A vision of a smarter city

How Nairobi can lead the way into a prosperous and sustainable future

An urbanizing world means cities are gaining greater control over their development, economically and politically. Cities are also being empowered technologically, as the core systems on which they are based become instrumented and interconnected, enabling new levels of intelligence. To seize opportunities and build sustainable prosperity, cities need to become 'smarter' and take a holistic approach to managing the 'system of systems' on which they depend. This report addresses some of the main challenges and opportunities facing Nairobi today and draws on the views of leaders and experts who are working to transform Nairobi into a 'smarter' and more efficient city.

Introduction

Nairobi has risen from humble beginnings. What is now a bustling city of over 3 million people was established in 1899 as a simple supply depot along the railway from Mombasa to Kampala. Today the city is growing faster than ever as it develops into a regional economic centre with the potential to become Africa's next major business hub. At the same time, its rapid growth has created significant challenges, piling increasing pressure on the city's infrastructure that must be addressed for the city to be more competitive.

With increased urbanization and substantial economic opportunities, major African cities like Nairobi are coming under more pressure than ever to transform. For Nairobi to reach its full potential as a regional powerhouse, new technologies and approaches are required to modernise the city's systems and to make it a better place to live, work and do business.

Tony Mwai, Country General Manager, IBM East Africa.

Against this backdrop, the Nairobi Smarter Cities Roundtable brought together 15 leaders and experts from the public and private sector, the World Bank, UN-HABITAT and civil society organisations. The IBM-organised event was the platform for open discussion on how Nairobi could best transform itself into a smarter, more efficient city, using the latest approaches and technologies to overcome some of the major obstacles the city faces.

The session covered questions such as:

- What systems does Nairobi need to prioritise in order to transform itself into a smarter city?
- How can technology be used to tackle areas ranging from traffic congestion through to safety and security?
- What is the role of the private sector in the development and management of Nairobi's systems?

As well as drawing on some of IBM's latest research, this paper highlights the views of roundtable participants and summarises the main themes, ideas and solutions discussed. It is designed to foster further debate and discussion around the opportunities and challenges facing Nairobi today and tomorrow on its path to a sustainable future.

Demographic challenges

The need to transform Nairobi into a smarter city is urgent. The city's infrastructure and systems are already struggling to support its existing inhabitants, even before the population swells to over 5 million by 2020. This rapid growth sets challenges in key areas such as transportation, utilities, safety and urban planning. "Kenya is undergoing a simultaneous demographic and geographic transition," explains Wolfgang Fengler, the World Bank's lead economist in Kenya. "Now it is a rural country but in a generation, by 2033, it will be an urban country."

While daunting, Kenya's demographic change is not bad news. The country will reap a significant demographic dividend from larger urban populations, more young people and longer life spans. This effectively means Kenya will have a large workforce that can be harnessed to build the country's infrastructure and make the nation more economically competitive. Urbanisation also creates economies of scale that can lead to an increase in the quality and efficiency of services.

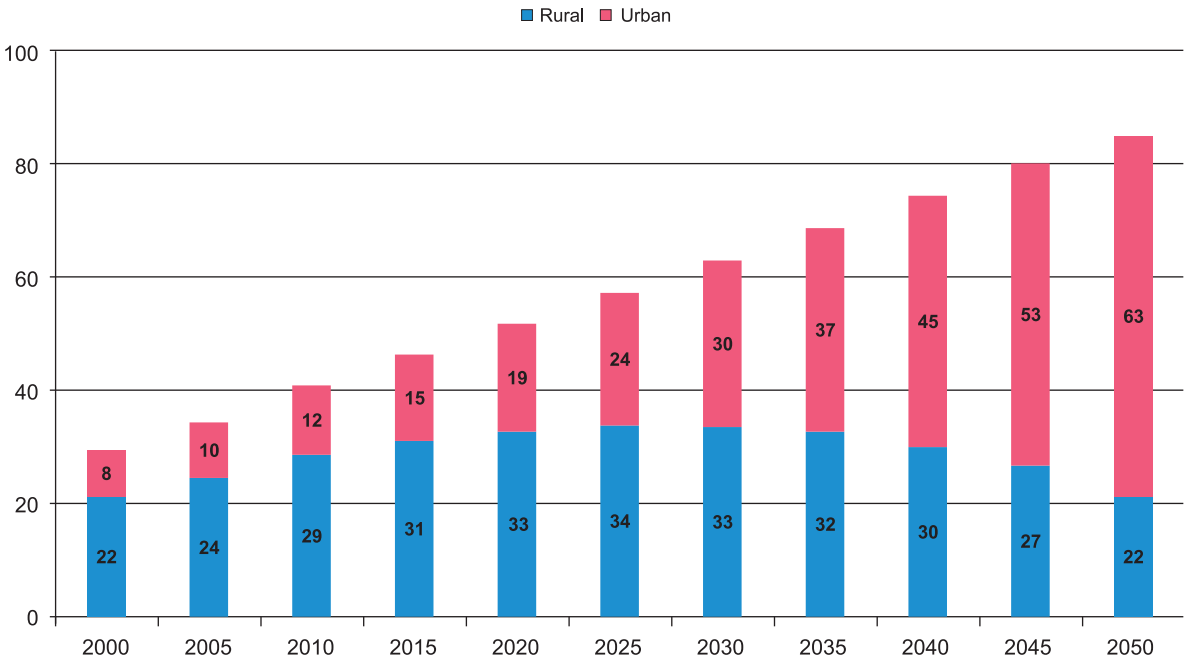
Such growth, in line with stable economic development, puts Nairobi on course to be a key economic centre and business hub. But without careful planning and management, Nairobi could see its status lost to faster movers in neighbouring states.

