
SMART CITY RWANDA MASTERPLAN



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VERSION 1.0



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ACKNOWLEDGEMENTS

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FOREWORD

Information and Communication Technology (ICT) is changing the way cities evolve, helping to respond to the challenges of rapid urbanization and the pressure that is exercised on infrastructure while citizens' expectations for better quality services keep rising.

The rapid growth in mobile and broadband penetration in Rwanda presents new opportunities for innovation that leverages the tremendous capacity of our youth to innovate and transform our cities into smart cities.

This Smart City Masterplan provides a framework to guide Rwandan cities and towns in their efforts to harness ICTs to provide a higher quality of life to their citizens, businesses and visitors. The document lays out a vision for cities of the future that embed technology and data across city functions to make them more efficient, competitive and innovative.

Financing smart city initiatives can be challenging. However, by creating an enabling environment, a variety of financing models and innovative financing instruments can be explored. They range from public investments to public-private partnerships but most importantly investment from the private sector.

It is important that regardless of the financing mechanism, the governance of smart cities is designed in such a way that the central and local governments remain in control to fully ensure a balance between required resources, effectiveness of technology solutions and quality of service delivery.



Hon Jean Philbert Nsengimana
Minister of Youth and ICT

EXECUTIVE SUMMARY

The transformation of Rwanda from an agrarian economy into a knowledge-based society is taking place in the context of two of the biggest drivers of change in the 21st century — rapid urbanisation and the increased application of digital technologies in all sectors of society. To meet these challenges, and take advantage of the opportunities of the digital world, Rwandan society is being transformed. Citizens are increasingly moving to towns and cities, acquiring new skills and demanding better services. Cities are growing and require better planning, governance and new financing.

Smart cities, in which leaders and citizens use data, information and knowledge to ensure a co-created resilient and sustainable future, can play a large role in the transformation of Rwanda. By ensuring inclusive data-led management and planning, efficient community-based infrastructure and services and localized and shared innovation, cities can be drivers for economic development and sustainable development.

This Smart City Masterplan is intended as a guide to help Mayors and urban managers go through the process of developing their own smart city strategies and masterplans, as well as providing a strategy for the government to promote the development of smart cities in Rwanda on a national level.

It is divided into five chapters. **Chapter 1** provides the context of the state of Rwandan towns and cities today and outlines existing urban and ICT-related challenges. It also describes existing smart initiatives in Rwanda and sets out the policy context of the Masterplan.

Chapter 2 provides a definition of smart cities and sets out what is meant by ‘smart city’ in the Rwandan context. The Rwandan smart city model is a combination of three often followed smart city models - the technological model, the strategic model and the collaborative model. This ensures that smart cities in Rwanda make use of scalable technology solutions and financing models; new data and monitoring processes that enable more flexible strategic planning and management; and improved and more accessible local services through collaboration, co-ownership and co-creation.

Chapter 3 describes how the national government and local authorities can go about building smart cities. Before embarking on the smart city journey, Rwandan urban leaders first need to make four early decisions, including committing to becoming a smart city, identifying smart city champions, setting the vision and choosing to be open and transparent. Once these four decisions have been made, local authorities should follow 10 steps to realize the vision, including creating a smart city stakeholder partnership team, creating a strategic action plan and testing smart city technology through pilot projects. Change management, including decisions related to privacy and cyber security, monitoring and evaluation and coordination at the national level, as well as financing, are also outlined.

Chapter 4 sets out the smart city action plan itself. This is based on three smart city pillars, smart governance and planning, smart and efficient services and utilities and localized innovation for social and economic development, followed by nine smart city building blocks and 27 action initiatives. The 27 initiatives provide a comprehensive plan that towns and cities can follow to implement smart city projects and solutions at the local level, as well as guidance for the national government. Each initiative is associated with a relevant urban scale - national level, capital city, secondary cities, towns and villages.

Finally, **chapter 5** sets out how the Rwanda Smart City Masterplan links with the wider smart city vision for Africa. The recommendations found in this document, along with the Smart Africa Alliance Smart and Sustainable Blueprint for Africa, can be used to provide guidance for future national and local smart city masterplans throughout the continent.

01

INTRODUCTION

The Government of Rwanda has set an ambitious vision: to transform the country from an agrarian economy into a knowledge-based economy by 2020. This transformation is taking place in the context of two of the most important trends of the 21st century — rapid urbanisation and the increased application of digital technologies in all sectors of society.

To meet the ambitious goal, and deal with the challenges and opportunities presented by urbanisation and digital technologies, major changes will take place in the Rwandan society. 35% of the population will live in urban areas by 2020 according to Vision 2020, meaning that large numbers of people will move to towns and cities, putting pressure on local governments to ensure that urban growth is managed sustainably. Reaching 95% internet penetration by the end of 2017, presents new opportunities to develop the digital economy but also requires new digital skills among the population.

Large-scale education programmes to build basic and digital literacy will be necessary. Citizens will need new skills — in engineering, urban planning, architecture and technology. New legislation around data privacy, security and access must be adopted. Changes will be required to urban planning and management processes and new ways will be found to deliver services to citizens.



This Smart City Masterplan provides a framework to help Rwandan towns and cities manage the transition of the 21st century and help ensure the future prosperity of all Rwandans. It is intended as a guide to help Mayors and urban managers go through the process to develop their own smart city strategies and masterplans.

The Masterplan was developed in 2017, based on extensive discussions, meetings and workshops with a variety of urban and ICT stakeholders in Rwanda, including ministries, regulatory bodies, local authorities, academia, civil society and the private sector. The development was influenced by the Smart Africa Alliance *Smart Sustainable Cities Blueprint for Africa*.

Kigali City © RDB Rwanda

1.1. THE CONTEXT OF CITIES IN RWANDA TODAY

POPULATION GROWTH

According to the Rwanda National Institute of Statistics, the Rwandan population is expected to grow from 10.5 million in 2012 to 16.3 million in 2032. The urban population is expected to increase from 1.7 million in 2012 to 4.9 million in 2032, a near doubling in percentage terms from 16.5% in 2012 to 30% in 2032. The Rwanda Vision 2020 which aims to transform Rwanda into a middle-income country, prepares the country for reaching 35% of urban population by 2020.

As a direct consequence of this growth, the country will experience an unprecedented increase in population density, which will reach 645 inhabitants per square kilometer by 2032, from the current 440 inhabitants per square kilometer. Rwanda has started to prepare for these developments. The Kigali City Masterplan of 2013, for example, accounts for a growth from 1.3¹ million inhabitants to 3.7 million inhabitants in 2032.

INTERNAL AND INTERNATIONAL MIGRATION AND DECENTRALIZATION

Regarding internal migration, most of the population of Rwanda tends to remain in their place of origin. Only 20% of the resident population reside in a different district than the one of birth. This percentage is even lower if migration is considered from one province to another, with migration happening to a larger extent to neighbouring provinces or countries.



Fig. 1: Rwanda map and provinces

1. Source: http://www.kigalicity.gov.rw/new_web/64/?L=0

1.2. URBAN AND ICT CHALLENGES

IN RWANDA

A ACCOMMODATING URBAN GROWTH AND HOUSING DEFICIT

The urban population of Rwanda has increased from 4.6% in 1978 to 16.5% in 2012, according to the Rwanda National Institute of Statistics. The average yearly urban growth rate is currently over 3.5%, which means that urban population in Rwanda will double in less than 20 years time. To have a clear picture of the magnitude of the challenge, by 2032², Rwanda, at the current urban density of Kigali of 1,020 inhabitants per square kilometer, will need to build eight new Kigalis to accommodate new urban residents.

From 1.7 to 4.9 million urban residents in 20 years

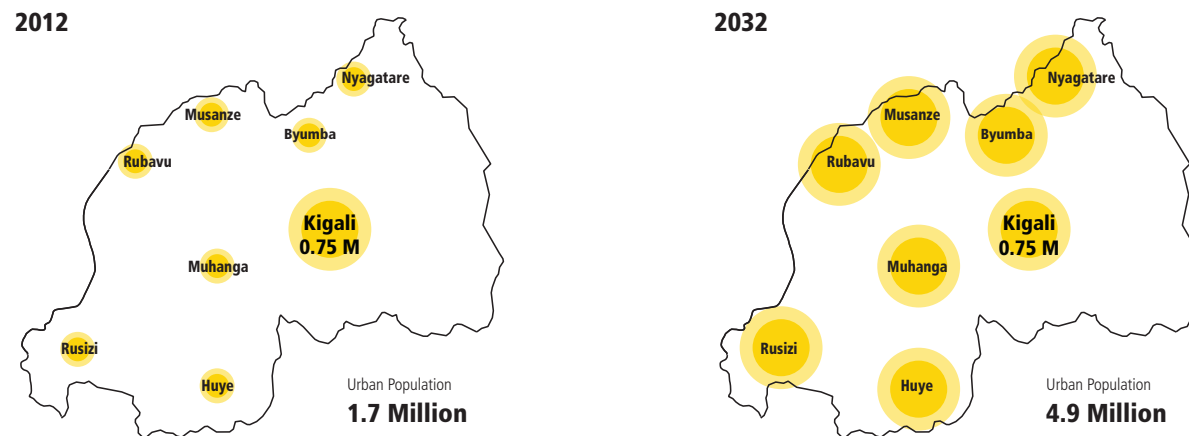


Fig.2: Urban population growth from 1.7 to 4.9 million urban residents in 20 years

2. 2045 if the average urban growth rate drops to 2.5%

This presents a great challenge — government institutions and private sector partners will have to coordinate and plan the extension, infill and regeneration of urban centers, together with the delivery of urban plots, infrastructure, public spaces, access to services, jobs and facilities and affordable housing.

