PPC | GIBS

# BUILDING AFRICA REPORT 2022

Gordon Institute of Business Science
Centre for African Management and Markets

PPC

PPC 130 YEARS

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The opinions expressed in this report represent the views of the authors and not of PPC or GIBS

# EXECUTIVE SUMMARY

PPC poured its first cement in 1902. On that day, Theodore Roosevelt was President of the United States (POTUS). He would become the first POTUS to ride in an automobile. On 31 May that year, the Second Boer War ended in South Africa. The year also saw the founding of the football club now known as Real Madrid, the opening of the Aswan Dam on the Nile and the glittering premiere of the Hunchback of Notre Dame in Monte Carlo.

How the world changes in just a few generations! A child today would be forgiven for thinking of Roosevelt chiefly as a dam in Arizona. South Africa has lived through close-on three decades of democracy, and Real Madrid holds 34 La Liga titles and 13 European Cup/UEFA Champions League trophies in the cabinet.

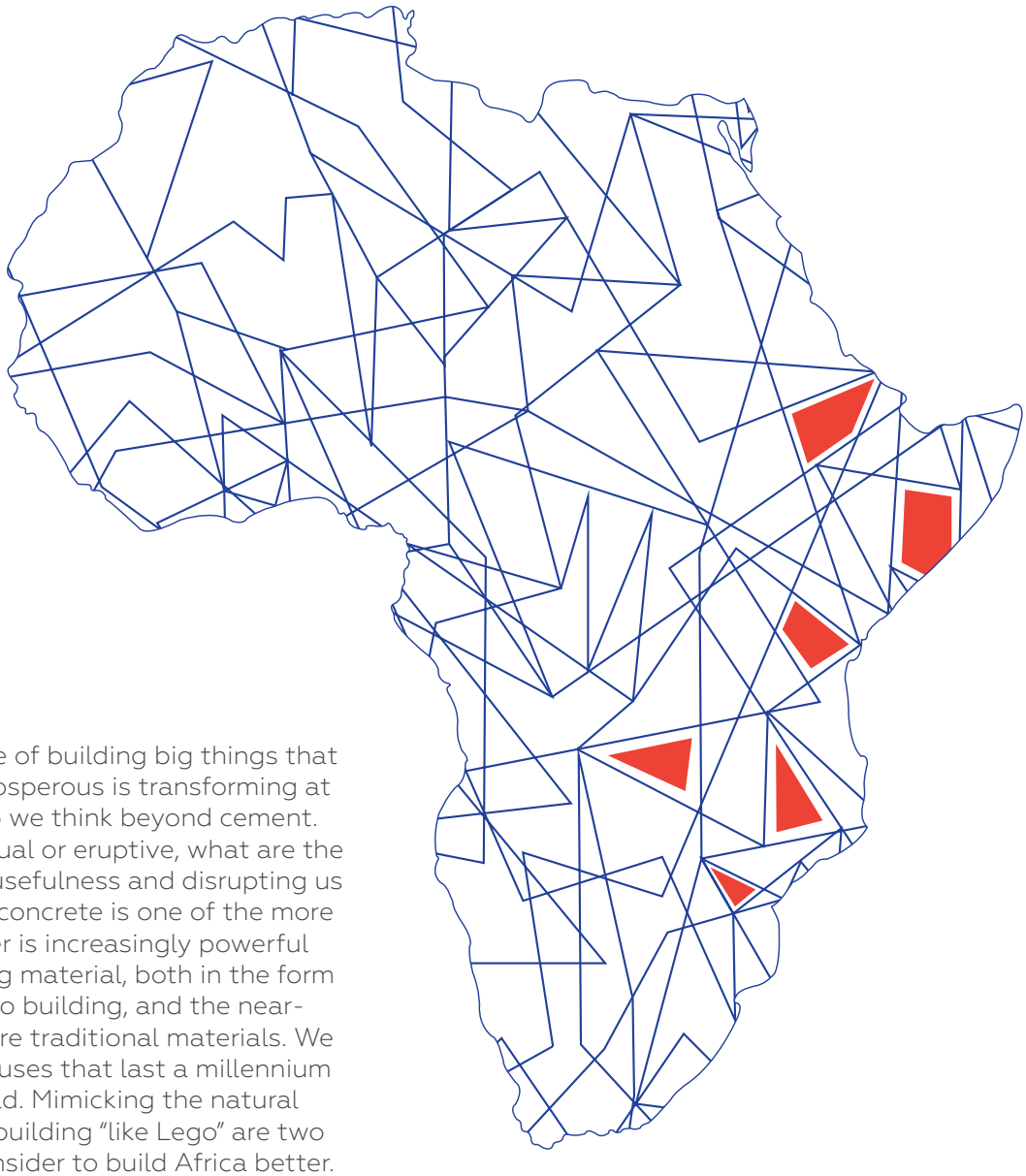
Of course, as the saying goes, sometimes the more things change, the more things stay the same. The internal combustion engine that powered Roosevelt's journey remains the heart of most cars today, despite the inroads made by electricity-powered cars. The mighty Aswan Dam holds firm, and Victor Hugo's Quasimodo lives on in the form of a Disney animation.

PPC lives through this same contradiction of consistency and change. After more than a century of having been listed on the Johannesburg Stock Exchange, it remains, at its heart, a producer of Portland cement. This most enduring of products – albeit vastly improved in many dimensions – remains the cornerstone of homes, bridges and skyscrapers the world over. The company's geographic footprint has been more expansive. PPC operations now spread from the original home in South Africa all the way to Ethiopia. The product line reflects that growth, now covering everything from fly ash to plaster.

In a faster and faster changing world, PPC has never been more cognisant of the need to evolve. The inaugural PPC-GIBS Building Africa Report is part of this effort to ensure the company stays relevant and successful in the years to come.

Recognising a deep commitment to the continent, this report begins with expert thinking on Africa as a developing story, a place and a cement market. We puzzle over the "African narrative" ahead of us, and analyse the major players in African cement.

# EXECUTIVE SUMMARY



However, the very nature of building big things that make the world more prosperous is transforming at a head-spinning rate. So we think beyond cement. What is next? Be it gradual or eruptive, what are the alternatives growing in usefulness and disrupting us before our eyes? Hybrid concrete is one of the more gradual solutions. Timber is increasingly powerful as an alternative building material, both in the form of small improvements to building, and the near-total replacement of more traditional materials. We are also able to build houses that last a millennium – and we ask if we should. Mimicking the natural world, 3-D printing and building "like Lego" are two more smart ways we consider to build Africa better.

We move swiftly onto the topic on everyone's minds in every corner of the world. Cement is carbon intensive, and we all want to address that challenge. Far from treating this as a threat, PPC sees the opportunity in doing more with less. In the Decarbonisation chapter, we dive directly into this challenge both from an engineering angle and a prickly political one.

Next is a deep dive into infrastructure as an industry, applying the mental habits of a business person. We think through interest rates, the opportunity of capacity and how to finance it all.

Continuing in the line of sustainability, our next topic is inclusivity. The intuitive take that cement and the built environment are dominated by men is backed up by statistics. We tackle this challenge with ideas to manage diversity better.

Finally, we apply our minds to the Africa that is represented most popularly by the African Continental Free Trade Agreement. We have known for a long time that trading among the countries of the continent is still far too limited. We can raise the tide for all ships by increasing the volume and quality of cross-border connectedness. We close with a chapter investigating this as creatures of international trade and transfer pricing.

Over 130 years, PPC has cemented a legacy as a reliable and supportive Pan-African industry partner, with a range of hard-working, 100% local, 100% premium quality products. Today, our products remain as proudly South African and unshakeable as the people who invest in them. The PPC-GIBS Building Africa Report 2022 is both a celebration of where we have come from and a hard look at where we are going.

# FOREWORD

One of the most powerful and enduring gifts we can leave the next generation of Africans is sound infrastructure. It is a differentiator. We know very well the positive correlation between more and better roads, buildings and ports, and prosperity in any society. Thus far, we are losing more on this trajectory than winning on this goal to achievement as a continent. We need new ideas and action. Now.

Do not let the disruptive and rapid rise of the virtual world distract you. Cyberspace is built on a platform of infrastructure. In fact, the speed of digital change should be our impetus to boost the creation and maintenance of infrastructure. That makes release of this publication all the more timely. The PPC-GIBS Building Africa Report 2022 is a source of rich and diverse thinking that we can turn into action. It gives me great pleasure to have been given the opportunity to pen this foreword.

## THE COVID-19 IMPERATIVE

Among the many lessons to be taken from the Covid-19 pandemic is the importance of infrastructure that is necessary to be able to stand up to exogenous shocks. It was research facilities, widespread online communication and novel, effective modes of transport that made the difference to lives and economies the world over.

But infrastructure is hard-earned. The pandemic further highlighted the way the private and public sectors have to combine forces to build infrastructure. Think of everything from collaboration on the development of medications between government laboratories and private scientists to the vast logistical challenges of ensuring essentials reach citizens during lockdowns. Africa tends to be lacking on these scores, too. Leadership and institutions must do better the next time emergency strikes.

Both evidence of shortcomings and guidance for the future are found in the UN Sustainable Development Goals, the SDGs. During the finalisation of these 17 vital goals, heads of state acknowledged the insufficiency of government capacity to deliver, and failings in coordination between the state and the private sector. These two sectors are powerful in their own rights, but can move continents when they work together. Imagine the possibilities of a "Marshall Plan" for Africa. Only this time, we have modern technology.

The African continent went into the lockdown with a sizeable existing socio-economic infrastructure deficit. Covid-19 merely deepened it. Relative to the pre-Covid-19 period, we will need multiples more effort and resources to raise our society's quality of life. Clearly, the challenges we are faced with are much bigger, more complex and excruciatingly urgent.

This heightened level of urgency is explicit in the discussions and outcomes of COP26. Similarly, an industry-led Task Force, the *Impact Task Force (ITF)*, under the aegis of the G7 Presidency of the UK, and with key contributions from South Africa, presented a report to respond to the emergency engulfing


the world and Africa in particular. It emphasises the thrust of this foreword with two statements:

"How can we accelerate the volume and effectiveness of private capital seeking to have a positive social and environmental impact?"

"How do we make sure this mobilisation has a real impact and does not leave people and places behind?"

These are not new questions, but the gravity of the context requires a more effective response than we have seen in the past. Thus, the title of the ITF Report – ***Time to Deliver***. The pressing need for an expedited approach to addressing our challenges could not be clearer.

The ITF Report makes one critical and encouraging finding that "there is more than enough private capital to fill the funding gap, and investment decision-makers are becoming increasingly alive to social and environmental risks." Again, the emphasis on the cooperation between the private ***and*** public sector is where the magic lies.

## ROLE OF CEMENT

Since time immemorial, cement has been synonymous with industrialisation, trade and development. It will continue to be essential for rebuilding and fool-proofing our economies going forward. The supply deficit as projected in this report comes as no surprise. That tells us that with little doubt, the expected efforts to turn around the continental economy will make the cement market a very promising area, for decades to come. This can bring with it the desired and much-needed development and jobs to the continental economy. The opportunity before us is more attractive, productive and competitive economies.

While it is no secret that the cement industry produces between 5-8% of the globe's $CO_2$ emissions, this is a problem that investors view as an opportunity. Businesses and investors that change the world do so, because they find opportunities where others see only risk and inevitability. As the inaugural PPC-GIBS Building Africa Report will illustrate, cement technology will get better and cleaner. It is a keystone to infrastructure, new work skills and, as a result, prosperity.

There is no doubt that the authors of this report have placed their finger on the right economic pulse. Congratulations are in order. However, as we get excited, it is essential that we leave no one behind. As we invest, do business and grow our infrastructure, we need to do so ensuring that this not only makes a profit, but improves people's welfare and is friendly to the environment.

**Elias Masilela**
Chairman, DNA Economics

# 1 AFRICA'S TRUE SIZE: THE GLASS IS IMMENSE

*Some see Africa's prospects as a glass that's half full. Others see the glass half empty. Neither view is wrong. Africa is a vast and complex place. Sometimes, it is the vastness alone that informs the discussion. In this article, Ian Macleod puts this size in context.*

*"Africa", you say? I ask, "Which one?"*

*That southern portion that equals the mighty United States of America for sheer size? Or the upside-down shaped duck that all of China could fit into? Perhaps you mean the extended "Horn" we could tuck the land mass of India into?*

*Of course, the tricky task of carrying out the above moves would add many languages to the 2,000-plus living languages in Africa. We need to clarify, which of those we mean when we say "Africa". These are spread over 55 countries with little regard for political borders. If we're talking business in Africa, we'll also have to pin down the legal jurisdiction that will govern our operations. How well-practised is our counsel in the customary law of the region we're considering operating in? And what does that system's Venn diagram do where it meets national legislation? We'd best also brush up on the influences of the great global legal traditions of civil and common law systems that have been integrated over the decades.*

*"Which Africa?" That is question number one.*

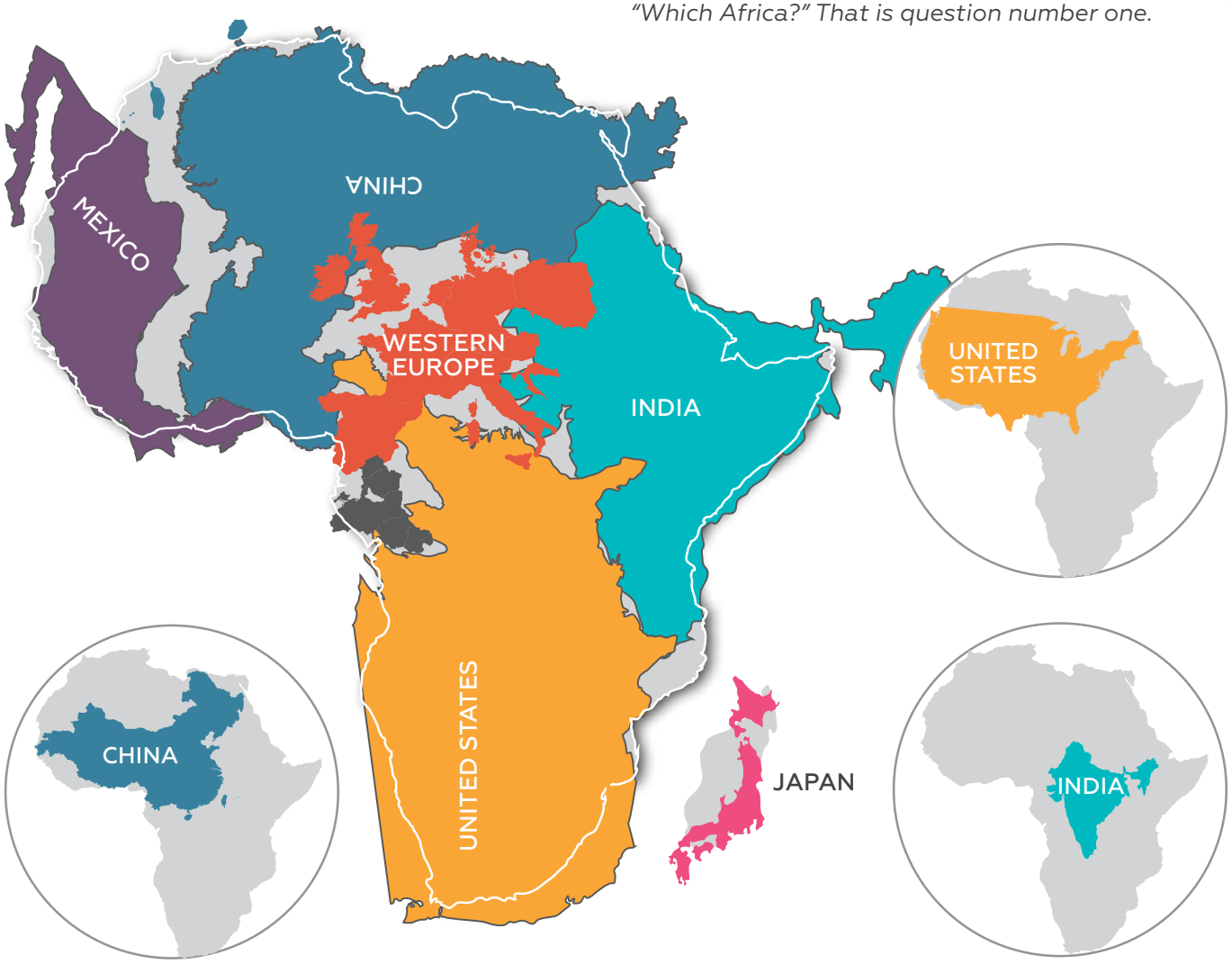
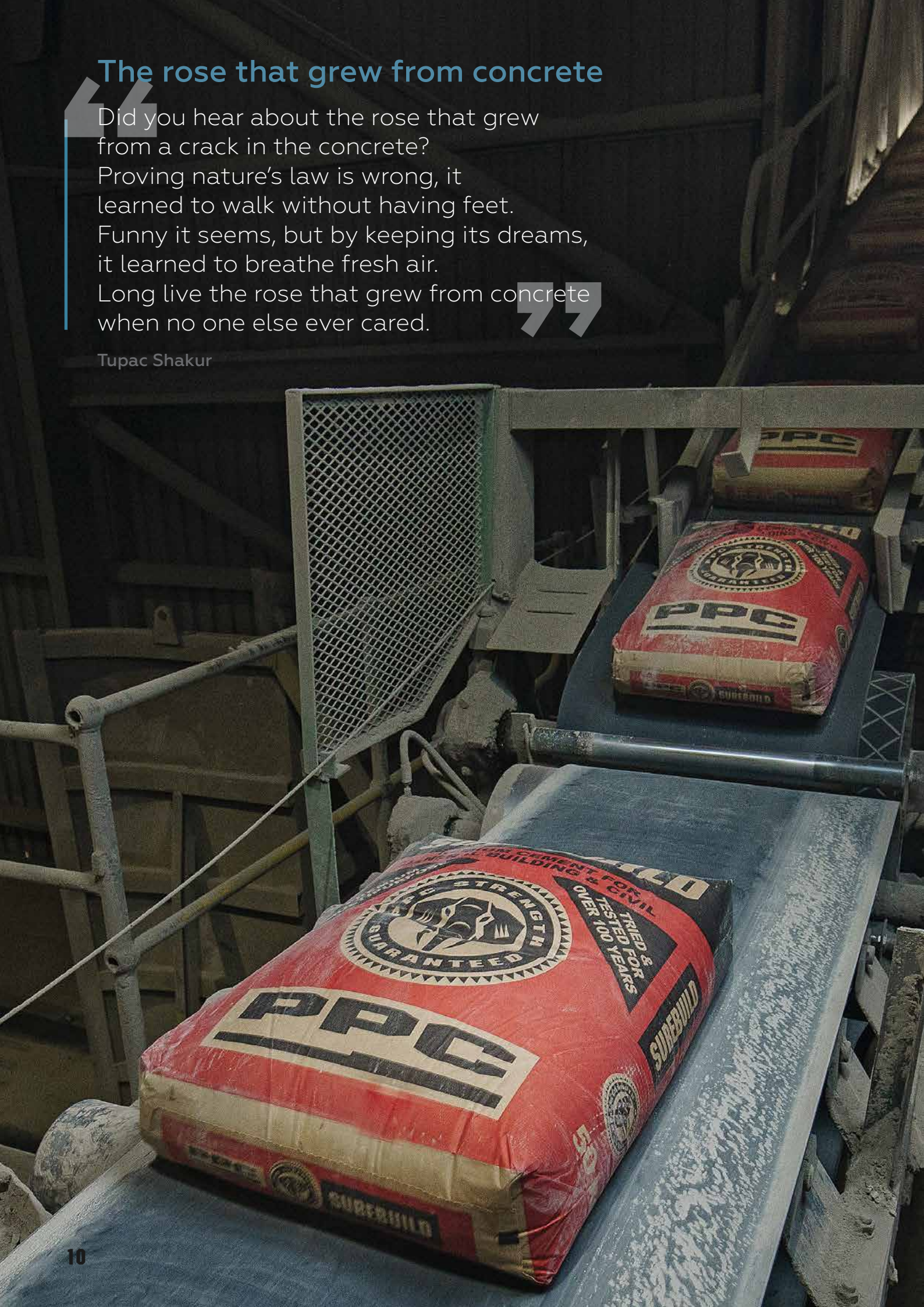



**Figure 1: Africa is bigger than it looks on most world maps**
Source: economist.com/graphic-detail/2010/11/10/the-true-true-size-of-africa?

## The rose that grew from concrete

Did you hear about the rose that grew
from a crack in the concrete?
Proving nature's law is wrong, it
learned to walk without having feet.
Funny it seems, but by keeping its dreams,
it learned to breathe fresh air.
Long live the rose that grew from concrete
when no one else ever cared.

Tupac Shakur



# AFRICA'S BIG NARRATIVE

> "The currency of financial decision-making is a narrative," says Prof David Tuckett of the University College, London. Indeed, we are a narrative animal. We conjure up and share stories to understand the world. That is how we build conviction to act – be it investing or otherwise. We follow this process to get a grip on Africa. Ian Macleod considers the African narrative as a preface to later analysis of the future of construction on the continent'.

Africa is variously referred to as the Dark Continent and the hope for the future. In truth, it is both, and more. It is troubled and has great potential. But what *is* Africa's economic hero's journey? What narratives are hurting us? What investible stories are there in regions and countries?

Prof Bob Shiller of Yale, a Nobel Prize winner for economics, has pioneered the field of narrative economics. His thesis: the economy is really just an accumulation of the stories we tell one another. It may be a discussion of interest rates over tea. Perhaps we share a stock tip with a friend at dinner. Or a journalist issues a warning of imminent collapse in house prices. These are analysed and considered individually. The ones we find of an impactful, we share. Over tea, dinner and the news wires. They grow. Curiously, they follow the sort of curves that viruses do. We can model them with epidemiological models – the science we have all become amateur experts at over the course of the Covid era.

Shiller monitors these narratives with Google Ngrams. Consider one iconic narrative: "machines are taking our jobs". The precise wording is immaterial. For a time, we moaned to colleagues about "labour-saving machines". More recently it was "technological unemployment".

We act on these narratives. Perhaps we will re-skill or advise our children to study the sort of technological subject that will keep them ahead of the curve. We'll likely invest in artificial intelligence. So will millions of other people.

Shiller sums it up like this: "Spread through the public in the form of popular stories, ideas can go viral and move markets, whether it is the belief that tech stocks can only go up, house prices never fall, or that some firms are too big to fail. Whether true or false, stories such as these, transmitted by word of mouth, by the news media, and increasingly by social media, drive the economy by driving our decisions about how and where to invest, how much to spend and save, and more." Shiller concludes: "We need a new kind of economics to understand this".

We have narratives for places, too. Some more accurate than others. Switzerland is a place of watch-like precision and a Silicon Valley address brings tech credentials. What is Africa's narrative as a future economic and engineering trailblazer? It depends on the stories we know and tell. Equally, the ones we do not tell. Say, the one about the Walls of Benin. How might it change the narrative if we were to know about this mid-fifteenth century Nigerian marvel and rival to the Great Wall of China for the largest man-made structure ever built? What would it do to our mind's eye looking at medieval West Africa? How did they build those concentric 18 m high walls over some 1,200 km$^2$ in what is today Edu State?

Figure 2: The Great Walls of Benin

This brings us to the important role of buildings in Africa and cement. Both cement and Africa need a new and an evolving narrative. Cement's old narrative is coloured by a troubling environmental footprint. "Concrete jungle" extends this unattractive metaphor.

As much of the innovative thinking and action, which the inaugural PPC-GIBS Building Africa Report shows, there is ample opportunity to change this narrative. The same goes for Africa. Not the "Dark Continent" or the great hope, but both, and more.