A smarter Nairobi will ensure the city makes good on its potential.

Most of Kenya's future population growth will be urban...

Kenya's population 2011: 40.5 million,
Kenya's population 2030: 63 million
Kenya's population 2050: over 80 Million
Source: World Bank

An urban future: Kenya's population growth



*Includes core- and peri-urban residents.
Note: Population growth projections are World Bank computations based on data from KNBS and UN, DESA (Source: World Bank)

Nairobi's biggest headache: traffic congestion

Driving in Nairobi during peak periods is mayhem. Every morning, 1.5m people pack thousands of cars and mini-bus taxis (called Matatus) and battle their way into the Central Business District. Commuters cram roads that were "designed for a city 10 times smaller" according to Christian Schlosser, Chief of Urban Transport with UN-HABITAT. As a result, congestion costs Nairobi Ksh50m a day (about US$517,000)[1] in lost productivity, fuel consumption and pollution.

UN-HABITAT is working on an intergovernmental drive to implement a public bus system in Nairobi. "Traffic in Nairobi faces several challenges. Commuting is really inefficient and on top of that you have really little provision for pedestrians and cyclists." Inefficiency is exacerbated by the fact that over 75% of the city's drivers are alone in their cars – a figure among the highest in the world[2]. Not surprisingly, it takes an average of 31.7 minutes to find a parking spot, against a global average of 19.8 minutes.

Beyond economic costs, traffic creates a lot of stress and frustration. The 2011 IBM Commuter Pain study estimates that Nairobi has the world's fourth most painful commute. Almost two thirds of locals report that traffic negatively affects their work, family and health. There is no doubt that this is limiting the city's competitiveness and economic development. For this reason, transport should be one of the key areas in which Nairobi leverages technology to become a smarter city.

So far there has been little use of technology to address Nairobi's transportation woes, but already experts believe care needs to be taken in selecting the solutions that will suit the current stage of the city's development. Tony Mwai, IBM's Country General Manager for East Africa, highlights congestion charging, which works well in London and Stockholm, but would not be the sole answer to Nairobi's traffic problems. "It's not just a case of needing fewer cars in the city, we don't have the right infrastructure yet."

Infrastructure is gradually improving but perhaps not fast enough. Nairobi is well into a large-scale highway project, but hundreds of crumbling roads remain to repair, widen and improve. In addition, many traffic lights hardly work and the majority of the city's busy junctions, the police are involved in physically directing traffic flow. Establishing an adequate, well-managed road network is a major priority for city planners.

But infrastructure investments alone will not be enough to make Nairobi's transport system smarter. As Mr Schlosser explains, there is "increasing political awareness that you have to think beyond the traditional model of just building roads to solve traffic problems". In a city where traffic rules are rarely obeyed, appropriate regulation and education campaigns would be needed to support transport initiatives. Mr Schlosser believes the car cannot reasonably be the primary mode of transport in the future Nairobi. Solutions that improve conditions for cyclists and pedestrians are vital, along with a large-scale public transport system.

