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A long haul, but we can do it together
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INTRODUCTION

No-one (not even I) can really capture all that went into bringing me to this point in my life: the hopes, the fears; the weaknesses, the strengths; the failures, the successes; and the dreams of what lies ahead.

But all that is in the past. Like stones thrown into a pond, or stepping stones in a stream that briefly rocked at my passing, the ripples have long since vanished to be remembered only imperfectly by a few. I won’t mention the really big ripples that happened when I missed my footing. Thankfully they too are gone. But each step, some more shaky than others, shaped me and brought me a little closer to who I am now. Doubtless you may not like everything that you see. I am still a work in progress, being shaped patiently by the hand of God for a future that only He can see.

FORMATIVE YEARS

For this gathering the logical starting point is my engineering career. I started in engineering rather tentatively, with little better reason than that I was good at maths and science, and my father was in engineering. After my first year I realised what I didn’t want (which I guess was progress), and switched from mechanical to civil engineering
(no disrespect to my mechanical engineering colleagues). Around that time I seriously questioned my choice of career and sought guidance as to serving God in the ministry. The answer was a conviction that I should continue in engineering, but without yet knowing why.

In my third year, Professor Des Midgley, a brilliant academic but a boring lecturer, delivered a double lecture on the topic *Water for peace in Southern Africa*. My friends were nodding off all around me, but I was riveted with the unshakable conviction that this was what God was calling me to. It was like standing on the top of a mountain and seeing a distant beckoning peak rising above the mist. In my final undergraduate year I wrote a paper entitled *Water for Peace*. This was adjudged the best paper and Professor Jennings (Head of Department at the time) had it published. This has remained the lodestone of my career.

However, as a bursary student I was contracted to work for the South African Railways and Harbours. The proviso was that my MSc had to involve railway engineering. The nearest I could find to water was a study of the water and salt circulation in Richards Bay before and after the development of a new estuary mouth. I was privileged to study under Professor Midgley in the Hydrological Research Unit. Although I enjoyed the challenges and opportunities, the next three years were like plodding down a mist-shrouded valley that seemed to take me ever further away from my dream. I spent the last year as a District Engineer in South West Africa (now Namibia), with the primary role of working on a deviation of the railway line between Swakopmund and Walvis Bay through one of the driest deserts in the world!
THE DREAM BECOMES REALITY

Then, in 1977, I surfaced from the misty valley to see a small advertisement for someone to join Stewart Sviridov and Oliver to be seconded to the Hydrological Research Unit to work under Professor Midgley on the Pretoria-Witwatersrand-Vereeniging project, which involved developing a ground-breaking suite of complex catchment hydro-salinity models of the Vaal River system. So I was able to do my PhD full-time while being paid as a consulting engineer. More importantly, I was able to use my models to identify and prove options that saved South Africa billions of rands and helped steer us towards adoption of the Lesotho Highlands Water Project, which I like to think helped lay the groundwork for mutual dependency between South Africa and Lesotho.

A personal highlight for me during this period was meeting and marrying the love of my life, Marina, in 1982. Since then we have been blessed with three marvellous daughters (Bronwyn, Sarah and Cherith), the arrival of our first grandchild, Michelle, last December, with our second, Daniel, due in February.

This particular mountain turned out to be an 18-year long rolling plateau filled with a rich variety of interesting and useful projects. But after the miracle of 1994 I wondered whether the dream had run its course. So for a time I was back in the next mist-shrouded valley hoping that there was another peak ahead.

THE NEXT PEAK

At our first SAICE Water Engineering Division meeting of 2008 I was unexpectedly asked to Chair the Division for another two-year stint. I was on the point of declining due to work pressure, when a verse from the Biblical story of Esther, a young lady who was
unwittingly positioned to serve her people at a critical time in their history, was imprinted on my mind and I had the conviction that I must accept, again not yet knowing why: “...who knows but that you have come to royal position for such a time as this?” (Esther 4:14). At the April 2008 SAICE Council meeting someone posed the question, “Are we facing a water crisis like the energy crisis?” Then I knew why God had called me to take up the reigns again. In October that year, with the help of a fantastic group of people, I presented a joint SAICE/WISA submission to a Parliamentary Portfolio Committee on water affairs, and the two words “water” and “crisis” were reluctantly, but indelibly, welded together. Since then this issue and its wider implications has taken more and more of my time.