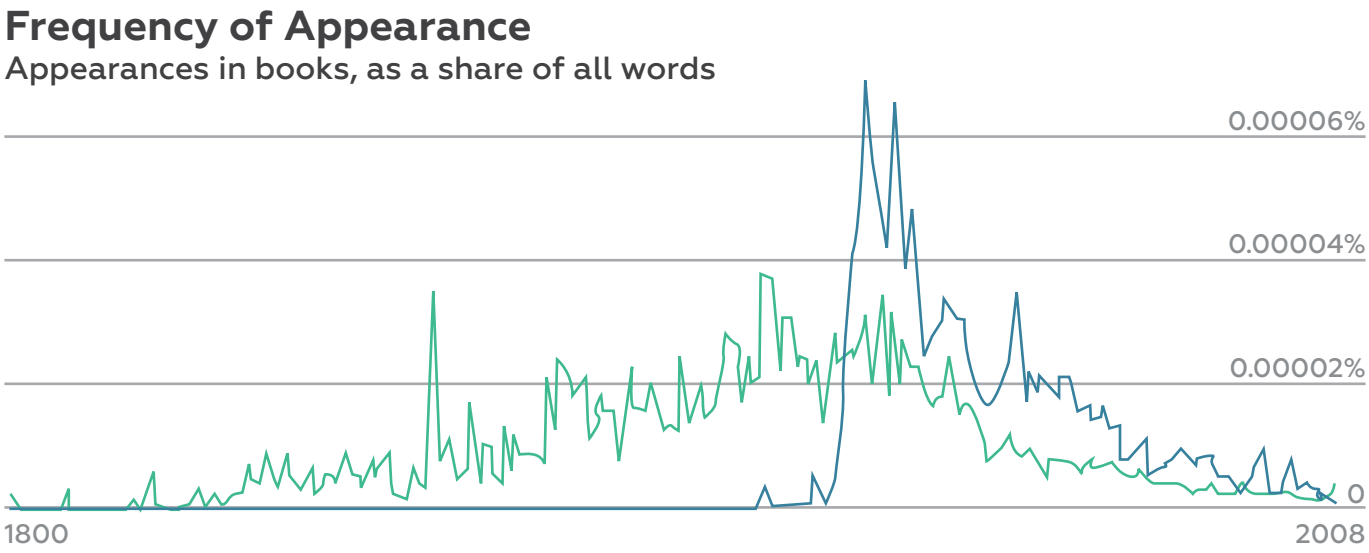



Figure 3: Frequency of Phrase Appearance in Books
Data source: Google Ngrams

**Ian Macleod**
Consultant at the GIBS Centre for African Management and Markets (CAMM)

Ian Macleod is a consultant at the GIBS Centre for African Management and Markets (CAMM) and founder of the Investment Narrative. A former feature writer and management consultant, Ian's current focus is the implementation of storytelling and narrative to drive investment decision-making.
http://www. investmentnarrative.com

"Your dreams are like the cement. If you water it with actions, it becomes a hard concrete mass. But if you leave it exposed and let it dry out, the air will easily blow it away!"

**Israelmore Ayivor**

# 2 CONTINENTAL CEMENT INDUSTRY

Who? Where? Where to? As demonstrated earlier, Africa is huge and complex. The cement industry mirrors this. To begin to understand it, we need to know the major players, their arenas, and where they are going. Dr Stanley Ko sets out the playing field.

Prior to 2010, limited local investment in the cement industry and resulting shortages positioned sub-Saharan Africa (SSA) as a market for imported cement. Traditionally, multinational European cement firms such as Lafarge, Scancem (Heidelberg Cement), and Holcim – via their network of import terminals and cement grinding plants – made use of SSA as a captive market for their excess clinker or cement. Thereafter, supply shortages and an economic boom in Africa in the early 2000s triggered a wave of investments, converting the SSA cement landscape from a deficit to a surplus market. Over the last 14 years, SSA witnessed a drastic increase in effective cement capacities from 38 mta to 162 mta (an increase of 424%)

Future supply and demand are based on Effective Cement Capacities (ECC) and a projected market growth rate equivalent to that of the recent past. ECC are derived from rated clinker capacities and estimated plant utilisation. A deficit in supply was balanced via imports of either clinker or cement.

## Sub-Saharan Africa Cement Supply-Demand 2007-2025

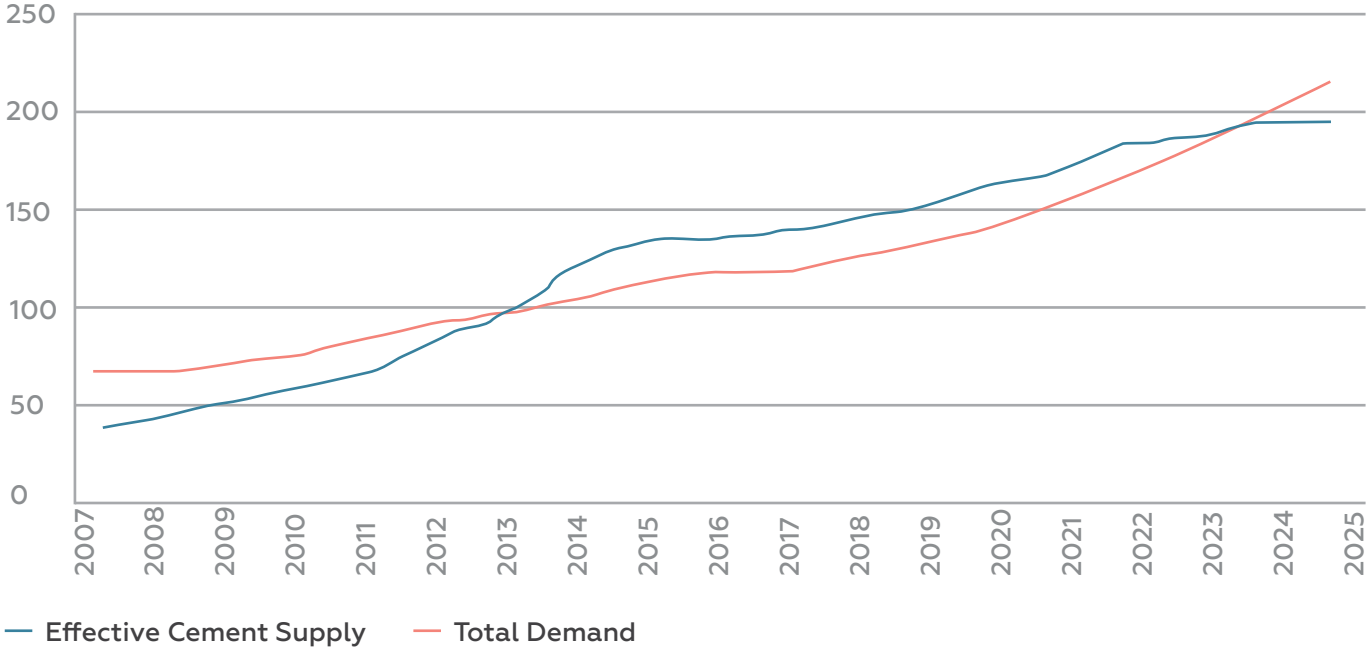



**Figure 4: Cement Supply and Demand in Sub-Sahara Africa**
Source: Global Cement Report (14th Edition)

Recent over-supply of cement inflicted hardship on several cement firms and new investments were put on hold, while cement prices crashed, as producers tried to retain market share amid several new suppliers entering. The over-supply conditions led cement producers to create barriers and encouraged collusion to block imports and slow down supplies. However, cement demand continues to grow, and the market could be in a deficit position again as early as 2024.

With a market demand of 216 million tons projected for 2025, the average cement consumption *per capita* in SSA will only be 189 kg. This is not particularly high when compared to China's 1,620 kg *per capita*, or the 911 kg *per capita* in Vietnam and 314 kg *per capita* in the USA in 2020.

While all sub-regions in SSA experienced an increase in cement demand, a noticeable upsurge was evidenced in the Economic Community of West African States (ECOWAS) region growing at double speed. Africa's largest economy, Nigeria, dominates the SSA region's cement industry, with Ghana being the second largest contributor, followed by Senegal. The largest cement supplier in the ECOWAS region is Dangote Cement. In 2002, Dangote's cement production capacity was a mere 0.8 mta, which ballooned to 29 mta in 2014.

A period of growth normally ushers in capital for investment, an evolution from local to regional players, and the attraction of new entrants. These players often arrive with diverse backgrounds, aspirations, and risk appetites.

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# MAJOR MNCS

With large balance sheets and technical know-how, multinationals are equipped to venture into emerging economies. European producers were more active participants initially, and firms such as Holcim, Lafarge, Blue Circle, Scancem, HeidelbergCement, Vicat, and Cementia AG entered Africa. Many of these faced shake-ups at home and sought external growth to sustain their ROIs.

Between **Holcim** and **Lafarge**, it was Lafarge that had bigger interests in Africa. Initially, these interests were mainly in French-speaking countries. In 1990, Lafarge acquired a Swiss company and inherited Mombasa Cement in Kenya and a network of bulk cement import terminals in the Indian Ocean. Many years later, Lafarge's financial position weakened, and exacerbated by a market slowdown, it was forced to merge with Holcim. Later, LafargeHolcim dropped the Lafarge name, simply becoming Holcim again and started to divest from the continent.

**Heidelberg Cement** acquired an interest in Scancem in 1999. Established in the 1960s, Scancem was a cement trading company that established grinding plants and bulk import terminals in West Africa. The company seems to mostly prefer grinding plants instead of integrated plants.

**InterCement,** a Brazilian cement group**,** acquired Portugal's CIMPOR and inherited two old integrated cement plants, one in KwaZulu-Natal, South Africa, and the other in Maputo, Mozambique.

French family-owned cement group **Vicat** has been involved in the West African cement market since 1999. It is the largest cement producer in Senegal and its market reach stretches to Mali and Mauritania.

| | Companies | SSA Countries |
|---|---|---|
| Major MNCs | Holcim (formerly LafargeHolcim) | Nigeria, Cameroon, Kenya, Uganda, South Africa, Benin, Guinea, Ghana, Ivory Coast, Madagascar, Zimbabwe |
| | Heidelberg Cement (Scancem) | Benin, DRC, Ghana, Guinea-Bissau, Sierra Leone, Mozambique, Tanzania, Togo |
| | Intercement (Cimpor) | Mozambique, South Africa |
| | Vicat | Senegal, Mali, Mauritania |
| Regionals | Dangote | Nigeria, Cameroon, Congo, Ethiopia, Tanzania, Senegal, Ghana, Ivory Coast, Gabon, Niger, South Africa, Zambia |
| | PPC | South Africa, Botswana, Zimbabwe, DRC, Ethiopia, Rwanda |
| | CIMAF | Burkina Faso, Congo, Gabon, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Mali |
| | WACEM | Burkina Faso, Ghana, Guinea, Ivory Coast, Mali, Niger, Togo |
| | AfriSam | South Africa, Tanzania |
| Nationals | BUA | Nigeria |
| | National Group (Deuki Group) | Kenya, Uganda |
| Chinese MNCs | West International | Mozambique, Ethiopia, DRC, Congo |
| | Huaxin | Zambia, Malawi, Tanzania |
| | Jidong | South Africa |
| Other Internationals | Pakistan - Lucky | DRC |
| | Turkey - Limak | Ivory Coast, Mozambique (GPs) |

Table 1: SSA Cement Producers' Profile
Source: Albarka Africa International Analysis

# REGIONALS

Africa is a continent with many landlocked countries. Africa is essentially segmented into Anglophone and Francophone areas. Language familiarity facilitates nationals to grow into regionals (e.g., CIMAF and WACEM). At the same time, more ambitious nationals can grow into Pan-African Regionals (e.g., Dangote and PPC).

The **Dangote Group** was launched in the 1970s as an importer and trader of commodities such as sugar, rice, fish and salt. Manufacturing began in the 1990s. Dangote's interest in cement started with imports before moving into cement manufacturing in 1992. Following a series of acquisitions of inefficient state-owned cement plants as well as its own expansion projects, Dangote quickly grew to be Nigeria's largest cement producer. In 2020, Dangote's cement sales gave the company a 61% market share. In 2020, Dangote commissioned an export terminal, but the company still relies on Nigeria to generate earnings, as surplus markets in Zambia, South Africa, and Ethiopia continue to dampen the group's financial performances. Dangote's export terminals in Nigeria and exportability from Senegal are expected to boost the company's dominance in the ECOWAS markets.

South Africa's Pretoria Portland Cement **(PPC)** was founded in 1892. Despite its long history in the cement industry, PPC did not initially take advantage of its African heritage to venture into the growing continent, with its only foreign operations initially being Zimbabwe and Botswana. Eventually, in the early 2010s, PPC started to venture into other African states, based on strong cement demand from the region. While the company has always been well established technically, it appeared to lack regional expertise and strategic cohesiveness of those investments. Some new investments destroyed value and loaded the company with heavy dollar-denominated debts. Today, PPC has 11 cement factories in South Africa, Botswana, DRC, Ethiopia, Rwanda and Zimbabwe with a combined cement capacity of 11.5 mta.

**CIMAF** or Ciments de l'Afrique was created in 2012. CIMAF controls 13 grinding plants in Burkina Faso, Cameroon, Chad, Ivory Coast, Gabon, Ghana, Guinea, Guinea-Bissau, Mali, Mauritania, Republic of the Congo, and Togo. CIMAF's total cement capacity is estimated at 8.95 mta.

**WACEM** or West African Cement SA was established in 1996 in Togo. From Togo, the company expanded into Burkina Faso, Ghana, Guinea, Ivory Coast, Mali and Niger, where it established grinding plants. The network controls cement capacities of about 7.4 mta.

**AfriSam** is the second largest cement company in South Africa. It was founded in 1934 as Anglovaal Portland Cement Company. The company underwent a series of name changes and ownership changes. AfriSam controls two integrated plants in South Africa and an integrated plant in Tanzania with combined capacities of 5.8 mta.

# NATIONALS

Nigeria's **BUA Cement** was incorporated in 2008 and started importing bulk cement via floating terminals. Through a series of aggressive capacity expansion programmes, the group's annual production capacity increased to 8 mta, making it the second largest cement company in Nigeria.

**National Cement (Devki Group)** is a privately-owned conglomerate. The owner started a steel mill in 1986 and ventured into cement production in 2011. By 2020, National Cement's total cement capacity reached 4 mta, making it the largest cement producer in Kenya.

# CHINESE MNCS

**Huaxin Cement Co Ltd** is listed on the Shanghai Stock Exchange and reports global revenues of $4.5 billion in 2020. Holcim has considerable shareholding in Huaxin. Huaxin controls more than 200 cement plants worldwide, with African operations in Tanzania, Zambia and Malawi, and an African production capacity of 4.1 mta.

**West International** production facilities are located in Western China, but they have focused on the development of Greenfield projects in Africa. A new 2 mta Maputo cement plant was opened in 2021. The group has projects in Ethiopia, the Democratic Republic of Congo and Congo.

**Tangshan Jidong Cement Co. Ltd** is a Shenzhen listed company and the sixth largest cement company in the world. Their first overseas investment was in Mamba Cement in the Limpopo Province in South Africa, with a plant capacity of 1 mta.

# OTHER INTERNATIONALS

**Pakistan**: **Lucky Cement** is one of the largest Pakistani cement producers (12 mta) and one of the largest cement exporters reaching from East Africa down to South Africa and the dominant player in the Bas Congo region. Their sole investment in Africa is in the DRC, where the company owns a 1.5 mta facility, located 200 km from Kinshasa.

**Turkey: Limak Holding AS** is one of the leading Turkish cement producers (18.4 mta). To offset the weakening domestic demand, they installed an export terminal and target exports of 2 mta. Their first foray into a foreign market was in Maputo, Mozambique with a 1 mta grinding plant and a similar one at the Ivory Coast.

# GAME CHANGERS

From a deficit in 2007 to a surplus 10 years later and a possible return to a deficit in the next five years, the SSA is experiencing a dynamic not regularly seen in other parts of the world. Cement is a highly capital-intensive business. In Africa, being a successful cement producer is even more complex. What are the drivers for this African industry?

| | Yesterday | Today | Tomorrow |
|---|---|---|---|
| **Geographical Areas** | Domestic country | Regional/ clusters | Interlinked regions/ clusters |
| **Product Mix** | Cement | Cement/ ready mix/ precast | Application formulations |
| **Players** | Local cement producers | Local, becoming regional producers<br>Vertical integration – ready mix | Regional/ cluster cement producers<br>Application providers |
| **"Rules of the Game"** | Monopolistic (Zambia)<br>Domestic cartels | Besieged oligopolies | Local oligopolies to cut-throat competition<br>Restructuring of industry |
| **Acquisition Targets** | Small, family-owned<br>State-owned plants | Divestments by global players<br>Divestment by regional players<br>Assets with serious financial stress | Assets with serious financial stress |
| **Acquirers' Profiles** | | Strong regionals<br>Influx of medium-sized Chinese groups | Chinese cement MNCs |

**Table 2: Evolution of Competitive Scenarios**
Source: Albarka Africa International.

## GEOGRAPHY

Many larger cement firms grow beyond their own country. The growth is influenced by strategic ambitions, accumulation of operational know-how and the availability of capital. Dangote and PPC are such examples. Africa is a continent, and most of the countries are linked by land borders. A natural transition will be for these clusters to interlink and optimise organisational and operational synergies. However, while Nigeria and Togo are a good geographical fit, Nigeria and Ethiopia are not.

## PRODUCT MIX

When there is a market shortfall, manufacturers produce a homogenous product and receive orders without much effort going into marketing or sophistication in sales. Often, these sales are made in cash or prior payment (e.g., Zambia before new entrants). As supply increases, manufacturers' desire to sell out of their products evolves into strategies such as vertical integration, for example, in supplying concrete or packaging special-purpose products. When a surplus persists, creative manufacturers evolve by formulating products serving a particular purpose, for example, a plastering cement mix, tiling cement mix, and water-proofing cement.

## PLAYERS

During a market shortfall, players tend to respond to market demand with production facilities rolling out standard cement. The attraction of strong revenue growth and accumulation of competencies motivate national players to expand into the larger region. Aggressive capacity growth could also compel players to leverage downstream products such as ready-mixed concrete. In Japan, players found a new income stream by transforming themselves from producers of cement also to becoming incinerators of waste.

# RULES OF THE GAME

At times, and especially when capacity is lacking and demand is growing, domestic cartels' intentions are to reap the benefits of superior returns. When the equilibrium changes and their oligopolies are besieged, instead of finding ways to improve sales and performance, players may seek to prevent imports and create barriers of entry for new players. They also collude with anti-competitive chess moves. When competition dampening tactics fail, cut-throat competitive pricing (e.g., Zambia) may transpire. Falling sales and weakening margins will then force a restructuring of the industry and mothballing of capacity.

# ACQUISITION TARGETS

The profile of acquisition targets has mainly been small family plants and inefficient state-owned plants. The acquisition of poorly managed state-owned plants was the strategy used by Dangote and BUA Cement to quickly enter markets. During a time of capacity surplus and increasing competition, cash-strapped MNCs and regionals began to exit their markets (e.g., Lafarge's divestments in Zambia, Malawi and Tanzania; and ARM in Tanzania). Hence, financially-stressed assets will continue to be available for purchase.

# ACQUIRERS' PROFILES

From 2007 onwards, the industry witnessed a rise in the number of MNCs buying cheap African assets and an increase in regionals such as Dangote and PPC venturing into other African countries. Even young companies such as ARM and National Cement expanded into neighbouring countries and reported various outcomes. The attractiveness of Africa caught the attention of Chinese internationals (e.g., Jidong, Huaxin and West International) despite the surplus situation. Because of their higher risk appetite and a longer-term vision of Chinese MNCs, they will likely remain the common profile for future acquirers.

**Dr Stanley Ko**

Africa Cement Specialist and Managing Principal of Albarka Africa Investments

Stanley hails from Singapore and now calls Johannesburg home. He is the founder and president of Albarka ("Blessing" in Nigerian Hausa), an Africa-based organisation that supports the developmental phases of mining, manufacturing and agricultural projects. Stanley consults for a Hong Kong-listed company focused on developing a cement production network in Africa.


Knowledge is a garden.
If it is not cultivated,
you cannot harvest it.
African proverb

# 3 INNOVATING OPERATIONS

## MODERNISING AND MOVING – THE CIMERWA, RWANDA STORY

Dig a hole, fire the kiln and load the trucks. Those have been the foundations of making cement since the emergence of the standard Portland variety in the mid-1800s. But there is immensely more to it than that. Lots that can go wrong. Lots that can go better. Natalie Buckham captures Carsten Schubert's experience at PPC's Rwanda plant as a case in point.

Nobody ever said doing business in Africa was "business as usual". Succeeding on the continent often means overcoming challenges that are fundamentally already optimised in an advanced economy. The privilege of a multi-carriage highway connecting you to your customers, for example, is not a given. PPC's entry into Rwanda in 2012 captures this phenomenon and highlights a few nifty solutions.

When CIMERWA PPC came into existence in Bugurama, in the west of Rwanda, its operation was little more than a cement factory some 330 km from the country's construction hub of Kigali. Not a first world 330 km. Trickier than that. A good 2 days by truck. The gap was filled by independent transporters, who clubbed together to take advantage of rebates for higher volumes.

When PPC acquired 51% of CIMERWA in 2012, the plant was both old and way behind on latest automation technology. Its capacity was also low for an efficient cement plant, at 95,000 tons *per annum*. This helps to explain why Rwanda was importing much of its cement.

Fortunately, the Rwandan Government was supportive of plans for a fully integrated cement plant – an all-in-one facility that mines the limestone and gets it all the way to the finished product. CIMERWA PPC effectively built a new, integrated, modern plant with a capacity close to 600,000 tons *per annum*.

Still, the extant selling system was antiquated. Transporters paid for their orders and waited for a phone call before collecting the load. The lag between these two steps was about a week. The transporter would then present himself at the factory, collect a voucher and the truck would drive down and wait in a queue, before loading cement. Only then did the 2-day journey to Kigali begin. Customers who ordered directly from CIMERWA and not from the "cement barons" – as the transporters became known – would have to source their own transporters to collect cement on their behalf.

This is where Carsten Schubert from TransNova came into the picture. His task was to advise on an alternate distribution strategy in order to undo the disintermediation. First came some easy remedies. The business then had one salesperson who sold to half a dozen transporters. The calculations suggested a team of six was needed. CIMERWA then set about recruiting experienced sales professionals with strong FMCG and beverage experience.

A toll-free line was set up, alongside a facility to give customers credit. To overcome the issue of interbank time lags when customers paid from a different Rwandan bank to CIMERWA's bank, accounts were opened at all local banks. Payments now reflected immediately.

An enterprise resource planning (ERP) system was set up to automate the ordering process. Now drivers picked up orders at the factory in a seamless manner.

Carsten turned to the matter of trucking tons of cement across a hilly countryside with well tarred, yet very winding roads. He reckoned that purchasing a fleet of trucks was an unnecessary burden on the balance sheet. The company also wanted to build sustainable relationships with service providers in the host country. The answer lay in a new deal with the transporters.

TransNova established that the transporters all belonged to a trade association, the Hima Cement Distributors Association. Carsten approached the group with an offer. CIMERWA PPC would provide guaranteed volumes of cement to transporters in return for ownership of the end buyer relationship. This would mean an additional 20-30% work for the trucks. But the group initially turned him down.

Carsten then approached the largest security company in Rwanda and proposed that they start a logistics business and offered them the same committed volumes for transportation. They agreed and signed a three-year contract. Seeing this, the original local transporters wanted in, and re-opened negotiations. Over time, a local transporter's business with originally 60 trucks, quickly grew to 140 trucks.

The next smart move was a novel approach to regional services trade regulations. Tanzanina-registered vehicles are restricted to pick up and drop off product procured and sold in Rwanda. As a result, Tanzanian transporters had been transporting the coal needed in the cement-making process and returning to Tanzania with empty trucks. Because of troubles in Burundi, the route between Bugurama and Tanzania goes through Kigali. Transnova's discovery was that their local Rwandan transporter could go through Kigali, drop the coal off, collect cement and on a backhaul delivery transport the cement into the heart of Kigali or onwards to the east of Rwanda. Voila!

