



# Materials and value chains for sustainable, inclusive, and resilient urbanisation in Africa

Accompanying booklet  
-  
Speakers' statements



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## About this booklet

This booklet was created as accompanying brochure for the conference “Materials and value chains for sustainable, inclusive, and resilient urbanisation in Africa”, which was held as a one-day virtual event on the 23 January 2021, organised by Dr. Kolawole Olonade, University of Lagos, Prof. Ravindra Gettu, IIT Madras, and Dr. Wolfram Schmidt, Bundesanstalt für Materialforschung und -prüfung.

The idea of the conference is to collect a wide variety of speakers from different fields of expertise and with different experience backgrounds to look at challenges of urbanisation processes not only from a single perspective but to include technical, societal and economic aspects. The objective was to underpin that there is neither a single nor a simple solution for sustainable, resilient and integrative urbanisation processes. At the same time, there are enormous potentials that lie in the rapid African urbanisation processes, if this be done impartially, interdisciplinary, with awareness of the complexity, and with conscious decision making. Therefore, this booklet provides a variety of opinions and statements of the speakers who look at challenges and potentials of urbanisation and sustainable materials use from the multiple perspectives they represent.

## Background

In this century, along with climate challenges, urbanisation is one of the most critical challenges humanity faces. For Africa, this challenge is even more pressing than for most other regions in the world. According to the Global Cities Institute, by the end of the 21st century 13 of the largest 20 cities in the world are expected to be in Africa. In 2050 the number of 5-Million-inhabitant cities will rise up from the current number of 10 to ca. 60. The expected growth should be sustainable. This urban growth will require enormous amounts and movements of construction materials, which in return will coin economic growth on the one hand along with ecologic impact on the other hand.

## Relation between urban materials use and socio-economic aspects

However, sustainability in the context of urbanisation goes far beyond economic and climatic aspects. The rapid migration to urban regions, often linked to lack of livelihoods and inaccessibility of health services, poses new challenges such as inequalities, discrimination, social unrest and crime. Furthermore, it puts additional pressure on educational, health, sanitation and supply systems, and it increases environmental pollution. Therefore, environmental challenges of urban growth in Africa are intimately linked to fundamental socio-economic aspects.

## Specific African challenges and potentials of African urban growth

While the African continent faces multi-faceted challenges that come along with urbanisation, at the same time African urban growth perspectives offer a unique opportunity to develop yet unexperienced sustainability potentials. Local material solutions can create livelihoods, the availability of space and resources offers opportunities to create socio-economically responsive urban regions that can be future-oriented without losing tradition and cultural heritage. The absence of historically grown regulative frameworks for construction materials and technologies offers potentials for leapfrog innovation in terms of materials and construction technologies.

Kolawole Olonade, Researcher

Topic: Sustainable construction and materials solutions

**"I foresee Africa to be self-sufficient in construction materials and driver for converting bio-wastes to bioresources, through cutting-edge research with firm regional integration."**



Dr. Olonade is a Senior Lecturer at the University of Lagos, Nigeria and an expert in cement and concrete. His research focus is utilizing bio-wastes for high-performance cement-based products for affordable housing and sustainable construction in sub-Saharan Africa. He pioneers the use of cassava peel ash as supplementary cementitious materials through which he won the first German-African Innovation Incentive Award. Dr. Olonade is an initiator for the Society of Cement and Concrete Researchers in Nigeria (SCCRIN) and member of professional bodies such as NSE, COREN, ACI and [RILEM](#). Currently, he is the Chairman Nigerian Society of Engineers, Abeokuta Branch.

Lagos is predicted to become the largest city in the world with possibly more than 80 million inhabitants by 2100. Which are the most severe challenges that come along with rapid urban growth, and what can be done to make the urban growth as sustainable as possible?

Lagos, no doubt, is the fastest growing city in the world. No one comes to Lagos without loving to stay back. Nevertheless, there are already challenges due to influx of people into Lagos. Housing is grossly insufficient in quantity, traffic is becoming hell, security and social vices are some of the major challenges the city is battling with and will continue to, unless drastic actions are taken to ameliorate the situations. There is need for calculated efforts to provide low-cost housing where local materials would be used, diversification in modes of transportation should be quickly adopted. Lagos needs to build mass rail transportation, expand water ways to reduce the number of vehicles plying the roads. Regeneration of the slum areas should be given necessary attention. Ports in other parts of the country should be developed to reduce the pressure on Lagos ports.

Which potentials do you see for bio-based materials and the bioeconomy? Are they unique to Africa or of global relevance?

Africa is the hub of agricultural activities and agriculture is the main source of its economy before discovery of petroleum. Though, many African countries have neglected agriculture for other sources of economy, but they have since resolved to revert to agriculture for sustainable economic recovery. More so, Africa has over 50% of global arable land ready for cultivation. These potentials position Africa as the continent that would generate largest quantity of biomaterials which would culminate into bioeconomy, through coordinated research.

Kolawole Olonade, Researcher

Topic: Sustainable construction and materials solutions

You have a vision that cutting-edge research with regional integration is the way forward to facilitate more efficient use of bioresources. How can this be achieved?

Abundant bio-resources are not enough to make a nation great but what values are derived from these resources. Converting bio-resources to bioeconomic values require ingenuity in purposeful research. African scientists need to think beyond the box and jettison the do-it-alone syndrome that has characterised research in Africa. They need to open up and give room for collaboration and cooperation within the continent where ideas are shared. Research should equally be domesticated to directly address the peculiar challenges in Africa. The mantra should be *thinking globally and act locally*. If this is achieved, new values and products are created, which subsequently requires open market and economic cooperation within the continent for it to thrive. Boundaries should be flexible for ease of movement of goods and services.