By 2032, more than 800,000 homes will have to be built to accommodate new urban residents in Rwanda. According to the Ministry of Infrastructure, demand for affordable housing is estimated at 560,000 units by 2020, requiring the construction of 93,400 units annually - **7,700 units per month**. With an average cost of 10 to 20 Million Rwandan Francs³ for the recently launched affordable housing programme Batsinda II, the estimated total required investment would be of around **115,500 Million Rwandan Francs⁴** per month. A study by the City of Kigali, the Ministry of Infrastructure and the European Union indicated that Kigali could face a housing deficit of 344,000 homes by 2020. An average of 800 to 1,000 homes are built annually in Kigali, which represents a shortage of 30,000 units per year.

3. 12,000 to 24,000 USD

4. 140 Million USD per month

The amount of population living in informal settlements in Rwanda has progressively decreased since 1990, when 96% of the population was reported to live in slums. According to the World Bank, 53% of the population in Rwanda was living in slums in 2014. Although this represents a crucial achievement, the estimation is that **unplanned areas will increase at a rate of 4% per year until 2022**. The appearance of new slums is explained by the 'vicious circle' of **reduced availability of suitable land** which creates the conditions for informal areas to develop in steep slopes. On the one hand, this creates environmental threats and on the other hand increases the cost for infrastructure provision. Additional factors such as **overcrowded and poor living conditions in rental markets** and **unaffordability of construction materials** add up to this problem by forcing the creation of unserved and unplanned settlements for lower income residents.

B MOBILITY AND ACCESSIBILITY TO URBAN SERVICES

The rough topography of Rwanda hinders mobility and provision of basic services. As a result of the rugged terrain, the different areas and neighborhoods in Rwandan cities have limited connectivity which hampers mobility and accessibility and drives up the cost of service provision. Furthermore, topography does not contribute to the densification of the urban pattern, creating sprawling urban areas in which it is financially not feasible to sustain a public transport network.

The lack of connectivity of different neighborhoods, combined with the low density, limits possibilities of creating alternative means of transport, hampering the development of proper multimodal public transport networks where public transport can be combined with alternatives such as biking or walking. From the perspective of capacity development, many transport companies have limited skills in how to run a profitable business with proper bookkeeping and financial recording.

C RESILIENCE, CLIMATE CHANGE AND ENVIRONMENTAL RISKS

Rwanda is an exemplary country in terms of functional initiatives for environmental protection such as promotion of reforestation practices, district forest management plans, the carbon-friendly energy policy or the plastic ban. Nevertheless, the rapid population growth that the country is experiencing is increasing the pressure on natural resources such as land, water, flora and fauna. The largest noticeable impacts are agricultural land degradation, soil erosion and reduced soil fertility, loss of biodiversity, deforestation and wetland degradation.

Climate change has also resulted in an increased frequency and intensity of extreme natural events, including floods and droughts. Rwanda needs to invest in adaptation and mitigation projects to address these issues. Urban growth and changing of urban patterns may expand these threats, calling for essential coordination and higher preparedness levels to prevent or manage emergency events such as floods and landslides.

D INFRASTRUCTURE GAP

Rwanda has solid infrastructure compared to countries on a similar stage of economic development, with a substantial government and donor investment. An estimated 7.6% of the infrastructure is developed with the support of international aid⁵. Despite this, investment is required in primary infrastructure, mainly in energy and transport but also in water supply, sanitation and watershed management.

Access to affordable energy has been identified as the number one challenge that businesses face when considering expansion plans. To meet energy sector policy goals by 2018⁶ Rwanda requires a \$4 billion total investment, representing almost 20% of GDP per year.

As a landlocked country and with no link to regional railway and inland water transport, most of the trade and transport in Rwanda is done by road. High transportation costs due to the lack of alternative infrastructure and dependency on imported fuel hampers economic competitiveness and development.

Without increased levels of investment, the maintenance, operation and depreciation of infrastructure will become major expenditures to be considered in the future. These additional costs will require Rwanda to develop capacity to put in place Public Private Partnerships, as well as human capacities and adequately developed supply chains.

In relation to Information and Technology Infrastructure, Rwanda has installed a comprehensive broadband network, although end user connectivity is in most cases limited to 4G connections, which could limit the implementation of solutions that require broadband connectivity.

5. *African Development Bank (2008)*

6. *Energy Sector Strategic Plan 2014*

E POVERTY AND INEQUALITY

The levels of poverty reduction in Rwanda have varied between different districts and provinces, generating an imbalance in social and economic development. Although poverty reduced more in rural areas than in urban areas from 2008 to 2011, poverty in rural areas still stands at 49% compared to 22% in urban areas. Poverty also affects women more than men in Rwanda. Although inequality peaked at 0.52 of the Gini coefficient in 2005 and then decreased progressively to 0.49, it is still high compared to other Sub-Saharan Africa countries.

F FINANCIAL STABILITY, JOB CREATION AND COMPETITIVE BUSINESS ECOSYSTEM

Poor economic global performance appears as the main challenge to Rwanda's economy and financial sector, which could reduce exports of the country. A weakened demand of Rwanda's commodity exports could dampen foreign exchange, reducing the purchase power of government and companies for imported goods and services, on which the country strongly relies.

To cope with the current population growth dynamics in Rwanda, the country will require 200,000 new jobs each year. Compared to this, the number of waged formal jobs in Rwanda in 2013 was 396,000, meaning that both the formal and informal sectors will need a significant increase in jobs. The 'Made in Rwanda' campaign is one attempt of promoting local businesses and products.

The private sector needs to play a key role in the economic transformation of the country but it remains small and with limited competitiveness. More than 99% of companies are micro or small enterprises focused on traditional export products. Lack of skills and low labour productivity pose further barriers to private sector competitiveness. Furthermore, high electricity costs and an insufficient logistic system further hinder the profitability and scalability of Rwandan companies.

G LACK OF ADEQUATE CAPACITY (EDUCATION SYSTEM, INNOVATION, DIGITAL LITERACY, AND CAREER SKILLS)

The Government of Rwanda has taken large strides in extending basic education access, but education in rural areas, among the urban and rural poor and among children with disabilities and special learning needs remains a challenge. The current net enrollment ratio for secondary school in Rwanda is 28%, which anticipates that a strong investment will be required to expand infrastructure and increase the number of teachers and teaching materials.

Although the establishment of the University of Rwanda in 2013 represents a milestone in the consolidation of quality education, improving the relevance of education and addressing labour market demands still presents a key challenge. The education sector needs to equip students with the competences and skills that are required to access the labour market and to create jobs.

Formal sector companies in Rwanda reporting inadequate skills in the workforce have more than doubled in Rwanda since 2006, with larger companies being specially affected. The 2009 National Skills Audit reported severe skills gaps in the private sector with over 60% of skills deficit in priority sectors such as agriculture, tourism, construction, finance and mining.

ICT application is still very low in the private sector in Rwanda. More awareness needs to be raised among companies and the competitive advantages that information and communication technologies such as software, hardware and internet can provide need to be properly communicated. Focus on improving capacity for research and development to promote a culture of innovation inside government and private sector needs to be included in the education system.

H NEED FOR USABLE REAL-TIME AND STRATEGIC INFORMATION

The urban environment of the 21st century is characterized by high complexity and uncertainty. The global built environment of the 21st century but even more in the dynamic cities of the emerging world, have a constant unbalance between available budgets and the necessary actions to mitigate climate change, high urban growth, necessary infrastructure and the availability of housing. To answer to these challenges and all those above, it is essential to manage the city based on real time information, or usable data, identifying levels of needed services, location of hazards and stresses as well as social and economic activities and how they affect or are affected by existing resources and facilities.

