well below the average of the last five years. Satisfaction amongst firms is at historically low levels, surpassed only by the 1998/99 recession caused by the Asian financial crisis.

GROSS FIXED CAPITAL FORMATION SLOW IN MEDIUM TERM
Gross fixed capital formation (GFCF) as a percentage of GDP averaged at 20.7% in 2014, but slowed to 20.6% in the first quarter of 2015, compared to an average of 21.1% in 2013. The National Development Plan (NDP) has what may seem a somewhat unachivable target of 30% contribution of GFCF to GDP by 2030. All economic indicators currently suggest that investment in relation to GDP is likely to slow over the medium term, due to slower government spending, financial constraints experienced by SOEs and continued weak private sector confidence.

TRANSFORMATION OF THE INDUSTRY
The appointment of Black executive staff (including Black, Asian and Coloured) increased to 39.5% from 38.0% and 36.0% in the previous two surveys. The appointment of Black executive staff has steadily increased from 28.1% in the June 2012 survey. This shows real progress in terms of industry transformation. There has also been a steady improvement in the appointment of women at an executive level. Women (of all races) appointed at an executive level represented 11.0% percent of total executives, up from 10.1% in the previous survey.

INDUSTRY CHALLENGES - PROCUREMENT THE BIGGEST CHALLENGE
Regulation issues, including the procurement of consulting engineering services, remain one of the biggest challenges faced by the industry. Procurement is currently based on price and broad-based black economic empowerment (BBBEE) points, with functionality or quality having a minimum threshold, thus being largely price-driven. This is affecting tender prices, as firms sometimes tender below cost in view of the diminished availability of projects. A further challenge to the industry is to find a way to standardise the procurement procedures applied by the different government departments. Procurement procedures should be standard for the country, or at least for the specific tier of government.

Unrealistic tendering fees remain a concern for members, while the extended time it takes in which to finalise a proposal is affecting profitability in the industry. The quality of technical personnel is argued by some firms to have deteriorated, putting greater risk on the built environment sector. Skills shortage is regarded as one of the most significant institutional challenges faced by the private and the public sector. CESA has offered their services to government to procure and implement projects.

Fraud and corruption are affecting the ethos of our society, with a lot of talk and little action accompanying the growing evidence of corruption. CESA is aware that members are under pressure from contractors and corrupt officials to certify payment for work not completed. This is regarded as an extremely serious matter by CESA, and as such CESA will be relentless in holding those in power accountable.

Unlocking greater private sector participation is seen as a critical element to fast-track delivery, which will support engineering fees, and as such engineering development, in the industry. Private sector participation in this context refers to involvement on a more technical level (and not as a client), to improve municipal capacity and efficiency. Government should create an environment for the private sector so that it can play a much bigger role in infrastructure delivery. Many of the projects highlighted in the NDP can be carried out by the private sector through public-private partnerships.

Service delivery, especially at municipal level, remains a critical burning issue. The consulting engineering industry is threatened by incapacitated local and provincial governments. As major clients to the industry, it is important that these institutions become more effective, more proactive in identifying needs and priorities, and more efficient in project implementation and management.

The involvement of non-CESA members in government tenders and procurement continues to threaten the standard and performance of the industry. Non-CESA members do not seem to comply with the same standards and principles as those firms who are members of CESA. This is further exacerbated by the notion which government procurement entities have that procuring the services of a professional engineering practitioner is the same as buying fruit from an informal trader where one bargains for discounted pricing. There also seems to be a gross misunderstanding regarding the application of fee scales on projects, where the professional practitioner managing the funds as the Principal Agent gets to claim the lion’s share of the fees (as is currently the case when the professional is from the quantity surveying or project management profession), while the professional engineering practitioners (who may be both Principal Agent and technically responsible for design risks), is compensated substantially less. There should at least be equity in the responsibility and remuneration in the roles as Principal Agent across the professions, and a separation of this role from that of the Engineering Practitioner who carries design risks and subsequent costs which are to be compensated separately in any project.

Large local firms are tendering on small projects at rates that are not competitive for small local firms, just to maintain a flow of cash – a practice which is counterproductive to the commitment of transforming the industry. Complaints have been received of some firms not producing proper as-built drawings and not attending site visits. Clients, unfortunately, are not always adequately experienced or educated to conduct proper procurement assessments, and unknowingly award contracts to “unscrupulous” firms. While these occurrences may be limited to smaller rural areas, it remains an unacceptable practice.

Lack of attention to infrastructure maintenance poses a serious problem to the industry. Not only is it much costlier to build new infrastructure, but dilapidated infrastructure hampers economic growth potential.

A copy of the CESA Bi-annual Economic and Capacity Survey can be downloaded from: http://www.cesa.co.za/node/21.
DEALING WITH READYMIX CONCRETE

Correct specifying of readymix concrete

This article is the second in a series of short articles on how to deal with readymix concrete. The first article (How to use readymix concrete) appeared in the May 2016 edition of Civil Engineering (pp 82–83). We trust that these ‘how-to’ pieces will address any uncertainties about the correct handling of readymix concrete.