Ravindra Gettu, Professor

Topic: Sustainable construction

“Emerging economies should be able to apply more sustainable and resilient technologies learning from the experience of other regions, along with improvement in construction quality and durability.”



Prof. Ravindra Gettu is the Dean for Industrial Consultancy & Sponsored Research, and V.S. Raju Chair Professor in the Department of Civil Engineering at IIT Madras. He is the President of [RILEM](#), the International Union of Laboratories and Experts in Construction Materials, Structures and Systems, and Fellow of the Indian National Academy of Engineering. He works closely with industry to promote technology implementation, and has co-authored about 500 publications in the areas of concrete technology and characterization, and sustainability.

You have been doing a lot of research in the field of cement and concrete. Which materials will be the key to more sustainable construction in the future?

Concrete will be here for a long time to come. However, the concrete of the future will be different in characteristics and performance, and may have more ingredients and complicated processes involved than the typical concrete of today.

Are there typical urban and typical rural materials solutions?

With the current level of understanding, I do not see solutions other than concrete for infrastructure and housing. We could have more prefabrication, and leaner and faster construction. Maybe we will see more automation in some regions and applications.

As the president of RILEM you have a good overview of research activities in materials and structures all over the world. Which topics are global megatrends, and which research topics are specific to tropical regions?

Design for durability is what I see as a megatrend. This is particularly relevant to tropical regions as the deterioration of concrete and corrosion of steel occur at higher rates. The next topic of utmost importance is the reduction of the carbon footprint, and increase in the sustainability potential, in general.

Joanitta Ndawula, PhD candidate

Topic: Sustainable construction

**“The unique challenges of sustainable urbanisation in Africa can only be addressed by equally unique, intuitive, adaptive and Afrocentric solutions using local talent and resources”**



Joanitta Ndawula is a PhD candidate at the University of Cape Town with research focus on service life extension of corrosion affected reinforced concrete structures. She has been a major driving force behind the implementation of a [RILEM](#) Youth Council (RYC) She presents the objectives of the RYC which is being implemented to increase the visibility and participation of young and emerging researchers in RILEM activities.

You have developed the concept of the RILEM Youth Council. What was the driving force to establish the council?

One of the first observations I made when I first joined RILEM was the generation gap between myself and established RILEM members. There were very few members within my age range with whom I could network with, and approaching the older, more experienced members seemed intimidating. Like all other organisations, RILEM needs to keep attracting and engaging younger members to ensure the successful continuity of the organisation. Such an important task could not be assigned to just one person, and therefore it was recommended that a youth council be established to develop and implement various initiatives to attract young and emerging researchers to RILEM, and to increase networking and participation in RILEM activities.

How is the RILEM Youth Council composed? Which are the first items you want to tackle?

The RILEM Youth Council is composed of 11 young RILEM members representing 10 different regions around the world. These regions are Sub-Saharan Africa, China, Eastern Asia, Eastern Europe & Central-Asia, Europe, Latin America, Middle East & North-Africa, North America & Caribbean, the Pacific and South-Asia. The first items we intend to address is to increase the number of young members by increasing awareness of the benefits of RILEM membership, not just for academics but for industry professionals as well.

Joanitta Ndawula, PhD candidate

Topic: Sustainable construction

Coming to you as a person who is Namibian and currently pursuing a PhD in South Africa. How do the countries distinguish in their urbanisation and construction challenges?

Namibia and South Africa have a uniform history in terms of urbanisation and construction as a result of colonisation. One of the major challenges I have observed in both countries is the increase and growth of informal settlements. This increase may be attributed to various factors including increased rural to urban migration, the high cost of accommodation and amenities in urbanised areas, high rates of unemployment and poverty, and to the legacy of apartheid. As these settlements are growing rapidly in both countries, it is evident that current policies to address the problem have been less than successful and new approaches need to be explored.

Wolfram Schmidt, Researcher

Topic: Sustainable construction/Urbanisation challenges

"I strongly believe that Africa's next generation of decision makers and researchers can become worldwide pioneers in greener, environmentally and socio-economically more sustainable construction technologies. Awareness, education and unbiased science-based approaches are key."



Wolfram Schmidt works at in the department "Safety of Structures" at BAM, responsible for the rheology and admixtures laboratory with a research focus on innovative cement and concrete constituents. Furthermore, he is secretary of the German Rheological Society, founder of the Pan-African cement round robin (PACE-PTS) and initiator of the conference series "Advances in Cement and Concrete Technology in Africa" (ACCTA) and [ISEE-Africa](#) (Innovation, Science, Engineering, Education). He received the German-African Innovation Incentive Award and is member of [RILEM](#) and fib and among others convenor for sub-Saharan Africa and officer in the RILEM Development Advisory Committee.

How can the construction business contribute to more sustainable urbanisation processes?

African urban regions will develop at dramatic velocity, with cities arising of unprecedented dimensions. This puts a lot of pressure on the societies and the environments, since the rapid urban growth takes place at much higher velocity than the rural growth and at the same times the livelihood potentials in cities increase, while they steadily decrease in the rural environments. This calls for synergies between urban growth and rural development, which can best be created by using what is available in abundance in the rural areas and required the most in urban areas. Therefore, agricultural waste products are a reasonable and feasible resources for chemical admixtures that help reducing water in concrete and for cement replacement materials that help to reduce the carbon footprint of cement production. Circularity in the process can help developing rural areas and mitigate negative effects of too rapid urbanisation.