A key technological improvement was the adoption of a virtual warehouse. This was nothing other than a cost centre in SAP software. Now the plant had the ability to dispatch trucks independently of orders coming in. With trucks constantly, proactively on the move, coupled with the capacity to hold orders in Kigali in the event of a gap in demand, lead times were cut to between two and four hours – down from the previous week or two.

CIMERWA turned to the rebate system. Selling to an agglomeration of transporters had accompanied larger rebates. The lower margins were, however, not translating into added sales, but while they were not in a position to slash rebates at the bulk level, it kept them more competitive for smaller buyers. By democratising the rebate system, it made it possible for the small retailer to participate in the rebate structure and it discouraged the formulation of group buying schemes. In sum, it was hardly business as usual. Not everyone is prepared to take on these wicked problems. That is where fortune favours the brave – and the smart.

**Carsten Schubert**
Director, TransNova

Carsten is a supply chain professional with over two decades of experience in the transport and logistics industry in Africa. He advises large continent-based businesses such as PPC and global megabrands on getting things from A to B efficiently in challenging conditions.

**Natalie Buckham**

Natalie is an independent management consultant, combining the realms of English language and economics. Natalie spent the early part of her career advising South African firms on economic inclusion and compliance with Black Economic Empowerment regulations. She also worked for a Big Four firm in management consulting. Her current fields of professional interest include economics, business strategy, ESG investing, diversity and development.

> I call architecture
> frozen music.
>
> **Johann Wolfgang von Goethe**

# 4 ONWARD TO ALTERNATIVES

## NURTURING NATURE: BIOMIMICRY IN BUILDING

We are all occasionally guilty of not seeing the wood for the trees. In architecture, the answers sometimes lie in nature. Lood Welgemoed and Marc Thomas explain how biomimicry is used to build more effectively and efficiently.

Evolution has often led to solutions to problems being found through trial and error. Plants and animals have adapted, learned from mistakes and survived. Proven and continuously improved methods in nature resulted in methods that can be incorporated into the built environment to engrain greater harmony and efficiency.

This is all to introduce biomimicry. Architecture can mirror the natural world to benefit from its wisdom. Consider the humble termite mound. The result of thousands of the tiny insects working apparently without a blueprint, the resulting structure withstands much of what the world throws at it. The residents are safe from rain and wind. The occasional anteater penetrates the castle walls, but that too is only by a formidably evolved trait in the form of a uniquely shaped tongue. Even the harshness of the African sun will not kill off the colony – no air-conditioning required.

This is all to introduce the Eastgate Centre in Harare, Zimbabwe, a mixed-use structure that harnessed insights from the humble termite mound. Chiefly, the designers built in the natural termitary enhancers of ventilation and cooling. The office block and shopping centre in the middle of the capital city was designed by Mick Pearce with Arup engineers. Opened in 1996, it was constructed without expensive and energy-hungry air-conditioning or heating. The virtues of the termite

Cathedral Termite Mound

mound, assisted by indigenous Zimbabwean masonry, regulates the temperature.

This structure covers 5,600 m² of retail space, 26,000 m² of office space and parking for 450 cars. Heating the building was the least of the challenges faced. The potent southern African sun shines during the day, while bustling people bring warmth of their own as they go about their business. So, how does one cool this space down? In short, hot air rises. Eastgate Centre's atria and chimneys passively draw heat out of the building at night, aided by fans installed at its base. Strategically positioned openings throughout the building assist by enabling the wind to provide ventilation.

Concrete and brick were chosen for their high thermal capacity. They act as a thermal mass to absorb and store relative heat or cold, gradually releasing them when the outside temperature changes. This is aided by a nifty design feature: The façade forms distinctive ridge shapes that increase the surface area exposed to the sun. This means more heat can be absorbed when it is hot, and more is released in cooler weather. The uneven exterior of a termite mound refers.

These passive design features are theoretically sound, but how does this translate into operational economy? Some $35 million was saved up-front by the limited need to install air-conditioning.

However, the real benefit is an ongoing one in the use of the building. Lower running costs and reduced operational carbon footprint pay dividends every day. The building uses some 35% less energy than comparable structures in Zimbabwe.

**Eastgate Centre in Harare, Zimbabwe**

Similar thinking went into the Department of Environmental Affairs building in the City of Tshwane, completed in 2014. Based on who the client was, one can imagine the environmental imperative.

Given the almost 20-year gap between this project and Harare's trailblazing example, technology and materials have evolved, but the principles used were fundamentally unchanged. The building's design and especially its 'feminine' public centre, was informed by the humble Nautilus shell, an excellent example of the Golden Section in nature. Its organic form allowed for the arrangement of the interior function to be easily discernible. Its natural geometry helped guide the structure's hierarchy and user movement to its more industrial, 'masculine' purposes. By employing nature as an informant to the organisation of its form and orientation, the building was able to arrange additional passive features within its operation to further reduce its reliance on energy consuming technologies.

A careful selection of honest materiality was chosen, as in Harare, for the thermal mass, allowing for passive circulation of cooler air during daytime operation, while large internal spaces and volumes flush warmer air out through strategic openings at roof level at night. This natural process is aided by an 'active' Building Management System (BMS) that monitors external and internal temperatures and opens windows accordingly.

The designers saved energy in other ways, too. Solar panels generate some 10% of the operational energy requirements by covering over 2,000 $m^2$ of roof space, essentially creating an urban solar farm environment. Extensive daylight and energy modelling inform the most effective window positioning and sizing, while wall, roof and transitional gardens not only aid in both cooling and aesthetics, but provide an instinctual human connection to nature, proven to increase our productivity. The BMS system adjusts the lux levels of the interior artificial lights, based on the quality of daylight and ever-changing activity of each internal space.

Water management is equally important. Each block's roof surface is shaped to funnel rainwater to a central feature downpipe, which directs water to storage tanks in the basement. Rainwater is thus able to be harvested for use in the gardens and restrooms. This natural innovation provides a 30% reduction in municipal water consumption compared to buildings of a similar size. The result is a 6-Star Green Office v1 Design rating from the Green Building Council South Africa (GBCSA), the first public building in the country to earn this recognition and the first in Africa.

There are many benefits of biomimicry, but they are summed up with the achievement of one simple goal: doing less with more. For Africa and other developing markets especially, this is key. It is not sustainable to target selling more to everyone, but to do more good for more people without raising kilowatt hours or cement consumption per person. This is the evolutionary takeaway humankind needs to embrace to ensure the future is manageable.

**Lood Welgemoed and Marc Thomas**
Creative Director & Architect, Lood Studio

Lood Welgemoed is an architect with experience at major and award-winning practices in London, Abu Dhabi and South Africa. He founded Lood Studio in 2018.

Marc Thomas has plied his skills for established architecture firms in the United Kingdom and South Africa. He joined Lood Studio as architect in 2021.

# TEAMING UP WITH TIMBER

We are getting used to hybrid work in the wake of Covid-19 lockdowns. Chris Greensmith has been on a mission to hybridise homes and offices in a different way for far longer. An engineer with long experience in the tried and tested concrete paradigm, Greensmith reckons we can and must move rapidly towards mass timber.

How do we feel about timber in big buildings in South Africa? In our cities, we love our concrete. Heavy foundations and thick concrete walls that feel robust, safe and long-lasting. The big concrete-framed and glass-clad buildings of Sandton seem cutting edge. They are the stuff of major financial districts the world over. However, we may be missing a trick: mass timber. Despite some of our preconceptions, this is strong, long-lasting and comes with financial and green benefits, and the fire hazard is manageable, too.

It is not a new idea. Timber predates iron and steel in buildings. It goes back to medieval ages. Look at the churches and cathedrals built in those times. The industrial revolution saw the rise of steel and concrete, specifically with the advent of Portland cement. This brought more consistency and reliability to designing with these materials.

In the last 20 years, we have come a long way with well-engineered mass timber. The construction industry is already somewhat familiar with Glue Laminated Timber (GLT, or Glulam), but newer siblings Cross-Laminated Timber (CLT) and Laminated Veneer Lumber (LVL) have led the way for construction-friendly properties. They are stronger and more predictable. We can also use lower grades of wood to make quality products that exceed the virgin material.

CLT is essentially taking layers of planks and gluing one on top of the other crossways. This gives greater dimensional stability. It is great for shear walls and floor plates. LVL is made by laminating very thin slivers of wood together, with the grain of each sheet all in the same direction. These are often used in the same way as with the grain being vertical, as beams or to make up floor cassettes. While this seems very similar to plywood, these new engineered timbers can be produced using structural grade material, at the sort of scales akin to a building structure. Hence the term *mass* timber.

South African structural design engineer and Technical Director at Zutari, Chris Greensmith is part of a new school of designers and builders driving the incorporation of mass timber such as this into construction in the country.

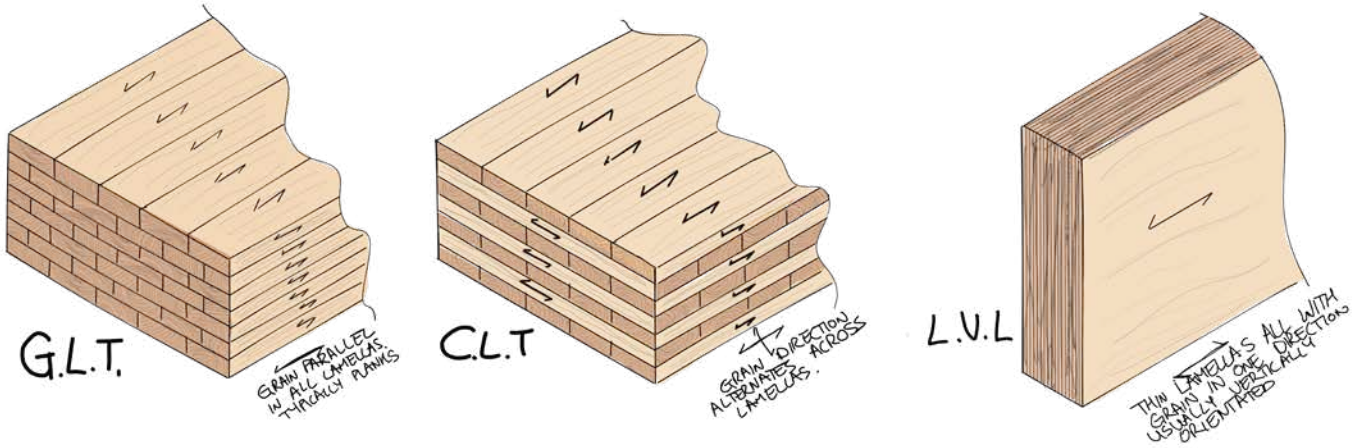



Figure 5: Differences between GLT, CLT and LVL

The following chart shows improvements in GDP output per employee over the past 62 years from 1950. Manufacturing has been stellar. Think iPhones, cars and batteries. Utilities and agriculture tell a similar tale, while construction is the ugly duckling. "We are not building in new ways. We are building more of the same with more of the same resources", says Greensmith. "So even if we do things faster, it's not because we've innovated. We are throwing more money, more materials and more people in to get the same outcomes." Things such as mass timber are essential if we plan to turn the duckling into a swan.

## Construction productivity 1950-2012

### Real productivity (GDP value-add per employee) by industry in the US Indexed; 1950 = 1.0

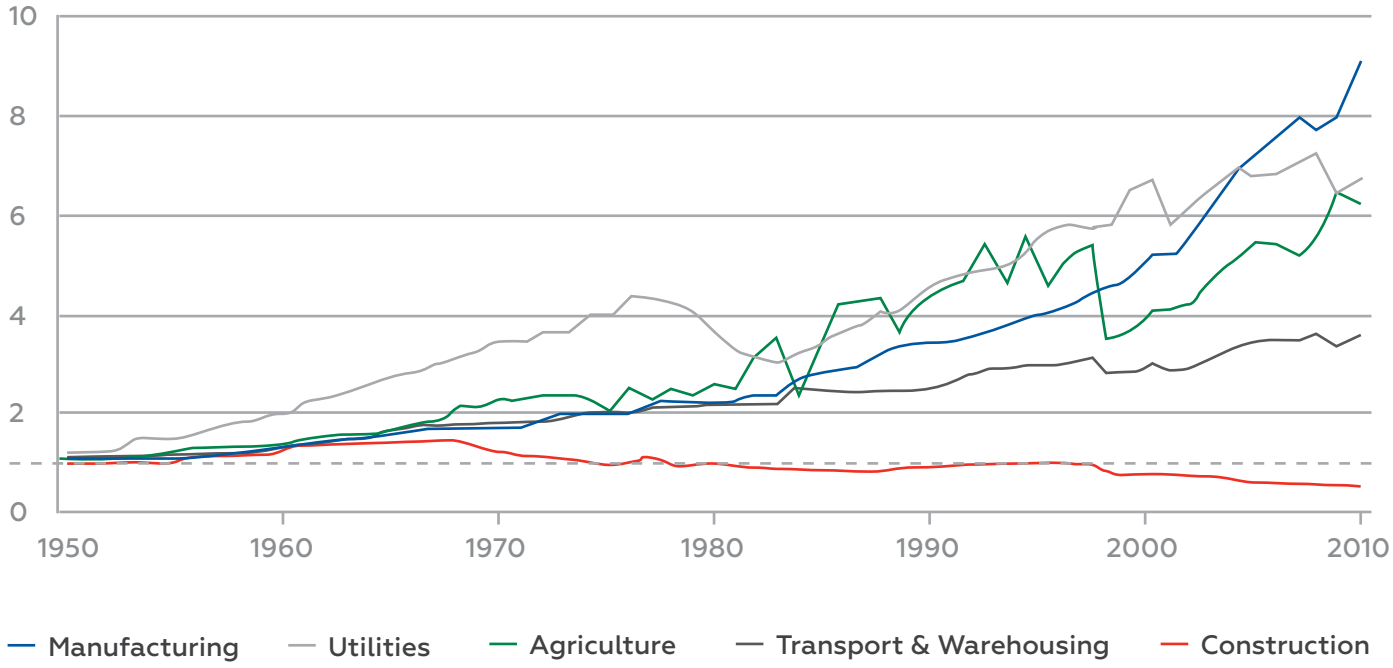



**Figure 6: Innovation across sectors measured by productivity (CURT)**
Source: Bureau of Economic Analysis (BEA), Hideyuki (2011)

# 4 ONWARD TO ALTERNATIVES

Figure 7: The Fourth Rail Bridge – 8 years to build (1890)

Greensmith captures the stagnation in the construction industry with a comparison between the Fourth Rail Bridge in Scotland, built in 1890 (Wikipedia), and the Tokyo Gate Bridge, completed in 2011 (Wikipedia). The latter took two years longer to complete than the former, only 120 years later. Both are cantilever steel bridges and around 2.5 km long.

Greensmith faces three common challenges to his promotion of timber in building in South Africa, each of which has some validity, but not enough to be deal breakers.

First: Structural engineers cannot design for mass timber buildings, especially in countries where this is yet to take off. "That's a bit of a cop-out," says Greensmith. "Structural engineers can rely too much on applying codes and using software with a black box mentality. Too infrequently, we go back to first principles thinking before launching into detailed calculations. We would do well to remind ourselves that structural behaviour and resolving forces are universals that apply regardless of the material specified, and this comes *before* applying codes and wielding software. It just takes a bit of self-education and mentorship – just as we did as graduates when mastering building with concrete and steel."

Figure 8: The Tokyo Gate Bridge – 9 years to build (2012)

Next, what about fire? Greensmith dispatches this concern with some strong science. "It is a misconception. Of course, fire is a risk factor. It always is, but we can design to manage it. As with any building, we can construct with mass timber to predictably ensure that if disaster strikes, people have sufficient time to escape to safety. The way this product burns is such that you get a layer of black charring forming on the outside. It effectively acts as a barrier that restricts oxygen supply to the inner wood. It insulates it."

"So, the risk is there, but we can manage for it. Thicker structures are better and we can calculate the charring rates, so we remain code-compliant and safe. Work out of Stellenbosch University has explored charring depth over time on locally produced CLT. They show us how long it takes to get to failure at 300 degrees Celsius. On three-layer CLT with standard SA Pine, we can get up to 60 minutes. With eucalyptus, we could get a 60 to 90 minute fire rating. These were achieved without incorporating any additional protective measures. We can design to get these up to as long as three hours with a rational fire protection design."

However, this introduces one hurdle. "Typically, fire ratings are highly regulated compliance matters," says Greensmith. "A fire consultant applies often just strict deemed-to-satisfy rules to sign off. Mass timber requires a different approach. The building regulations allow for us to use rational design to demonstrate fire safety and we need to make use of this. Here we rely on the latest research, international best practice and, as before, first principles." This necessitates the client hiring a professional fire engineer, which means an additional cost.

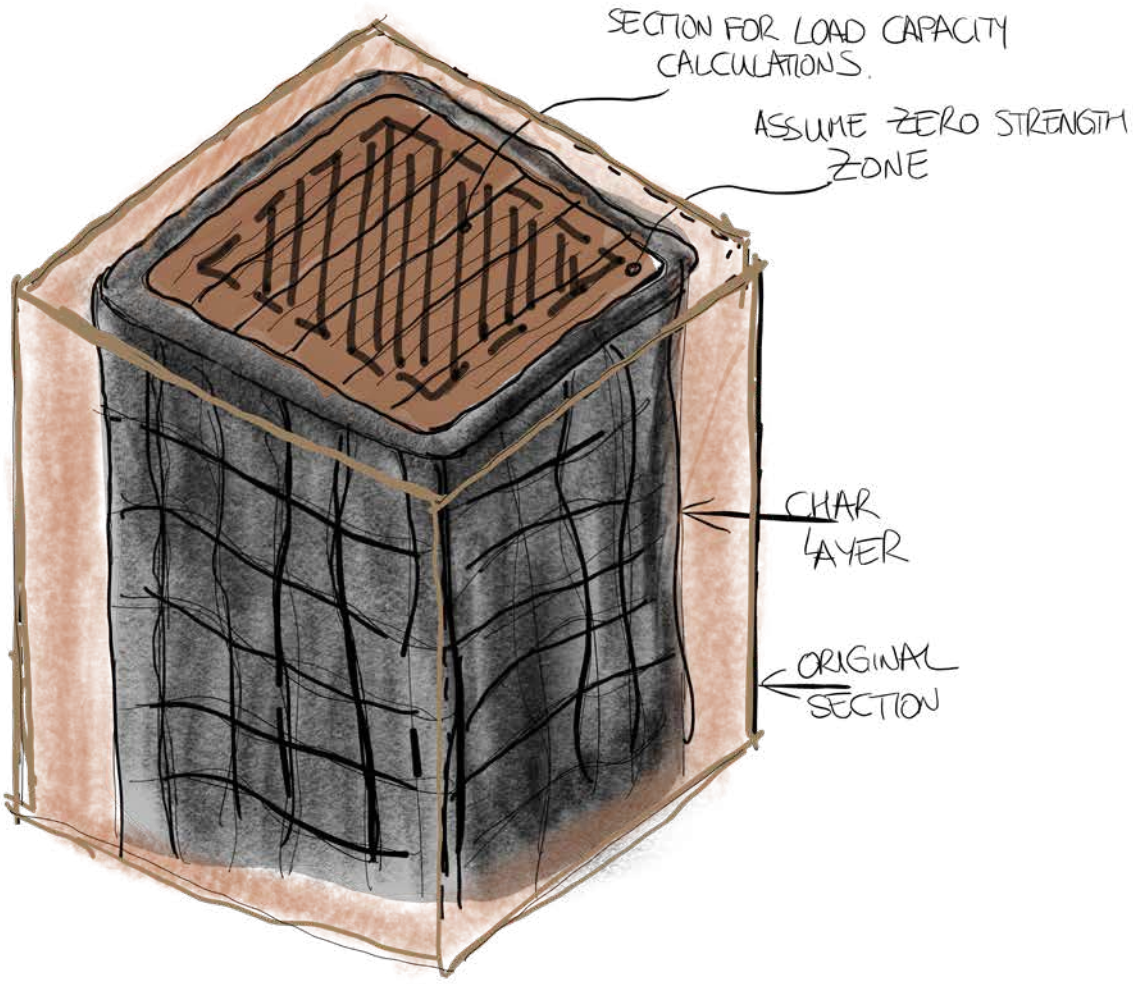
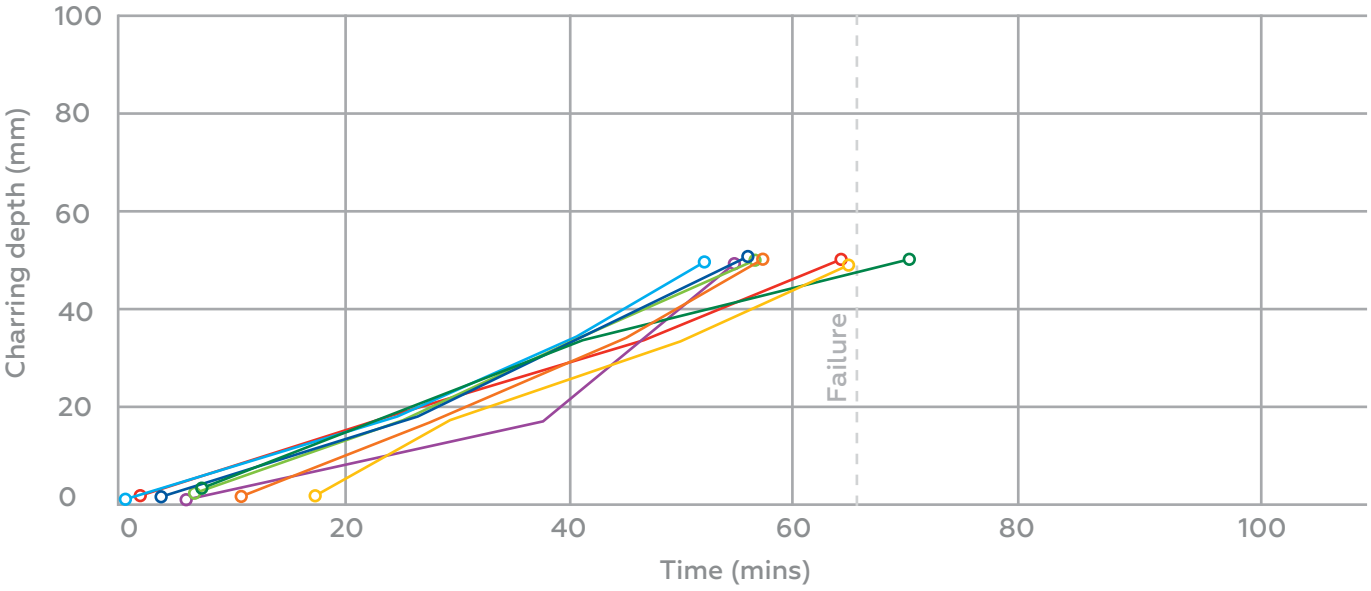
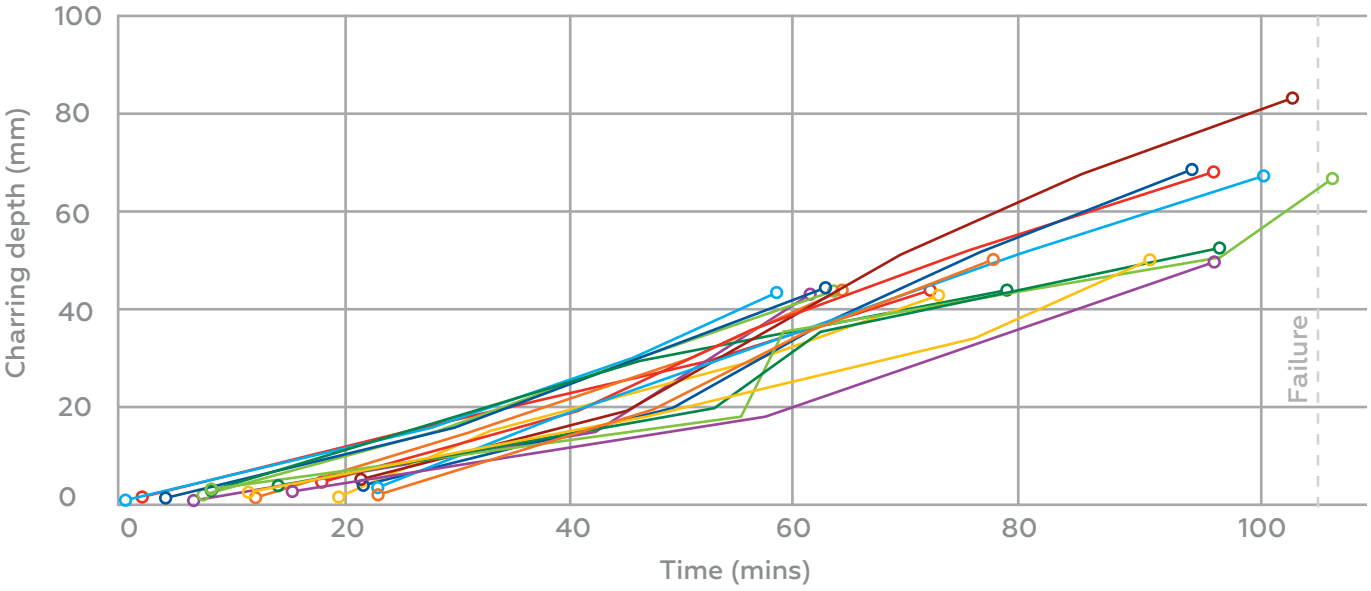