Even more importantly, information is needed for future planning and strategic management, collecting and analysing data regarding urban trends, indicators and urban hotspots. This information is essential to understand how actions succeed, what the citizens see as more important and which areas need more attention. Data is crucial to enable municipalities and ministries to decide where to use budgets most efficiently, or where to orient private resources.

Such real time and strategic data and information should be updated regularly, while caring for privacy and data safety. This needs resources, knowledge and budgets, but without it, cities will act as if they are blindfolded, spending budget and time on activities that may not be relevant and therefore wasteful.

1.3. CURRENT SMART INITIATIVES IN RWANDA

IREMBO E-GOVERNMENT PORTAL

Online platform where citizens can access more than 30 different government services in one place.
<https://irembo.gov.rw>

KIGALI LAND AND CONSTRUCTION ONE STOP SHOP

Online 'one stop shop' platform where developers can apply and pay for construction permits and receive an answer within 20 days. The databases also contain information for landowners.
<http://www.kcps.gov.rw>

KIGALI SMART BUS PROJECT

Public buses in Kigali are being fitted with free wifi and contactless payment terminals from a Rwandan company called Tap'n'Go.

KIGALI POLLUTION MAPPING

The Rwanda Climate Observatory partnered with Safe Motos to use low-cost sensors to measure air quality in Kigali. Each day, a Safe Moto driver would pick up an air quality sensor and drive it around the city. The data from the sensors was then mapped to assess air quality across Kigali.

WATER AND ELECTRICITY ONLINE PAYMENTS SYSTEMS

Online water and electricity billing system for customers with a direct connection to their property. Customers without a direct connection will soon be provided with the option to pay for water or energy with an online pre-paid card. Connectivity will be provided through central points that are located a maximum of 400 meters from customers.

4G LTE ROLLOUT

Through a public-private partnership between the Government of Rwanda and KT Corporation, 95% of Rwandan citizens are expected to have access to 4G LTE by the end of 2017.

MICROGRIDS

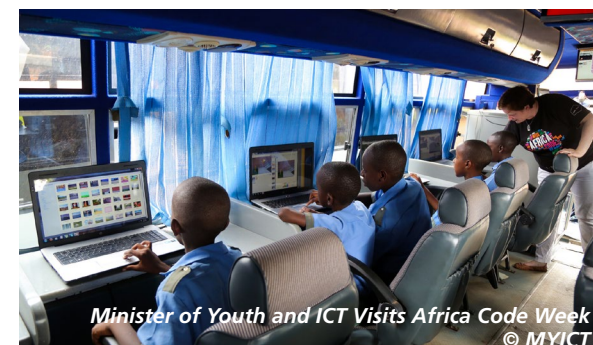
There are a number of ongoing electricity microgrid initiatives in Rwanda, including a collaboration between Rwanda's Energy Development Corporation and Ignite Power which aims to connect 250,000 people to solar energy by 2018 and Smart Village Microgrids, a research project by the Energy Institute at Colorado State University.

NDI HANO!

The Ndi Hano! program enables daily SMS reporting from public primary schools to create data on teacher and pupil attendance. The data is shared with education managers, schools, teachers, and parents in order to improve accountability.

DIGITAL REVENUE COLLECTION

Rwanda has a comprehensive e-payment and certification system which includes some local authority payments and taxes.



SMART ELECTRICITY METERS

Rwanda Energy Group is in the process of providing smart meters, communications networks, and data management services to a number of large and medium customers representing 50% of total sales. This will provide a platform for further distribution grid modernization as Rwanda Energy Group develops and deploys more functions related to smart grid functionality.

KIGALI INNOVATION CITY

Plans are underway to establish an innovation park on the outskirts of Kigali.

HUZA ENERGY RESOURCE PLANNING SYSTEM

Rwanda Energy Group is in the process of implementing a new integrated business management system to make the energy utility more responsive to customer needs, minimise revenue leakages across the network and standardize workflows.

RWANDA INFRASTRUCTURE GEOPORTAL

Online platform maintained by the Ministry of Infrastructure with data about infrastructure, planning, urban and rural development, transportation, water and sanitation.
<http://mininfra-geoinfo.maps.arcgis.com>

DATA REVOLUTION POLICY

An open data policy, currently in draft form, is being developed. The policy is based on the 2013 Rwanda Open Data Readiness Assessment report and proposes the implementation of several initiatives, including the establishment of an open data steering committee, an open data desk at NISR, institutional data release guidelines, data hosting incentives for investors, a personal information protection law, a national open data portal and a data innovation centre.

E-HEALTH SERVICES

A range of e-health services, including the Rwanda Health Management Information System, Community Health Worker Information System, the CBHI monthly indicator reporting system, and RapidSMS, an SMS-based platform enabling effective and real-time two-way communication and alert system for community health workers.

E-POLICING SERVICES

A range of e-policing services, including CCTV services connected to a central command centre in Kigali, an e-policing strategy which includes registration of drivers licenses through Irembo, the use of social media for first responders and online tracking of vehicles and speed governors.

ONE LAPTOP PER CHILD PROGRAMME

Programme to provide all children with laptops. So far the programme has helped distribute 100,000 laptops and is set to distribute another 500,000 in the next 5 years.
<http://one.laptop.org/map/rwanda>



1.4. POLICY FRAMEWORK



TOWARDS A KNOWLEDGE-BASED SOCIETY



In recent years, Rwanda has adopted a series of important policy frameworks that lay the foundations for this Smart City Masterplan.

Vision 2020

Established in 2000 and revised in 2012, the aim of Vision 2020 is to transform Rwanda from an agrarian economy to a knowledge-based society by 2020. To achieve this, the Vision 2020 identifies six interwoven pillars: good governance and an efficient state, skilled human capital, vibrant private sector, world class physical infrastructure and modern agriculture and livestock, all geared towards prospering in national, regional and global markets. Within the infrastructure pillar, communication and ICT and urban development are highlighted as important drivers. The Vision 2020 document is currently being updated and extended to Vision 2050.

The Smart Rwanda 2020 Masterplan

Following the adoption of Vision 2020, national information and communications infrastructure plans were initiated to provide strategic frameworks for using ICT to achieve development. The first of these, NICI 1 (2000-2005), focused on putting in place the foundational legal and regulatory framework to allow the liberalization of the telecommunication sector and attract private sector investments. The second, NICI II (2006-2010), focused on infrastructure and connecting people and on the launching of several flagship ICT initiatives such as the One Laptop Per Child projects. The third, NICI III (2011 – 2015), focused on transforming services, for example e-government services.

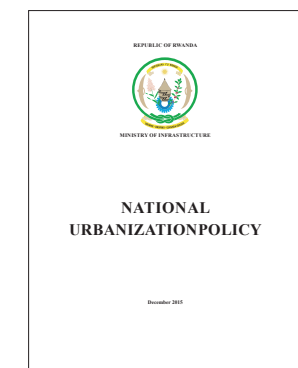
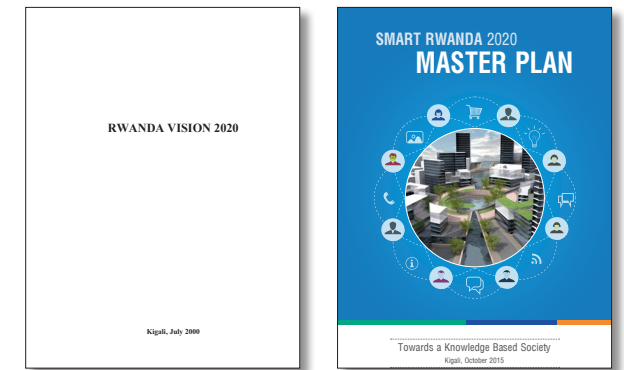
The fourth and most recent NICI Plan, the Smart Rwanda 2020 Masterplan, which builds on the previous NICI Plans, has three goals: economic transformation, job creation and accountable governance. These in turn are supported by seven pillars ranging from education to finance and women and youth empowerment in technology. The Masterplan identifies 67 priority projects, with an estimated investment need of around \$500 million, to implement between 2016-2020. However, to reach the ambitious goal of reaching a knowledge based society, the Masterplan recognizes, will require Rwanda to make serious investments in education, ICT awareness and digital literacy and ensure that cooperation between academic institutions and the ICT industry is strengthened.

The Smart Africa Manifesto

The Smart Africa Manifesto, adopted by African heads of state in 2013, provides a vision for achieving socio-economic development through ICT. The Manifesto outlines five key principles: to put ICT at the centre of the national socio-economic development agenda, to improve access to ICT, especially broadband, to improve accountability, efficiency and openness through ICT, to put the private sector first and to leverage ICT to promote sustainable development. The Smart Africa Manifesto is being implemented through the Smart Africa Alliance, established in 2016. Within Smart Africa, Rwanda is leading the smart cities theme.