What are the preconditions to achieve circular value chains and resource saving processes?

A holistic view on structures and infrastructures has to be established and accepted by the societies. Every structure we build has a cost that goes far beyond its monetary price. We inevitably consume resources, change the environment and the socio-economic interaction in the vicinity. All players and decision makers in the urban construction process have to be aware of their enormous responsibility. Initiatives such as the [GLOBE Consensus](#) that give guidelines to all players in the field can become important game changers, but they need both political and societal backing, which can only arise based on awareness of the challenges and consciousness in technologies. Therefore, education towards conscious engineering as proposed by [ISEE-Africa](#) is the key to implement principles of sustainable construction at all level.



**Wolfram Schmidt, Researcher**

**Topic: Sustainable construction/Urbanisation challenges**

Your statement strongly underpins the important role of the next generation of decision makers in the field. How do you think the young generation can make a change?

By nature, existing knowledge, technology solutions and particularly standards are based on past research and experiences with already existing technologies. However, a sustainable framework requires adaptability to a yet unknown future. Therefore, students need the capacity to cope with these unknown challenges of the future. This cannot function by only teaching the application of knowledge of today and the past. Student education therefore should be an interactive process, where students and professors mutually benefit from each other. The professors bring knowledge and experience, the students bring newness and affinity to new technologies. Both influences have to go hand in hand and cross-fertilise. Then, this can facilitate the creativity and innovation spirit of the future decision makers to break free and develop adequate, unbiased solutions. In this context, we all in the field have to become life-long, global learners. In the light of the climate change, we better learn quickly, and therefore we cannot afford to waste any talent by exclusion based on gender, age, sexuality, religion or colour of skin. Sustainable urbanisation processes are a challenge to the world that can only be solved on an equitable foundation and based on mutual listening, understanding and learning.

Nonkululeko Radebe, PhD candidate

Topic: Sustainable construction/Urbanisation challenges

“Access is everything! Without the tools and networks, progress is stagnant. I believe that the vast talent found on the African continent can and will only flourish through decolonized education, infrastructure and general resources needed to manifest the visions and ideas.”



Nonkululeko Radebe is a 3rd year PhD candidate at the KIT doing research focused on early hydration and mechanical behaviour of cement. She is passionate about the access to education and resources to the African youth and has contributed to several papers for the [ISEE-Africa](#) conference on these topics. Additionally, she was selected as the representative for sub-Saharan Africa in the [RILEM](#) Youth Council (RYC), where she attracts and engages with young researchers to facilitate networking with top scientific minds in the built environment. Lastly, she is Lindau Alumni, a volunteer for STEMi Makers Africa and founder of ArtScie, a youth development program based in South Africa.

You strongly recommend focusing stronger on the less developed regions in Africa instead of overdeveloping already developed regions. How do you mean this?

Well, over-urbanization seems to be a problem unique to developing countries in that with urban sprawl comes a decrease in the standard of living of the people living around a city than those who live in the city itself. Even saying that is flawed because in a city like Johannesburg, it's possible to find slums right next to a mansion and this is reflective of either poor urban planning, colonial spatial planning, a disproportional number of services being provided in urban areas than rural areas or the general lack of opportunities (i.e. jobs). For this reason, the issue of migration really needs to be looked at holistically rather than use Western cities as a blueprint for urbanization being directly proportional to economic prosperity.

Which types of settlements will have the strongest impact on a sustainable future path of Africa? Will it be the urban or the rural areas, or something in between?

It is certainly not going to be informal settlements found in urban areas, that is for sure. I would assume more vertical style settlements in urban areas would be a more feasible option, in terms of sustainability but this is really up to the people. If people want gardens and less noise, then rural settlements will have to become fashionable but of course this needs to come with better employment perspectives too. It is all intertwined.

Nonkululeko Radebe, PhD candidate

Topic: Sustainable construction/Urbanisation challenges

As you mention in your statement there is vast talent in Africa that needs to flourish and raise voice in the world. Which are the most important lessons the world needs to learn from Africa?

Well, that collaboration is key. Everyone is role player in these conversations, and I believe that Africans, in some ways, respect the notion that the people who will be impacted the most by certain decisions need to also take part in the decision making. There are many community-based initiatives that are run by locals and work and this is perhaps something the West seem to misunderstand. When help is needed, it does not mean that the people who need the help are without ideas. To put it bluntly Europe and North America need to stop with the saviour complex. Collaborate, do not dictate. Additionally, Africa is a rich continent not only in minerals but in knowledge creation. And for that reason, it is and will continue being a shame if lessons from Africa and Africans are not welcomed by the global North. Lack of access to resources and infrastructure does equate to a lack of knowledge. The continued alienation of African voices and talent on the world stage serves as a disadvantage for both the African continent and the rest of the world.

## Johan Vyncke, General Advisor and Director

### Topic: Sustainable construction

Please add a short vision statement



Johan Vyncke is currently General Advisor at BBRI, the Belgian Building Research Institute. Previously Johan has been Director for Research & Innovation at BBRI. He is at present President of the Belgian Concrete Society and has been serving also as president for [RILEM](#). At the start of his career at BBRI Johan has been especially working on recycling of concrete. Following the 2005 Kashmir earthquake Johan has been active for IzG Engineers without Borders in setting up recycling activity in Muzaffarabad, Pakistan. He has been playing a mentoring role for RILEM in the [GLOBE](#) Global Consensus on Sustainability in the Built Environment.