**Figure 9: Char layer & oversizing of a timber section**

## SA Pine




## Eucalyptus




Point 1 Point 2 Point 3 Point 4 Point 5 Point 6 Point 7
Point 8 Point 9

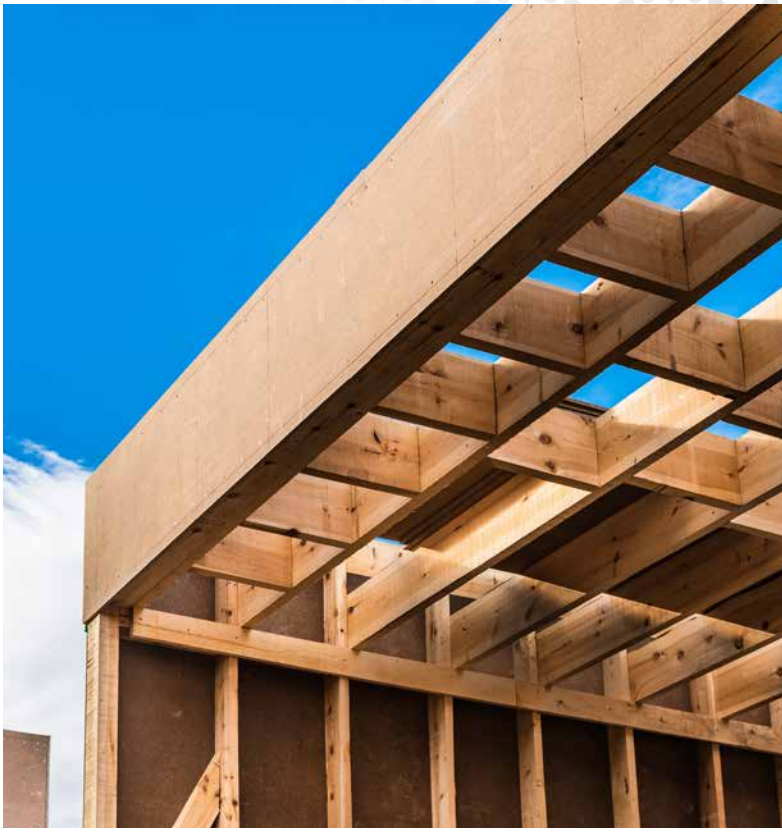
Figure 10: Development of the charring layer in SA Pine and Eucalyptus CLT Panels (S vdWesthuysen, 2020)

The popular perception is that timber is too expensive to add to the conventional mix of concrete and steel. "There are contradictory data sources out there," explains Greensmith. "That is not surprising. It is a hard question with vast differences between projects and geographies. The calculation needs to be done over the entire lifecycle of any build as well. That adds to the complexity, but there are scenarios when timber is cost competitive. A careful review of the evidence is essential for us to identify cost benefits and to flag areas that need work to reduce costs."

"We are heading in the right direction. Think back to when clients first began asking for us to design for solar panels on roofs. They were a luxury then and seldom implemented 10 years ago, but today it is almost commonplace as PV panels have improved and become cheaper."

What about benefits of timber over concrete in a building structure? Let's start with weight. A major drawback of concrete is its immense weight. That makes transport a voluminous portion of the cost and greatly limits the economical radius to deliver it from plant to site. Add to that the cost of craneage on site and the added cost of foundations and supporting columns and walls, and the cost escalates. Greensmith points to a study done on an apartment building in Australia, highlighted in a 2015 case study from the Timber Development Association of New South Wales. "Timber in the structure was shown to significantly reduce self-weight (the load on a structure imposed by its own mass). That reduced costs of the foundations and of the vertical structure. However, the fire safety requirements were more onerous. So, the engineers used more gypsum board and other passive protection, highlighting the need for proper, rational fire design."

Costing is not a simple factor. A study from the US in 2017 (C Kopczynski & Co., 2018) compared costs in timber only, concrete only and mass timber buildings. They took figures from completed projects across the US. They found the CLT frame about 20% more expensive than the concrete frame.



However, we need some caution interpreting this. The authors took typical concrete frames and simply substituted the concrete elements for timber – i.e., the floor layouts, column positions, and so on were unchanged. This is unrealistic. A more accurate methodology would have adjusted for the fact that what is an efficient design for concrete is not efficient when you change the material to timber.

Seagate Structures, a Canadian firm, has done just that (Seagate Structures Ltd, 2017) and they illustrate the efficiency benefits of targeted, material-appropriate design. Seagate's studies find CLC a lot cheaper. "It is likely driven by a reduction in the costs of labour," explains Greensmith. "Timber allows for fewer workers on site. They are also a bespoke practice, and highly skilled and experienced mass timber manufacturers and contractors. So their practice and supply chains are all efficient. There's no reason we cannot achieve the same."

Timber has several other benefits that save money. "Construction can be three times faster when we incorporate timber in structures. There is no

programme time required for curing of concrete, for example. There's less wastage. Crane costs are reduced, as we are not lifting as many heavy pieces."

Concrete buildings have an immense degree of embodied carbon, and all of the $CO_2$ we emit throughout the vast process of getting a building to completion. It includes everything from mining the granite for countertops and transporting cement, to powering angle grinders and clearing vegetation. This is also where the bulk of the green gains still have to be made.

"Thus far, our focus has been on operating efficiencies," says Greensmith. "So we have made great strides in greening the building during its operational lifetime. We have addressed energy-efficient temperature management and water recycling systems. Now the bigger, faster gains are in embodied carbon footprint reduction."

Much of that potential lies in timber. "Done right, timber can sequester carbon," says Greensmith. "Trees spend years growing and cleaning the air before we harvest them for building. Wood is lighter to transport and displaces some degree of concrete in the structure."

Apart from the ethical imperative, growing political pressures increasingly makes greening a priority. "Carbon taxes are becoming the norm in Europe," says Greensmith. "They are likely to become more prevalent in Africa. Already in South Africa, we have seen Absa partner with Balwin Properties to create financial incentives for greener builders".

Operational efficiencies in energy use from buildings have been the focus until now, but there is a plateau in how much we can achieve with this. Embodied carbon is where the design engineers can make savings, referring to all the greenhouse outputs that go into getting the building done. So materials are key.

Greensmith cites data from Burohappold Engineering to show the savings timber brings (BuroHappold, 2020). "This shows that the most to be gained lies in floor plates and second, the walls and structural foundations. Even if we keep the rest of the frame relatively unchanged, these have potential for massively improved green credentials by incorporating more timber."

Sustainability is about more than the green issues. Social and economic factors are important, especially in Africa. These three areas are inextricably interlinked and we will struggle to show gains in one area if the others are ignored. Greensmith believes that there are social and economic benefits to be derived from using timber.

"Socially, a more developed mass timber sector is great for good job creation," he explains. "The

construction industry has long taken advantage of cheap, unskilled labour that operates largely on a project-by-project basis, while timber opens up more secure jobs that demand more skills development. This derives from the need for off-side manufacturing of a relatively labour-intensive product. Many wooden products will need to be prepared in factories and moved to site. This is positive and in line with the South African Department of Trade and Industries' Master Plan for the Commercial Forestry Sector in South Africa 2020-2025."

There is proof of this move as the use of CLT is booming in Europe and it is predicted to grow faster in the next few years. The chart below shows the finding from a study by Zion Market Research (Zion Market Research, 2018). The economics speak for themselves. Larger volumes mean returns to scale, better techniques and innovation. Costs will continue to fall as we get better and more efficient at producing and using mass timber.

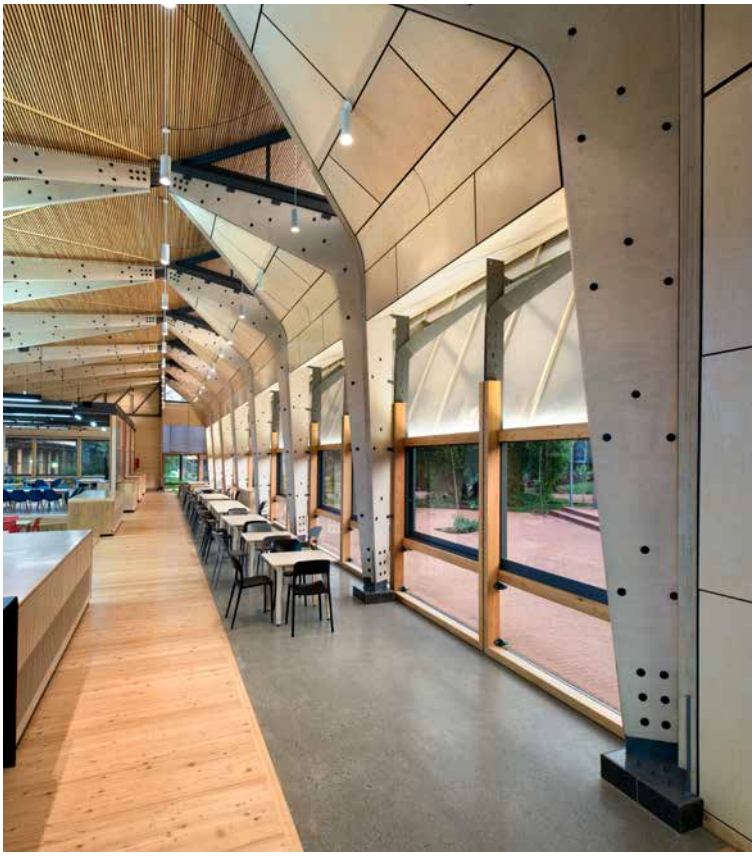
What is the next step? Greensmith urges the industry to enable an urgent shift to more and more mass timber, chiefly to address climate issues. But he is a realist. "I don't expect the industry to embrace this revolution fast. That is why I advocate we begin with a concerted effort to move to hybrid designs, which will lead to a snowball effect. Mass timber could essentially replace steel and concrete in building structure, but we need to integrate it into the mix of materials."

He refers again to Stellenbosch University's work to show how this may look. "We also need to collaborate more and learn from people who are a few steps ahead of us. When we design a building, we can get it reviewed by someone who has more experience with hybrids, allow quantity surveyors and program planners to come on board. That is key to understanding feasibility of hybrid buildings up-front."

Greensmith points to two excellent examples in South Africa that have incorporated mass timber. "The Ridge commercial office building at the V&A Waterfront in Cape Town, completed earlier in 2021, features a CLT façade made from pine sourced from George, also in the Western Cape. studioMAS and Arup combined forces to craft this to maximise natural light and natural airflow to limit cooling costs. I have also been involved in the conceptual design for some portal framed structures using GLT, and we have shown that a timber frame can be more economical and efficient than using a traditional steel design. The Future Africa campus at the University of Pretoria is another beacon of light. Earthworld Architects designed this with a plywood portal frame and roof and it is very attractive."

**Chris Greensmith**
Technical Director - Zurati

Chris Greensmith is a Chartered Engineer (CEng) with an MSc in civil engineering from Wits University. He holds a PrEng and MSAICE locally, as well as being an Associate of the Institute of Structural Engineers (international). He has been a structural and façade engineer on commercial developments for 18 years. He recently joined Zurati as Technical Director of Structural Engineering in the Gauteng Built Environment team. Chris is a founding member of the Mass Timber Focus Group (MTFG) and has been appointed to the committee of the International Association for Mass Timber Construction (IAMTC).



Earthworld Architects and Dook Photography

# HOW LONG SHOULD A BUILDING LAST? THE 1,000-YEAR HOUSE


The Pantheon

It is not a question most of us frequently ask, but it is an intriguing one. How long *should* a building last? In a world of rapid change, the growing trend of work-from-home and the environmental challenges of our day, the answer is not as obvious as it may sound. Brian Potter makes the case for the 1,000-year house.

What does society want? With the appropriate maintenance, buildings can last for multiple centuries or even millennia while remaining in use – the Pantheon, Aula Palatina, the Brihadeeswarar Temple, Verona Area, Chartres' Cathedral are a few examples. The most central examples of long-lived buildings are large, culturally important buildings that required huge investments to create and maintain, but there are many examples of more modest buildings with long lifespans: England's Listed Building registry lists nearly 30,000 homes built prior to 1700.

However, we do not achieve this sort of longevity for most buildings. Data from the American Housing Survey indicates an average home age at demolition of approximately 50 years (Ianchenko, 2020). In a survey of 227 demolished buildings in St. Paul, Minnesota, at demolition the average was between 50 and 100 years, depending on the type of building. Concrete buildings were older than wooden ones; residential buildings were older than commercial ones (O'Conner 2004). Surveys from the UK, Japan, and Finland showed similar ages at demolition. A survival analysis by Gleeson (1985) suggested an average lifespan of 100 years for a newly constructed home in the US.

These relatively short service lives are a function of the kind of world we live in, and thus the kind of infrastructure it makes sense to build. In a world that is changing rapidly, we want our built environment to be able to change as well. This often means tearing down an existing building and constructing a new one in its place. In a world where there is positive economic growth, the investment required to extend a building's lifespan may be better spent elsewhere, although extending the life of a building would be less costly than building or buying a new house. Also, the costs in terms of additional carbon dioxide emissions needs little elaboration, but longer-lasting houses also have obvious financial benefits.

As the world changes rapidly, we want different things from buildings, but more and more buildings consume more and more resources. Thus, can we build a house that not only lasts 1,000 years, but one that we and all the next generations will want for the entirety of that millennium? Dare we dream of a Y1K house?

There are three predominant ways of thinking about building durability. First, the traditional architectural approach, where the focus is on using construction techniques that have empirically achieved long service lives. A strong proponent of this is Hope for Architecture, which builds houses using structural masonry.

Second, is the building science approach, which is based on a deliberate analysis of the forces and conditions a building is exposed to, and designing the assemblies accordingly. Finally, there is the flexibility approach that attempts to create dynamic structures that can be changed to adapting needs over time.

These approaches are not mutually exclusive. We can combine them. However, they can clash. Designing for, say, a Colosseum-like structural endurance can be hard to combine with flexibility. Still, none of these approaches is enough on its own. We must find ways to combine their respective and different benefits.

The next question begging for attention: What are the forces that contribute to so many buildings lasting just a few decades? We need to know our "enemy", the causes of failure. Discrete destructive events such as fires and earthquakes can reduce years of work to rubble in minutes. Then there's decay of rafters and rivets. And there's the cultural element. The house our grandparents built for the height of fashion 60 years ago may not be de rigueur today. It may not serve modern lifestyles such as it once did, even if it could be renovated.

## SOLUTIONING

Natural disasters are not going away, but we have ways to limit their ability to spoil the 1,000-year-old house dream. More relevant to construction is mitigation. These days, we are good at working out where a hurricane is very likely to strike.

When Notre Dame went up in flames in 2019, the importance of fire defences entered the global discourse. The Parisian landmark was not as resistant as, for example, Chartres' Cathedral. Some 80 km south-west of the French capital, this

**Notre Dame**

building famously survived three major fires since its opening in 1252. The keystones are building with non-combustible materials as far as possible. Metal, concrete, masonry, and the like are very good, but even timber these days can have acceptable fire resistance for a variety of uses. Larger, heavier elements are also better than smaller, thinner ones.

Of course, location is also important. While fire can strike anywhere, in wildland-urban areas, it is best to avoid the path of rampaging wild fires. Risk maps such as those from Missoula Fire Lab guide us effectively on these.

From one extreme to another, water damage. Again, we go to the fundamentals of avoidance and mitigation. Our best bet is to stay out of the way of floods. There are several scientific tools to guide us. One remarkable and effective one is flood estimation tools developed for choosing nuclear power plant sites. These are based on the maximum flood that could occur in a given area and take into account aspects such as floods caused by dam failure during an earthquake. If it is good enough

**Water damage**

to prevent a nuclear meltdown, it should be good enough for our 1k house.

Africa tends to have enviable freedom from serious seismic events such as earthquakes. These can be so incredibly devastating that our only goal is to build to prevent loss of life. By far our best defence is, as the old real estate saying goes, location, location, location. Tools such as the map FM Global produces[1] guide us on avoiding seismic zones, as well as flooding areas and hail risks.

As terrifying as these disasters are, fortunately they account for a relatively small number of the destruction of buildings. Looking at this graph from O'Conner (2004), we see only 7% were demolished attributed to disaster (in this case, fire damage).

Physical decay is best addressed by a combination of traditional architecture and building science approaches – using building systems and details that empirical evidence suggests will perform well over extremely long periods.

Our number one priority for avoiding physical decay (and the associated costs of repair and maintenance) is to *keep the water out*. Our number two priority is to prevent water from damaging the building when we inevitably fail to do this.

A huge number of decay processes can be traced back to water finding its way into the building. Rust, corrosion, rot, mould, settlement, salt crystallisation, sulphate attack, and freeze/thaw cycles are all attributable to water being somewhere it should not. To fight this, we want to construct our homes with well-vetted design details and known best practices to prevent water from intruding. Companies such as the Building Science Corporation are a good source for these.

On the other hand, for the 1,000 time spans, this probably is not sufficient. No matter how careful we are, water will make its way into the building at some point over the course of 1,000 years. Therefore, we also want to use corrosion-resistant materials, especially for the more permanent pace layers (the structural framing, the foundation, and the exterior 'skin'). Stainless steel, galvalume, unreinforced concrete, unreinforced masonry, slate, and stone are all materials that have demonstrably long lifespans. If we look at a list of surviving old buildings, their construction is dominated by corrosion-resistant materials such as these.

We also need to choose systems and materials that have a track record of long-term survival. For many modern materials (such as OSB[2]), we lack good data on extremely long-term performance, and they are often manufactured using glues, resins, or other components where it is hard to predict how they will perform over long periods (or are likely to be damaged by water exposure).

[1] fmglobal.com/research-and-resources/nathaz-toolkit/flood-map
[2] oriented strand board

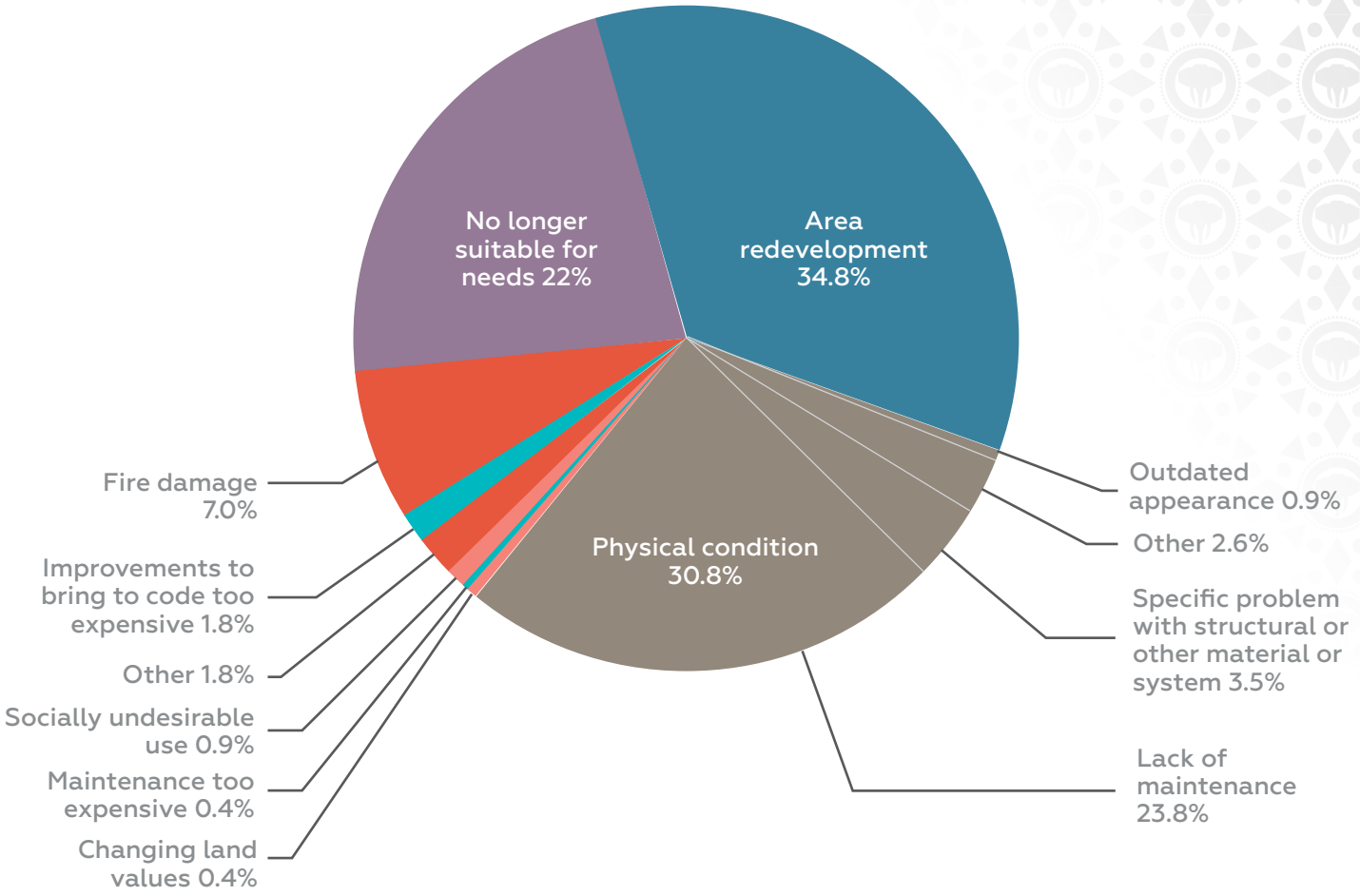



Figure 11: Causes of the destruction of buildings

Gradual settlement and ground movement is another potential source of long-term damage, one that will be difficult to fix if it occurs. Long-lasting buildings tend to be built on large, substantial foundations to prevent this. Our best bet here is avoidance, with either an oversized shallow foundation or even a deep foundation system, depending on the site chosen.

The "pace layers" concept popularised by Stewart Brand provides a useful framework for flexible buildings. In this formulation, a building consists of several different layers, which age and get replaced at different rates. Some layers, such as the foundation, last for the entire life of the building. Others, such as the "keeping up with the Joneses" factors, can change with the latest episode of your favourite home improvement reality show. Thus, we design to reduce the decay on the most enduring parts of the building, reduce the maintenance burden and then make it as easy as possible to replace faster-paced layers.