FIT-FOR-PURPOSE READYMIX CONCRETE

It is essential to establish the credentials of readymix suppliers up-front to ensure that they are SARMA accredited. In this way questions relating to quality standards and ethical business practices are assured and specifiers can rest easy knowing that they are dealing with a professional organisation. It is important to remember that all SARMA plants are audited for quality management, environment, health and safety, and road transport compliance.

By selecting a SARMA member, the specifier is also assured that the company has the necessary in-house technical skills and technical support to be able to ensure that concrete supplied is fit-for-purpose and complies with SANS 878: 2012, which is the specification used for generic readymix concrete. Thereafter the technical attributes of the concrete can be laid out and agreement sought on the type of testing to be conducted on site.

The specifier then needs to spell out the workability characteristics and delivery points for different types of concrete. Also, the method of discharge needs to be made clear, as well as the method of conveying the concrete once delivered on site. Readymix companies have vast experience in the field, and to interact with the technical staff before finalising the specification is worthwhile.

WHAT WAS SPECIFIED?

It is important that all the parties concerned understand exactly what was specified. When it comes to the workability of the concrete, the question can be asked whether it shouldn’t be the responsibility of the people on site, who actually work with the concrete, to specify workability.

All construction professionals know that a 30 MPa concrete for a floor is not the same as a 30 MPa concrete for a column, but does the buyer understand this? Very frequently all 30 MPa concretes
are grouped when pricing readymix concrete, and then complications arise when a “standard” 30 MPa concrete arrives on site for a specialist application (such as columns, for example). Discussions relating to exact requirements on site are extremely important at the planning stage of every project. If the project is large or complex, it is wise to have the technical staff of readymix suppliers visit the site to look at the practicalities and identify possible pitfalls.

Strength is generally a design consideration, but all factors need to be considered when specifying workability and slump retention, such as:

■ Mode of transport on site
■ Application of the concrete
■ Mode of compaction on site
■ Stripping times of formwork
■ The way that the concrete will be "worked" on site.

WHAT IS ACCEPTABLE?

Slump acceptance is a very good example of knowing what is acceptable. SANS 878: 2012 – Readymixed Concrete states that concrete shall be available within the permissible range of slump for a period of 30 minutes from the arrival of the readymix truck on site. It also states that the slump test needs to be done within 15 minutes from sampling the concrete. Furthermore, if a slump of 90 mm is specified, then slumps of 65 mm to 115 mm are acceptable. The engineer can, however, specify a narrower slump range for acceptance, but in order to do so, he needs a very clear understanding of the actual tests done for workability.

From the above it is clear that all parties concerned with concrete, from the specifier all the way to the concrete worker, need to know what the acceptance criteria are for the concrete. Pre-planning and discussion are extremely important when it comes to accepting concrete.

HOW IS TESTING GOING TO BE DONE?

Testing does not happen naturally. Testing has to be specified, along with all the other criteria for quality concrete. Reputable readymix producers do regular process control testing. Results from this testing are only available to engineers for acceptance and quality control, if specified and agreed upon beforehand. Some readymix producers have accredited laboratories doing their process control testing, but this might not be seen as producing an independent result. It is also not a guarantee that your specific batch of readymix concrete will be tested, as only one in every ten trucks will be tested. The following should therefore be agreed on beforehand:

■ Who is going to do the sampling and making of cubes?
■ Who is going to do the actual testing?
■ What concrete will be tested?
■ To what standard will the concrete be tested?

When everybody knows what the specification is and how the specification will be measured, then everybody can cooperate to ensure that fit-for-purpose concrete will be used on every project.

To find out more about readymix concrete suppliers available in your area, visit the Southern Africa Readymix Association (SARMA) at:

T: +27 11 791 3327
E: office@sarma.co.za
W: www.sarma.co.za

SARMA represents reputable readymix concrete companies and promotes readymix concrete as the preferred construction material. Established to regulate the readymix industry, SARMA aims to advance industry technology through research and participation, and develops industry standards that promote the use of readymix concrete. To counter unscrupulous producers who supply inferior quality readymix, engineers are encouraged to work with SARMA to formulate strategies which will ensure access to the highest quality concrete. All SARMA members are subject to stringent annual plant audits to ensure compliance with the SARMA health and safety, quality, environmental and road safety standards.
A new engineering qualification replacing the BTech degree

BACKGROUND
The Higher Education Qualifications Framework was first published for comment in July 2004 in accordance with the Higher Education Bill of 1997. This new framework was designed to be the roadmap of qualifications for the future. It covers post Grade 12 qualifications at all levels, from a one-year Higher Certificate right through to a PhD.

Technology qualifications in South Africa have a history of change every ten to fifteen years, and in this instance it was to be no different. The BTech as we know it, with the diploma as basis containing an industry component, topped up with an extra academic year to grant the degree, was afforded no place in the Framework, and will therefore be terminated.