You have been a major force driving the so-called GLOBE Consensus forward. What is it about?

Well it is getting clear, that sustainability in the built environment can only be achieved in a joint, consolidated, and global effort. Approaches have to be consolidated and synchronised on a global scale between experts, politicians, academia and further stakeholders including urban planners as well as economic and social science experts. These efforts have to be supported by funding and tax policies, approval and a standardisation framework that can quickly, yet reliably, adopt and adept existing and future innovation potentials. However, to date, despite a vast number of sustainability initiatives, there is a lack of consolidated actions to streamline the entire existing knowledge and convert it to tangible action recommendations. The GLOBE Consensus calls for a paradigm shift within the entire built environment to give aspects of sustainability the same value as aspects of structural integrity and durability.

Why is it so important to have consolidated actions, and to have the support of leading international institutions?

The GLOBE Consensus is a consolidated document agreed upon between major associations and networks in the areas of research, education, and development of building codes and recommendations, such as RILEM, IABSE, fib, CIB, ECCS, IASS which was elaborated under the umbrella of the Joint Committee for Structural Safety JCSS. The GLOBE working team operated under the direction of Prof. Michael Havbro Faber, Department of the Built Environment, Aalborg University, Denmark, President of the Joint Committee on Structural Safety and initiator of GLOBE, assisted by Dr. Dipl.-Ing. Wolfram Schmidt, Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany. As the GLOBE Consensus is calling for a shared responsibility it is of course necessary that it is widely supported by all involved stakeholders. The international communities represented by the mentioned association constitute an efficient worldwide network to spread the GLOBE message.

Johan Vyncke, General Advisor and Director

Topic: Sustainable construction

Where do you see the most important global challenges, and possible ways out?

Global population growth and rapid urbanization demand enormous construction activities and materials use. Within the next ten years, the overall global land use requirement of the built environment is expected to double. In addition, it is expected that in more developed economies infrastructure and maintenance of structures will significantly increase. **If we do not change our present practise, the emissions from the construction sector alone will jeopardize the achievement of the objectives of the Paris agreement.** The construction sector is organized in a decentralized way with a vast number of organizations and participants. There is only little integrative organization between service providers or owners and clients. In addition, applied technology enhancements are incremental and international standards, codes, and guidelines that govern the design and construction of the built environment evolve only slowly. **So redirecting the construction sector comprises a major challenge which necessitates strong and persistent focus to keep pace with the rapidly increasing technological advances.** This is where the Globe Consensus is seeking to contribute through the different associations supporting the initiative.

Sabbie Miller, Professor

Topic: Circular economies and climate change

"We are faced with a myriad of global challenges, and by coming together, we have the potential to meet all of our societal needs without causing further harm to the environment. The only way to meet these challenges is through global engagement, continuous sharing of information and knowledge, and the active support of our current and future scientists."



Sabbie Miller is an Assistant Professor at the University of California, Davis. Her research focuses on lowering the environmental impacts of the built environment. She is developing methods for improving materials design procedures to concurrently assess environmental impact and material performance by linking concepts from structural engineering, materials engineering, and life-cycle assessment. She is a member of several national and international technical committees pertaining to environmental sustainability of construction materials.

Which are the most important climate numbers, decision makers in the construction industry should always have in mind when they plan and implement construction projects?

Understanding the greenhouse gas (GHG) emissions associated with the production, placement, use, maintenance, and disposal of our materials and systems is essential to make decisions that reduce impacts on our climate from the construction sector. Cement production is responsible for approximately 7% of global anthropogenic CO<sub>2</sub> emissions, and most projections suggest that we must achieve net-zero GHG emissions before 2080 to limit global warming to 2 °C. Simultaneously, the production of cement, cement-based materials, and other construction materials result in localized impacts on human health and resource scarcity. These local concerns can be exacerbated by external conditions, separate from the construction sector, based on regional variation. Decisions made in the construction sector must incorporate measures that can directly contribute to meeting GHG emissions mitigation goals, while also considering factors that can influence the local environment. By selecting routes to mitigate GHG emissions that also lead to co-benefits in for other environmental impacts, we can build a sustainable future.

Sabbie Miller, Professor

## Topic: Circular economies and climate change

Why is it so difficult to mitigate the climate impact of materials?

Several factors work in unison to contribute to the difficulty of mitigating climate impacts from the production of construction materials. Growing urban populations and affluence are driving escalating levels of material consumption, which lead to commensurate impacts. Additionally, for many construction materials, there are well established (and sometimes quite complex) supply chains. Within supply chains, there can be different motivations among stakeholders (e.g., material producers, designers, occupants/users, and governments). These supply chains currently use mature technologies for production that often require large capital investment to establish and operate for several decades. These factors coupled with typically small profit margins can slow how quickly change can be implemented. Further, we experience “lock-in” issues in which we are significantly more prone to continue using the same materials that we are already using, particularly when those materials are long-lived. Finally, data used to assess climate impact, generally fail to consider variability, uncertainty, and critical local impacts on human health and resource scarcity.

In your statement you underpin the necessity of global information sharing and empowerment of future scientists? Is there an equitable way to achieve this on a global scale?