Cultural decay (or cultural drift) is what we get when a building remains unchanged, while society gradually changes around it. Avoiding this is not something that is especially easy to accommodate with the design of the house itself. At best, we can try to guess which trends are least likely to change and use that to inform our house design. Call this the "popularity principle", where our design choices should be informed by what is likely to remain popular and appealing. Architects have a role in selecting timeless styles.

# 4 ONWARD TO ALTERNATIVES

**Mineral wool batt insulation**

There's also the more difficult task of some economic forecasting. Are we building our dream home in a place with 1,000 years of prosperity ahead of it? Cities rise and fall. Much such as the rotary phone gave way to mobile phones, mechanical, electrical and connectivity systems will keep becoming redundant. We can design to incorporate the likes of the internet of things more easily and cheaply into connected houses.

We can make it as easy as possible to swap out parts, favouring things such as bolted connections over welded ones, batt insulation[3] over spray-foam, and mechanical connections instead of epoxies or glues. We should also aim for components that are small and light enough that workers can manipulate them without needing a lot of heavy equipment. Keeping drawings and other data safe is too often ignored.

**Conclusion.** To answer our initial question, yes. We can build the elusive 1,000-year house. It will not be perfect, but we'll put it in a good place and build it with the right materials. We can design for durability from father time's persistence and those occasions when mother nature gets angry. We even have tools to roll with the punches of the whims of fashion. In short, we can be smarter and focus our eyes farther. Should we? If we want to save money and cut carbon emissions, we must.

**Brian Potter**

Structural Engineer, Devita Inc, Atlanta, USA

Brian Potter has a Master's degree in systems engineering and is based in Atlanta, Georgia. His construction industry experience has seen him design buildings, using everything from structural steel and concrete to masonry and timber. His work ranges from commercial buildings and multi-family residences to water treatment plants and schools.

[3] A type of insulation made of fibre-glass material or mineral wool, similar to a blanket

> In one three-year period, 2011-13, China consumed more cement than the United States did in the entire twentieth century.

**Page 132, Yergin, Daniel, 2020, "The New Map: Energy, Climate, and the Clash of Nations". Penguin Books.**

# HYBRID CONCRETE – ADVANCES IN CONCRETE ACTIVATION

We hardly think of "crystalline and amorphous gel" when we talk about concrete, but we must do so when it comes to hybrid concrete. It has important results for many things we need to address in the industry.

Hybrid concrete has physical and chemical benefits. We can achieve environmental and economic improvements, for starters, and to pique the attention of engineers, there are implications for compressive strengths – grit when we squash it – flexural strengths – hardiness when we bend it – shrinkages and durability. To create hybrid concrete, one replaces as little as 60% and as much as 100% of traditional Portland cement with what we call eco-binders. These base materials are GGCS, (Ground Granulated Corex Slag), GGBS, (Ground Granulated Blast-furnace Slag), PFA (Pulverised Fuel Ash), and mineral sand slimes.

Several physical and chemical characteristics of these products have been analysed and summarised in a thesis based on the practical application on construction sites in Southern Africa since 2010. Three case studies from South Africa expand on the prospects of hybrid concrete. In each case, we consider keystone properties. These range from hardening for compressive and flexural strength to durability of the final product and implications for profitability.

This section collates work conducted on three sites in South Africa between 2011 and 2016 related to concrete mix designs. Compressive strengths, flexural strengths, shrinkages and durability for Portland cement replacements ranging from 60 – 100% are reported and discussed.

## FIRST.

Portside is a high-rise building in Cape Town's central business district, not far from the V&A Waterfront. It stands 136 m high, with 30 storeys above ground level and two below. It has a gross floor area of 116,000 m² and 22 elevators. Portside is rated by the Green Building Council in South Africa as the country's only 5-star green, tall building.

Most of the concrete had 65% of the Portland cement replaced with a Slag by-product from the steel industry, known as ground granulated corex slag (GGCS). Further development work was conducted to produce instead a concrete with 85% replacement. Testing done by PPC, Lafarge and the University of Cape Town on the alkali-activated concrete confirmed compressive strengths, shrinkage and durability results comparable or superior to standard Portland cement concrete.


**Portside Building – Cape Town**

### Some of the notable findings included:

- A reduction of 49% of carbon footprint[1] related to all materials for concrete;
- Total saving of 5,646,762 kg of $CO_2$;
- Increase of profit through savings of 4.8% on concrete.

[1] Carbon footprint calculations are based on The Concrete Institute's InEnergy report as per their website, theconcreteinstitute.org.za/#!inenergy-report/c1ioa, where both the direct and indirect environmental costs are considered.

The Transnet City Deep Container Terminal

## SECOND.

The Transnet City Deep Container Terminal is in City Deep, about 4 km east of the centre of Johannesburg. A major upgrade project was designed to increase the throughput of the terminal from 130,000 twenty-foot equivalent containers (TEUs) to 500,000 TEUs per year. This was the first commercial 100% Portland cement replacement concrete project in South Africa. Three large test sections were cast to review the long-term durability, compressive strengths and abrasion resistance. The 100% Portland cement replacement concrete exceeded all specifications and outperformed the Portland cement concrete.

**Compared with the original concrete designs with 35% replacement of Portland cement with PFA, this novel approach achieved the following:**

- A reduction of 35% of carbon footprint related to all materials for concrete;
- Total saving of 6,586,580 kg of $CO_2$;
- Increase of net profit through savings of 8.3% due to concrete;
- As the project specification required a minimum of 24% of the old concrete to be removed and recycled, Murray & Roberts were able to recycle 100% of this material, while increasing the net profits by approximately 5.7%.

## THIRD.

The Loeriesfontein Wind Farm is situated in the Hantam Municipality, 60 km north of Loeriesfontein in the Northern Cape. This vast site has 61 99-m high wind turbines erected on 3,453 hectares of agricultural land, which connect into a 132 kV Eskom line. Again, impressive benefits were measured.

### Based on the original concrete designs with 35% replacement of Portland cement with PFA, there was:

- A reduction of 30% of carbon footprint related to all materials for concrete;
- Total saving of 805,438 kg of CO2;
- Increase of net profit through savings of 1.9% on concrete.
- These three cases provide strong evidence that the use of hybrid concrete has a promising future and can become a technology that increasingly makes construction greener, more profitable and technically superior for its strength and durability.

However, more work and testing need to be done. One area needing special attention is the carbon implication. The footprint is not consistently better when replacing 100% of Portland cement. So, watch this space.

**Cyril Attwell**

Chemist and material scientist, Arc Innovations, a biotechnology enterprise.

Cyril consulted on the concrete side of construction for blue chip engineering firms on major green-award-winning projects such as the Khobab Wind Farm in Loeriesfontein, Northern Cape. A director at Arc Innovations since 2017, his mission is to maximise the use of waste materials, develop alternative materials and solutions for construction, and do this through internal and community skills and employment.

# BUILDING(S) WITHOUT CEMENT – SUCH AS LEGO

"Building blocks" is a metaphor translatable to any scenario in need of analysis at a foundational level. In the context of incorporating modularity into construction, it serves a literal job too. Stephen Goodburn explains how our childhood games of Lego were good training for a growingly popular way to build.

Waco International traces its origins back to 1952, and provides equipment rental and industrial services such as scaffolding, forming, portable sanitation, cleaning, pest control and hygiene services, aerial work platforms, suspended access and relocatable and modular buildings (RMB) with operations in 13 African countries. The building modules are manufactured in South Africa and shipped all over Africa. The modular structures are then bolted together on site. A modular building is similar to a sophisticated form of Lego. It competes with bricks-and-mortar construction.

Permanent modules have a 50-year lifespan. Temporary structures look very similar to permanent ones, and are typically supplied on a rental basis.

For example, offices and mess halls were required during a large construction project such as the building of the Kusile Power Station by the South African national electricity supplier, Eskom. In Mozambique, with its Liquefied Natural Gas (LNG) project, temporary construction camps were erected, and the modular units were successfully used as hospitals, schools and office blocks.

A key differentiating factor between conventional bricks and mortar vs modular building is the time it takes to erect them. Whereas it typically takes approximately 18 months to build a bricks-and-mortar school to accommodate 1,000 students, the equivalent school in modular form can be built in only four months.

For deliveries into Africa, distances are greater and transportation costs are steep, hence modules are transformed into a so-called "flatpack" configuration. Stephen Goodburn compares this to a Mechano set, fitting one on top of the other and then being "pulled out" on site to become a square building.

Temporary modular structures are moveable. Entire classrooms, for example, can simply be picked up and moved. With permanent modular structures, portions of these can also be moved. According to the Waco's CEO, approximately 60% of new schools in the USA, the UK and Australia are constructed as modular buildings. One of the reasons for this is the changing demographics of neighbourhoods over time. It has been found that once children have left school, they tend to settle elsewhere, leaving the older generations behind. Since there is not always an influx of young families moving into all suburbs, schools may become redundant, but required elsewhere. A modular school can then be moved to where it is most needed. An entire school can be moved.

Construction speed is the greatest advantage offered by modular building, but a close second is easier and more controlled quality control, since all is done within the confines of the factory, helping to make health and safety controls easier to enforce and less of a risk than on a conventional building site. Once the modules are on the building site, they are simply bolted together, ensuring that as little work as possible is done on site.

The modular building market has grown rapidly over the last decade. However, a continued perception that bricks and mortar is a safer option still lingers among many South Africans, with adoption of this method in the developed world outpacing the local equivalent, but the modules' re-usability makes this alternative more environmentally friendly.

How difficult is it to build (modular) in Africa? Africa is a tough place to do business. The recent Covid pandemic has not changed the difficulty of doing business, but brought other challenges to the fore, in the sense that first, sentiment is low. Second, there is simply not enough liquid capital available. For these reasons, building of infrastructure, general construction as well as mining, have slowed down in some regions. In addition, political risks remain high. Goodburn cites the example of the political uncertainty leading up to Zambia's elections, when mining houses were threatened or manipulated by politics. Their response was to simply close their businesses, which had dire economic consequences for all who depended on the mines.

In Zambia, mines fortunately opened up again *post* elections, following a three-month shut-down. However, when issues around tax and foreign ownership began to intensify in the Democratic


Republic of Congo (DRC), many business owners exited for good. Equally, in Northern Mozambique, many business activities have been put on hold because of terrorist activity. Another major challenge of doing business in Africa is that corruption can significantly drive up the price of investments, making it intensely challenging to realise adequate returns.

On the other hand, Africa can also be a lucrative place to do business. For one, infrastructure is still lacking in all African countries, which presents significant future opportunities, but requires

a long-term view. Being compliant is vital and having a physical presence in the country, with a registered company, paying taxes and getting involved with the local structures and communities. When opportunities arise, the company is then well positioned to capitalise on it. Simultaneously, however, and seemingly in contradiction to having a long-term view, Goodburn believes that one also has to be very "nimble" and "fleet of foot" when doing business in Africa. "We don't bet the farm," he explains. Waco always sets up its African operations in such a way that if the political or business environment becomes untenable and looks to remain that way for the foreseeable future, then they can exit with haste and without incurring too great losses. For example, once they made the decision to exit the DRC, Waco was able to do so in a matter of two months. Removing their physical presence naturally was made easier by the fact that their buildings were all their own relocatable, modular structures.

Goodburn also advises those looking at doing in business in Africa to conduct thorough due diligence exercises. Each country has its own unique quirks. This kind of homework should cover all bases, and consider unintended consequences, which are not obvious at first glance. Time spent on due diligence around a potential unplanned exit is just as critical as researching how to establish a business in Africa. Another factor to consider is that it is expensive to do business in Africa. For example, it is not uncommon to have to pay two years' rent up-front when signing a lease. Costs, other than labour, in most African countries other than South Africa, are usually US dollar denominated.

Goodburn remarks that they have noticed a marked change in the relationship between Chinese funders and African governments in the last few years. When the Chinese first began funding infrastructure in Africa, many governments traded mineral rights for financing and Chinese firms shipped in all their own labour, equipment and other raw materials. The result was that the only value that the African country enjoyed, was the infrastructure itself, but not even its maintenance. Now, in Goodburn's opinion, some African governments are negotiating differently: They are looking for in-country value-add and turning down offers of funding if these conditions are not met. They insist that only local labour be employed, jobs be created and as far as possible, raw materials be sourced on the continent.

Although there are many business and investment opportunities in Africa, it would be wise to choose carefully.

**Stephen Goodburn**

CEO, Waco International Limited, an equipment rental and industrial services business.

Stephen grew up in Free State, South Africa. He has an Honours degree in accounting and served his CA(SA) articles at a small audit firm. Steven started working for Waco International 32 years ago as an admin clerk in Bloemfontein and rose through the ranks to take over as group CEO in 2011, a role he performs with passion to this day.

# 3-D CHESS AND THE SEARCH FOR THE ULTIMATE PRINTED HOME

Decca Recording Co. infamously rejected a little band called The Beatles in 1962, announcing pithily, "We do not like their sound, and guitar music is on the way out". Off the mark by magnitudes more was Thomas Watson, chairman of IBM in his 1943 analysis that "there is a world market for maybe five computers". Of course, naysayers can be absolutely right. Think BlackBerry, Gangnam Style and Rick Astley's *Never Gonna Give You Up*. But what about 3-D printing? It is certainly the flavour of the month. The question is, will it be Psy or McCartney? BlackBerry or iPhone?

One domain 3-D has vast potential in, is housing. This is of particular importance in Africa. The International Finance Corporation estimates that Nigeria alone has a housing shortfall of 17 million units. And with some 40,000 people from across the continent relocating to cities, the challenge is growing.

We are well past the phase of prototype proof. The novelty of watching a giant printer head layering cement up until a solid wall emerges is no longer the spectacle it was five years ago. The goal now is to prove we can do it practically. That is, can we make it economical, enduring, safe and, perhaps most of all, attractive? The best engineering solutions in the world sometimes fail to catch one, because end users say "no thanks".

One company on the cutting edge of 3-D printed houses on the continent is 14Trees. They delivered the first of these in Africa and can now deliver the house's walls in 12 hours flat and for $10,000. They even claim reduced carbon emissions compared to conventional building methods.

**3D printed construction**

New Story, a non-profit also working in this area, has gone a step further with a whole 3-D printed community in Tabasco, Mexico, where the median household income is just $76 per month. The 500 square foot homes go up in 24 hours over several days using their Vulcan II printer. The two-bedroom units are designed for families. Sitting atop a seismic zone, New Story managed to engineer the structures to above safety standards.

Indian start-up Tvasta unveiled their 3-D printed house in the first half of 2021. A primary achievement was cutting the usual several months for conventional construction to just five days, with a claimed 30% reduction in costs and a forecast useful life of over 50 years. Speaking at the launch of Tvasta's innovative solution, economist and India's finance minister Nirmala Sitharaman

**World's largest concrete 3D printer**
Source: Defense Visual Information Distribution Service

pondered, "If this technology can produce houses in different locales at five days per house, it would not be a big challenge to build 100 million houses by 2022". While Sitharaman's confidence on the size of the task may be overoptimistic, Tvasta's work does portend good things for that portion of the 1.38 billion population in need of affordable housing.

In March 2022, South Africa's Department of Science and Innovation (DSI) kicked off a 3-D printed housing pilot in KwaZulu-Natal in partnership with that province's Department of Human Settlements. Plans for 25 units were presented to Parliament, outlining the concept developed chiefly from research out of the Universities of Johannesburg and Stellenbosch, and plans to import the country's first printer from the Netherlands.

So, the strategising and competing are well under way. The winners have much to gain – both the start-up that gains first-mover advantage and the millions who stand to enjoy better, more affordable housing. 3-D printed houses as a flash-in-the-pan fad has probably been debunked. The challenge is for this technology to do for housing what the Beatles did for Rock 'n Roll. The real work starts now.


"We do not inherit the Earth from our ancestors, we borrow it from our children."
Native American Proverb

# 5 DECARBONISATION

> "There is no sense in denying it," says CEO of PPC Roland van Wijnen. "We dig a big hole in the ground, process inputs that burn carbon and move large volumes on heavy vehicles." Making and especially transporting cement is not a green operation. Ignoring this fact is no solution. Neither is another extreme. We're getting better at smarter solutions.


## TRADITIONAL METHODS POLLUTE

The ancient Romans were master engineers. They made a special mortar out of wet lime and volcanic ash, which they used to bind small stones and bricks. They used it to build some of the greatest wonders of the ancient world, but when the Roman Empire fell, so did their secrets of making volcanic concrete.

It was not until the 19th century that the English bricklayer, Joseph Aspdin, invented Portland cement – a fine powder made by heating limestone and clay in a kiln and grinding it down to a powder. This was the precursor to the modern cement industry. Soon, concrete was at the heart of a global construction boom, building everything from cities and houses to roads and dams.

The concrete we use today is not fundamentally that different from what the Romans used. It is still made of just a few key ingredients: cement, water and cheap filler rocks such as sand and gravel. The cement is what gives concrete both its incredible strength and toxic emissions. By mixing cement with sand and gravel, you can make what is essentially a strong durable artificial rock – for very little money. That is why this ancient invention is now the most widely-used material in the world after water.

If concrete is so difficult to make without hurting our climate, then shouldn't we just stop using it altogether? The industrial world modernised their societies with concrete for more than a century.

People in lower-income countries have a right to build affordable housing and infrastructure that can stay strong in the face of extreme weather.

Alternatives to concrete are not necessarily better. In some parts of the world, sustainably sourced timber has a huge potential to replace concrete and store carbon dioxide at the same time. However, building entire cities out of trees would put too much pressure on forests that are already struggling with the changing climate, and deforestation would speed up damaging climate change even faster.

"Concrete is not the problem. Concrete is actually the solution." So, says Jorge de Brio, a Civil Engineering Professor at the University of Lisbon. "Most people think that concrete has a huge impact on the environment, and they are right, but concrete has that impact because it is the most used material."

If concrete is here to stay, then how exactly can we make it green? In October 2021, the global industry took a massive step forward and unveiled its plan for doing just that. A big chunk of the emissions savings by 2050 will basically come from enhanced efficiency.

Another 22% of the planned savings will come from designing more efficient buildings and extending their lifetimes (see our 1,000-year house section). We have to bear in mind that this is not entirely in the hands of the cement industry. It is also relies on how architects and engineers design our cities. They could retrofit old buildings, instead of knocking them down and design new ones to last longer, just as the Romans did. The Pantheon went from a Pagan temple to a Christian church over many years.

The big question mark is the final option: Capturing carbon dioxide after it is emitted and then storing it. The technology broadly exists in plants, but just not cheaply or at scale. In the next 10 years, we have to mature the production technology and prove the industrial and commercial scalability of such technology.

It will not be easy. Commitment of other actors and stakeholders in the value chain should help the industry to embrace the initiative to really make it work. In turn, governments need to create a policy environment that helps cement producers pursue ambitious emission reductions. To this end, several rich industrialised countries have established carbon pricing systems that cover the cement subsector.

Analysts say a large part of the solution would be incentivising the industry to change by taxing carbon and subsidising emerging technology. However, because cement is so profitable and alternatives are still in the early stages of development, governments would need to guide or even push the development forward. "It is a capital-intensive sector that has been conservative, and reluctant to move in the past, and hasn't faced a lot of policy pressure. People do not really think about it, and this is part of it being difficult to abate", said Johanna Lehne, an expert in the decarbonising industry at the European environmental think tank E3G.

At the same time, there are already pockets of good news. A British company has successfully captured $CO_2$ from a cement plant in France and turned it into materials that can be used in construction. In Sweden, a pilot study has shown cement can technically be made from electricity without using fossil fuels, although this would also mean even more demand for clean energy. In Norway, a cement factory is set to open a carbon capture facility in 2024 that should single-handedly halve the plant's emissions.

The common thread behind all these solutions is making low carbon concrete cheaper and that takes policies, investment and research. Very few consumers think about their concrete and cement consumption. The place where those decisions reside are with governments. However, that does not mean that the ordinary citizens and business leaders do not have a voice. The more attention the cement industry receives, the more pressure it will face to go green. Concrete is one of those climate-challenging problems that nobody is talking about, but where a massive amount needs to be done.

# 5 DECARBONISATION

> “Me, We”
>
> **Muhammad Ali, 1975.**
>
> Regarded by many as the world’s shortest poem.
>
> Decarbonisation. If it affects me, it affects all of us.

# THE DECARBONISATION IMPERATIVE

Let's get straight to it: Cement-making is responsible for some 5-8% of total global greenhouse gas emissions. The tried and tested methods demand massive energy inputs such as digging, heating, grinding and transporting, and all on a tremendous scale.

According to the GNR Indicator[1], 642 kg of carbon dioxide was released per ton of cement manufactured, on average, across the world in 2016. In the same year, India's ratio was 582 kg of $CO_2$ per ton. North America scored 745 kg and South Africa 671 kg, respectively.

These numbers are not getting any lower, either. Demand for this hugely important product certainly is not slowing. While 4.1 billion tons of cement was manufactured in 2015, demand is expected to reach approximately 18 billion tons by 2050[2] – as it happens, the deadline year many have set to achieve zero emissions. The International Energy Agency (IEA) forecasts a 12-23% increase in demand for cement in the next 30, and the WWF sees that number likely being around 25-30%[3].

Much of this demand will come from the developing world. This means the concrete in homes, bridges and factories will be a strong enabler of prosperity. Despite its drawbacks, this is a product that simultaneously correlates with and helps to cause better lives. So, the goal cannot be an absolutist mission to cut back. We need to do more with less.

PPC has taken a leading position on this strategy. Their recently announced ambition is a net zero emission by 2050. This includes staggered intermittent milestones of 10% reduction in emissions by 2025 and 27% by 2030[4]. This is significantly bolder than the International Energy Agency (IAE) Technology Roadmap to a *low-carbon transition in cement* goal of decreasing emissions by 24% by 2050[5]. But how can we achieve this? As with any difficult challenge, no solution is pain-free or total, but there are solutions.

[1] Getting the Numbers Right (GNR) Indicator in Lowitt, Sandy (2020). Towards the Decarbonisation of the South African Cement Industry: Opportunities & Challenges, Trade & Industrial Policy Strategies (TIPS) Research Organisation.
[2] ibid
[3] ibid
[4] PPC (2021) Task Force on Climate-Related Financial Disclosures (TCFD), PPC Limited
[5] Lowitt, Sandy (2020). Towards the Decarbonisation of the South African Cement Industry: Opportunities & Challenges, Trade & Industrial Policy Strategies (TIPS) Research Organisation

## BLEND AND SUBSTITUTE: QUICK WINS

Analysis by the South African Department of Environmental Affairs, published in their Greenhouse Gas Mitigation Potential Analysis (MPA), suggests that decreasing the proportion of clinker in cement – currently about 95% – will make up half of all emission mitigation in the cement industry in the short to medium term[1]. Other organisations hold different views on the extent to which clinker substitution will contribute towards the reduction in emissions. The IEA projects that this option will account for 37% of emission reduction. The UK-based think tank Chatham House is more bullish. It puts the figure at 70%. Whether one third or two thirds, this is a powerful decarbonisation lever to pull.

According to Zero Carbon Australia, there is a 1.67:1 relationship between clinker reduction and carbon emission reduction. Hence, even at 40% clinker reduction, emissions fall by 24%. We already have viable substitutes for clinker, or substitute cementitious materials (SCMs) in the jargon. These include the waste products from processes such as coal burning and steel production.

The calculus on efficient injection of substitutes includes a variation in costs, changes to setting or drying times for the concrete, and altered strength and durability attributes. All engineering and business obstacles that we are learning to overcome over time.