At the time of publication of the Framework for comment, a number of professions and industries, such as the tourism industry, health, financial and engineering professions, all petitioned the Minister, but the BTech was to be discontinued. The National Diploma, however, was allowed to stay, but some changes were introduced there as well.

DEBATING THE CHANGE
There was huge debate at the universities of technology about the accommodation of the present qualifications in the new Framework. If a diploma and advanced diploma were decided on, candidates would end up without a degree, and this would not be acceptable. The universities also did not have the resources to offer both a diploma and a degree. The industry had become used to a technology degree, and the universities, as well as their students and parents, insisted on a degree.

When the idea of a three-year degree was mooted to the Department, they adamantly insisted that it had to be a totally academic degree with no “practical” or “industry” component. The engineering industry favoured a practical component, but this was refused. A delegation went all the way to the Minister, where they were afforded a very friendly reception, but nevertheless received a negative answer. The reason for this was that large numbers of diploma students were not able to find sponsors for their industry year, and hence could not receive their diploma despite having completed all their academic subjects. Therefore, if an industry component was required in a new qualification, it would have to be added after attainment of the qualification.

INTRODUCING THE NEW THREE-YEAR DEGREE
The only logical way to introduce a new qualification was to glean from the four-year degree model that has over many years proved successful at the traditional universities, and introduce a three-year academic degree, with no industry component. This new qualification, which is being introduced from 2017 onwards, will be called the Bachelor of Engineering Technology (BET) degree.

Many people in industry still maintain that the practical or industry component is absolutely essential for technology qualifications, distinguishing it as the hallmark of technology training, and that graduates would not be able to function in industry without it. This view hails from the time when the technology qualifications were introduced in the late fifties and early sixties as the so-called “sandwich courses,” with the student doing alternate academic and practical semesters. Up to around 2008...
the rule was still that the student had to complete his industry year before being allowed to do his final academic semester. This model worked well for the construction industry, but it was found that the consulting engineers preferred students who had completed all their academic subjects. Hence the civil engineering departments at the universities of technology had to allow students to do their industry year either during or after the academic semesters. This situation then in fact proved that students who gained industry experience after their academic semesters were not inferior to those who gained industry experience during their academic tour. The argument that the industry experience was an essential component of technology qualifications therefore does not hold water, as technology graduates are well able to hold their own having gained their industry experience after completion of their academic subjects.

THE NEW BACHELOR OF ENGINEERING TECHNOLOGY (BET) DEGREE

The question arose how to design the new Bachelor of Engineering Technology degree. Was it to be a BSc Eng "light" or a National Diploma on steroids? This would be an easy trap to fall into. However, much thought was given to the development of a unique qualification catering for (a) the requirements for accreditation of the qualification as set up by the Engineering Council of South Africa (ECSA) for registration of Engineering Technologists, and (b) the needs of industry. To achieve the ECSA requirement, the minimum guidelines as set out in Table 1 had to be satisfied.

The nature of the work done in practice by the engineer, technologist and technician also had to be taken into account. This can best be illustrated by describing the construction-product-process-system lifecycle profile on the conceive-design-implement-operate continuum (Figure 1).

The new Bachelor of Engineering Technology degree was therefore designed with more pure mathematics and science than the old qualifications, with an emphasis on broadly-defined problem-solving and design, and a fine balance of theoretical and applied knowledge. It teaches the technologist to go beyond established standards and codes in a disciplined and informed manner, and provides a theoretically-based but hands-on and practical focus beyond that of the engineer, and with less front-loading of mathematics and science. It is therefore a functionally focused qualification with direct industry application and relevance. It aims to produce the educational base for a well-rounded professional engineering technologist.

**Table 1: Comparison of engineering qualifications**

<table>
<thead>
<tr>
<th>Minimum ECSA-required credits in knowledge areas</th>
<th>Diploma</th>
<th>BET</th>
<th>BSc Eng</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical Sciences</td>
<td>35</td>
<td>42</td>
<td>56</td>
</tr>
<tr>
<td>Natural Sciences</td>
<td>28</td>
<td>28</td>
<td>56</td>
</tr>
<tr>
<td>Engineering Sciences</td>
<td>126</td>
<td>140</td>
<td>180</td>
</tr>
<tr>
<td>Computing and IT</td>
<td>21</td>
<td>21</td>
<td>-</td>
</tr>
<tr>
<td>Complementary Studies</td>
<td>14</td>
<td>28</td>
<td>56</td>
</tr>
<tr>
<td>Work Integrated Learning</td>
<td>30</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>282</strong></td>
<td><strong>308</strong></td>
<td><strong>420</strong></td>
</tr>
<tr>
<td>Re-allocation of the above areas</td>
<td>78</td>
<td>112</td>
<td>140</td>
</tr>
<tr>
<td><strong>Total credits</strong></td>
<td><strong>360</strong></td>
<td><strong>420</strong></td>
<td><strong>560</strong></td>
</tr>
</tbody>
</table>