In order to engage a global environment of information sharing, we must emphasize inclusivity. Increasing educational opportunities, supporting open-source information dissemination, facilitating international collaborative efforts, and developing forums for the active exchange of ideas is necessary. There are several multinational organizations that support such work, and continued funding efforts from these groups as well as from others will be critical to improve upon our ability as a global society to empower future generations in an equitable way.

Mark Alexander, Professor

Topic: Sustainable materials solution

“Africa is the continent of youth, who need to understand the need for science- and community-based solutions in order to progress. Africa’s youth must shake off both colonial vestiges and unproductive approaches still extant in some parts of the continent and emerge as a powerful lobby for sustainable approaches for the future.”



Mark Alexander is Emeritus Professor of Civil Engineering, and a Senior Research Scholar in the University of Cape Town. He has a PhD from the University of the Witwatersrand, Johannesburg, and is a Fellow of the University of Cape Town, [RILEM](#), the South African Institution of Civil Engineering, and the South African Academy of Engineering. He teaches and researches in cement and concrete materials engineering relating to design and construction, with interests in concrete durability, service life prediction, concrete sustainability, and repair and rehabilitation of deteriorated concrete structures. He is a past President of RILEM.

What are the specific African challenges, and what makes them unique to Africa?

These relate to a) materials – many of which are still not properly understood or characterised for African regions; b) lack of expertise, testing facilities, etc. in many African regions in order to undertake scientific studies of materials to ensure greater durability, c) a strong reliance on overseas knowledge and expertise, that is often imported uncritically and is often unsuitable for African contexts, and d) a great need for advanced education and training for research professionals in the continent, so as to advance proper solutions for durability.

What can be adopted? What needs to be adapted, and what needs to be invented in Africa?

Of course, there are many ‘global’ approaches that can be adopted in Africa, at least in principle. However, construction materials (and concrete in particular) are dependent on local materials of which a sound scientific and practical knowledge is required, in order to adapt the global approaches. But there will undoubtedly emerge specific African solutions, both technological and scientific, to the overall materials and durability problems.

In your vision you mention the youth. Where do you see the special role of the African youth for a sustainable African and global future in construction technology?

Firstly, in thoroughly educating themselves so as to enter into the global scientific arenas with confidence; secondly, in pressuring governments, local industries, and potential sponsors to fund meaningful research in the African context; thirdly, by forming networks and supportive groups across the continent and regions thereof, to mutually support each other.



## Esther Kamaara, Social Innovator & Policy Analyst

### Topic: Inclusive, socio-economic sound urban planning

"I believe that through multi-directional learning the development of a sustainable and resilient urbanisation of Africa is only a grasp away."



Esther Kamaara is the Founder and Executive Director of Star Kids Initiative, a community-based organization in Nairobi, Kenya that empowers children to reach their full potential by providing access to quality education to underprivileged children living in urban slums. Through several education programs, the initiative aims to develop the mindsets of the next generation into one that is morally upright, self-aware, socially responsible and environmentally cautious. Kamaara has 7 years of experience in 'Education for Development' sector and is currently a Masters candidate in Development Studies at Erasmus University Rotterdam, Netherlands.

What distinguishes the reality of an 8-years old and a grown-up person?

At the age of eight, the mind is full of innocence and very formative; nothing is impossible for an eight-year-old. The fluidity of the minds of children enables them to dream without inhibitions and adjust to changes seamlessly. Unfortunately, the same cannot be said for adults who are often rigid in thought. Therefore, I tend to believe they live in reality full of hope.

Why do you think it is so important to take the 8-years old's perspective so serious?

Contrary to popular opinion, children are capable of contributing to complex development concepts. This is because their minds simplify problems which lead to the simplification of solution provision. Additionally, the sustainable world we seek to develop is a world they will live in, surely, they should have a say in the future we all dream of.

In your statement you mention the importance of multi-directional learning. What does it mean, and how can it be effectively implemented?

Multi-directional learning entails learning across backgrounds, specialities and generations. It involves the intersection of industries, old and modern technologies as well as experienced and novice personnel. It can be implemented through conferences such as this where diversity in speakers and participants is sought.

Nadine Ibrahim, Professor

Topic: Circular economies and climate change

“The adage “what gets measured, gets managed” is one that guides meaningful action. Data-driven decision-making is key to supporting climate action to achieve more sustainable cities, but we must first ensure that we start with a good baseline to build upon.”



Nadine Ibrahim is the Turkstra Chair in Urban Engineering, and a Lecturer in the Department of Civil and Environmental Engineering at the University of Waterloo. She holds a BSc, MSc, and PhD in Civil Engineering, and a Certificate of Preventive Engineering and Social Development from the University of Toronto (UofT). She worked internationally on Engineering Education for Sustainable Cities in Africa. She leads new educational attitudes and advocates for civil engineers as municipal leaders, where she leverages her industry experience in Canada and abroad, to expand her inquiry into cities through urban and environmental projects.

How can urban metabolism demonstrate material and energy flows in cities?

The technical definition of urban metabolism is the sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste. In lay terms, I'll use the human metabolism as an analogy, which is the process by which our bodies convert food and drink into energy and waste. Similarly, urban environments have material and energy inputs that are converted to useful growth outputs and waste. Understanding the metabolism of cities allows us to track material and energy flows with a goal of turning these linear flows of inputs to outputs, to more circular flows with reuse of materials for a more circular economy. This linear metabolism is regarded as an urban world process, whereas in a circular economy, there is nearly no waste and almost everything is reused – this is the similarity with a natural world process. Achieving a circular economy is no easy challenge, which makes urban metabolism very relevant and timely today to track and identify the stocks and flows while recognizing and respecting the environmental limits within which we live. One of the key flows that are tracked through an urban region is the energy consumption that results in a city's greenhouse gas emissions.