PRESIDENTIAL EMPHASES

The water crisis is here for years to come, probably until after Polihale Dam has been commissioned and warmed up to re-secure the water supply to the wider Vaal River system. Hopefully my involvement will continue until then and the coming presidential year will help to advance it.

But my responsibilities for the coming year must embrace the aspirations of a much wider engineering community, with every discipline facing a number of daunting crises. Hence my focus must broaden, but remain concentrated enough to be effective. I have chosen two main focus points for 2016, the first of which is engineering capacity, and the second procurement.

Engineering capacity

The sterling work done by Allyson Lawless made us all aware of the acute shortage of technical capacity in the municipal sector, with the number of engineering practitioners
available in 2005 having shrunk to nearly half of the complement available in the 1990s. Given that during this period the serviced population incorporated into formal local government increased from about 14 million to 42 million, the number of municipal engineering practitioners per unit of population reduced to about one seventh of the previous dispensation. Several rural municipalities in fact have no technical capacity at all, which impinges on all their engineering services.

In 2008 the Water Engineering Division was informed that only 39% of the engineering posts in the Department of Water Affairs and Sanitation (DWS) were filled. More importantly, there was a looming middle management gap (see Figure 1), with most of the remaining experience and institutional knowledge in senior positions clustered near the exit doors.

Within ten years 47% of these were expected to retire. Three years later I asked a senior DWS engineer how things were going and received the terse reply, “We are running on fumes.” The predicted 47% loss of senior engineers had been exceeded in just three years, with more heading in the same direction. This trend is most alarming since it cuts to the very head of the water sector, threatening paralysis of the body.

At the other end of the scale there was a healthy complement of bursary students and a heartening influx of graduate engineers. After obtaining the necessary in-service training and attaining professional status these young engineers were expected to move onto the lowest rungs of the managerial ladder in Grade 8 of the civil service. However, of the 45 posts waiting for them, only six were filled. The rest of the candidates had already resigned. Why?
In the first instance there was no-one to mentor the Candidate Engineers. The remaining experienced engineers were in senior positions working feverishly to hold the line and deliver the DWS's core services. They also had little contact with the raw recruits, who should have been mentored by the missing middle managers.

They were too poorly paid to afford to raise families. So why stick around if they could earn twice as much elsewhere?

This was exacerbated by procurement targets that place a premium on black engineers in the private sector, who were in short supply. Since nearly all the bursary students fitted into that category, they were eagerly snapped up.
On looking to their future they were confronted by a daunting edifice packed with non-technical managers blocking their career path. In many instances posts are occupied by incumbents who had been parachuted into the organisation, but lack essential technical skills and knowledge of the organisation. In the eight years since 2008 there have been three ministers of Water Affairs. In the same period I have seen no less than five Director Generals (DGs) come and go. Two permanent DGs were suspended (on full pay), with one person acting in their place (twice) while their contract periods slowly ticked by. Hopefully the present DG will remain long enough to make a positive mark.

State policies provided for OCD (Occupational Specific Dispensation) posts that allow professional engineers and others with scarce technical skills to be paid better. However, unwise HR implementation has placed the OCD posts in staff positions, which means that engineers wanting to enter line management positions are penalised with a sharp drop in salary. As a result most of the key technical decision-making was in the hands of technically ill-prepared or inexperienced managers.

Amazingly, at the same time the number of top managerial posts has burgeoned. At the top the number of Deputy Director General (DDG) posts shot up to six (one or two would do the trick). Chief Directors, of whom there used to be only a handful, now require a large room to meet. Under them there used to be a couple of dozen Directorates. Although at the time organograms were inexplicably a closely guarded secret, someone did a count in the internal telephone directory and came up with about 130 Directors posts. So, from the traditional management pyramid the management tree assumed the distinctive shape of a rapidly expanding mushroom cloud.
The insecurity of poorly qualified senior technical managers was stalling key decisions, sometimes by years, causing frustration amongst their own engineers, and starving the private sector of much needed work.

The tone of the organisational culture that had emerged is epitomised by one of the earliest post-apartheid ministers of Water Affairs who vowed that he would see to it that an engineer would never again be DG. He didn’t live to see the consequences of this rash decision.

Is it any wonder then that young graduates didn’t feel welcome in what had become an engineer-unfriendly environment?

Many of these problems and their inevitable consequences are still with us today.