**Johan de Koker PrTech Eng, Hon F SAICE, Hon F IPET**

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Many people in industry still maintain that the practical or industry component is absolutely essential for technology qualifications, distinguishing it as the hallmark of technology training, and that graduates would not be able to function in industry without it. In practice, however, technology graduates proved to be well able to hold their own having gained their industry experience after completion of their academic subjects.
Integration of project management skills to manage the fourth-year civil engineering research project

Most final-year engineering students find the research project extremely daunting. This is mainly because, for most of them, it is the first time that they are not learning passively, and they are not adequately prepared for the challenge of executing a research project. During the first three years of their undergraduate studies the students are not prepared sufficiently for the difficult tasks the research project requires of them. Their time is largely spent sitting passively in classes listening to lecturers who have prepared the syllabi, provided notes and textbooks, and who coach them towards passing an exam. Universities traditionally teach mostly content. Students are overwhelmed by the amount of knowledge they are confronted with, and tend to retain just enough for just long enough to complete their examinations.

In the case of the research dissertation there is a role reversal, and the student now has to take the initiative by finding a suitable topic, searching for and understanding relevant literature, acquiring data by setting up and conducting suitable laboratory experiments (or obtaining secondary data – not always easy), analysing the data and making proper conclusions. Additionally, they have to, for the first time, compile all this into a properly structured 12 000 word (in our case) dissertation. Over the years it has become clear that for final-year students this is by far the most difficult programme to complete.

For students who lack proper project management skills this is an even more daunting task. In the Civil Engineering and Survey Department of the Cape Peninsula University of Technology we have for more than 20 years’ integrated project management theory with the research project. The two subjects have to be taken in parallel in the BTech year, with the specific aim of applying the acquired project management skills in the execution of the research project.

Aspects of each of the project courses are listed below.

- Research methodology
- Ethics
- Writing a project/research proposal
- Conducting a literature review
- Practical time management
- Presentation skills
- Writing a dissertation

Project management theory
- Project management context
- Project management cycle
- Project management for strategic goal achievement
- Scope management
- Integration management
- Communication management
- Time management
- Human resources management
- Quality management
- Cost and financial management
- Procurement management
- Risk management

Many students have commented positively on this approach, saying that, without the project management skills, it would have been very difficult to successfully manage the research project. Others have stated that the combination of project management and problem-solving skills which they acquired had benefited them in their work by, for example, enabling them to run a construction site more efficiently and with real cost savings.

Even though this is such a tough experience for final-year students, we have always been adamant that it is essential for them to go through this process, as the growth in their ability and confidence is huge. Students find this a very uncomfortable experience, but feedback at the end of the course is mostly positive, as they acquire both technical and life skills which they can apply in their professional careers. A more detailed discussion of the topic can be found in:


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DR ANDRIES MEIRING VAN NIEKERK
(Dok André), an internationally respected and recognised water/wastewater treatment plant design expert in the municipal, mining and industrial sectors, business unit leader, board member, strategic advisor and mentor passed away peacefully on the morning of 14 January 2016 following a short struggle with an aggressive cancer.

Dr van Niekerk was born and bred in Pretoria, and he studied civil engineering at the University of Pretoria, where he obtained a BSc (Eng) in 1975.

He started his engineering career with the East Rand Administrative Board in Johannesburg as an engineer-in-training in the water and sewage group of technical services, which was responsible for the planning, designing and construction supervision of water distribution, water reservoirs, sewer reticulation, outfall sewers and sewage treatment plant projects. It is here where he found his passion for water treatment. He became a part-time lecturer in hydraulic engineering at the University of the Witwatersrand where, as a research assistant in their wastewater sludge stabilisation project, he obtained an MSc (Eng) degree in civil and environmental engineering.

He then moved his young family to the United States of America to continue his studies at the University of California, Berkeley, as a full-time graduate in environmental engineering and a research assistant at the UC Berkeley Field Station. He concentrated his research on biological wastewater treatment and the optimisation of microbiological culture treatment capacity, and obtained a PhD in Environmental Engineering in 1985.

After returning from the USA, he continued growing in the water treatment and wastewater treatment field, leading to his registration as a professional engineer. André became a partner at Wates & Wagner, and a Director at Wates Meiring & Barnard, which laid the foundation to be successfully absorbed into the global engineering practice of Golder Associates in 2003. André was one of the three founding members of Golder Africa, as well as one of the first Golder Africa Principals.

His professional interest in pollution control, water quality management, water/wastewater treatment, and processes related to biological treatment and desalination, were encapsulated in his published works. He freely, and respectfully, shared his knowledge with interested parties throughout the world, including in Namibia, Tanzania, Eritrea, the USA, Canada, Australia, Peru, and of course South Africa.

His biggest technical strength was his clarity of mind. He was able to analyse the most complex water treatment issues and come up with a simple solution. André was a respectful listener, but when he talked we all listened, as he invariably had the solution to a problem. With his vision and leadership in mine water treatment, he put Golder Africa on the map. Thanks to his expertise, Golder designed the two largest mine water treatment plants in Africa and the first biogas-to-energy-from-sewage process.