Has urban metabolism changed with history? What is the case for Africa?

The origins of urban metabolism goes back almost 60 years ago, when an article was published in Scientific American in 1965 by Abel Wolman on The Metabolism of Cities. The research was motivated by the attention being focused on water shortages and air and water pollution in the United States, yet recognizing that there was plenty of water, but its supply required foresight, and that the pollution caused required the need for economic decisions to be made. The first urban metabolism study was a model to determine the inflow and outflow rates of a hypothetical

Nadine Ibrahim, Professor

## Topic: Circular economies and climate change

American city with a population of 1 million people, which was constructed to visualize flows and be able to respond to metabolic challenges, particularly with regards to water supply management, sewage disposal and air pollution control. There are studies of Tokyo, Brussels, Hong Kong, Miami and Paris, where their urban metabolism diagrams look different in terms of what is being captured on the diagrams, and how inflows and outflows are depicted in each one. In every city, it looks different. When I think of cities, I marvel at the image of the world at night, and where there is light, there are concentrations of people. But I also can't help but notice the darkness of Africa, and the call for energy justice as the population booms on the African continent in the next few decades, while contributing the least to global climate change today. Urbanization is a global phenomenon which has local manifestations and therefore local solutions to its challenges. This brings to the forefront questions like: How can African cities sustain their growing populations through global challenges, and achieve urban prosperity? And, how are the future engineers in Africa prepared to take on the challenges resulting from rapid urbanization? I believe African urbanization will be a hallmark of human development in this century and will transform the planet. Solutions for climate change may look different in Africa. Urban metabolism will drive solutions that look strikingly different in terms of greater urban density, forms of energy production and consumption, buildings, water solutions, etc.

In your statement you strongly support the use of data-based decision making for mitigation of climate challenges. In what ways can this data collection effort support climate action?

With better data comes better decision-making that enables more effective evidence-based policies. Urban metabolism is one such tool to guide that data collection process. Knowing what we have makes us in a better position to know where we're going next, in other words, our baselines put us on the sustainability pathway. Of relevance to climate change, when a city has climate targets to achieve, it's a good idea to know where it's at in terms of greenhouse gas emissions. The GHG inventory is the accounting process and are estimates of the amount of emissions resulting from activities in the city. What can be measured, can be managed, so a city's GHG emissions inventory is particularly valuable as the first step in a city's response to climate change. The inventory serves as an account of the emission-intensive sectors, as well as providing metrics to facilitate targeted climate policies. An inventory of GHG emissions gives a reliable picture of the energy consumption of the residents of a city, and the resource intensity of the activities within. Knowledge of the cities' population, land area, economy, energy mix, industries, transportation modes, environmental regulations, and climate policies, greatly enhances the understanding of these inventories. These numbers tell the story of the city.

Manu Santhanam, Professor

Topic: Sustainable materials solution

“The projected growth in cement demand over the next several decades in Asia and Africa brings about a need for understanding the proper utilization of supplementary materials. A sound scientific approach is required to judiciously choose the right cement replacement material for durable concrete.”



Manu Santhanam is a Professor and Head of the Department of Civil Engineering at IIT Madras in Chennai, India. He is a Senior Member and Fellow of [RILEM](#), and has been an active researcher in concrete for nearly 20 years. His research focuses on supplementary cementing materials and their impact on special applications as well as durability of concrete. He is an Associate Editor for the ASCE Journal of Materials in Civil Engineering and Journal of Sustainable Cement Based Materials, as well as serves on the Editorial Board of Cement and Concrete Composites, and Advances in Cement Research.

What is the specific challenge for cement and concrete based construction in tropical climate?

The tropical climate with its high heat and humidity exacerbates the problems of concreting, and also increases the rate of chemical deterioration. In several countries in the tropical belt, there is a significant coastline, and protecting structures from chloride induced corrosion is a top priority. Further, these countries are mostly emerging economies with a labour-driven construction market. This presents challenges in terms of the concrete quality, which further adds to the increased risk of durability problems.

How can the market adapt to the specific challenges? What will be the cost?

There are several opportunities for producing good quality concrete with supplementary materials, which are available aplenty, albeit with varying levels of quality. The industry has to ensure that the best processing of these materials is done to make them useful in a cementitious composite. The additional processing may lead to an escalation in the cost, but this has to be justified using a life cycle approach.

You state that supplementary cementitious materials are the key for durable concrete. How can this be facilitated on the political, industry and academic level?

The role of academia would be to create awareness through sound systematic research on supplementary cementitious materials. The industry has to be open to adapt these developments in field trials and prove the efficacy in large construction projects. Alongside, there is a need for policy creation that enables increased used of SCMs. This is only possible when there are rewards for lowering CO<sub>2</sub> and energy associated with concrete construction, or penalties for the opposite scenario – SCMs would go a long way in fulfilling the global targets of lower CO<sub>2</sub> and energy. Unless the right policies are created, there will not be a major transition in the industry.

Firehiwot Kedir, PhD candidate

Topic: Urbanisation challenges

"I am curious and driven about the path to the betterment of our built environment. At the moment, provision of sustainable urban infrastructures through Innovative and Industrial Construction is an increasingly important core research topic."