National Urbanization Policy

In 2015, Rwanda adopted the National Urbanization Policy in order to use urban development as a driver for economic development. The purpose of the Policy is to enhance institutional capacity to manage urbanization in a coordinated manner, integrate urban planning and management to ensure sustainable growth, to improve urban quality of life and provide job opportunities and increase urban productivity. This will be achieved through a series of guiding principles: sustainability and resilience, integrated planning, decentralized urban governance, participatory planning, market-responsiveness, sustainable land use, appropriate urban management and social inclusion.



Rwanda Smart city pillars	Rwanda Smart City Masterplan building blocks	Smart Rwanda 2020 enablers	Smart Rwanda Masterplan pillars
1. SMART GOVERNANCE AND PLANNING	A. Data led management and planning	GOVERNMENT AND MANAGEMENT	GOVERNMENT
	B. Smart policies and regulations		CITIES
	C. Public engagement and open data		
2. SMART AND EFFICIENT SERVICES AND UTILITIES	D. Shared local infrastructure	SECURED AND SHARED INFRASTRUCTURE	EDUCATION
	E. Efficient, demand based services		SMART AGRICULTURE
	F. Sustainable and resilient resource management		HEALTH
3. LOCALIZED INNOVATION FOR SOCIAL AND ECONOMIC DEVELOPMENT	G. Education, innovation and digital literacy	ICT CAPABILITY AND CAPACITY	BUSINESS and INDUSTRY
	H. Localized and challenge based financial opportunities		FINANCE
	I. Digital transformation of financial and municipal services		

Smart Rwanda 2020 Masterplan	Smart Africa Manifesto 2013	National Urbanization Policy	UN-Habitat urban planning principles
Enhance the national ICT Governance and regulatory structure	To improve accountability, efficiency and openness through ICT	Decentralized urban governance	More compact cities
		Appropriate tools for urban management	Better integrated cities
		Sustainable land use	Socially inclusive cities
		Participatory planning	
Utilize ICT for education as a tool to enhance teaching and learning	To leverage ICT to promote sustainable development	Integrated planning	Resilient to climate change
Expand medical and health services to enhance citizens quality			
Boost agricultural productivity, industrialization and commercialization		Sustainability and resilience	
Build shared, robust resilient infrastructure to underpin service delivery and national ICT initiatives	To improve access to ICT, especially broadband	Social inclusion and cultural preservation	Better connected cities
Improve and expand access to ICT skills and innovation capacity			
Advance women and youth social economic empowerment through ICT	To put ICT at the center of the national socio-economic development agenda	Flexibility and market responsiveness	
Improve financial infrastructure to expand access to financial services			
Promote trade and industry development by enhancing value of products and services			

Table 1. The relations between the new Rwanda smart city strategies and current urban, smart city and ICT guidelines

02 SMART CITIES

2.1. WHAT IS A SMART CITY?

A smart city uses digitalization and technology to provide a high quality of life for its citizens, businesses and visitors. A smart city embeds technology and data across city functions to make them more efficient, competitive and innovative. Cities become smarter through a series of steps that enable them to become increasingly resilient and able to respond quicker to new challenges.

A smart city is also a sustainable city. Through innovation, openness and connectivity, smart cities ensure that they meet the environmental, social and economic needs of present and future generations.

2.2. THE RWANDA SMART CITY VISION

In Rwanda's smart cities, **leaders and citizens use data, information and knowledge to ensure a co-created resilient and sustainable future.**

This will be achieved by **inclusive** data-led management and planning, **efficient** community-based infrastructure and services and **localized** and **shared** innovation and economic development.

Rwanda, has the potential to champion the development of smart cities in Africa, due to its stable and innovative leadership, the fast digital transformation and the innovation capacity of its youth.

2.3. THE RWANDA SMART CITY MODEL

The research on smart cities highlights three main models that smart cities follow.

The **technological model** is based on formulating a framework for new economic opportunities, enhancing the startup ecosystem, testing new technology in 'urban beta-sites', and seeing the city as a hub of knowledge and experience. In this model, global technology companies are invited to apply and test their technology and finance implementation within the city borders.

*This model has been the smart city driver for: **Barcelona, Singapore and Chicago.***

The **strategic model** is based on a culture of long term strategic planning and constant monitoring. This model sees technology as a tool to assist in achieving long term urban goals, through data-led monitoring and ICT.

*This model has been the smart city driver for: **Vienna, Birmingham and Copenhagen.***

The **collaborative model** is based on the understanding that municipal services and community wellbeing are challenged by size, complexities and the dynamic character of cities in the 21st century. This model is based on small scale solutions that reach out and engage communities and neighbourhoods, innovative municipal workers and motivated and engaged citizens that work towards mutual ownership. This model sees collaboration and engagement as one of the main tools and goals

*This model has been the smart city driver for: **Boston, Tel Aviv and Medellin.***

The best approach to follow for Rwanda, and other African countries, is a combination of **the three models**. This allows for new or improved scalable technology solutions and financing models; new data and monitoring processes that enable more flexible strategic planning and management; and improved and more accessible local services through collaboration, co-ownership and co-creation.

The Rwanda smart city model is centred around **3 main pillars, 9 strategic building blocks and 27 action initiatives.** (See Chapter 4)

3 main pillars	Smart governance and planning			Smart and efficient services and utilities			Localized innovation for social and economic development		
	①			②			③		
9 building blocks	A	B	C	D	E	F	G	H	I
27 initiatives	1	4	6	10	12	16	19	23	26
	2	5	7	11	13	17	20	24	27
	3		8		14	18	21	25	
			9		15		22		



WHEN RWANDAN CITIES...

Kigali City © RDB Rwanda

Use technology to engage citizens and other urban stakeholders,

...they reach wider audiences and enable more voices to be heard in order to create joint ownership that better prepare citizens and stakeholders for needed changes.

Localize infrastructure, utilities and services and utilize co-ownership and co-creation,

...they narrow service delivery and infrastructure gaps while minimizing costs and raising efficiency of urban systems.

Use accurate and relevant data to manage and plan,

...they are better equipped to manage urban challenges, climate change and the dynamic needs of their citizens

Promote digital transformation of financial and municipal services,

...they improve service delivery while reducing costs and promoting a more reliable and attractive local business environment

Include innovation training and mindset in formal education,

...they create a future generation of scientists, businessmen, teachers and leaders, better equipped for dealing with the complexities of the 21st century.

Create smart and performance-based policies and regulations,

...they allow city leaders to “feel the pulse” and react to urban, financial and social changes, while improving governance and the regulatory objectives and visions.

Use localized and challenge-based financial opportunities,

...they create partnerships between the innovation and business sectors, work towards common goals and needs, while reducing costs for local authorities and improve the competitiveness of the local business sector.

Utilize sustainability and resilience strategies in their resource management,

...they make better decisions, balancing between social, economic and environmental aspects and are better equipped for sudden changes and events within the built environment and its surroundings.

Use technology to engage citizens and other urban stakeholders,

...they reach wider audiences and enable more voices to be heard in order to create joint ownership that better prepare citizens and stakeholders for needed changes.

03

BUILDING SMART CITIES IN RWANDA

A smart city masterplan should not be a unique “stand alone” document. The plan must be synergetic and strongly linked to day-to-day management routines and processes of the local authorities and to strategic and long-term policy making.

In order to help leaders and managers of Rwandan towns and cities start the process of becoming smarter, four early decisions need to be taken. These four decisions are followed by 10 steps to implement the smart city vision.

3.1. FOUR EARLY DECISIONS

1. COMMIT TO BECOMING A SMART CITY

Many cities around the world have chosen to brand their cities as “smart” without thinking about what it really means for them. These brand-led “smart cities” tend to phase off very fast, losing the inspiration and creating suspicion among those who initially acted fast to embrace the change. City leaders, who decide that they want to become smart have to understand the responsibility that comes with collecting data, sharing it, and acting on it. This is particularly important when taking actions or making changes based on data collected in the smart city. Becoming smarter has great advantages, but it is a journey that no one should start without understanding what is required from the city.

Any Rwandan smart city must start by following the ‘10 steps’ (see 3.2) and implement at least one smart city initiative from each strategic building block (see Chapter 4).

2. IDENTIFY THE CHAMPIONS

A really smart city does not only implement projects, but follows a process with connected action plans which are managed constantly. A city which focuses too much on discrete projects may miss opportunities for change or lose focus on the areas and topics most relevant for the city. To manage this, the smart city process has to have a dedicated leader. In some cities it may be a senior elected leader, in others a senior c-level director. Appointing such a leader is essential. Without one, the necessary changes — for example removing barriers, distrust and managerial problems — will be difficult, particularly in a context of managing issues affecting several departments, administrative levels and different types of organizations. Navigating this unknown territory will need a high-level leader confident to make changes, for example to regulations and processes, based on new information or data. The leader is, in many cities, followed by a dedicated team of digital champions (existing staff trained for the task) or a team of external consultants and essential stakeholders — all defined by size typology, local challenges and availability of funds.