André was a tower of strength and an incredible inspiration to any Golder office that he visited. He was one of the kindest, most caring people we knew. He combined his faith and his work in a very simple yet elegant way, and was always prepared to help his younger colleagues make important personal and professional decisions.

André certainly exemplified the ‘servant leader’ principle. He served his God, his family, the company and its clients and employees, his profession and his community. He was a caring man of unwavering integrity. His passion for mentoring and developing the next generation was visible in his decisions and priorities — he wanted to give young people of all races and religions the opportunity to experience ownership and all that comes with it.

His bigger legacy, however, was outside of business as a strong, faith-filled man — a person who truly lived his values. He was a generous man in so many ways, one who trusted others and, in turn, received their trust. Always sensitive to people, he took time to make each person feel special, and he believed in a better world with more justice, tolerance and solidarity.

In commemorating the passing of a legend, fellow engineer, friend, and mentor with the highest ethics and integrity, our thoughts turn to Estie, Jacques, Suzanne and Rensche and the extended family.

We all learned from Dok André and we are all better people for having been touched by his generous and gentle nature.

Dok, it was our privilege to have known you, we mourn your passing, you will be truly missed.

Eric Bezuidenhout
ebezuidenhout@golder.co.za
IT WAS WITH GREAT SADNESS that colleagues (many of them transportation engineers) and friends of Colleen McCaul heard that she had passed away on 5 February 2016, after a short illness.

Colleen studied at the Universities of Natal and the Witwatersrand, and later at the University of Pretoria, and began her Johannesburg-based career with eight years as a researcher at the SA Institute of Race Relations, followed by some ten years with the transportation consulting practice of Stanway Edwards Associates. In 2001 she established her own transportation consulting practice.

Colleen carved a niche for herself as an expert transport planner with an in-depth knowledge about the workings of the minibus taxi industry. She authored one of the first books about the taxi industry, *No Easy Ride*, and after 1994 served as a specialist advisor on the National Taxi Task Team (NTTT). She was then involved in drafting the public transport-related parts of both the National Land Transport Transition Act and the National Land Transport Act to provide for the public transport restructuring recommended by the NTTT.

Her instrumental role in the planning and operation-alisation of the Rea Vaya Bus Rapid Transit system in Johannesburg – the first BRT system in South Africa, which began operating in 2009 – is legendary. On behalf of the City of Johannesburg, and under very difficult circumstances, Colleen successfully project-managed a group of mostly international BRT consultants working on the Rea Vaya, and she was integrally involved in negotiating the first BRT bus operating contract.

Colleen will be remembered as a consummate professional who often had to deal politely but firmly with a predominantly male-dominated transport fraternity – from taxi and bus operators and drivers to dyed-in-the-wool padmakers and traffic engineers – who eventually came to respect her and her extraordinary transport expertise.

We will always remember her as a considerate and gentle person with a ready sense of humour. Our thoughts are with Neil Hickson, her life partner, and her mother and sister. Rest in peace, Colleen.

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ON 20 FEBRUARY 2016 the transport industry lost a passionate and determined leader in a car accident. Pauline Froschauer had worked for thirty years in the transport sector, making her mark in more ways than one.

When Pauline started working as a transport researcher at the CSIR in 1986, transport planning was still a relatively young discipline in South Africa, predominantly practised by ex-roads engineers and transport economists. With her economics and industrial psychology education Pauline soon added a new dimension to transportation planning, eventually playing a significant role in advancing transportation planning. She was one of the pioneers to establish ‘social inclusion’ as an integral element of transportation planning to the benefit of transport-disadvantaged passengers.

Well-known in the industry for her direct and decisive style, Pauline’s presence was felt in projects around the country, both as a planner and a project manager. Her more recent achievements included working on the establishment of the National Transport Forum, driving new thinking for the annual Southern African Transport Conference, and guiding various local, provincial and national government transport initiatives. She was passionate about non-motorised transport, and placed great value on the importance of marketing and communication in the planning process. Her most recent major project was the Rustenburg BRT programme, where she led one of the best integrated multidisciplinary project teams in the field, breaking new ground in her hands-on management in implementing billion-rand public transport projects. It was a role she took on while completing her MPhil (civil engineering) degree.

Pauline’s philosophy in life was that *the world keeps happening anyway, and it is up to us to make sense of it and give it value*. She loved working in South Africa, and never entertained leaving, as she saw a country with so many possibilities and opportunities. In recent months, Pauline had begun to pursue her love for the arts, and was well known in the Tshwane arts community, where she sponsored a number of promising students.

Pauline leaves her father, and the many transport colleagues who will miss her feisty presence.