Firehiwot Kedir is doing her PhD at the chair of Innovative and Industrial Construction ETH Zürich. Her research focuses on evaluating resource efficiency performance and opportunities of industrialized construction materials and methods. Recently, she led a technical report together with ARUP and ETH Zurich titled 'Sustainable Transition to Industrialized Housing Construction in Developing Economies'.

How can a "Sustainable Transition to Industrialized Housing Construction in Developing Economies" be achieved.

I think it starts with identifying local resources. These resources will be the most valuable assets in the transition. It also requires capacity building in respect to impact factors such as local skill availability, infrastructure, and manufacturing capability. The transition depending on local resources and capacity will take different forms.

Which political and socio-economic pre-conditions are required to spark transition?

It requires a commitment from stakeholders. The commitment can be translated as identifying tailored strategies for the given city/country. From our research, we have found out that government agencies can take on the role of the facilitator to spark a sustainable transition.

You say that you are curious about the path towards a betterment in the built environment. How much of the path lies ahead and how much behind us?

I think we are somewhere at the starting point. We are still defining and agreeing on what is a sustainable built environment for our society. There is still a myriad of factors that are difficult to overlook. I see my research identifying these factors and identifying their interrelationship. This can help stakeholders in their decision-making process.

Ruoyu Jin, Professor

Topic: Circular economies and climate change

"I believe the urbanisation trend in Africa could bring the joint opportunities for inter-disciplinary research and practices in enhancing Circular Economy, by integrating the knowledge, experience, and technologies from scholars, policy makers, and local stakeholders. Sustainability amid the urbanisation needs a cross-disciplinary approach integrating social, economic, technical, and environmental aspects."



Dr Ruoyu Jin specialises in Building Information Modelling (BIM), construction waste management especially recycled aggregate concrete, and off-site manufacturing for construction. Dr Jin is highly motivated to link technological development in built environment (e.g., digitalisation in construction) into the managerial aspect, such as multi-stakeholder perceptions towards digitalisation in a socio-technical approach. Dr Jin has the established track record of adopting digitalisation in construction & demolition waste demolition. He has authored over 70 peer reviewed journal articles, and one patented innovation in reusing construction wastes as sustainable materials.

Building Information Modelling (BIM) is heavily being discussed as a future trend all over the world, but it seems to date there are more questions than answers. When will digitisation and digitalisation pay back, and which steps are required to get there?

No doubt new technologies could accompany challenges. Using the robotic bricklaying machine as the example, should we worry about the job loss of traditional brick layers because of the technological movement of robotics? Similarly, there have been so many questions on the challenges brought by BIM in the architecture and construction industry, such as people's readiness and cost of BIM, just to name a few. But if we look back how industry professionals moved from hand drawing to CAD or Computer-Aided-Design, would BIM become commonplace in the years to come? If so, that could be the turning point when the digitalisation is being paid back. If I use UK as the example, since 2011 BIM Roadmap was released by the Government defining the different BIM maturity levels, which could specify the steps to get there. That will be from CAD, to BIM Level 2 regarding information sharing among different stakeholders, and to finally with the concept of BIM Level 3 to be achieved in mid-2020s highlighting the cloud-based platform and latest Industry 4.0 integrated technologies. In a nutshell, the steps should involve both technological integration and multi-stakeholder engagement.

Ruoyu Jin, Professor

## Topic: Circular economies and climate change

You propose that digital tools can in deconstruction management. In which way should this already be considered in the construction planning?

From project clients' perspective, especially the public clients, we can see more and more construction projects require the utilisation of BIM in the early planning and contracting, or other pre-construction project stages. Using the standard contract documents as the example, for instance, JCT Standard Building Contract, you would see how BIM is being brought into the contract between client, client representative, and contractor. It is not only BIM, but BIM-related digitalisation, that is creating the new platform of early stage project stakeholder engagement, for example, cloud-based drawing approval, and e-contract. These are not uncommon now today, especially under the current global pandemic which drives more remote and cloud-based platforms. But what we would like to address here is the Circular Economy for deconstruction, apart from construction. I believe Design for Deconstruction is still at the early stage for the global building construction industry. There are lots of oncoming research and practice that can be done in integrating digital technologies with Circular Economy for building deconstruction, if we consider each building is a "bank" of different materials. These existing materials from the Bank at its end of serve life could be back to new life for new construction.

In your statement you demand for more interdisciplinary collaboration to facilitate the implementation of circular economic concepts. What needs to be done to train the players in the area for the challenge of interdisciplinary operations?

I do believe circular economy applied in building design, construction and operation is an interdisciplinary topic involving engineering, technologies, policies, legislation, environment, and social subjects. What we have seen for decades is the bespoke "information island". Think about how the construction industry is widely suffering from its fragmentation, and the lack of efficient communication and coordination between stakeholders. The information passing from the architects or engineers may not be interpreted the same from the contractors, and further building operation or facility managers. Similarly, circular economy, for the sake of its efficient implementation in building industry, we do have lots of challenges to overcome. So, what needs to be done in the training? As an academia in the higher education sector, I have put lots of efforts in the interdisciplinary education adopting BIM for students from different subjects to work on the same building project. I believe we could further bridge the higher education and industry needs for university graduates with both technical and management skills. In a short summary, I would say what needs to be done should be in two aspects: people and technology. People involved in Circular Economy come from different disciplines and there is a strong need to understand other stakeholders, that is to put yourself in the shoes of others. The other is the technological movement as the driver to enhance circularity, such as data capturing and analytics to benchmark the sorts and categories of different materials in buildings at end-of-service.