3. CREATE A SHARED VISION

A smart city must have a unique vision. Although the main objectives and components might be based on a document such as this Masterplan, each municipal leadership has to create its own vision, practical objectives, indicators and targets. This vision then needs to be communicated well in order for it to be accepted and understood by fellow leaders and civil servants. It also has to be complemented by individual targets, frameworks and a comprehensive action plan. The vision is not static and may be altered, if new data and public acceptance allow for change.

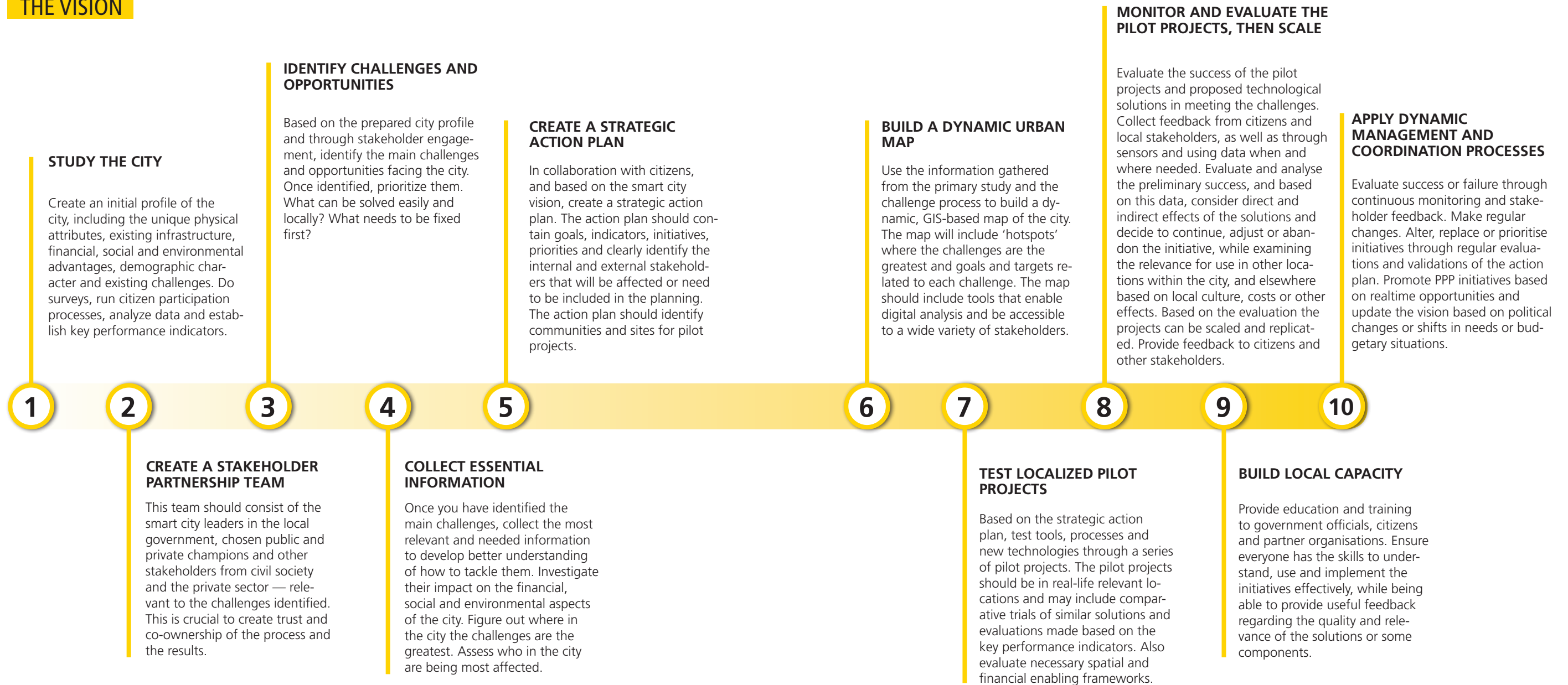
4. CHOOSE TO BE TRANSPARENT

One of the most important components of becoming “smart” is accepting openness and transparency and sharing the process with all urban stakeholders. Communicating the vision, targets and roadmaps, as well as the results — even if the outcomes are not what was expected — will result in higher acceptance. This will also get better results in the long term as the city can change what has proven wrong and build on successes.



Kigali Cityscape 2016 © Alex Niragira

3.2. TEN STEPS FOR REALIZING THE VISION





3.3. MANAGING THE CHANGE

Kigali © Dmitri 66

The process of creating smart cities requires change — partly related to technology, but also with regards to government processes and approaches to technology and innovation among government officials, citizens and other stakeholders. In order to manage this change, the following issues should be considered.

A. NATIONAL COORDINATION

Create a Smart City National Coordination Committee, consisting of senior national ministry officials, high-level local authority managers and other stakeholders. The Committee will work to overcome barriers and obstacles and ensure that successes can be learned from and replicated.

B. COMMON STANDARDS, DIFFERENT SOLUTIONS

Create relevant planning and building codes, technological standards and common procurement and evaluation methods. Ensure that successes of different solutions, products and processes can be compared across localities.

C. MONITORING SUCCESS

Create a common monitoring system. Ensure that this includes information on what should be evaluated, the evaluation and iteration methods and who does the evaluation. Finally, decide on how to present results to the public.

D. LOCALLY APPROPRIATE TECHNOLOGY

Many urban technology solutions have been created for northern cities, not for the dynamic and emerging cities of Africa. To ensure that technology is appropriate for the Rwandan context, develop a system of technology assessment which includes examining specifications, design, usability, deployment models, synergetic potentials, adoption rates, business models and maintenance models. Once relevant technology has been selected, divide them into three groups: mature and directly implementable solutions, solutions that need further development and essential new development needs. New solutions and those that need further development should be tested in beta-sites and evaluated properly.

E. PRIVACY AND CYBER SECURITY

A technologically integrated smart city exposes potential vulnerabilities. Insecure hardware is prone to hacking, leading to system shutdowns, unencrypted links open up possibilities for security lapses, while a simple bug can have a huge effect on an integrated system like a smart city.⁷ These risks can affect economic stability and national security, leave companies vulnerable to the theft of their intellectual property, and lead to the misuse of vast amounts of personal data. Mechanisms need to be implemented that protect the handling of sensitive data. Responsible smart city master-planning means giving citizens the opportunity to provide consent to the processing of their personal data, monitoring the extent to which private organizations collect data from the 'public' sphere as well as ensuring that the data collected is only used for defined purposes.

7. Ernst and Young (2016) *Cyber Security: A necessary pillar of Smart cities*

F. YOUTH AND WOMEN

Rwanda's smart cities need to be socially inclusive so that everyone benefits from the transition from an agrarian to a knowledge-based economy. Women, youth and marginalized communities especially need to be included in decision-making and planning processes. Introducing a smart city partnership team (section 3.2.), consisting of a diverse group of representatives, provides a platform for different perspectives and opinions to be heard.