---

Dr Johan Bosman Pr Eng
johan@sciendum.co.za
With input from Sara Butchart
sara@adzone.co.za
## SAICE Training Calendar 2016

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course Dates</th>
<th>Location</th>
<th>CPD Accreditation Number</th>
<th>Course Presenter</th>
<th>Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCC 2015 (Third Edition)</td>
<td>16–17 August 2016</td>
<td>Pretoria</td>
<td>SAICEcon16/01869/19</td>
<td>Benti Czanik</td>
<td><a href="mailto:cheryl-lee@saice.org.za">cheryl-lee@saice.org.za</a></td>
</tr>
<tr>
<td></td>
<td>6–7 September 2016</td>
<td>Midrand</td>
<td>SAICEcon16/01869/19</td>
<td>Benti Czanik</td>
<td><a href="mailto:cheryl-lee@saice.org.za">cheryl-lee@saice.org.za</a></td>
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<tr>
<td></td>
<td>26–27 September 2016</td>
<td>Richards Bay</td>
<td>SAICEcon16/01869/19</td>
<td>Benti Czanik</td>
<td><a href="mailto:cheryl-lee@saice.org.za">cheryl-lee@saice.org.za</a></td>
</tr>
<tr>
<td>GCC 2015 and GCC 2010 Differences</td>
<td>27 July 2016</td>
<td>Cape Town</td>
<td>SAICEcon16/01890/19</td>
<td>Benti Czanik</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<tr>
<td></td>
<td>29 August 2016</td>
<td>East London</td>
<td>SAICEcon16/01890/19</td>
<td>Benti Czanik</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<tr>
<td>Supply Chain Management Body of Knowledge (SCMBOK) Fundamentals</td>
<td>1–2 August 2016</td>
<td>Cape Town</td>
<td>SAICEcon16/01934/19</td>
<td>Benti Czanik</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
</tr>
<tr>
<td></td>
<td>4–5 August 2016</td>
<td>Midrand</td>
<td>SAICEcon16/01934/19</td>
<td>Benti Czanik</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<td></td>
<td>11–12 August 2016</td>
<td>Durban</td>
<td>SAICEcon16/01934/19</td>
<td>Benti Czanik</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<tr>
<td></td>
<td>22–23 August 2016</td>
<td>Port Elizabeth</td>
<td>SAICEcon16/01934/19</td>
<td>Benti Czanik</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<tr>
<td>Project Management of Construction Projects</td>
<td>19–20 July 2016</td>
<td>Midrand</td>
<td>SAICEcon15/01754/18</td>
<td>Neville Gurry</td>
<td><a href="mailto:cheryl-lee@saice.org.za">cheryl-lee@saice.org.za</a></td>
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<tr>
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<td>13–14 September 2016</td>
<td>Durban</td>
<td>SAICEcon15/01754/18</td>
<td>Neville Gurry</td>
<td><a href="mailto:cheryl-lee@saice.org.za">cheryl-lee@saice.org.za</a></td>
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<tr>
<td>Technical Report Writing</td>
<td>25–26 July 2016</td>
<td>Port Elizabeth</td>
<td>SAICEbus15/01751/18</td>
<td>Les Wiggill</td>
<td><a href="mailto:cheryl-lee@saice.org.za">cheryl-lee@saice.org.za</a></td>
</tr>
<tr>
<td>Structural Steel Design to SANS 10162-1-2005</td>
<td>24 October 2016</td>
<td>Midrand</td>
<td>SAICEstr15/01726/18</td>
<td>Greg Parrott</td>
<td><a href="mailto:cheryl-lee@saice.org.za">cheryl-lee@saice.org.za</a></td>
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<tr>
<td>Reinforced Concrete Design to SANS 10100-1-2000</td>
<td>25 October 2016</td>
<td>Midrand</td>
<td>SAICEstr15/01727/18</td>
<td>Greg Parrott</td>
<td><a href="mailto:cheryl-lee@saice.org.za">cheryl-lee@saice.org.za</a></td>
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<tr>
<td>Practical Geometric Design</td>
<td>21–25 November 2016</td>
<td>Midrand</td>
<td>SAICEbus15/01784/18</td>
<td>David Ramsay</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<tr>
<td>Leadership and Management Principles and Practice in Engineering</td>
<td>17–18 August 2016</td>
<td>Durban</td>
<td>SAICEbus15/01784/18</td>
<td>David Ramsay</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<tr>
<td>Water Law of South Africa</td>
<td>20–21 September 2016</td>
<td>Cape Town</td>
<td>SAICEwat13/01308/16</td>
<td>Hubert Thompson</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<tr>
<td>The Legal Process dealing with Construction Disputes</td>
<td>26–27 July 2016</td>
<td>Polokwane</td>
<td>SAICEcon13/01368/16</td>
<td>Hubert Thompson</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<tr>
<td></td>
<td>17–18 August 2016</td>
<td>Nelspruit</td>
<td>SACPMP/CPD/15/010</td>
<td>Hubert Thompson</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<td></td>
<td>30–31 August 2016</td>
<td>Bloemfontein</td>
<td>SAICEcon13/01368/16</td>
<td>Hubert Thompson</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<tr>
<td>Earthmoving Equipment, Technology and Management for Civil Engineering and Infrastructure Projects</td>
<td>20–22 July 2016</td>
<td>Midrand</td>
<td>SAICEcon15/01840/18</td>
<td>Prof Zvi Borwilsch</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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</table>