[1] *Ministry of Planning, Kenya*
[2] *IBM Commuter Pain Survey, 2011*

Infrastructure needs to be supported by education, regulation and enforcement

An efficient, cost effective public mass transit system would probably do the most to alleviate traffic congestion in Nairobi, but it needs to be the right system. Three years ago a private sector initiative called 'Smart Buses' was launched in Nairobi, which allowed commuters to load money onto cards that could be used to travel on new commuter buses. These were expected to help Nairobi's traffic problem but the project failed within months.

There were two key reasons for this. First of all, a smartcard payment system is not well suited to Nairobi where cash and mobile payment systems like M-PESA dominate. Secondly, having decided on smartcards, there was insufficient education about the system. Commuters were sceptical of the new technology and so stuck to what they knew. As Mr Schlosser puts it: "You have to have technology, but you also have to have education (…) what is needed is a combination of physical infrastructure, new ways of thinking and new technologies".

Esther Passaris, a local entrepreneur, points out a further way in which smarter transport transcends infrastructure. "We've seen some infrastructure, but it's more than that, it's also how to manage the flow of traffic" she says. Without better rules, regulations, education and enforcement, the traffic situation in Nairobi would not improve. She calls for a change in driving culture in Nairobi where a bit "more courtesy" would solve many of the traffic problems by leading to more cooperative and coordinated behaviour.

Roundtable ideas for Nairobi's transport system

- Investment in a large-scale public transport system has the greatest potential to address Nairobi's traffic and transportation issues.
- Priority should be given to solutions that not only improve driving conditions but also improve conditions for cyclists and pedestrians.
- Attention should be given to initiatives that help promote a safer and more courteous driving culture.
- Dangerous driving could be curbed through updated licences with chips that hold the record of the driver.
- Nairobi's road developers should consider collaborating with the energy sector to tap into new techniques that use roads to help generate energy.
- Pricing road usage appropriately might help reduce traffic. Privately managed toll roads and city zones could be developed – revenue raised could be reinvested into the city's road and transportation system.
- Mobile phone signal density could be a way of pinpointing and predicting traffic problems. Over 70% of Kenyans have mobile phones[3].

[3] *Communications Commission of Kenya Quarterly Survey, 2011*

Smarter cities need reliable and affordable energy

The reliability and efficiency of energy is a pressing issue in many African countries. Despite East Africa being relatively rich in natural resources and alternative energy sources, Kenya's systems for the production and distribution of energy require significant transformation and investment. This is most apparent in urban areas where mass consumption of energy places tremendous strain on ageing infrastructures and where the economic impact of energy unreliability is felt the greatest.

"Energy is one of the biggest problems we have," says Linus Gitahi, CEO of Nation Media Group, East Africa's largest independent newspaper and media house. "The first problem is that power is not consistently available. Nairobi's unreliable energy supply is not just an inconvenience, but also a critical business issue – we have had late delivery of newspapers on three occasions in the last month due to power failures."

The second problem is cost: "Kenyan businesses have almost no chance to compete with businesses in other African countries like Egypt where energy costs three or four times less." Kenya Power, the utility company, also adds a surcharge whenever they need to use diesel power to supplement the grid. Businesses have no control over this extra charge and have a hard time predicting what their energy bills will be month-to-month.

Nairobi suffers from 11,000 high voltage fluctuations and power outages every month (KENGEN)

Ms Passaris echoed Mr Gitahi's concerns. Her business, called 'Adopt a Light', uses advertising revenue to build sponsored streetlights in order to improve safety and security in Kenya's urban areas. "Energy has to be affordable. In Nairobi, energy is very expensive which has a direct impact on manufacturing output. The world is a global market and we need to be competitive."

According to Dr Bitange Ndemo, Permanent Secretary for Information, Kenya needs to "double the current capacity of energy in the next five years". It isn't currently clear how the country will meet this challenge, but with opportunities for both geothermal and hydroelectric power in Kenya, additional energy requirements may not need to increase the country's carbon footprint.

Kenya's Energy Regulatory Commission hopes to generate about 27% of the country's electrical power from geothermal sources by 2031

Ultimately, energy is a key threat to Nairobi's future. As the roundtable highlighted, nearly all smarter city initiatives depend on a reliable, cost-effective supply of energy.