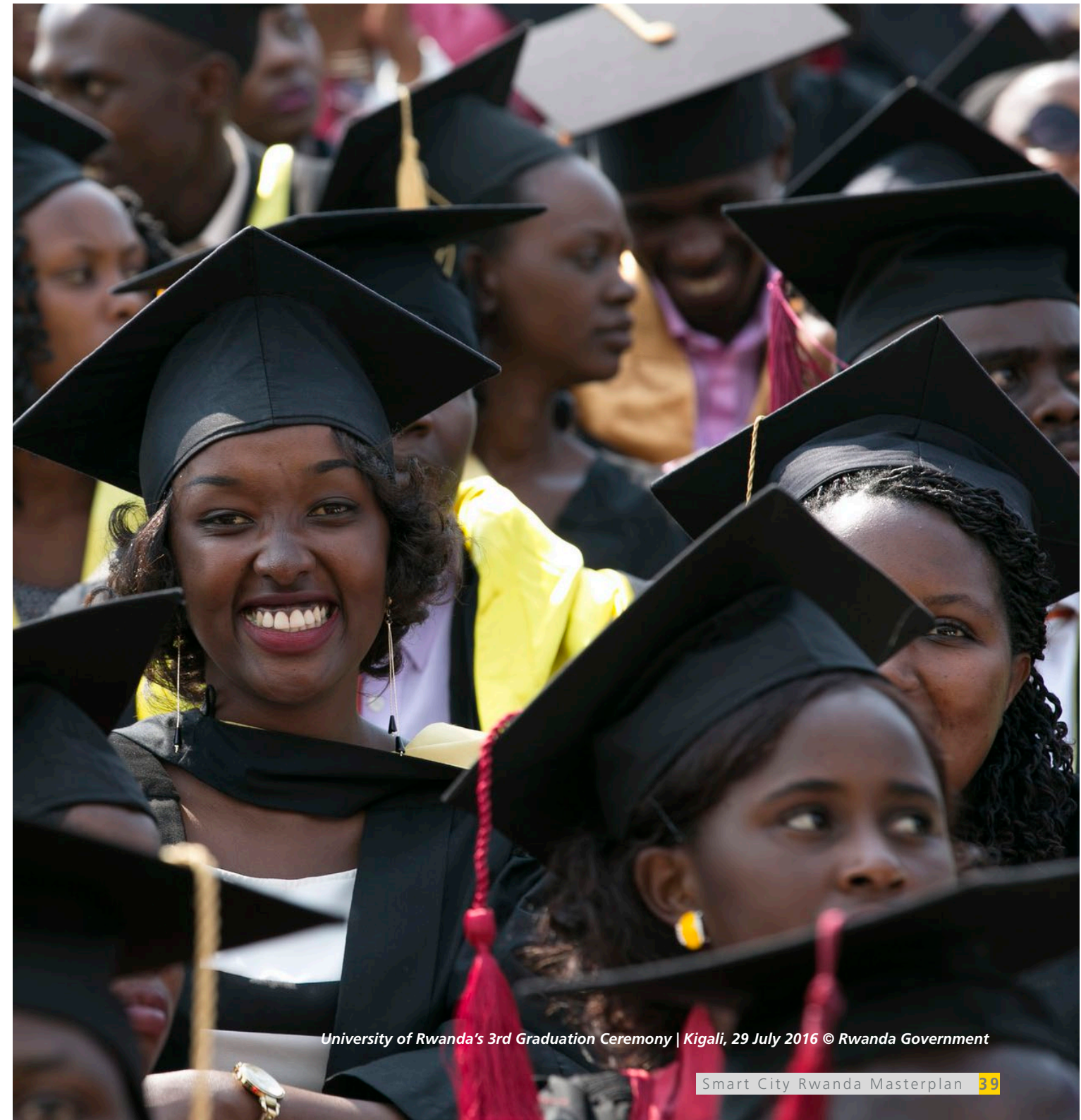
Social inclusion within the smart city relies on awareness raising and ensuring access to ICTs. Investment in the development of digital tools and ICTs need to be accompanied by policies enhancing people's digital education and incentivizing the use of these technologies. Making WiFi freely available in public places, community outreach programmes to spread digital literacy, and community initiatives to increase and encourage WiFi access and availability all open up possibilities for everyone to access the benefits of smart cities.

G. POLITICAL CHANGE AT LOCAL LEVEL

During the smart city implementation process, local political leaders or senior civil servants might change. To ensure the sustainability of the process, a strict documentation and evaluation process is essential. Strategies and policies need to be approved and followed.

H. NEWLY INVESTOR-BASED BUILT CITIES AND DEVELOPMENTS

Many medium to large new developments are led from beginning to end by private sector developers and investors, with limited involvement of local or national governments. These kinds of development should be seen as an opportunity to realize the smart city vision. In order to do this, a policy should be created which requires all large developments to be smart, sustainable and connected to the community.



University of Rwanda's 3rd Graduation Ceremony | Kigali, 29 July 2016 © Rwanda Government

3.4. FINANCING SMART CITIES

Financing smart city initiatives can present major challenges. Up to now, many smart city initiatives in the world have been presented as pilot projects with initial funding by public research bodies (such as the EU Horizon 2020 programme), grants by innovation funds (such as those created by donors such as USAID and Sida) or by private vendors interested in learning and experimenting in real-life locations.

However to make these projects sustainable in the long-term, they have to be based on local financial models and resources (even when they might be financed by external resources or public-private partnerships), ensuring that national government and local authorities are in control and fully evaluate the financial processes, understand methodologies and find a balance between needed resources, effectiveness of technology solutions and ensuring quality of service delivery.

Although smart city initiatives have clear financial and social value and many of them do present a clear return of investment, there are still barriers related to financing. Often these barriers are due to the following reasons:

- **Uncertain project costs** - mainly due to the novelty of solutions
- **Regulatory risks** - as regulation may not yet exist or be fit for purpose for some new technologies
- **Lack of existing impact assessments** - providing clear data on cost and revenue
- **High upfront costs** - compared to using existing solutions
- **Small scale and small markets** - which may deter investors due to high investment costs and longer periods for returns



View of Kigali City Tower © Rwanda Government

Considering these barriers, focus on the following potential financial strategies:

1. Create enabling regulation

Such regulations and standards should enable the testing and evaluation of previously untested technology and may include the following:

- **Special testing areas**, for example urban labs or innovation neighbourhoods allowing unregulated or untested technologies to be tested. (See Initiative 5)
- **New and flexible regulatory frameworks** for initiatives such as micro-grids and peer-to-peer solutions. (See Initiative 12)
- **Innovative tendering processes**, including reducing requirements for innovation-based tenders, use of challenge-based tender processes and shifting to performance-based tenders instead of descriptive processes.

2. Reduce information gaps

A common barrier to private investment is uncertain project costs and lack of information related to return of investment. National and local authorities can reduce this information gap by making relevant data available, including:

- **Magnitude and locations of challenges** - to allow for better understanding of the size of the market and financial constraints that may exist. (See Initiatives 1 and 4)
- **Potential starting points** - defined by urgency, opportunities or urban strategies. (See Initiatives 1, 2 and 17)
- **Data regarding previous/current projects and case studies** - in different locations, including success factors and financial results, in order to reduce financial and operational risk and uncertainty.

3. Create new financial models

Smart city initiatives differ largely in scale and costs, and may be divided into three main groups:

A. Small or medium-sized projects in the startup space

Many small projects lack initial start-up funds. This can be solved by making available grants, loans (including convertible debt), and equity investments. However, often these funding models can be inaccessible to startups and SMEs due to:

- High interest rates
- Low rate of return
- Long repayment periods
- Perceived or real risk to investors
- Small scale of projects reducing revenue and initial profit

To deal with these issues the following financial strategies can be used:

- National guarantees to reduce risks for investors and banks
- National loans to companies working on specific strategic smart city initiatives
- Compulsory grace periods to projects approved in municipal innovation tenders
- A national fund for startups and entrepreneurs (see initiative 21)
- Create specific financing solutions for smart city initiatives (see initiative 27)

B. Medium-sized projects that may be implemented internally or outsourced

Projects related to existing municipal structures and challenges could be funded locally but may face difficulty in implementation due to the novelty of the solutions. This can be solved by the following financial strategies:

- Multi-stage procurement processes, starting with small-scale pilot projects that require less investment
- Implementation trials led by innovation teams in local authorities prior to procurement (see Initiative 22)
- National guarantees to investors and companies after A or B trial stages
- National innovation fund with national and global partners giving low rate and high risk loans to local authorities or to selected companies
- Exploring the use of blockchain instruments to finance projects and reduce bureaucratic burdens in the financing process

C. Large scale projects that may be financed by national or international budgets, or by PPPs

Projects that need substantial funds are usually infrastructure projects such as microgrids, or large pilot projects. These can be made with different PPP solutions⁸ such as concessions, build-operate-transfer (BOT) and design-build-operate (DBO) options. However many of these solutions are used for large scale infrastructure projects when working directly with national governments and not local entities. Therefore we propose methods and initiatives to ease the barriers and enhance the will of private investors to compete in such projects (see Initiative 2).

Concessions - gives a concessionaire the long term right to use all utility assets conferred on the concessionaire, including responsibility for operations and some investment. Asset ownership remains with the authority and the authority is typically responsible for replacement of larger assets. Assets revert to the authority at the end of the concession period, including assets purchased by the concessionaire.

Build Operate Transfer (BOT) Project - is typically used to develop a discrete asset rather than a whole network and is generally entirely new or greenfield in nature (although refurbishment may be involved). The project company or operator generally obtains its revenues through a fee charged to the utility or government rather than tariffs charged to consumers.

Design-Build-Operate (DBO) Project - the public sector owns and finances the construction of new assets. The private sector designs, builds and operates the assets to meet certain agreed outputs. The operator is taking no or minimal financing risk on the capital and will typically be paid a sum for the design-build of the plant, payable in installments on completion of construction milestones, and then an operating fee for the operating period.