## SAICE / South African Road Federation (SARF)

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course Dates</th>
<th>Location</th>
<th>CPD Accreditation Number</th>
<th>Course Presenter</th>
<th>Contact</th>
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<tr>
<td>Asphalt: An Overview of Best Practice</td>
<td>5–6 July 2016</td>
<td>Durban</td>
<td>SAICEtr15/01806/18</td>
<td>J Onraet</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> / <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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<tr>
<td>Concrete Road Design and Construction</td>
<td>20 July 2016</td>
<td>Durban</td>
<td>SAICEtr15/01802/18</td>
<td>B Perrie, Dr P Strauss</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> / <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
</tr>
<tr>
<td>Pavement Rehabilitation by Recycling / Bitumen Stabilisation</td>
<td>10–11 August 2016</td>
<td>Bloemfontein</td>
<td>SAICEtr15/01810/18</td>
<td>Prof Kim Jenkins, D Collings, K Louw</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> / <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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<tr>
<td>Construction of G1 Bases</td>
<td>18 July 2016</td>
<td>Cape Town</td>
<td>SAICEtr15/01809/18</td>
<td>E Kleyn</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> / <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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### SAICE / Induna Training Services

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course Dates</th>
<th>Location</th>
<th>CPD Accreditation Number</th>
<th>Course Presenter</th>
<th>Contact</th>
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<tr>
<td>Comparing Construction Contracts</td>
<td>29–30 July 2016</td>
<td>Cape Town</td>
<td>SAICEcon15/01855/18</td>
<td>Lydia Carroll</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<tr>
<td></td>
<td>8–9 September 2016</td>
<td>Durban</td>
<td></td>
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</table>

### SAICE / Mentoring 4 Success

| Mentors Masterclass in Engineering and Construction | 13–14 July 2016 | Midrand | SAICEcon14/01675/17 | Philip Marsh / Celestine J eftha | info@m4s.co.za                |
| Knowledge Mentoring in Engineering and Construction | 23–24 August 2016 | Midrand | SAICEbus16/01886/19 | Philip Marsh / Celestine J eftha | info@m4s.co.za                |
| Kick-start Structured Mentoring Programme         | Book on request | -       | SAICEbus16/01887/19 | Philip Marsh / Celestine J eftha | info@m4s.co.za                |
| Head Start Structured Mentoring Programme in Engineering and Construction | Book on request | -       | SAICEot14/01701/17 | Philip Marsh / Celestine J eftha | info@m4s.co.za                |

½-day, 1-day and 2-day courses are based on a minimum of 10 participants.
In-house courses and workshops are limited to a maximum of 15.

### Candidate Academy

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course Dates</th>
<th>Location</th>
<th>CPD Accreditation Number</th>
<th>Course Presenter</th>
<th>Contact</th>
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<tr>
<td>Road to Registration for Candidates</td>
<td>2 August 2016</td>
<td>Durban</td>
<td>CESA357-04/2016</td>
<td>Allyson Lawless</td>
<td><a href="mailto:lizelle@ally.co.za">lizelle@ally.co.za</a></td>
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<tr>
<td></td>
<td>12 September 2016</td>
<td>Midrand</td>
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<td></td>
<td></td>
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<tr>
<td>Road to Registration for Mature Candidates</td>
<td>23 August 2016</td>
<td>Midrand</td>
<td>CESA484-01/2017</td>
<td>Peter Coetzee</td>
<td><a href="mailto:lizelle@ally.co.za">lizelle@ally.co.za</a></td>
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<tr>
<td></td>
<td>7 September 2016</td>
<td>Cape Town</td>
<td></td>
<td>Peter Coetzee</td>
<td></td>
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<tr>
<td></td>
<td>15 November 2016</td>
<td>Durban</td>
<td></td>
<td>Peter Coetzee</td>
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<tr>
<td></td>
<td>1 December 2016</td>
<td>Midrand</td>
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<td>Stewart Gibson</td>
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<tr>
<td>Basic Contract Administration and Quality Control</td>
<td>31 Aug–2 Sept 2016</td>
<td>Durban</td>
<td>CESA359-04/2016</td>
<td>Theuns Eloff</td>
<td><a href="mailto:lizelle@ally.co.za">lizelle@ally.co.za</a></td>
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<td></td>
<td>9–11 Nov 2016</td>
<td>Midrand</td>
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<tr>
<td>Getting Acquainted with Road Construction and Maintenance</td>
<td>5–7 September 2016</td>
<td>Durban</td>
<td>CESA379-05/2016</td>
<td>Theuns Eloff</td>
<td><a href="mailto:lizelle@ally.co.za">lizelle@ally.co.za</a></td>
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<tr>
<td>Getting Acquainted with Road Construction and Maintenance</td>
<td>30–21 October 2016</td>
<td>Cape Town</td>
<td>CESA376-05/2016</td>
<td>Dup van Renen</td>
<td><a href="mailto:lizelle@ally.co.za">lizelle@ally.co.za</a></td>
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<tr>
<td>Getting Acquainted with GCC 2015</td>
<td>11–12 August 2016</td>
<td>Durban</td>
<td>CESA377-05/2016</td>
<td>Theuns Eloff</td>
<td><a href="mailto:lizelle@ally.co.za">lizelle@ally.co.za</a></td>
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<tr>
<td>Getting Acquainted with Sewer Design</td>
<td>19–20 July 2016</td>
<td>Midrand</td>
<td>CESA378-05/2016</td>
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<td><a href="mailto:lizelle@ally.co.za">lizelle@ally.co.za</a></td>
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<td>22–23 November 2016</td>
<td>Cape Town</td>
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</table>