In the interim the DWS Candidate Academy (CA) has done good work in trying to bring graduate engineers to the point of professional registration. But will they stay? Perhaps the CA’s efforts, aided by the lack of work in the private sector, will keep the young engineers in government employ for a bit longer. But even if they do stay longer, who will pass on the crucial institutional knowledge and steer the ship during the decades required for them to learn the ropes? Especially since the small pool of knowledge is shrinking fast.

Those familiar with other government departments, state-run entities (SOEs) and municipalities may have picked up some similarities.

So much for the challenge.
Fortunately the uphill battle of overcoming the former spirit of denial is dissipating, and there is a growing awareness and ownership of these problems amongst decision-makers. Now we have to provide the solutions.

The task ahead of us is steep, but not insurmountable – solving difficult problems is what engineers are good at.

Urgent short-term actions are required to bolster the core functions of state organisations. To achieve this we have to:

- Get experienced engineers back into key management positions.
- Revitalise organisational structures and remove the impediments that drove engineers away in the first place, so that engineers can participate fully in decision-making.
- Improve engineering employment conditions and pay scales, especially at the lower end of the spectrum.
- Use the limited available engineering expertise to the full by putting aside all the ‘nice-to-haves’ that are diluting the efforts of the limited pool of expertise, and rather focus on the really critical core functions.
- Mentor candidate engineers and pass on institutional knowledge.

SAICE has key roles to play in the areas of advocacy, identifying retirees willing to be ‘re-treaded’ and encouraging the secondment of engineers to work in the public sector.
Both of the last two actions are urgent. In the first instance retired engineers are ageing, and along with it losing willingness and sometimes their ability to go back into the working environment. With them goes much of the institutional knowledge.

In parallel, secondment of skilled engineers from the richly endowed private sector is required. This would be a win-win solution. The public sector desperately needs the skills, while the private sector is facing the grim prospect of having to retrench valuable staff members. Secondment is a wonderful solution for both parties (not to mention for the worried professionals who are facing retrenchment). If these valuable skilled professionals, many of whom have excellent experience gained from working in and with the public sector, are not used, they will seek alternative employment and will be lost to the industry forever. Moreover, once the economy heats up again, the window of opportunity for secondment will be lost, since private sector firms will then be loath to part with well-skilled professionals.

Longer-term, but no less important initiatives have to be taken on the educational front. At the near end of the educational pipeline engineering faculties need to be strengthened and policies improved to facilitate the training of excellent engineering graduates.

At the other end of the pipeline we need to play a largely advocacy role in turning around maths and science education in our schools and attracting talented youth into an engineering career. We need excellent and well-prepared feedstock into our tertiary institutions.
Procurement

The other string to my presidential bow is engineering procurement. Public procurement policies have degenerated to the extent that engineers have to spend much of their time bidding ineffectively against scores of competitors for every job, often with hit rates of 1:25 or worse. The cost of this wastage on preparing 24 fruitless technical bids to win just one is enormous.

The main culprit behind this deplorable situation is the two-envelope system. Just about anyone who has read the terms of reference and can regurgitate it can scrape together enough technical points to satisfy the requirements of the first envelope. Then the technical results are thrown away and the outcome depends largely on the price offer contained in the second envelope. In essence the bidder who knows the least and underestimates the cost usually gets the job. In desperation to get at least some work, reputable firms have been forced to guess what the least knowledgeable bidder will quote and try to undercut them. This has escalated to the extent that all of our members are forced to cut one another’s throats in a frenzy to win at least some work, even at a loss.

All this sounds like a great deal for clients. But is it?

Having been treated like contractors, consulting firms are now acting like contractors and carefully trimming the scope of their proposals to give clients less than they expected, with anything more becoming an extra. But, because public sector budgets for up-front consulting services are generally cast rigidly in concrete, these extras seldom get approved, resulting in incomplete delivery. Hence the ability to evaluate alternatives suffers.
The life cycle costs of a project look something like the depiction in Figure 2.