Henri van Damme, Research Director, French

Topic: Sustainable construction

“One of the key evolutions of our social awareness in our climate change and human migrations era is that diversity - biological, geographical, anthropological and cultural - is widely recognized as wealth. This is contrasting with the evolution of the modern construction sector, privileging a limited choice of globalized materials and constructive solutions. I am convinced that this will end very soon and that the construction sector will see an explosion of inventive solutions.”



Henri Van Damme is emeritus Professor of Thermodynamics & Materials, Ecole de Physique et Chimie Industrielles de Paris (ESPCI Paris), France. He was Scientific Director of IFSTTAR, and President of the Condensed Matter Physics division of the National Committee for Scientific Research. With his broad international experience Henri will chair the session on “inclusive, socio-economically sound urban planning”

You have seen the world and its construction. Which of the sustainability challenges are common all over the world, and which are specific to regions?

I see three sectors which, in the present state of the world, are totally unsustainable and which are our main global sustainability challenges: food, energy, and construction. The preservation of high-quality farmland and the institution of sustainable agricultural practices is probably the most critical need. This includes the management of water. Next is the transition to a sustainable energy sector. It is the most popularized challenge but, thanks to a huge R&D effort, we know the (theoretical) solutions. Do we have solutions for the construction sector which, on top of being a large emitter is the most voracious raw materials predator? Not yet. Each one of these three challenges have region-specific solutions, within a framework of global guidelines.

Which potentials do you see for Africa to spearhead green, environmentally friendly, and sustainable construction technologies?

Africa is taking off right at the time when the “old” continents are encountering dead ends and have to revisit their industrial and social schemes. This is an extraordinary opportunity for Africa to lead the way by investing from start in the most promising and sustainable technologies. However, this will not occur without informed leadership at the highest level. Young scientists and engineers take the lead!



Henri van Damme, Research Director, French

Topic: Sustainable construction

You are a strong supporter of vernacular techniques and technologies. These often underwent centuries of applied research in the field, but they are neglected by modern research. How can the gap be closed?

Two keywords are inseparable from vernacular: “local” and “frugal”. This looks OK to everybody. The problem comes from the fact that vernacular materials and techniques are often considered as “for the poor”. In order to reverse this image and to make vernacular or vernacular-inspired solutions attractive and acceptable, we have first to analyse their performance scientifically. Next, we have to switch from composition-based standards to performance-based standards.

Patience Tunji-Olayeni, Lecturer, Nigerian

Topic: Sustainable construction

“The quest for resilient, safe, green and sustainable cities in Africa begins with sustainability awareness, which can be attained through the intentional and systematic delivery of green skills that will promote sustainability literacy and transformations among stakeholders in the construction industry.”



Patience Tunji-Olayeni is a Senior Lecturer in the Department of Building, Covenant University Nigeria. Her research interests include sustainable/green construction, construction education, and gender issues in construction. She has published widely in these areas. Patience is currently the Chair of the Regional Centre of Expertise (RCE) Ogun, an initiative of the United Nations University Institute for Advanced Sustainability (UNU-IAS), which helps to create solutions to sustainability challenges through dialogue, education and learning. From this background, she will moderate the session on ‘urbanisation challenges’.

In Nigeria there are multiple cities that face severe urbanisation pressure. To which extent is the social and economic life of the people affected by the construction demand and the ongoing construction?

Lagos is one of the cities in Nigeria currently facing severe urbanisation pressure with attendant negative effects on the social and economic life of ‘Lagosians’. The high population is exerting pressure on the existing infrastructure which has necessitated the ongoing massive construction in Lagos, particularly housing estates and road construction. However, the entire process can be better managed so that the good intention does not become a burden to the people or benefit only a few in the city. For instance, most of the new homes are unaffordable for majority of households, as a result many Lagosians may have to continue living in poor quality homes. Although housing unaffordability in the Mainland and Island areas of Lagos is opening up more satellite towns with affordable housing, these towns still need to be upgraded to city status. Also, the lack of proper road network coordination is taking a toll on the health and wellbeing of the people as a result of traffic congestion due to the ongoing road construction. This situation can be ameliorated by the adoption of sustainable urban planning that will ease the burden of city dwellers while enhancing their social and economic outcomes

Patience Tunji-Olayeni, Lecturer, Nigerian

Topic: Sustainable construction

How would you assess the awareness of the need for sustainable construction solutions in Africa and Nigeria in particular?

Although sustainable construction solutions are yet to be properly diffused in African construction industries, awareness of the concept is gaining traction. Increasing global awareness of sustainable development is placing pressure on the construction industry to act sustainably, thereby producing better environmental, social and economic impacts. In Nigeria, the use of renewable energy sources such as solar energy (solar panels) is on the increase, with many households now using solar panels to augment power supply. But there is still significant room for improvement particularly in diffusion of sustainable practices on construction sites and the adoption of bio-based building materials with huge potential for mitigating climate change.

Where do you see the greatest potentials for African academic institutions to pioneer sustainability research and education?

Several areas exist for African academic institutions to pioneer sustainability research and education but more urgent and critical are in the areas of green skills and sustainable materials. Students and young researchers form a critical mass of stakeholders in the construction industry. They are one of the most significant groups in need of attitudinal transformations towards sustainability because raising future professionals with environmental and social awareness is a major way through which sustainability concepts can be integrated into the construction industry. Research focus on sustainable materials with lower carbon emission is crucial for African academic institutions to reduce embodied energy/carbon in building materials and to keep the greenhouse gas emission rate in the region consistently low.