Roundtable ideas for Nairobi's energy system

- Over reliance on hydroelectric power sources means Kenya needs to actively seek alternative energy supply sources such as solar and wind power generation in order to meet growing demand for power.
- There is increasing justification for public private partnerships between the government and companies to cooperate to solve Nairobi's energy challenges. Tax breaks could be given to manufacturers and independent power producers who can pool resources to increase supply to the national grid.
- Smart meters and other technologies can be used to help energy users better understand their own consumption patterns and create efficiencies.
- Incentives could be given to heavy power users such as manufacturers to shift their operating times from traditionally high use hours to off-peak timings to stabilise demand from the national grid.
- Increasing consumer awareness of electricity usage and government-led promotion of energy-saving initiatives would free up more power for national use.
- Tying alternative energy use to the country's economic and environmental health would spur smarter energy use. A survey recently found that younger consumers today evaluate their energy choices based on the environment while those over 55 noted the health of their national economy as a key motivator for behavioural change.

[4] *IBM Global Utility Consumer Survey, 2011*

Nairobi's city systems and services need to support all parts of the city - including its slum areas. In September 2011, The capital's emergency services were put to the test when the impoverished Sinai neighbourhood was hit by an explosion and fire caused by a leaking fuel pipeline.

A safe and secure Nairobi

On 12 September 2011, in the impoverished Sinai district of Nairobi, more than 100 people were killed as they tried to salvage fuel from a leaking pipeline. A large explosion, reportedly sparked by a cigarette butt, engulfed nearby residents and sent a raging fire through the neighbourhood's densely packed shacks. "We sent fire engines but could not get in," explains Lucas Ndolo, Group Training Manager at KK Security, East Africa's largest private security firm. He says disaster management is a big problem in Kenya and the "Sinai fire was an example of how more coordination between emergency services is needed to save lives".

9 out of 10 calls to state emergency services in Nairobi go unanswered (KK Security)

Alongside state run emergency services, many of Nairobi's residents have come to rely on private security companies which provide rapid response services for fire, medical and security emergencies. In a place like Sinai however, where many residents survive on less than a dollar a day, the luxury of paying for specialised emergency response services is an impossible dream. For them, the reality that nine out of 10 calls to state emergency services in Nairobi go unanswered translates to increased loss of life and property. In Sinai, fuel had been leaking for 12 hours before the explosion. Just one police unit could have been enough to cordon off an area around the leak and reduce the chances of disaster.

Greater connections between sectors

The proliferation of a number of private enterprises in the emergency sector means groups often act independently. "When we are called to tackle a fire we do not know who else is going to respond, so it's impossible to coordinate," explains Mr Ndolo, "there is a dire need to have an integrated approach to safety and security." Private security companies have become such a critical part of Nairobi's safety and security sector that they believe they should be invited to play a larger role in defining the strategy. Many experts also believe that there should be better information exchange between public and private sectors. "The private security companies already have centralised information, so they can help," he says, "but the private sector has yet to be officially accepted as a proper partner by the government."

A further argument for better integration of the public and private sectors is the way in which safety and security intersects with so many other aspects of city management. The most obvious of these is infrastructure development. Private security companies often either cannot respond fast enough because of traffic congestion, or cannot respond at all due to the lack of access roads into many of the city's slums. Private fire companies could be much more effective if they simply had access to the city's fire hydrants.

Keeping an eye out for trouble

Closed circuit television feeds are one of many tools that the authorities in Nairobi are looking into to give first responders insight about what is happening in specific parts of the city. As well as the question of whether to integrate public information systems with those of the private sector, the challenge for city authorities is how to identify what is really important and understand why it is relevant. It's just not about a single source of information. It's about bringing together multiple sources that are meaningful and make it work for them. By taking advantage of analytics solutions, public safety officials can bring together vast amounts of relevant information to protect the public's safety.

Roundtable Ideas for a safer Nairobi

- The city could benefit from creating shared information resources for public and private security sectors such as a centralised information system and city control room.
- Kenya Police have made several attempts over the last 15 years to use technology such as CCTV and mobile monitoring tools to limit crime but with limited access. New efforts to build a CCTV monitoring system integrated with a central emergency response control room are underway – city authorities could consider partnerships with private sector security firms to pool expertise, resources and information.
- There are 18 car-jackings every week in Nairobi, which is half as low as in recent years[5]. This is largely down to better legislation that now helps track car parts. Security companies like KK Security would like to see a road design for Nairobi with limited, controllable routes in and out of the city so that stolen cars would be harder to export.
- Developing a 24-hour economy in the city centre would be good for efficiency and attractive for investors, but brighter and safer streets are needed to do so.

[5] *KK Security Survey, 2011*

The new Operations Centre in Rio provides the incident commander and responders with a single, unified view of all the information that they require for situational awareness.