## NEW NORMAL CEMENTS

In the longer term, we can start to consider products different enough from traditional cement, where the gold standard is to make clinker obsolete. There are seven options on a short list. Many are betting on geopolymer cements (GPCs) and believe that these will have the greatest impact in reducing carbon emissions in the long term, and when perfected, will be as little as 25% carbon intensive and at least as strong. For now, this option is too expensive to make a business case. Regrettably, the construction industry cannot boast anything such as the Moore's law that applies to technology: microchips doubling in speed and halving in costs every two years.

## CATCH AND STORE

Carbon capture and storage (CCS) is technologically doable. However, costs are currently many times too high to be viable. According to Zero Carbon Australia, both the cost of capital as well as operating costs of a cement plant would double with the introduction of CCS. Storage is also an issue, especially given that the geographic conditions conducive to limestone mining do not suit carbon storage.

## COLLECTIVE POWER

Making cement demands plenty of power. The vast majority of this takes the shape of burning fossil fuels. Quick wins would include optimisation of existing systems and processes to use energy more efficiently. Even improving maintenance has encouraging returns on effort.

Of course, the optimisation of cleaner and renewable sources of energy are imperatives, such as hydro, wind, solar, nuclear and the other regulars in the climate change discussion. Global imperatives, global projects.

[1] ibid

# THE POLITICS OF DECARBONISING AFRICA

## Leapfrogging opportunity or impossible challenge?

During the recent 12-day COP26 summit in Glasgow, Scotland, new promises were made and agreements signed by world leaders to address climate change. However, COP26 broadly left a bad taste in the mouths of African policymakers and leaders, as an undue burden was placed on the continent to achieve a myriad of ambitious sustainability targets put forward by the West. From deforestation to green energy and decarbonising local industry, including construction, expectations of the continent are sizeable. With many states still facing electricity deficits, economies reliant on fossil fuels and ageing infrastructure, financing shortfalls and varying degrees of political resistance, is the continent facing an impossible challenge to decarbonise in a timely manner? It is certainly a tall order.

However, Africa is also arguably in a position to emerge as the global front-runner of green energy and industry. A dire need to bolster energy provision, large tracts of land conducive to green power projects, emerging industries and developing economies present an opportunity for African states to shift growth in a green direction and surpass their Western counterparts. If the continent's leaders play their cards right, Africa's impossible challenge can quickly turn into an opportunity.

## OBSTACLES

From the outset, asking Africa to shift its energy production from fossil fuels to sustainable sources is a big task – especially when, as per the African Development Bank, over 40% of the continent does not yet have access to electricity. Obviously, this varies from country to country, but even in prominent economies such as Ghana, Nigeria and South Africa, stable electrification remains a key issue. With current energy infrastructure on the continent facing varying degrees of constraints, and premised on ageing fossil fuel sources, asking to merely shift to green is not achievable - at least not without upgrading or replacing infrastructure that governments are already neglecting. Without substantial investment to rapidly increase electrification, such change would still leave the bulk of Africa with the same energy deficit.

This task becomes even more challenging amid limited political will and funding constraints. With the bulk of African countries having faced significant economic contractions, accruing debt rapidly to finance deficits and a return to pre-pandemic economic conditions only expected in the coming years, the majority of the continent is not in the financial position to prioritise green energy over a myriad of other economic and social issues. While climate change and sustainability are invariably posited as a key concern for the state, it is not placed above addressing poverty, debt, growth and deficits.

Compounding this factor is limited political will by ageing officials and various other actors. In South Africa, for example, since COP26 energy minister Gwede Mantashe has repeatedly rejected the rapid move to green power production and aggressively pushed his agenda to construct additional coal power plants – calling the imposition of green energy by the West "energy apartheid" or another form of colonialism. Meanwhile, many leaders at all levels of government on the continent are tied in some form to ongoing fossil fuel ventures. Ghana and Uganda are looking to oil over the coming years to bolster growth and revenue, and thus, cannot afford to begin dramatically shifting away from fossil fuels, at least not in the near term and without requisite funding.

Within this context, it becomes even more challenging for African nations to decarbonise other areas of their economies, especially industry. In the cement industry, for example, which produces the largest amount of $CO_2$ during production compared to industries such as iron and steel, mining, oil and gas, and chemicals, options to decarbonise are few and far between – at least without the adoption of new technologies or a wholly green energy source. In terms of the latter, the primary issue is the tremendous amount of energy used and burning of $CO_2$-producing chemicals to produce cement. Simply put, if your energy grid is not green and current chemicals are not changed, you cannot produce cement in a sustainable fashion. Meanwhile, despite the creation of alternative materials for construction or the use of synthetics in cement, these have yet to be widely adopted and remain an expensive option. This is similarly the case with alternative chemical products. As such, Africa's largest cement producers, South Africa and Nigeria, have limited options or incentives at present to decarbonise the industry at scale. Incidentally, these countries also produce the highest volumes of $CO_2$ in Africa.

## OPPORTUNITIES

Is the continent trapped in transitionary limbo forever? The short answer is no, not just yet. If one takes a step back from COP26's ambitious medium-term targets, Africa is in fact in a position to leapfrog the West in the fight against climate change and specifically green energy production. However, several factors will need to align for this to be achieved.

Foremost among these is that Western peers and multilateral financing institutions need to deliver on financial pledges to address climate change on the continent. With governments already struggling to address energy deficits, it is improbable that African states can begin to dramatically overhaul their power generation in the absence of significant funding. With the required financing, Africa has the opportunity to direct electricity development on a purely green course. However, this cannot be done while concurrently replacing existing fossil fuel energy generation, whereby a considered and phased approach will have to be taken. Green energy will need to complement existing power infrastructure, and the latter then gradually being phased out.

However, financing alone will not facilitate such an endeavour. African leaders will need to champion green power projects to not only acquire the requisite funding, but to effectively steer their country in the appropriate direction for a green transition. In Uganda and Angola, for example, the government has expressed how oil will finance this transition over the coming years. Meanwhile, strong

leadership will be required to build a regulatory and operational environment – which is conducive to sustainable electrification – while curtailing possible political interference. From here, the state can begin to increasingly attract foreign investment into the green energy sector. Indeed, external funding and subsequent government projects alone will be insufficient to increase energy production and private investment will need to play a crucial role. With large tracts of uninhabited land and conducive weather conditions, Africa is in a strong position for the impending green investment drive by industries across the world. In countries such as Angola, the government is signing partnerships with major energy players such as ENI to begin new sustainable energy ventures from 2022. In Mauritania, the government is planning to expand its energy regulatory framework to account for sustainable projects amid interest in using its land to produce green hydrogen. Making the country conducive to the green revolution will prove vital not only finding the necessary funding and closing the capacity gaps, but may also just nudge the politicians engaged in fossil fuels into renewable energy ventures.

## BUT WHAT ABOUT BUILDING A SUSTAINABLE ECONOMY?

Broadly, government's approach to green power production will dictate how the economy can/will decarbonise. However, a correct approach by both the state and private sector could expedite the rate at which the economy, and industry, can decarbonise – potentially faster than the national energy grid. While government undertakes large-scale projects to service the country's energy requirements, greater public-private energy partnerships, independent power producers and private investment into the energy sector could see various sectors of the economy decarbonise at a faster rate – if government allows it. Alternatively, in several countries on the continent, private companies are already undertaking green energy production initiatives to power their operations to meet global industry standards, although this is subject to the country's regulatory energy framework. In some cases, governments have assisted in such projects, and excess power supply has been allocated to local communities. However, economic decarbonisation will never be even. Some energy-intensive industries, such as cement, will inevitably struggle to undertake production in a sustainable manner at scale – at least without a predominantly green national grid or substantial investment into alternative power and chemicals. Some industries will have to champion their own transition.

There is no quick or easy fix for the continent's decarbonisation conundrum. The African continent faces a unique trilemma of how to balance the energy access required for development with climate mitigation and the inevitable impacts. To do this successfully, Africa's private and public sector players will need to navigate significant trade-offs, which include balancing short- and long-term considerations, the risks and rewards, as well as the potential of clean energy with pitfalls of energy poverty. It is a Herculean task, but there is simply no other option.

**Ronak Gopaldas and Daniel van Dalen**
Signal Risk.

Ronak Gopaldas is a political economist with an Africa specialisation. He is a fellow of the GIBS Centre for African Management and Markets (CAMM) and frequent public speaker and media commentator. Ronak joined Signal Risk as a director in 2018.

Daniel van Dalen earned a Master's degree in political science, where he focused on organised crime and the security environment in Brazil. He joined Signal Risk in 2019 as country risk analyst and editor.


> Where a woman rules, streams run uphill.
>
> **African proverb**

# 6 CEMENTING INCLUSIVITY

> The data backs up casual observations on the matter. Similar to many resource-based heavy industries, the cement industry is male-dominated and not just at the kiln-face. Corporate boards have their inclusivity work lined up. We have ways to do this, too. Ogechi Adeola tells us how.

Digging quarries and laying bricks have long been *de facto* a man's work. The reasons range from the cultural to the political, but there is no good reason for the low participation rate of women in the cement, concrete and construction (CCC) industry. We are rapidly learning ways to address the issue.

## THE WHY

It is no secret that part of the reason for male dominance in the construction industry is the pervasive stance that it is a place for 'rough and tough' people, and therefore women should not be a part of it (Agherdien & Smallwood, 2008). According to Ikpotokin (2020), there are basic reasons why women are excluded from the primary functions in the cement, concrete and construction industry (see the next figure).

In Nigeria and other developing countries, religious beliefs, customs, norms, and the stereotype that the construction profession is masculine have limited women's inclusion in the sector (Jwasshaka & Amin, 2019). Tunji-Olayeni, Kajimo-Shakantu, and Oni (2021), in their study on the work-life experiences of women in the construction industry, reveal that women working in the industry in Nigeria find it challenging to manage their dual roles of workload and family responsibilities, a submission that is consistent with many other studies and industries. This is exacerbated by the heavy workload and the lack of gender-sensitive policies in the industry. The authors identified these factors among others as negative outcomes for the retention and loyalty of their female employees, and ultimately, their performance.


Similarly, Kansake, Sakyi-Addo, and Dumakor-Dupey (2021) report the challenges in the mining and construction industry that prevent gender inclusiveness. They identify the prevalence of gender discrimination, sexual harassment, sex in exchange for employment, and a noteworthy gender pay gap in a multi-country survey that includes Ghana, the US, Ireland, and Canada (see Figure 13).

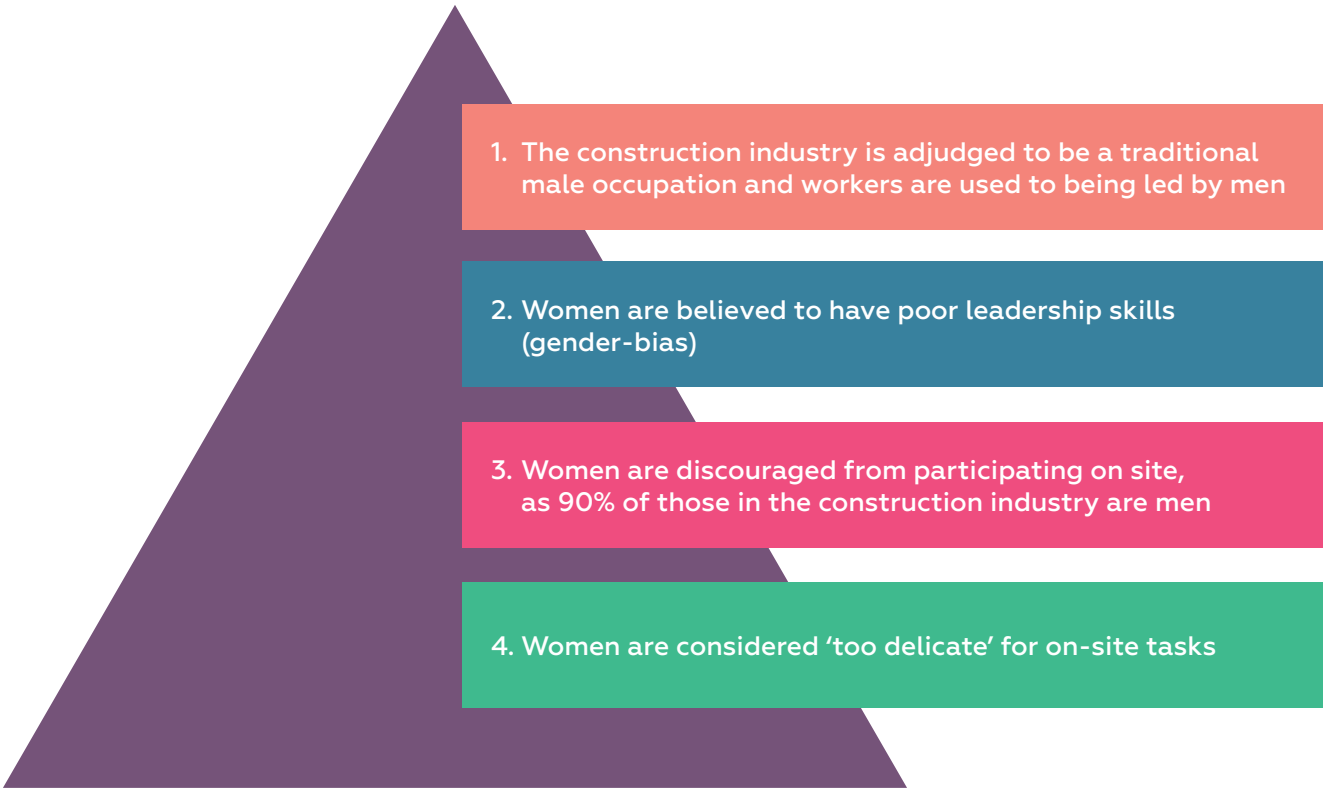



**Figure 12: Why women are excluded from primary functions in construction**
Source: Adapted from Ikpotokin (2020)

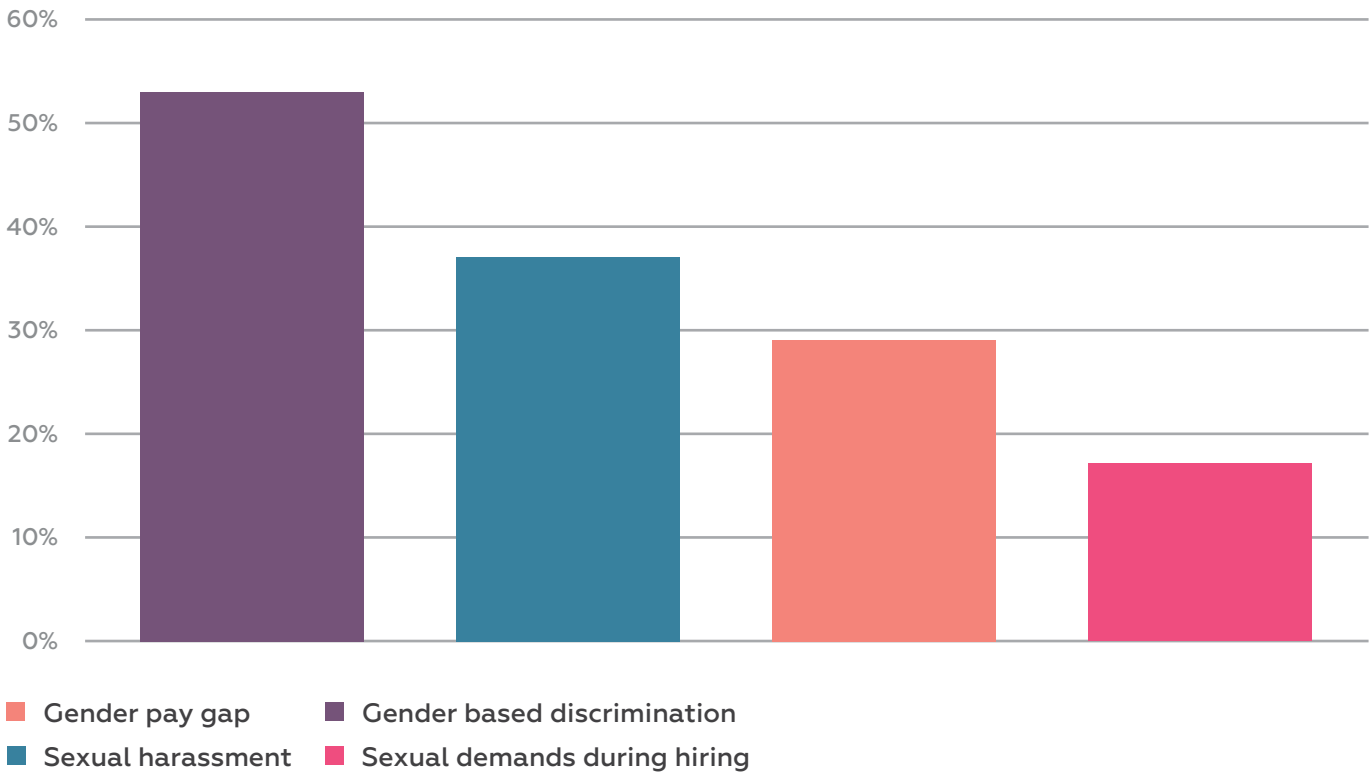



**Figure 13: Challenges of female mining and construction stakeholders**
Source: Kansake et al. (2021)

## CURRENT STATUS QUO

Studies confirm the observations that the construction industry is still dominated by men in Africa (Jwasshaka & Amin, 2019; Agherdien & Smallwood, 2008; Ozumba & Ozumba, 2012). In Nigeria, to pick one notable example, although the industry is the largest local employer, only 16.3% of the construction industry workforce are women (Edike, Aina, & Adeoye, 2021).

Emphasising the low rate of women's inclusion in the construction industry, the Global Gender Gap Report (2021) shows that the construction industry had the lowest level of women representation in 2019 (see Figure 14).

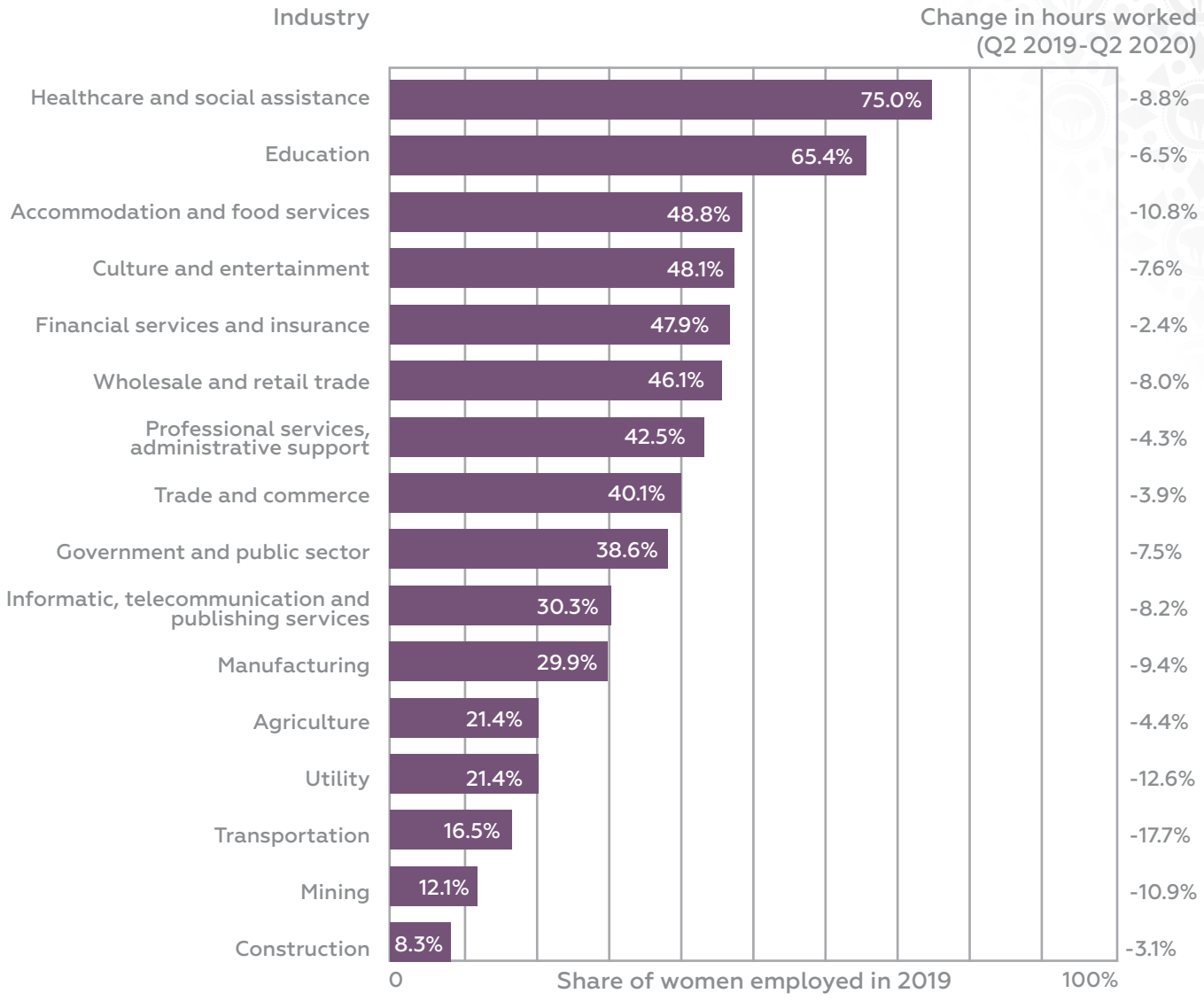



**Figure 14: Global Gender Gap Report by sector in 2019**
Source: World Economic Forum (2021). Global Gender Gap Report 2021. Retrieved from https://www3.weforum.org/docs/WEF_GGGR_2021.pdf

However, this result varies across the continent. In South Africa, for example, women are playing an increasingly important role in the construction industry. South Africa's Construction Industry Development Board (CIDB) estimates that women own about 48% of South Africa's construction companies. In Kenya, Maichuhie (2022) reports that a recent study on 'Women in the Built Environment' shows a low rate of women's participation in the construction sector, even though the construction industry has recorded remarkable growth.

## THE WAY FORWARD

First, consider government's role. South Africa has a legislative charter on women inclusion in the construction industry (English & Hay, 2015). As earlier mentioned, South Africa's Construction Industry Development Board (CIDB) estimates that women already own about 48% of South Africa's construction companies. Second, corporates also have a major role to play. Adapted from the Calvert Women's Principles by the UN Global Compact and the UN Women, the Women's Empowerment Principles provide a non-industry-specific framework for implementing and adopting gender equality practices in corporate organisations. These principles present a blueprint that the CCC industry should consider adopting and working with (see Table 3).

| S/N | Principles |
|---|---|
| **Principle 1:** | Establish high-level corporate leadership for gender equality |
| **Principle 2:** | Treat all women and men fairly at work – respect and support human rights and non-discrimination |
| **Principle 3** | Ensure the health, safety and well-being of all female and male workers |
| **Principle 4:** | Promote education, training, and professional development for women |
| **Principle 5:** | Implement enterprise development, supply chain, and marketing practices that empower women |
| **Principle 6:** | Promote equality through community initiatives and advocacy |
| **Principle 7:** | Measure and publicly report on progress to achieve gender equality |

**Table 3: Women's empowerment principles (WEP)**
Source: United Nations Global Compact[1]

Principle 1 captures the need for transformation at the level of the corporate C-suite. It argues that gender equality must be part of the organisation's corporate agenda, and must be embedded in the organisation's short and long-run economic goals. Best practice requires companies to publicly and transparently disclose gender equality goals and initiatives, and equal employment opportunity statements in media forms that will include the websites, company reports and annual reports.

Principle 2 is about corporate culture. For instance, the language used in organisations can encourage stereotypes and discrimination. It extends to the way safety wear is designed. Corporate culture, therefore, manifests in overt and subtle ways.