8. <http://ppp.worldbank.org/public-private-partnership/agreements/concessions-bots-dbos>

04

THE SMART CITY ACTION PLAN

4.1. OVERVIEW OF THE ACTION PLAN

The following Rwanda Smart City Action Plan builds on three pillars, nine building blocks and 27 action initiatives and apply to five city profiles - the capital city, secondary cities, towns and villages, as well as the national level. The 27 initiatives have been developed in consultation with a wide variety of Rwandan stakeholders, including government ministries, local governments, academia,

civil society and the private sector. They constitute a comprehensive multi stakeholder action plan to help make Rwandan cities smarter. Town and city leaders can use these initiatives to develop their own smart city masterplans, strategies and processes.

Five city profiles

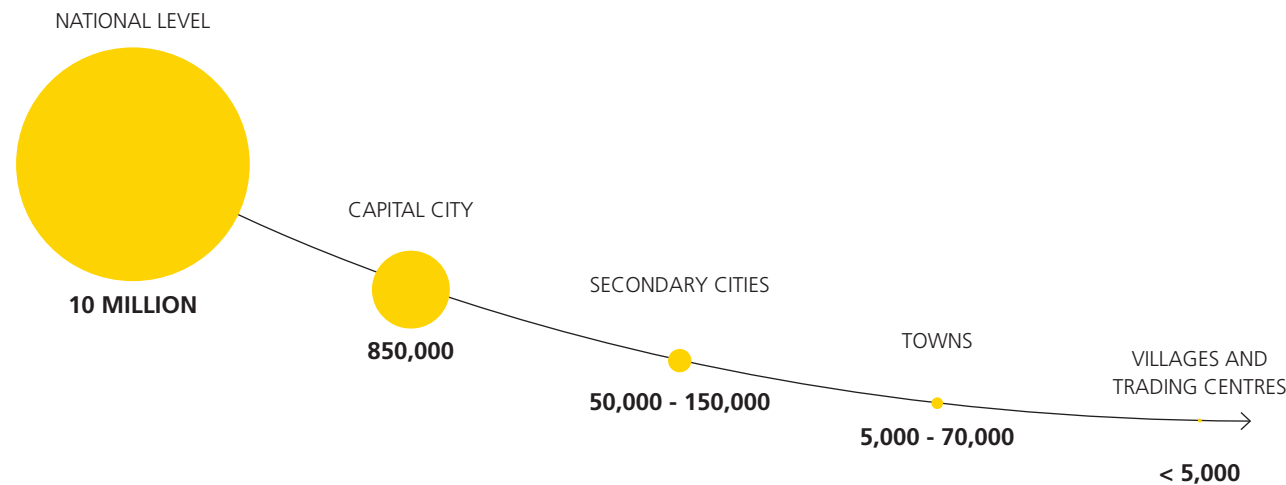


Fig.5: Scales of the five city profiles

PILLARS

BUILDING BLOCKS

ACTION INITIATIVES

PILLARS	BUILDING BLOCKS	ACTION INITIATIVES
1 Smart governance and planning	A Data-led urban planning and management	1 GIS-based urban management platforms
		2 Cross-ministry finance and project management platform
		3 Multi-stakeholder safer cities programme
	B Smart policies and regulations	4 Dynamic data-led master planning
		5 Enabling environments for urban technology testing
	C Public engagement and open data	6 Data strategies including open data, privacy and cybersecurity
		7 Free internet zones in strategic and residential areas
		8 Digital citizen engagement tools
		9 Ensure citizen engagement tools are accessible to all
D Shared local infrastructure	10 Digitally monitor and manage utility infrastructure	
	11 Explore smart micro grids based on the prosumer model	
2 Smart and efficient services and utilities	E Efficient, demand based services	12 Introduce regulatory frameworks for virtual power plants and other demand based management systems
		13 Promote smart data-led 'door-to door' mobility solutions
		14 Collaborative multi-ministry one-stop platform for e-services
		15 Digital access points for rural villages
	F Sustainable and resilient resource management	16 Use sensor networks to collect environmental data
17 Smart and resilient buildings and neighbourhood pilot projects		
18 Designate some public buildings as smart and green buildings and educational labs		
3 Localized innovation for social and economic development	G Education, innovation and digital literacy	19 Innovation in education, from primary school to higher education
		20 ICT skill training in education, for local authorities and the general public
		21 Provide a national fund for startups and innovation accelerator centers
		22 Establish innovation teams in ministries and local authorities
H Localized and challenge-based financial opportunities	23 Promote local digital business platforms	
	24 Create collaborative community co-working spaces and digital excellence centers	
	25 Establish collaborative urban innovation labs with academy, community and industry	
I Digital transformation of financial services	26 Introduce a one-stop e-payment platform for all life-time services	
	27 Enable electronic due-diligence and business loan systems for SMEs	

Table 2. Action Plan

4.2. THE 27 INITIATIVES FOR SMART CITIES IN RWANDA

The initiatives were developed through a stakeholder process, including meetings with a wide range of stakeholders from national and local government, private sector, academia and civil society. The process considered challenges, opportunities and existing smart initiatives as well as existing urban and ICT-related gaps that may be informed by this Smart City Masterplan.

Based on this process, 27 smart city initiatives have been identified. They vary in scale, cost and focus, and may not all be relevant for every local authority or urban scale. The initiatives are intended as a starting point for towns and cities to become smarter, and local authorities may decide to build on them or develop their own initiatives under each strategic building block. Each initiative is related to a smart city pillar, a strategic building block and an urban scale. Some have been proposed as strategic initiatives. Each initiative has also been linked to the city flows, city services, smart citizen services and smart city domains found in the *Smart and Sustainable Cities Blueprint for Africa*.

Each initiative has an associated short case study. The case studies are intended as inspiration for the development of Rwanda-specific projects, not as prescriptive processes to follow or recommendations for technologies to implement.

Kigali City © RDB Rwanda



Strategic initiative

INITIATIVE 1

Integrated, GIS-based urban management platforms

PILLAR

1

BUILDING BLOCK

A

CITY PROFILE

KIGALI, SECONDARY CITY, TOWN



Governance



Cross agency collaboration

MINIFRA has established a geo-database with the objective of integrating all spatial data available in the Ministry on one data platform. Building on this work, it will be possible to integrate urban data on the Kigali, secondary city and town level. Many different datasets can then be presented and analyzed using user-friendly dashboards by local government officials.

This will help local government to jointly coordinate urban planning and management processes, while also making the data publicly available to ensure transparency and to allow the private sector to make informed investment decisions, including on PPP projects.

Consider presenting data in both two dimensions and three dimensions (such as in Singapore). Integrate all data, both static and real-time, generated through the smart city process. Help local authorities manage urbanisation processes by establishing local GIS-based platforms that include location-based data.

Case study

The London Infrastructure Mapping Application, UK

A geodatabase created to allow the public, investors and local government to understand the phasing of projects, synergies and tensions that arise from the cumulative impact of development, the potential for greater coordination of works and the ability of systems to respond to London's growth in the short, medium and long term.

<https://maps.london.gov.uk/ima/>

INITIATIVE 2

Cross-ministry financial and project management platform

PILLAR	1		
BUILDING BLOCK	A		
CITY PROFILE	NATIONAL	Governance	Cross agency collaboration

In order to coordinate planning and deployment and promote transparency across urban projects throughout the country, create a national level digital platform integrating all government, private sector and foreign aid projects. By providing forward-looking information on ongoing and planned projects, all stakeholders, including national and local government bodies, utilities, service providers, donors and private companies can better coordinate efforts, eliminate gaps and identify overlaps.

Use the platform to reduce financial management burdens, enable PPP projects, make better planning decisions, promote information sharing and improve coordination. Ensure that all projects are geo-located. The initiative should include a classification between government-to-government projects (focusing on those to be led by local authorities and districts) and business-to-government projects, matching local authorities with the private sector and donors.

The platform can be integrated with Rwanda's existing Development Assistance Database.

Case study




The Rwanda Development Assistance Database

Used by the Ministry of Finance and Economic Planning to track and manage aid funds and development results across all major donors and NGOs. The system is integrated with Rwanda's SmartFMIS budgeting platform.

<https://dad.minecofin.gov.rw>

INITIATIVE 3

Multi-stakeholder safer cities programme

PILLAR	1			
BUILDING BLOCK	A			
CITY PROFILE	KIGALI, SECONDARY CITIES, TOWNS	Governance	Safety and emergency response	Cross agency collaboration

Although Rwanda is considered one of the safest countries in Africa with low crime levels, safety and emergency management remains an important issue. Building on existing processes and solutions deployed (currently mainly in Kigali), in Kigali, secondary cities and towns, create a safer cities framework, combining data collection and analysis and digital platforms with responsive urban design guidelines and policies to manage and prepare for a wide range of safety and emergency related issues.