Case study – Rio de Janeiro, Brazil

In Rio de Janeiro, Brazil, city officials now benefit from a central command center that integrates over 20 city departments to improve emergency response management and collaboration across the city. Predictive analytics capabilities use information to decide how to best react to current events and how to best plan for what is likely to happen in the future in order to minimise impact on citizens.

The Rio de Janeiro Operations Centre was instigated to help the city improve its response to emergencies, such as the floods and mudslides that hit part of the city in 2010.

It incorporates an advanced meteorological warning system and also helps orchestrate the logistics of emergency response in the case of floods, including ambulance scheduling and medical supply coordination.

In the long term, operation centres like the one in Rio could expand beyond flood management into other city services such as transportation, public works, and utilities.

IBM has taken its experience from projects like that in Rio de Janeiro and embedded it in the analytical capabilities and rules engine built into its Intelligent Operations Centre.

The aim is to help cities of all sizes use analytics more effectively to make intelligent decisions based on high quality and real-time information. Local leaders can manage a spectrum of events, both planned and unplanned, such as deploying water maintenance crews to repair pumps before they break, alerting fire crews to broken fire hydrants at an emergency scene, or anticipating traffic congestion and preparing redirection scenarios.

Smarter cities in focus

Public sector integration, private sector partnerships

During the course of the roundtable, a striking example emerged for the need for better coordination and integration across three areas: between different levels of government, between different government departments, and between the private and public sectors. It unfolded when Dr Ndemo noted in his address that his department was in talks with investors about how to develop a CCTV system, incorporating an existing control room.

This was a surprise to lower levels of government. Ms Benter Ogot, Director of ICT at Nairobi City Council said: "As a city council we are also in the process of entering a Public Private Partnership for CCTV. I wasn't aware that the Government is also working to establish another control room. There are a number of initiatives we have started putting in place but it looks like everybody has their own approach. What I've realised is that we need to be able to coordinate our efforts so that we do not duplicate."

Coordination, integration and communication are all lacking

Additionally, KK Security announced that they – like several other security firms operating in Nairobi – are establishing a central control room in Nairobi. In KK Security's case, the operations room will cover the whole of East Africa. Integrating these facilities and sharing information is a great opportunity to improve both efficiency and effectiveness in safety and security, but there is currently insufficient integration, communication or coordination to get this kind of collaboration off the ground.

This is a common problem across the public sector in Kenya. As one participant pointed out, "you can see the energy department surveyors measuring a road and then months later the water surveyors will go out and measure the same road independently". The number of projects to lay fibre optic cables in Nairobi also underlines the need for better coordination between the different public and private sector parties involved. High-bandwidth technology has the potential not only to boost the city's economy but to also improve communication and create the foundations for smarter city systems. However, as these critical projects are rolled out across Nairobi, contractors sometimes disrupt services while digging their own trenches and cutting existing cables in the process. Participants at the roundtable expressed the need for greater collaboration across public and private sectors for these initiatives to be fully successful. This is not only to minimise disruption, but also to maximise the return on investment.

An artist's impression of Konza City

Konza and Tatu: Africa's new smart cities

Konza City and Tatu City are new, small-scale smart cities close to Nairobi. Konza City is a government-led technology city targeting businesses and commercial developments, while Tatu City is a private sector-led mixed-use environment that will be home to an estimated 62,000 residents and 23,000 day visitors.

Dr Ndemo describes them as, "Two of the newest and smartest cities in Africa, built with an understanding of better urban planning, management, better living, better infrastructure, better roads, better transport – because we are incorporating these technologies, these are the first new smart cities in Africa." It is hoped that these will provide lessons and case studies that will inform Nairobi's future development. Additionally, their close proximity to the main city means they may serve as satellite cities, relieving pressure on Nairobi's Central Business District.

The technology that will make Nairobi smarter

"The good thing about Kenya," explains Mr Fengler from World Bank, "is it is not only importing innovations, but exporting innovations - in the case of mobile money, crowd-sourcing, and many other small less visible innovations that are actually quite remarkable."

Recent technological advances are creating new opportunities for transforming cities. We can now monitor, measure and manage nearly any physical system at work in our cities. We have the ability to collect and analyse real-time information on everything from transportation networks to hospitals to the electricity grid. We can also use technologies to interconnect the different systems operating within a city.