The basics of health and safety in Principle 3 include not just physical safety, but also psychological and emotional safety. People need to feel well to be productive. Tools to achieve this

[1] https://www.unglobalcompact.org/take-action/action/womens-principles

goal include policies to address grievances and handle resulting disputes. Organisations also need to identify and put in place enforceable policies on sexual harassment, workplace gender-based violence and gender discrimination.

Principle 4 refers to a longer time horizon. Women need the appropriate training and education to enter and then advance in the industry. The caveat is that the spectrum of skills ought to be addressed. Ticking boxes with only executive education, for example, is not sustainable. Job shadowing and mentorship are part of this element, too.

Principle 5 incorporates supply chains and marketing practices. The CCC value chain is large. The industry can have a positive impact that extends well beyond its own walls.

Similarly, as Principle 6 recognises, businesses all operate in communities. Especially the CCC industry needs strong relationships with those around them. A quarry or building site produces negative and positive externalities, challenges and opportunities. Corporate social responsibility as well as good business practices must include quality relationships with all stakeholders.

Principle 7 emphasises that companies need to hold themselves to account, which means transparent and full reporting on all gender-relevant data, such as employment figures and their investments in projects to address gender inequality. This should be reported widely, in annual reports and newsletters.

In summary, heavy industries such as CCC should take stock of their status quo regarding gender equality. Ignoring the topic is no solution, neither is accepting the status quo.

**Dr Ogechi Adeola**
Associate Professor, Lagos Business School, Pan-Atlantic University, Nigeria

Ogechi earned her doctorate in business administration from Manchester Business School and spent well over a decade working in the financial sector in Nigeria. Now an author, researcher and associate professor of marketing at Lagos Business School, Nigeria, her multidimensional research is at the intersection of marketing, strategy, tourism and gender in sub-Saharan Africa.

> The city is not a concrete jungle, but a human zoo.
>
> **Desmond Morris**

# 7 AFRICA'S INFRASTRUCTURE

Infrastructure is on everyone's lips at national budget time, during every macroeconomic debate, and a staple driver of job growth. The Biden administration's infrastructure plan has been among the globe's hottest political and economic debates for months – and for good reason. This is even more important for Africa, where infrastructure needs represent either a great opportunity to be grasped, or a gap whose power-to-power prosperity will remain poorly filled.

## BOOSTED: LOWER INFLATION, LOWER INTEREST RATES

High inflation is usually accompanied by high nominal interest rates, since savers require an interest return above inflation to be motivated to continue saving. High interest rates inhibit borrowing or investment; conversely, low interest rates facilitate borrowing or investment, easing the cash flow burden on capital projects and advancing their breakeven point.

During the 1970s to 1990s, inflation got a strong foothold in Africa, initially triggered by the sharp oil price increases of the early 1970s, but soon gaining its own momentum with wage-price spirals facilitated by monetary and fiscal policies that were not vigilant enough. Double-digit inflation became entrenched in many parts of the continent, as it also did in Central and South America and some parts of Asia. The high inflation was also variable, reinforcing uncertainty in economies and in many instances, it also brought about considerable swings in interest rates, as markets and monetary policymakers responded to the inflationary pressures. It gradually became clear that high inflation is a destructive force and that the trade-off, in which less unemployment can be "bought" by allowing more inflation, is not sustainable as inflation creeps higher. Accordingly, economic policymakers started to clamp down on inflation.

As a result, in most parts of Africa, inflation and interest rates have moderated considerably over the past three decades. The accompanying graph illustrates these trends.

Most studies attempting to capture a common trend across several countries are troubled by the existence of a few strong outliers caused by special circumstances. For instance, in this analysis, use of an arithmetic average of country inflation rates – to depict the typical course of inflation on the continent – could be sabotaged by hyperinflation in a single economy, pushing up the average considerably, while in reality, low inflation was the norm.

The figure below illustrates trimmed mean inflation rates and Central Bank interest rates. For every year, all the individual country inflation rates are ranked from lowest to highest. The top three and bottom three have been deleted, and the average computed for the remaining countries. A similar procedure was followed for the Central Bank's interest rates.

## Trimmed average inflation and Central Bank interest rates in Africa, 1990 - 2021

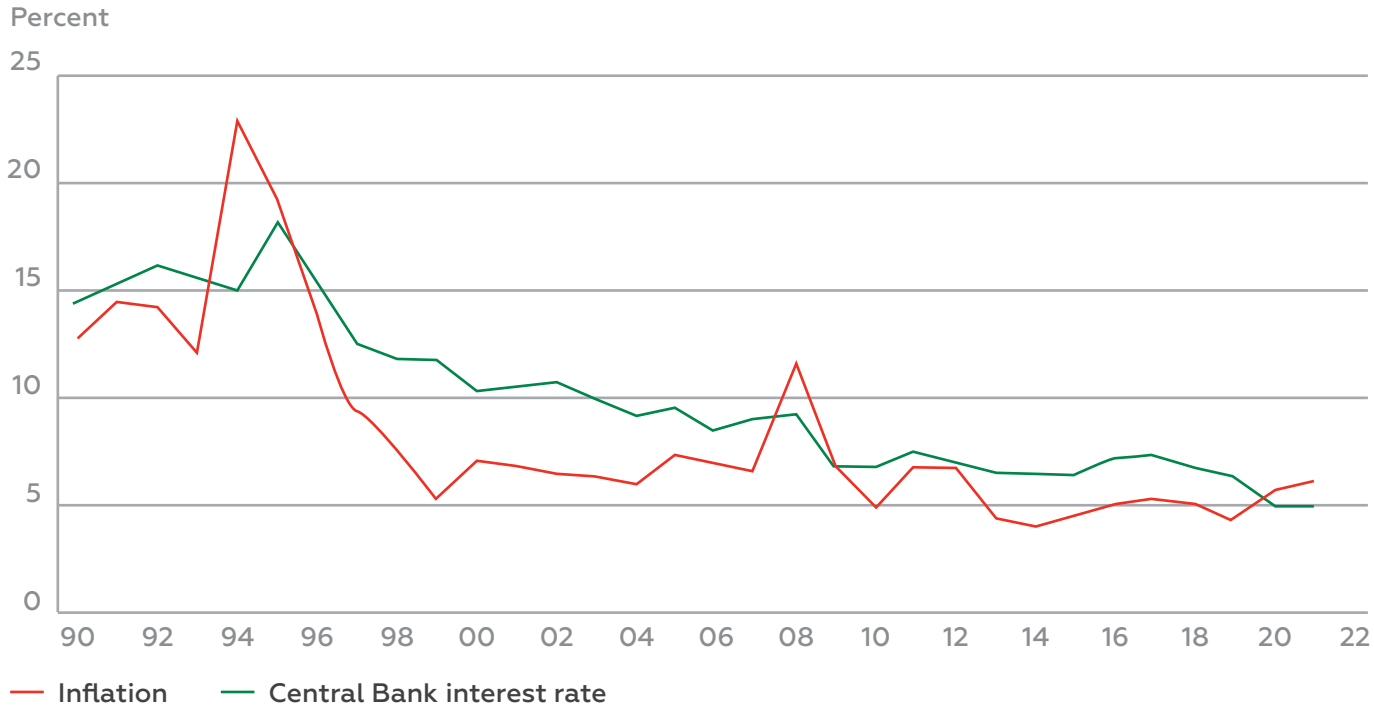



**Figure 15: Average inflation & interest rates in Africa**
Source: IMF, Tradingeconomics.com and author's calculations.

The figure illustrates that from an inflation and interest rate perspective, the policy environment in Africa has become much healthier, more sustainable and supportive of sound investment projects. The typical inflation rate has roughly halved over the past 30 years, while the typical Central Bank interest rate is down to a third of its level in 1990. Off course, the magnitude of the interest rate reduction received additional impetus in the last two years from the Covid-19 pandemic, which amplified the need for policy support to ailing economies. Some of that additional stimulus may in fact be withdrawn as soon as inflationary pressures appear and the need to counter them rises. However, building Africa is set to benefit over the long haul in a lower inflationary environment, which supports sound planning and makes it easier to fund projects that are more readily utilising lower nominal interest rates.

**Dr Johan van den Heever**
Technical Expert: Research & Financial Stability Department, Bank of Namibia and previously Head of Economic Research, South African Reserve Bank (SARB).

Johan was an Economics lecturer at the University of Pretoria until 1987, when he joined the SARB as an economist until 2016, serving three years as head of its Research Department.

# THE OPPORTUNITY OF CAPACITY

During the late 1990s, Old Mutual, a South African asset manager, began a concerted effort to invest in infrastructure, based on the premise that improving this type of long-term investment capital would have knock-on benefits for the wider economic health of the continent. The expectation was, in turn, that business prospects for many of the companies they had invested in would improve with a consequent positive portfolio impact. They looked for assets in transport infrastructure such as roads, rail and airports, and expanded to power generation and telecommunications.

Infrastructure has the direct additional investment benefit of an income stream linked to inflation (very useful for retirement investments) and a correlation benefit for risk diversification of a portfolio. The latter came in handy when the global equity markets were pummelled with the advent of the Covid-19 pandemic. During the same period, infrastructure assets, such as communications or power, were resilient. This position, taken in the 1990s, has proven to be a sound investment call, with infrastructure being a strong performing asset class over the last 25 years.

Where should capital be usefully deployed in Africa so that it will not only generate desirable investment returns, but also build economic capacity? A few themes are discussed in the next section.

The African Development Bank estimated that Africa needs infrastructure investment amounting to approximately $150 bn *per annum*. However, the fiscal capacity to provide this level of investment, is no more than 50%. Hence, there is an extraordinary need, and opportunity, for private sector investment capital to participate.

Of this investment requirement, electricity would constitute the largest deficit. Six hundred million people in Africa do not have access to electricity. Access to electricity indubitably enhances economic prospects. In Nigeria, where an enormous load is placed on diesel generators as backup or primary power source, this comes at a cost of around four times that of the electricity supplied by the grid. An obvious economic arbitrage is to increase capacity on the grid, thereby reducing power costs to the overall economy.

Another opportunity in power is distributed generation. In many instances, the costs of extending the grid to customers is not economically viable, given Africa's massive footprint. Africa is three times the size of Russia and twice the size of the US.

In the case of telecommunications, in many instances, Africa has been connected with mobile telephony, where there were no previous landlines. The same leapfrogging of traditional centralised

power generation networks is happening, where rooftop solar and mini grids often provide improved solutions. This development is further facilitated by mature digital technology that permits remote monitoring and scale benefits that allow for simple and viable power systems. It is estimated that 25% of Africa's electricity will ultimately be generated by distributed capacity.

South Africa has a carbon intensive economy. In 2020, it was the 13th largest fossil fuels $CO_2$ emitter, responsible for 1.3% of global emissions. Its national utility has an ageing coal fleet that needs replacement. The once successful Renewable Energy Independent Power Producer Programme (REIPPP) was recently revived, with solar and wind energy prices continuing their downward slope. Evidently, renewables represent a significant investment opportunity, although competitive bidding pressures resulted in tight tariffs requiring innovative financing structures to deliver attractive investment returns.

A more recent development in 2021 provided further impetus to a growing industry, when it became legal for private firms, especially mines, to generate and sell their own electricity, up to 100 MW.

Another energy transition is the inexorable transition globally to electric vehicles. This constitutes both a profound risk and opportunity. The global automotive industry produced 40 million cars in 1980[1], but production grew by 10 million units a decade and peaked at 97 million in 2017. There have been winners and losers. China has gone from a production of 200,000 units to 25 million, while France went down from 3.3 m to 1.3 m and Australia from 400,000 to zero. The US and South Africa have weathered the storm well, given that China effectively absorbed most of the growth in unit numbers over the last 20 years.

In South Africa, the automotive industry makes up 5% of the economy and 15% of all South African exports. The risk, however, is that South Africa is not producing any electric vehicles, where all the international growth is found. On the other hand, with electricity supply already under severe strain and not improving, electric cars will face many challenges, not only of loadshedding and other down-times, but also long distance travelling with limited opportunities to recharge the battery. There might thus only be an opportunity for localised public service (minibuses and buses) or individuals who use their cars for short trips to the office, shops or schools, and where the car can be recharged conveniently.

[1] Organisation Internationale des Constructeurs d'Automobiles includes passenger cars, light commercial vehicles, minibuses, trucks, buses, and coaches.

## Global plug-in vehicle sales

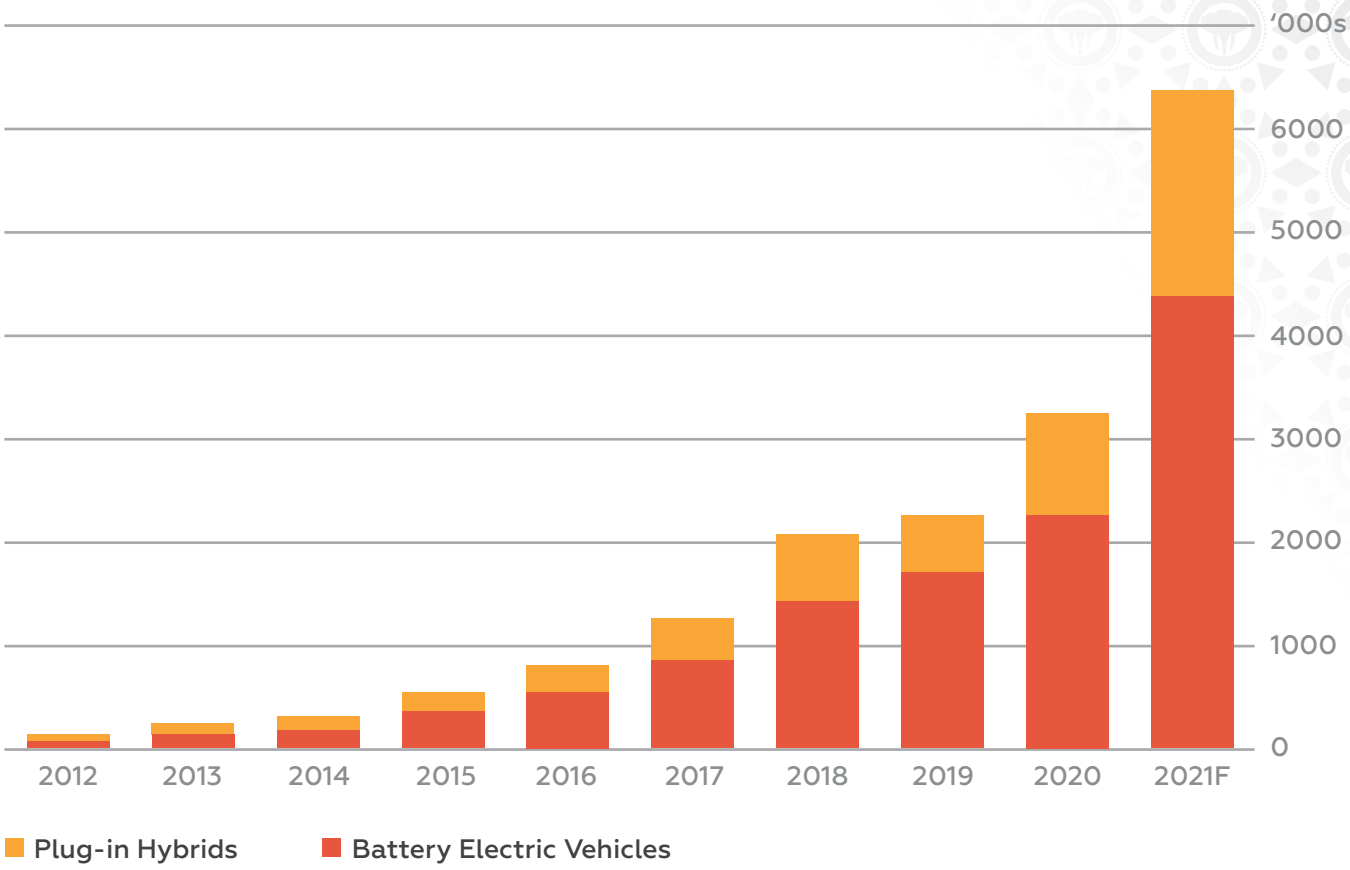


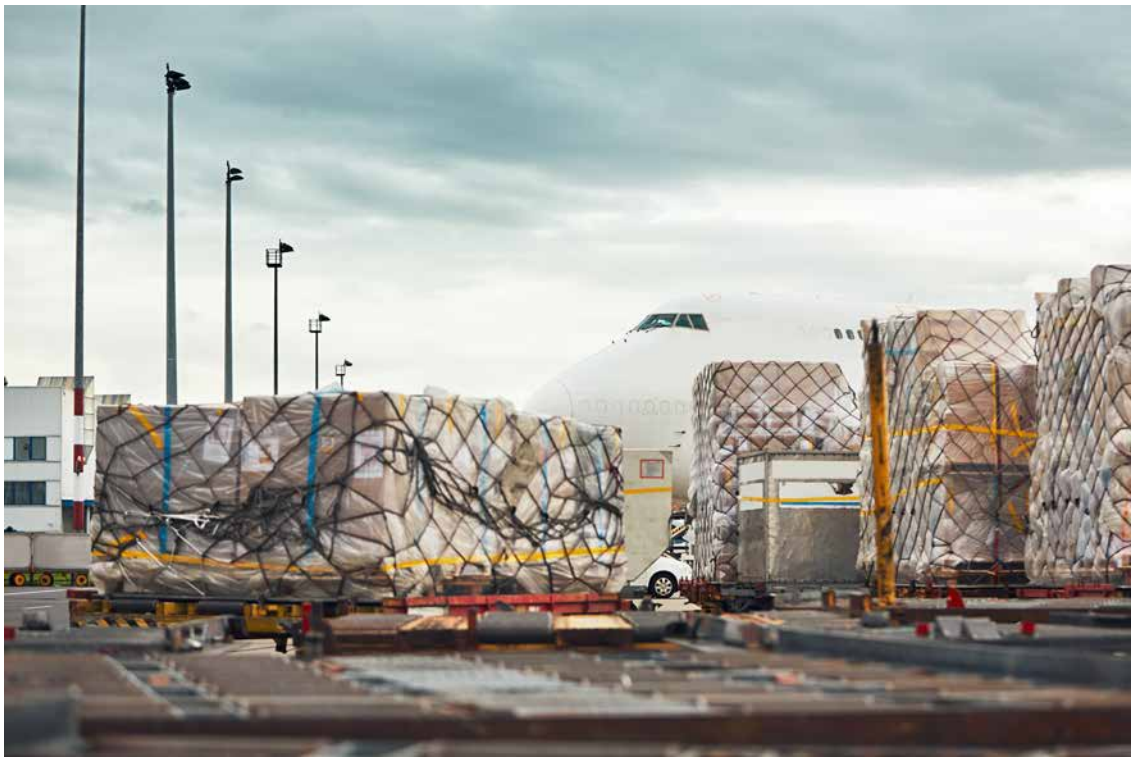

**Figure 16: Global growth in electric vehicle sales volumes**
Source: EVvolumes.com

Electric car sales are surging globally. In key markets, this transition is happening a lot faster. In South Africa's two biggest export markets, sales are growing fast. In fact, in many of these export markets, the constraint on electric vehicle sales is availability of stock and not demand. Another driver of this transition is the anticipated ban of new diesel or petrol vehicles in the next decade in the developed countries.

The EU wants to ban these cars in 2035, and the UK and Germany already in 2030. For key export markets, this is a frighteningly short time span. However, this also represents an opportunity for those who can reconfigure rapidly. This is usefully illustrated by the world's largest producer of electric cars, Tesla's rapidly rising sales.

Another area in need of investment is agriculture, with the rising global population projected to increase to 10 billion by 2050. Half of the increase in population numbers will be in Africa, so food production is vital. Sixty percent of the remaining uncultivated arable land on the planet is in Africa. The opportunity exists across many of the 55 countries in Africa to deploy capital to capture this opportunity. In many instances, countries are importing agricultural produce for local consumption that given appropriate development, could be produced locally. Another key area for consideration is the development of agriculture added-value chains to export, especially to Europe.

The last area to explore is the impact of the African Continental Free Trade Area (AfCFTA) and



what it may mean for investment. The AfCFTA will ultimately cover a market of 1.2 billion people and a gross domestic product (GDP) of $2.6 trillion (2019).

Intra-African trade is currently low at only 14% of African exports. In comparison, in the EU, intra-EU trade ranges between 50-75%. Businesses are currently paying average tariffs of 6.1% to export within Africa, which is higher than the tariff they pay when they export outside Africa. Elimination of tariffs on intra-African trade will make it easier for African businesses to trade with each other, leading to the development of African value chains. The UN Economic Development in Africa Report 2021 estimates that partial tariff lowering by 2025 is expected to increase the intra-African export potential by $9.2 bn.

However, unless Africa reforms non-tariff barriers, such as transport and logistics infrastructure, very little of the modelled gains will materialise. Currently, to export goods through ports in Africa can cost three to four times what it would cost in Europe. The ECA estimates that the AfCFTA has the potential both to boost intra-African trade by 52% by eliminating import duties, and to double this trade if non-tariff barriers are also reduced.

Africa has an extraordinary opportunity for growth, underpinned by the strong demographic trajectory through 2050 and a considerable resource endowment. It is also urbanising at a rate of 24 million people a year (twice the rate reported in India or China). Cities are drivers of growth and will require appropriate investment in infrastructure and capacity.

**Paul Boytnon**

Non-Executive Director and Investor.

Paul is a chartered accountant with an MBA from the University of Cape Town, and has spent more than 30 years in investment and capital markets initially as a listed equity portfolio manager and more recently involved in alternative unlisted investments. He serves on the boards of several high-profile investment entities, including African Infrastructure Investment Managers (AIIM), African Clean Energy Development, 10X and various investment committees. Paul recently retired as CEO of Old Mutual Alternative Investments (OMAI), a business with over R60 billion in assets under management, and which he led from inception.

# FINANCING IT ALL

> Ex Africa semper aliquid novi[1]

In 2018, the most widely quoted measure of the African continent's overall infrastructure funding requirement, was $93 bn *per annum*. During the same year, the African Development Bank (AfDB) released its annual Africa's Economic Outlook, with a special focus on infrastructure. By revisiting certain assumptions, especially around the imperatives informing the ideal provision of power, water and sanitation, the AfDB report revised this figure to between $130 and $170 bn (35-45% of GDP according to the World Bank). With approximately $100 bn successfully mobilised annually, this indicates a funding gap of up to $70 bn. One suspects that these figures remain blushingly modest.

Research conducted by PwC (*Capital Projects and Infrastructure Outlook to 2025*) suggested that between 2012 and 2025, global spending on infrastructure would rise from $4 trillion to $9 trillion. This means that, at best, and adjusting roughly for inflation, the higher estimate of Africa's infrastructure requirements in 2018 would have accounted for about 3% of the global total. Given the glaring inadequacies in Africa's infrastructure, especially in contrast to other regions of the globe, it is safe to say that in an ideal world, expenditure on Africa's infrastructure would be well beyond the $170 bn cited in 2018.

## So why are there such inadequacies? Industry insiders cite the following:

**Anaemic fisci are endemic throughout Africa**.
The bulk of infrastructure is publicly funded, with private funding and public-private partnerships accounting for at most 30% of all infrastructure funding. Thus, weak government spending capacity hamstrings most countries on the continent in the provision of infrastructure.

**Inadequate long-term planning**.
The provision of infrastructure is a long-term undertaking. Lack of planning and coordination means that African countries generally play with a short deck in the quest to develop well thought-out infrastructure.

**Governance**.
Since infrastructure projects invariably require long tenures to produce adequate returns, a stable and corruption-free policy environment is mandatory for attracting investment. In many African states this has proven an elusive goal.

**Inability to mobilise private participation.**
All these factors, plus a weak indigenous private sector, contribute to limited private participation in infrastructure and the funding thereof.

**Paucity of bankable projects**.
Global resources have significantly more funds available vs. bankable projects. The base case for infrastructure investment is strong. Improved infrastructure provision in Africa could significantly benefit not just Africans, but the regional economy too, thereby boosting aggregate demand and accelerating employment in Africa and beyond. The key problem appears not to be a lack of available funding, but the scarcity of bankable infrastructure projects.