In-house courses are available.
For SAICE in-house courses, please contact Cheryl-Lee Williams (cheryl-lee@saice.org.za) or Dawn Hermanus (dawn@saice.org.za) on 011 805 5947.
For Candidate Academy in-house courses, please contact Lizelle du Preez (lizelle@ally.co.za) on 011 476 4100.
Clause 3.1.1 of the By-Laws reads as follows:

“Every candidate for election to the Council shall be a Corporate Member and shall be proposed by a Corporate Member and seconded by another Corporate Member.”

Nominees accepting nomination are required to sign opposite their names in the last column of the nomination form. Nomination for election to Council must be accompanied by a Curriculum Vitae of the nominee not exceeding 75 words. The CV will accompany the ballot form, and the format of the CV is described in Sections A and B. According to a 2004 Council resolution, candidates are requested to also submit a focus statement. Please see Section C in this regard.

Section A: Information concerning the nominee’s contribution to the Institution.

Section B: Information concerning nominee’s career, with special reference to civil engineering positions held, etc.

Section C: A brief statement of what the nominee intends to promote / achieve / stand for / introduce / contribute, or preferred area of interest.

Please note: Nominations received without an attached CV will not be considered.

Closing date: 29 July 2016. Acceptable transmission formats – email, fax and ordinary mail. All nominations are treated with due respect of confidentiality.

In accordance with Clause 3.3 of the Constitution, the Council has elected Office Bearers for the Institution for 2017 as follows:

President Mr S Naicker
President-Elect Mr E Kerst
Vice-President Mr V Krishandutt
Vice-President Mrs D Magugumela
Vice-President Mr A Frieslaar
Vice-President Mr E Chinnappen

In terms of Clause 3.3.4 of the Constitution, the following are ipso facto members of the Council for the year 2017:

The immediate Past-President Dr C Herold
The two most recent Past-Presidents Mr M Pautz

Mr S Mkhacane

If more than 10 nominees from Corporate Members are received, a ballot will have to be held. If a ballot is to be held, the closing date for the ballot will be 31 August 2016. Notice of the ballot will be sent out using two formats, i.e.
1. By e-mail to those Corporate Members whose electronic address appears on the SAICE database, and
2. By normal surface mail to those members who have not informed SAICE of an e-mail address.

M Pillay Pr Eng
Chief Executive Officer
April 2016

Please turn over for nomination form >>

TO ALL CORPORATE MEMBERS

NOMINATIONS FOR ELECTION OF SAICE 2017 COUNCIL

THE SOUTH AFRICAN INSTITUTION OF CIVIL ENGINEERING – Nomination for election of Members of Council for the year 2017 in terms of Clause 3.1 of the By-Laws

For more engineering humour, please visit “Unreal Bridges” on Facebook and “@TheUnrealBridge” on Twitter.
**NOMINATION FORM 2017**

**10 Corporate Members**

<table>
<thead>
<tr>
<th>SURNAME</th>
<th>FIRST NAMES</th>
<th>PROPOSER</th>
<th>SECONDER</th>
<th>SIGNATURE OF NOMINEE</th>
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<tr>
<td></td>
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<td>Signature</td>
<td>Name in block letters</td>
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**Under 36 Members**

<table>
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<tr>
<th>SURNAME</th>
<th>FIRST NAMES</th>
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</table>

Please fax, e-mail or post this form, plus the CV of the nominee, to SAICE National Office, for attention Memory Scheepers, by 29 July 2016

Fax: 011 805 5971 | e-mail: memory@saice.org.za | Postal address: Private Bag X200, Halfway House, 1685
Reinforced Earth Applications

- Bridges & Highways
- Railways
- Ports & Waterways
- Dams & Reservoirs
- Marine & Shorelines
- Construction Materials
- Energy
- Industry
- Land Development & Mining
- Ports & Coastal Works
- Roads & Motorways
- Railways
- Mining & Minerals
- Energy
- Construction Materials
- Industry
- Land Development & Mining
- Ports & Coastal Works
- Roads & Motorways
- Railways
- Mining & Minerals
- Energy

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South Africa
Tel: +27 11 726 6180

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www.terre-armee.com

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