The front-end planning and feasibility studies are small change, maybe 0.5% to 1% of the total life cycle cost. This work is done on a time basis, the theory being that the scope of the work may need to be revised to accommodate unforeseen changes in scope required to explore new possibilities for improving the plan. That is the theory, anyway. In practice, time-based work is simply a thinly veiled subterfuge for grossly underpaid fixed fee work, because most clients risk losing their merit bonus if the budget price is exceeded by more than a modest margin. Design work is based on a fixed-fee scale running from about 5% to 15% of the construction cost, depending on the size and complexity of the works. Construction requires the biggest slice, in this example about 50% of the life cycle cost. The remaining cost comprises on-going operation and maintenance costs.
Figure 2: Typical life cycle costs and potential for savings

Now let’s look at where the client can save money. There is little to save on the construction cost. To the contrary, the client will have his time cut out trying to contain cost over-runs. There is hardly any scope to save on the design, since the costs are in lockstep with the construction costs. The more concrete and steel, the more they get paid. Anyway, what client wants to risk having something big fall down because he skimped on the design work? Sometimes clients foolishly try to cut down on maintenance costs. They can get away with it in the early years when everything is new, but only at the expense of paying much more for the ensuing damage in later years. Roads and municipal water infrastructure are cases in point.
So where can they reduce costs? At the planning and feasibility stage of course! Let us examine the consequences of this practice.

One of the biggest power stations in the southern hemisphere provides a sobering example. At 86% the size of Medupi power station, Majuba power station was probably South Africa’s biggest capital investment of that time. The client saved a few bob by refusing to pay for the geotechnical engineers to drill slanted boreholes while investigating the feasibility of the underground mining operation. As a result the vertical hard rock dykes criss-crossing the coal seams were missed. During the construction of the mammoth power station the mine surface works proceeded and the shaft was sunk. When mining started to extract coal to feed the first generating units they ran into dyke after dyke criss-crossing the coal seams, rendering longwall mining unfeasible. Hence the mine had to be abandoned in 1993. Consequently coal had to be railed in at great cost via a circuitous route from Khutala Colliery near Ogies. We are still paying for this mistake. Aside from the rail haulage, two-thirds of the coal is now trucked in from various locations at the rate of one truck every two minutes, thereby contributing to the destruction of our roads. Plans are afoot to open up a new coal mine much further north in the Waterberg to rail coal all the way to Majuba.

Penny wise and pound foolish – the power station had been built in the wrong place.

Unfortunately Majuba is not the only example of big and very costly mistakes arising from bad planning that have assaulted our economy during the short span of my career. Yes, Eskom features in some of them, both past and present. Water resources and water quality also feature prominently.
The one area that is the easiest to cut the costs of just happens to be the tiniest, and the one where all the biggest and most expensive decisions are made (see Figure 3).

![Figure 3: Penny wise and pound foolish](image)

These include questions of: What to build? Is there a better alternative? Where to build it? How big? How many phases? When should it start? What are the unforeseen traps? and, Do we even need it?, all of which should be evaluated during the feasibility stage.

My biggest engineering contribution came about by identifying and demonstrating a fatal water quality flaw in an otherwise attractive scheme that took it out of contention, saving us tens of billions of rands in fruitless on-going expenditure and endless operational headaches.

Cutting the cost of planning and feasibility studies through poor procurement policies is extremely unwise. Placing this crucial work in the hands of the lowest bidder, who may not even have the expertise or experience to appreciate the big picture and look out of the box for the best solutions, is even more damaging.
Right now we are not just facing the possibility of a few more costly mistakes that can serve as cautionary examples in presidential addresses; we are on the brink of making unprecedented massive capital commitments on infrastructure that hold the promise of unlocking our economy. That is good and essential. However, our economy has been so degraded and debt levels have risen so high that we dare not make any more big mistakes that risk pushing our nation over the edge into a debt trap that would lock our people into generations of grinding poverty and possible insurrection. This is not idle speculation. International rating agencies are already a hair’s breadth away from relegating our borrowing potential to junk status. This could easily happen if, through bad planning, the wrong schemes are chosen and the heavy investment cost does not yield the hoped-for benefit.

We have to make absolutely certain that our investments are well spent and will yield a return that outstrips the cost by a healthy margin.

The challenge is to derive a well-balanced and workable procurement policy, which will require the wisdom of our best procurement managers. We certainly do not want to put forward a flawed model that overlooks unforeseen consequences. And then we have to get the buy-in of key decision-makers.

**LAST WORD**

I have no illusions about the size of the bites that I am trying to take. I expect the haul to be a long one that is likely to extend well beyond my presidential year. But I also know that our engineering fraternity is packed with talent and energy, and is a force to be reckoned with. By the grace of God we can do it together.