[1] Latin for "out of Africa, always something new"

## WHERETO FROM HERE?

What can be done to address these shortcomings?

**Improved development assistance coordination**. It is encouraging that there have been significant multilateral efforts to tackle Africa's infrastructure challenge and create enduring infrastructure-focused institutions. These efforts greatly benefited from deliberations that began around the turn of the century at NEPAD – the New Partnership for Africa's Development, and have given rise to important, highly-focused initiatives and institutions. These include the Programme for Infrastructure Development in Africa (PIDA) and the Infrastructure Consortium for Africa (ICA), with the latter managing to bring in significant resources and membership from beyond the continent, including G8 countries.

**Enhanced private infrastructure funding.** There have been several important initiatives in this regard, including the Private Infrastructure Development Group (PIDG), funded by several European governments, the Emerging Africa Infrastructure Fund (EAIF), the US-backed Power Africa and the EU-Africa Infrastructure Fund.

**Governance must improve**. The "international solidarity" developments are positive. However, much remains to be done to establish strong governance as the norm on the continent. Africans in their sovereign polities must desire and strive to attain this goal.

New funding sources must be exploited more efficiently, some of which include:

**Sovereign wealth funds**, which globally manage over $7 trillion of resources. Several have mandates that would appear tailor-made for infrastructure investment.

African **pension funds** enjoyed a four-fold growth spurt in the last decade, from $300 bn to over $1 trillion by 2020. This is testament to the rapid growth of the African middle class, albeit off a very low base. Globally, pension funds are an important part of the infrastructure funding mix, as they are by nature conservative and seek stable, long-term investments, and Africa should not be an exception. The rider, of course, is that weak governance and corruption undo the intrinsic characteristics that make infrastructure investment attractive.

**International bond markets** are an attractive proposition. In the past decade, several African countries have made highly successful, even oversubscribed forays into these markets, including Gabon, Ghana, Mozambique, Nigeria, Rwanda and Zambia.

## MORE BANKABLE PROJECTS

> Focus on project preparation facilities (PPFs).

Significant efforts must be expended to capacitate Africa to produce more bankable projects. In recognition of this, the Project Preparation Facility Network (PPFN) was formed in Tunis in June 2014, with the key objective to co-ordinate, rationalise and consolidate the support provided by PPFs.

Shortly after the PPFN was formed, the ICA conducted a study on the efficacy of 18 PPFs operating in Africa. One measure of this efficacy was the percentage of projects that reached financial close – 50% being the threshold for success. Only three PPFs, linked to the EU, the US and the IFC, met this mark.

### The study listed several factors, including:

1. Lack of financial resources, with funds mobilised in an *ad hoc* manner and without adequate plans for replenishment;
2. Overly broad mandates, with scant specialisation;
3. Excessive bureaucracy;
4. Lack of requisite skills;
5. Fragmentation and lack of coordination;
6. Lack of sustainable funding models, where PPFs do not sufficiently recover expenses to ensure their sustainability.

The coming decades will herald frenetic project activity to develop Africa's infrastructure. In the energy sector alone, PwC conservatively estimates (Africa Energy Review 2021) that the cost to achieve net zero for Africa by 2050 is $2.8 trillion. Moreover, to attain its SDGs, Africa must double its generation capacity by 2030 and increase it five-fold by 2050.

The task is daunting, as the research goes on to note that Africa still suffers from negative risk perception, even though project finance defaults on the continent are the lowest globally. The continent will prove too important for the decarbonising world to ignore. Some of the best solar potential in the world is in Africa, with South Africa and Egypt boasting the largest capacity, followed by Algeria. Likewise, with wind power, Africa has even more significant potential, led by South Africa, and with Egypt, Senegal and Morocco not far behind. Coupled with the advent of green hydrogen, these endowments represent nothing short of the ability to bottle sunshine and wind power, for export to a world hungry for sustainable, green energy.

**Fana Marivate CA (SA)**

CEO, Bankable Models, a project finance consultancy firm in Johannesburg.

Fana is a Chartered Accountant (SA). His career has spanned over 25 years and covered project finance, fund management, tax consulting and business incentives, including several years at Deloitte and at the Industrial Development Corporation of South Africa (IDC). Fana is the Founder of Bankable Models, a 100% Black-owned project finance advisory firm in Johannesburg.

> If you want to go fast, go alone. If you want to go far, go together.
>
> African proverb

# 8 ACROSS AFRICAN BORDERS

> "Major trading partners". What comes to mind? Is it how much buying and selling we do with China and America? It often is. There is strong evidence that we have more to gain from boosting trade within Africa. More bang for buck. There are reasons we don't do enough intra-continental trade, but also ways to overcome them.


## MADE AND TRADED IN AFRICA

"If you build it, they will come," went Kevin Costner's famous line in the 1989 drama *Field of Dreams*. In the cement industry, the question is getting the product there in the first place, so building can commence. Francois Fouche explores the intricacies of trading cement across borders in Africa.

For many African countries, the cement industry provides opportunities to add value to otherwise low-value raw materials. With healthy trade, we can generate a tide that raises all ships... and cement trucks. However, this is a complex market with political nuances, and cement is very heavy.

The production of cement is both capital and energy intensive. It is estimated that raw materials account for 30-40% of the overall cost of production; energy for 30%; transport for 10%; and other cost elements, including labour and administration, for the remaining 20% (Byiers et al., 2017).

In many ways, transport is the magic formula for cement. Its low value-to-weight ratio makes land transport significantly more expensive than maritime transport. To illustrate, it is cheaper to cross the Atlantic Ocean with a cargo of 35,000 tons of cement than to transport it 300 km by truck[1].

Africa has long been a net importer of cement. Its trade deficit rose sharply between 2004 and 2010 and remains about $2 billion per year. Yet, domestic demand outstrips supply in most African countries. Africa accounts for 10% of global cement exports,

[1] World Business Council for Sustainable Development, (2002), The Cement Sustainability Initiative: Our Agenda for Action


while its share of global imports is approximately 21%. These supply and demand pressures contribute to high prices. Some estimates have a 50 kg bag of cement costing an average of $9.57, compared with $3.25 in the rest of the world (World Bank, 2016b).

Market size and geography are key considerations that have a material influence on additional kiln or grinding capacity investment decisions. The location of a new cement plant is not determined by its closeness to limestone deposits and cheap energy sources alone. Infrastructure and market demand also play a key role. In addition, economies of scale need to be combined with sufficiently high plant utilisation rates.

We can discuss African countries in three categories, based on their cement producing status. First, there are countries without limestone deposits. They are usually small and must rely on imported cement. Second, there are those that lack deposits, but do have grinding capacity. They import clinker to make cement and augment this with imported products. Most African nations are in third and best of the three categories: their deposits and full production capacity enables their net exporter status.

Cement business ownership structures in Africa are characterised by oligopolistic tendencies, i.e., a few firms dominate the market. Over time, leading multinational firms consolidate their positions by acquisition to position themselves strategically and thereby improve economies of scale in transport and distribution, and to deter external competitors. Some of these strategies are productive and healthy. Sometimes, they form barriers to competition. Several studies have shown cartel-like operations in this market. (African Competition Forum, 2013; United Nations Economic Commission for Africa et al., 2017).

Prior to the Covid-19 pandemic, with the long-term decline in shipping costs, the relative price of imported cement was expected to fall gradually, eventually eroding the rationale for adding more production capacity. The significant spike in maritime transport costs caused by a pandemic have interrupted this trend. Whether landlocked countries in Africa may also eventually benefit from this development, will be determined by the progress in intra-African trade (largely a function of hard and soft infrastructure, such as logistics, and typical non-tariff barriers).

Given the economic and political sensitivity of the industry and oligopolistic tendencies, import protection for cement is a hotly debated topic. There is widespread use of non-tariff barriers, ranging from import bans and import quotas to limiting foreign exchange availability for cement importers. In COMESA (Common Market for Eastern and Southern Africa), cement is designated as one of the products of "particular importance to

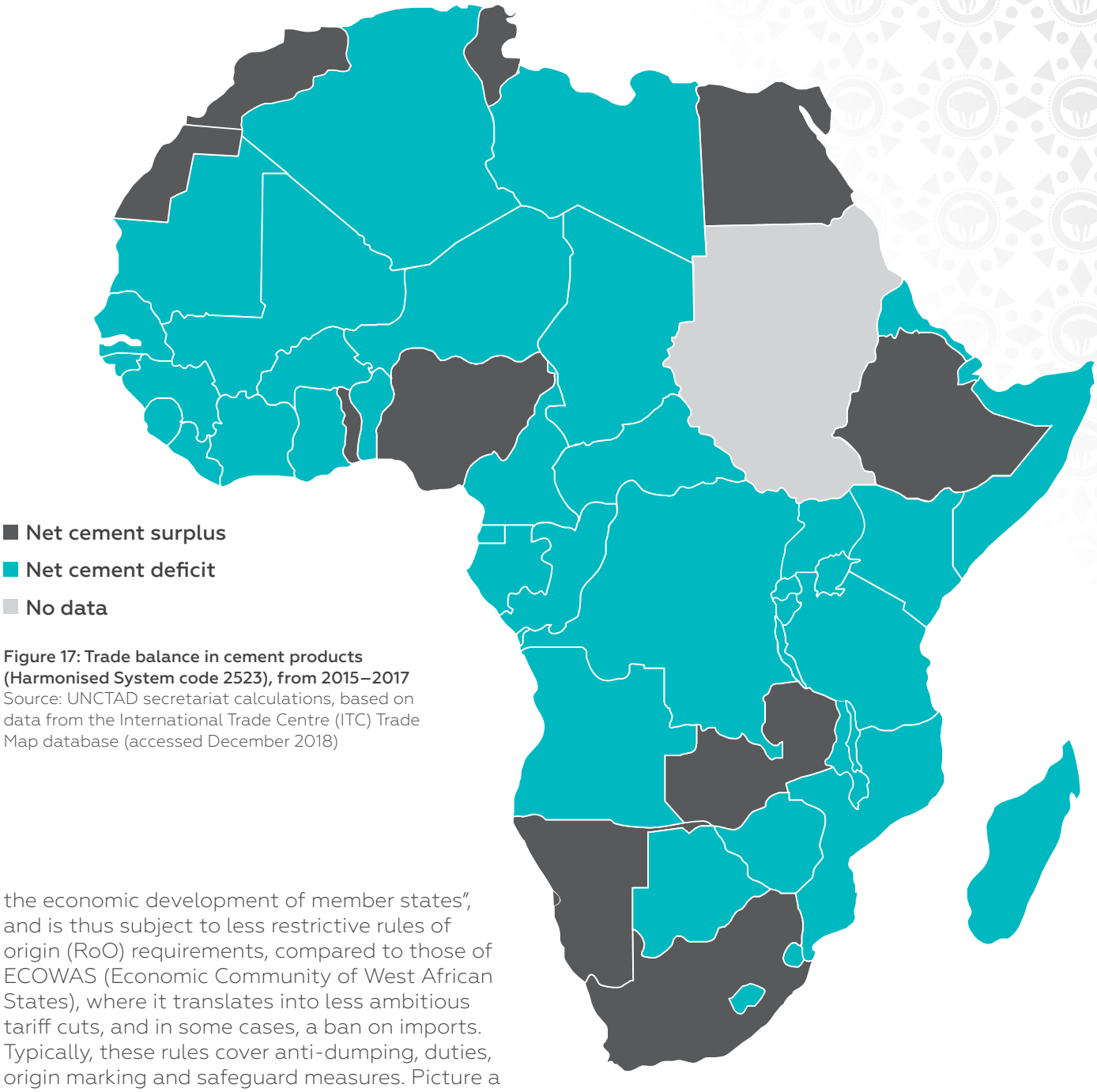



**Figure 17: Trade balance in cement products (Harmonised System code 2523), from 2015–2017**
Source: UNCTAD secretariat calculations, based on data from the International Trade Centre (ITC) Trade Map database (accessed December 2018)

the economic development of member states", and is thus subject to less restrictive rules of origin (RoO) requirements, compared to those of ECOWAS (Economic Community of West African States), where it translates into less ambitious tariff cuts, and in some cases, a ban on imports. Typically, these rules cover anti-dumping, duties, origin marking and safeguard measures. Picture a passport for goods.

The African Continental Free Trade Area (AfCFTA) will be decisive in the liberation of trade for years to come. This brings great potential to uplift everything from regional value chains and greater industrialisation to greater formalisation of business and job creation.

**Francois Fouche**

Research fellow at the GIBS Centre for African Management and Markets (CAMM) and director of Growth Diagnostics, an economics advisory firm.

Francois hails from the earlier Wharton Econometric Forecasting Associates, a USA-based commercial think tank founded by Nobel Prize winner Dr Lawrence Klein. Today Francois advises central banks, governments and industry on all matters trade and investment related, like evidence-based export strategy development.

# TRANSFER PRICING: OPPORTUNITIES AND AVOIDING DEATH BY TAXES

This is the realm of high finance. Tax rates, trade deals and international banking. In a globalised world, multinational corporations are hubs in supply chains that span continents. That means multiple legal systems, income streams and tax bills. Michael Hewson outlines these considerations for an African multinational cement maker.

The cement, concrete, construction and infrastructure industries are key to the growth of developing economies. Many major companies operating in these industries have established operations in multiple countries and rely on a multinational value chain to provide quality products and services to clients on a reliable basis. These companies are large employers and important contributors to local economies. Thus, it is important to consider the factors that affect these companies' ability to establish and expand their operations in various countries.

The exchange rate – especially where raw materials or finished products are sold cross-border – can have a considerable impact, particularly for cement producers in emerging markets. If a company is reliant on imports of certain raw materials to supplement supply, it can have a detrimental impact when a local currency depreciates. It is often very expensive to hedge emerging market currencies, which means that companies operating in those markets generally choose to live with the risk of the foreign exchange fluctuations rather than insure against the movement in currencies.

In addition, construction standards vary across countries, and this affects the quality of

construction materials that can be used. In certain instances, cheaper inputs are tolerated, which may put considerable price pressure on companies that ordinarily produce higher grade cement.

In certain countries, there is also legislation that affects the importation of cement. This may be in the form of anti-dumping legislation or local product procurement requirements for government projects, which has a considerable bearing on the level of competition in a particular country[1].

Another important feature of the cement industry is the relatively high cost of inland transportation of cement. A local producer has greater competitive advantage where its production operations are inland rather than when they are located near to the coast, because foreign competitors will be required to incur expensive transportation costs to move the product inland. In addition, recent supply chain disruptions have increased the need for countries to have adequate local supply of products to mitigate the risk of the shortages having significant inflationary pressure.

Factors that affect the demand and supply of cement have a significant impact on the price of the product in the different countries. The prices vary considerably across regions, with cement in Brazil costing $60 per ton in 2019, whereas in Mexico in 2019, it was almost double at $113 per ton[2].

While the industry is subject to external factors that can pose considerable challenges, larger companies appear to be more resilient to external shocks. This is evident in the composition of the industry. Most of the top producers are either based in China (where there is considerable demand for the product) or are large multinational enterprises (MNEs).

MNEs can "balance out" external shocks in that they can diversify their exposure to the infrastructure projects in one country by targeting projects in multiple countries. They are also able to leverage production processes from one country to another[3].

Fluctuations in the demand for cement can create instances of idle capacity, which can be significant and often unsustainable for smaller participants in an industry. In the US, the demand for cement decreased between 2015 and 2018, and this resulted in a peak of idle capacity of 46% there[4]. This trend has also been seen in many other countries.

[1] Department of Trade & Industry, Government Notice No. 216, National Regulator for Compulsory Specifications Act, 2008 (Act 5 of 2008), as amended through Legal Metrology Act (Act 9 of 2014), 15 March 2021.
[2] statista.com/statistics/1232594/latin-america-cement-price-country/
[3] cfic.dz/images/telechargements/global%20cement%20magazine%20decembre%202020.pdf
[4] http://snic.org.br/assets/pdf/relatorio_anual/rel_anual_2019.pdf

## TRANSFER PRICING AND TAX CONSIDERATIONS

Transfer pricing refers to the prices at which a member of an MNE provides goods or services to another related party, usually in another country. Most countries apply the regulations to cross-border transactions, while some, such as Mozambique and Tanzania, also apply them to domestic transactions with related parties. The arm's length principle is widely applied, which requires that transactions between related parties take place at the same price as they would if the parties were independent. For example, if a subsidiary of a multinational cement manufacturing group needs to purchase chemicals from another member in the group, the price levied needs to be consistent with the price that would be charged by an external supplier transacting under similar terms and conditions. Alternatively, if one company in the group renders technical support to another, the fees charged need to be in line with what would have been charged by an independent third party.

MNEs have often come under scrutiny, where revenue authorities suspect, they are avoiding paying their fair share of taxes by structuring their transfer pricing transactions in a particular way. This has been a significant concern to revenue authorities, especially within the resource sector in Africa.

During the past 10 years, the number of countries in Africa with specific detailed regulations on transfer pricing has increased from 15 to over 25. This has been driven largely by support from international institutions such as the Africa Tax Administration Forum, the OECD, the United Nations and the World Bank, among others. These bodies have run programmes to establish transfer pricing legislation and assist with transfer pricing audits in many African countries with the goal of closing any tax gaps.

**Aside from transfer pricing regulations, there is a raft of other legislation specific to many countries in Africa and certain other emerging markets that will potentially affect cross-border transactions for the companies operating in the cement industry. These include:**

**Withholding taxes** on service fees, whereby the provider of the service is taxed by the country of the recipient of the service on the value of the service rendered. The withholding tax may be 15% or 20%, unless it is reduced by a double taxation agreement between the country of the service provider and service recipient.

**Exchange control regulations**, which limit the extent to which a service recipient can pay for certain services (for example, in Ghana, management services are limited to 5% of EBITDA).

**Limitation on deductibility** of certain expenses by the company incurring certain costs. For example, in Zimbabwe, if the management or technical support fees charged exceed 1% of revenue of the recipient entity, the tax deduction that the Zimbabwean recipient can claim is limited to only 1% of revenue. This means that the additional expense for management or technical services is non-deductible.

In certain countries, these regulations overlap. For example, in Zimbabwe, the amount of fees that can be paid to a foreign related party for management and technical assistance is capped at 2% of revenue from an exchange control perspective. In addition, of the 2% of revenue that is permitted, only half of that amount (i.e., 1% of revenue) is permitted as a tax deduction for the Zimbabwean entity.

New taxes that are likely to have an impact on the industry in future include a digital services tax, which many countries are considering introducing (some countries, such as Kenya, have already introduced this to tax the fees paid by local companies for the use of digital services and certain technology), and environmental levies, which may be introduced in one way or another.

In addition to these taxes, an overarching risk that many of the MNEs are facing is a transfer pricing audit. These are often triggered when a company that is a member of an MNE is loss-making or pays a large amount of service fees to a foreign related party.

For example, shared technical, information technology (IT) or human resources (HR) services are common within large MNEs for a number of reasons. It might be that certain skills are not widely available in each country in which the MNE operates, or to create synergies and uniformity within the group, or purely as a cost-saving measure. Increasingly, MNEs operating in various African countries are being subjected to scrutiny in relation to these intra-group service costs and are being asked to provide evidence to support business decisions taken in respect of such costs.

One example we have seen at Graphene Economics relates to executives' activities. Assume the executives of an MNE group spend 20% of their time working on protecting shareholder investments and 80% of their time on strategy and other actions to grow the group's revenue. The business might decide that this 80% of the executives' time should be charged out (plus an arms-length mark-up) to the various group entities. However, in recent audits performed by the Tanzania Revenue Authority (TRA), these types of charges have been challenged. In such cases, MNEs are being asked to trace back executives' activities (sometimes as far back as six years) to justify what they have done for the benefit of the Tanzanian subsidiaries. Providing a high-level explanation of their activities has not proved adequate to satisfy the TRA that the service was rendered, and the charge is appropriate. Consequently, the groups may be at risk of losing their full tax deduction (or a part thereof). In the worst-case scenario, the TRA may even implement a transfer pricing adjustment and levy an equivalent penalty for the more recent years.

## PROTECTING AGAINST TRANSFER PRICING RISK

As noted above, the cement industry is significantly affected by several external factors, any of which on their own could cause a company to incur losses. The key test from a transfer pricing perspective, namely applying the arm's length principle, is made more challenging by the factors that have an impact on demand and supply. For example, often a company will sell certain products to customers locally and will then sell certain products to a foreign related party. The question that arises is, at what price should the sale take place?

Using the cost example of Mexico and Brazil cited above, it is apparent that prices in nearby regions can be significantly different. The question arises whether it is the pricing factors in the supplying country or the receiving country that should be considered? Or both?

What if an entity in one country has surplus capacity (as noted in the example of the US between 2015 and 2018) and seeks to at least cover some of its costs by selling its product at a slightly lower price than it would to its ordinary customers? This is certainly a decision that could be expected between independent third parties. So, when it comes to transactions between related parties, it is necessary to carefully consider all the relevant factors to arrive at an appropriate arm's length price. In other words, the arm's length price needs to take into account the relevant geographic, industry and commercial features that are having an impact on demand and supply.

## WHY TAX AND REGULATION FACTORS ARE CRITICAL

As noted, the cement industry plays an important role in the development of a country. It is an industry that will need to continue to reform in the face of climate change, given that it is the largest contributor to $CO_2$ emissions. The ideal would be for MNEs to play a major role in building the industry locally, while providing the technology required to have a significant positive impact on the environmental footprint of the industry. To encourage and promote the growth of the industry, which experience shows will require MNEs to invest based upon their ability to endure external shocks, it is essential that the tax and regulatory environment does not disincentivise them from doing so. The greater the restriction on fees for technical assistance, digital services and technology, the less likely companies operating in Africa are to receive access to these technological developments. Likewise, the more uncertain the operating environment (in the form of volatile exchange rates, trade policy on importation of cement), the less likely MNEs are to invest in local production capacity and the greater the dependence on imported product will be.

## WHAT MNES CAN DO

Several countries have introduced government incentive programmes, made available to companies that operate in the cement industry. Where these have not been introduced, active lobbying can be beneficial.

Where companies have been incurring losses or been required to transact at prices that may deviate from what they would ordinarily charge customers (for example, caused by the Covid pandemic, or for other commercial reasons, such as excess capacity), the reasons for such decisions and the basis for determining the adjusted prices should be carefully documented at the time that the decision is taken, so that these companies can avoid transfer pricing audit shocks down the line.

Where MNEs are seeking to introduce new technology, especially where it could have more widespread benefits to the country, such as a reduction in $CO_2$ emissions, to the extent that there are regulatory constraints, it is advisable to engage with the relevant regulator prior to introducing the technology. Where the technology has been introduced already, the regulators may simply decline any application to deviate from their policy on the payment of fees. However, where the provision or access to a particular beneficial technology is dependent on arm's length fees being paid and a deviation from the standard pricing restrictions, and the regulator is approached before the technology is introduced, there is greater likelihood of the provider of the technology being paid for the use of the IP.

In summary, for MNEs operating in the cement, construction and related industries in Africa, it is important to not only consider the various business and operational issues at play, but also give thought to the cross-border tax challenges and the regulatory environments within which they are operating, and how these are changing. These factors are important when aiming to create a sustainable sector in the long term, to prioritise growth on the continent, while balancing environmental concerns, and protecting businesses against unexpected shocks down the line.

**Michael Hewsen**
Director, Graphene Economics, a specialist African transfer pricing advisory firm

Michael Hewson has a Master's in Financial Economics and the HDip Tax (Law) both from the University of Johannesburg. He honed his skills as a transfer pricing expert at two large professional services firms in South Africa before founding his own firm, Graphene Economics. He helps his clients with transfer pricing solutions in key African markets with a special focus on the economics lens.


Children are like wet cement, whatever falls on them makes an impression.
- Haim Ginott

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