One area in which Kenya is leading the way is mobile technologies. Kenya has become a pioneer in mobile payment and money transfer systems creating some of the world's most innovative technologies and services in the field – such as the M-PESA system managed in East Africa by mobile operator Safaricom. With a mobile phone penetration rate of over 70%, mobile technologies present a strong platform for potential solutions to Nairobi's urban challenges. For example solutions using mobile technologies to help manage traffic and identify parking spaces, coordinate emergency services and healthcare workers, identify and report security risks could all have a role to play in transforming Nairobi into a smarter city.

The potential for mobile technologies is beyond better functioning infrastructure – it also presents great opportunities for getting people connected and contributing to the city's development. As Johann Jenson, of the United Nations Environment Programme (UNEP) puts it, "the mobile internet will enhance social justice and get citizens involved in doing more for their city, taking actions in areas where previously it was government only."

Digitisation and centralisation of records is a big step forward

One area where innovation has been slow is in public records and information systems. "Right now we've got 16 departments and each department has been operating independently with its own data. Most of this data is still in manual form," says Benter Ogot Director of ICT at Nairobi City Council. She is currently leading the huge task of digitising and centralising this information, which is currently piled in back rooms within municipality buildings. For example, in the planning department, "people submit their plans to the city and in the past this has been in paper form. Traditionally this data has been stored manually and some of it is over 50 years old. After a few years it begins to fade and it is prone to tearing. So one thing we have been doing is digitising these plans and enabling architects to submit plans online."

The digitisation, centralisation and better management of records and civic information will certainly go a long way towards making Nairobi a smarter city. After all, as Ms Ogot puts it, "to have a smart city, you need to first know your city." Once records are digitised, technologies can be used to search, analyse and interpret the information. In the planning department at Nairobi City Council putting records online will not only make it easier to submit an application, but also to help the council to more easily identify trends, risks, opportunities and areas for improvement.

Roundtable ideas for a high-tech Nairobi

- Social media could help communication between government departments, citizens and the private sector.
- Kenya's leadership in the development of mobile applications could be applied to improve the functioning of Nairobi's city systems – such as for identifying traffic congestion, locating parking spaces and paying for city services.
- Cloud computing could help Nairobi with the challenge of data storage and sharing information across different organisations and sectors.
- A campaign to encourage commuters to capture bad driving using their mobile phones and post the photos or video online could be linked to higher insurance premiums for dangerous drivers.

Conclusion

The Nairobi Smarter Cities Roundtable demonstrated the overwhelming positivity, energy and enthusiasm that exist in modern day Nairobi. The city is at an exciting and highly significant point in its development where the twin prospects of enormous potential and enormous challenge loom larger than ever. Technology is already starting to help make Nairobi smarter and empower citizens, but the key now is to use existing momentum and initiatives like the Nairobi Smarter Cities Roundtable to drive collaboration between the public and the private sector and help Nairobi cope with becoming a much bigger city.

There is no doubt that urbanisation and population growth are driving increased demand for effective infrastructure in Nairobi. These forces are putting increasing strain on the city's resources. The roundtable addressed some of the main challenges that Nairobi is facing – transportation, public safety, energy and the role of technology in helping to overcome them. However, there are many areas critical to Nairobi's development that were not addressed in detail during the roundtable – water, healthcare, education, telecommunications, urban planning, airports and rail, social services, economic development and other areas all warrant further consideration and discussion.

Despite these challenges, Nairobi should not lose sight of the enormous opportunity it has to build its profile as a regional powerhouse, to become an African success story and to improve the lives of its citizens.

Tony Mwai, CGM IBM East Africa and other leaders from public and private sector at the Nairobi Smarter Cities Roundtable.

The Nairobi Smarter Cities Roundtable took place in October 2011 and was attended by:

- Dr Bitange Ndemo, Ministry of Information, Permanent Secretary
- Lucas Ndolo, KK Security, Group Training Manager
- Linus Gitahi, Nation Media Group, Chief Executive Officer
- Wolfgang Fengler, The World Bank, Chief Economist
- Steven Oundo, Architectural Society of Kenya, Head
- Christian Schlosser, UN-HABITAT, Chief of Urban Transport Section
- Ms Benter Ogot, Nairobi City Council, Director of ICT
- Esther Passaris, Adopt-A-Light, Former CEO
- Eric Aligula, Kenya Institute for Public Policy Research and Analysis, Head, Economic Services
- Johann Jensen, United Nations Environment Programme
- Idy Pembere, Consumers Federation of Kenya
- John Kariuki, Vision 2030
- Aly-Khan Satchu, Rich Management (moderator of Nairobi Smarter Cities Roundtable)
- Tony Mwai, IBM East Africa, Country General Manager
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