This initiative should include the implementation of integrated systems at town level, including basic C4i capabilities, safety and emergency data collection and analysis. Install early-warning systems using sensors for landslides, floods and other natural disasters to enable emergency services and municipalities to react as early as possible. This data should be collected and displayed on local integrated platforms (such as initiative 1), as well as through mobile solutions.

An important component is connecting and engaging with citizens and community leaders via an integrated system of call centers, mass sms systems, social media, crowdsourcing and mobile engagement tools to collect information closer to the source, while strengthening community awareness (see initiative 8).

Case studies

Safetipin, India

Application that enables citizens and governments to crowdsource urban safety information.
<http://safetipin.com/>

Sayvu, Israel

Mobile platform that provides fast connectivity to first responders, social service personnel and government agencies. The system provides big-data analysis and a remote server algorithm, providing detailed overviews in every emergency situations, enabling better prioritization and decision making.
<http://sayvu.com/>

The Medellin Integrated Metropolitan Emergency and Security System (SIES-M), Colombia

Platform that brings together more than 10 government agencies from the security, transportation, health, disaster management and environment sectors on a single operations platform. With a single emergency call from citizens, different services can respond in a coordinated manner. The platform also integrates data from 823 video surveillance cameras distributed throughout the city and the systems of 10 government agencies.



Strategic initiative

INITIATIVE 4

Dynamic data-supported master planning

PILLAR

1

BUILDING BLOCK

B

CITY PROFILE

NATIONAL, KIGALI, SECONDARY CITIES



Governance



Cross agency collaboration

In recent years, Rwanda has created masterplans and spatial development frameworks for Kigali and secondary cities such as Rubavu and Nyagatare. Building on these processes, consider creating a national master planning process which also takes into consideration time and data as part of the planning process. Unlike the common planning approach which produces a static plan which only defines land use and scale, amounts of public spaces, public buildings, roads, etc, a dynamic plan based on up-to-date data takes into consideration changes in population density, living styles, traffic flows and the needs of citizens.

A dynamic process can include urban values (what goal do we want to meet?), data-led performance based indicators (what physical performance do we want to achieve?). The benefit of such a process is the potential elimination of the continuous production of master plans (or the problem of outdated plans).

Dynamic planning is not a “low hanging fruit” and needs resources such as a regulatory framework, a good GIS and data collection system (Initiative number 1), training at all levels and initial pilot projects to create trust and better understanding of necessary processes. New or major urban expansions, or a lack of detailed masterplans will justify the development of dynamic master-plans (i.e. only 800 out of 4000 hectare in Muhanga have a detailed masterplan).

INITIATIVE 5

Enabling environments for urban technology testing

PILLAR

1

BUILDING BLOCK

B

CITY PROFILE

KIGALI, SECONDARY CITIES



Citizen services



Business services



Governance

Discussions are underway to establish “Kigali Innovation City” — an ICT innovation area in the capital city. Building on this, establish innovation and testing environments in secondary cities as well. The implementation of new technologies often require testing and feedback at the early stages and are thus difficult to fit into standard approval and procurement processes. Cities that cater for testing and experimentation attract investment and start-ups. Challenge-based innovation contests can help cities identify solutions to challenges at low cost. Regulations related to planning and building and financial incentives, for example innovation funding or tax breaks are crucial in order to encourage innovation in cities.

Regulations may include “simplified planning zones”, that allow for flexibility in planning and land use, or “special purpose districts” that allows, for a specific period of time to alter regulations to allow for renewal or innovative experimentation. Another possible approach is to create specific innovation districts (new-built or existing areas) that promote innovation activities and create enabling environments for startups, research and beta-siting.

Case study

@22 Barcelona, Spain

An innovation district promoting social and economic urban renewal. The district, located in an old industrial part of the city, developed a strategy for ‘a new model of a compact city’, based on innovation activities, green spaces, advanced industries, a strong industrial heritage, subsidized housing, a new mobility model and revitalized public spaces.

<http://www.22barcelona.com>



Strategic initiative

INITIATIVE 6

Develop data strategies including open data, privacy and cybersecurity

PILLAR

1

BUILDING BLOCK

C

CITY PROFILE

NATIONAL, KIGALI, SECONDARY CITIES



Governance



Information and Open Data



Tools for citizen engagement

Building on the existing draft Data Revolution Policy and the 2013 Rwanda Open Data Readiness Assessment, approve a data strategy, license and personal data protection law, outlining the following:

- Which data can be shared across ministries, districts, local authorities and with citizens and the private sector.
- How to collect and distribute data.
- How data can be saved, for how long, and by whom.
- Which personal data can be collected and shared and how privacy of citizens can be ensured.
- The regulations and systems necessary to ensure good use of data (procurement rules, supervising bodies, cybersecurity systems).
- The necessary staff, training and systems required to ensure cybersecurity

In addition, create an Open Data Licence, explaining the conditions under which the data may be used, with every government agency following the conditions of the licence. Open licences are inappropriate in certain circumstances, such as where consent has not been granted (i.e. personal data) or is subject to licences or is third-party generated data. Similarly, classifying data as 'open' potentially removes a revenue stream for local municipalities. Local municipalities could consider charging a licence fee in the event that a private company uses public data for profit-making purposes.

As recommended by the draft Data Revolution Policy, create Kigali and secondary cities open data portals, making available data for citizens, government bodies, researchers and the private sector to use for research, innovation and for transparency. Open data portals need resources for management and maintenance, and should be funded and managed by the national government, or alternatively funded and managed by private bodies.

Case Studies

The Hitachi City Data Exchange Copenhagen

This system, funded by Hitachi and collaboratively owned by the municipality, gives public bodies full access to datasets for free, basic access to civilians and academia and pay-per-use access to private companies and research organizations.

<https://www.citydataexchange.com>

London Datastore, UK

Free and open data-sharing portal where anyone can access data relating to London. The site provides over 600 datasets to help citizens, business owners and developers understand the city and develop solutions to London's problems.

<http://data.london.gov.uk>

INITIATIVE 7

Accessible internet zones in strategic and residential areas

PILLAR

1

BUILDING BLOCK

C

CITY PROFILE

SECONDARY CITIES, TOWNS



Connectivity

At the secondary city and town level (and in a more basic extent at the village level, see Initiative 15), it is crucial to work towards eliminating the digital divide. Although the government is working towards full countrywide 4G coverage, citizens in many parts of the country lack the financial means to access the internet. Lack of internet access means no access to e-learning, to e-services and sometimes the possibility of applying for certain jobs. Internet zones should be located in strategic locations, but more importantly, in residential areas with large numbers of people without the financial capacity or in areas that lack internet connectivity. This can be implemented using public funds, for example by adding the areas to tenders and licenses, or by private entrepreneurs, for example by requiring them to provide free basic internet when providing fast internet for a fee.

Case study

Free wifi, Johannesburg

The City of Johannesburg has rolled out over 1,000 free wifi hotspots across the city. The hotspots are located in public facilities such as libraries, swimming pools, clinics and bus stations. Each network user is allowed 300mb of data a day, plus unlimited access to some services via the Maru a Jozi portal.

<http://www.marujoji.joburg>



Strategic initiative

INITIATIVE 8

Digital citizen engagement tools

PILLAR

1

BUILDING BLOCK

C

CITY PROFILE

KIGALI, SECONDARY CITIES, TOWNS



Tools for citizen engagement

Rwanda has a long history of citizen engagement, for example by making the annual budget available in a user friendly format to citizens or the Rwanda Citizen Report Card Survey carried out by Rwanda Governance Board in 2015. Building on these processes, gathering feedback from citizens can be strengthened with the use of digital tools. Therefore, in Kigali, secondary cities and towns, create digital citizen engagement tools to collect feedback and reports from citizens and other stakeholders to improve municipal services.

These tools can be used to receive reports from citizens, for example related to broken infrastructure, poor service delivery or corruption, or to crowdsource ideas for urban innovation. These can take the form of a combination of a municipal reporting website, mobile applications and sms-based systems. The tools should provide information on municipal services and provide dialogue between citizens and local government officials. They could also enable citizens to share data with the local government - for example geo-location, age, sex, occupation or hobbies - in return for better services, or enable local governments to share important information with citizens, for example relating to infrastructure works or service interruptions.

The tools can be developed and maintained by local authorities or by the private sector. All platforms should be available in Rwanda's official languages.

Case Studies

DigiTel, Israel

A digital service used by nearly 40% of the population of Tel Aviv to pay water and municipal tax bills, order parking permits and send photos of potholes or broken park benches to the municipal complaint line. Linked to the online service, the DigiTel Resident's Card is a smart ID card that provides discounts on all kinds of shows and cultural events and access to a personalized web page, where they can manage their bills and get personalized notifications.

BOS:311, Boston, US

Formerly known as Citizens Connect, BOS:311 is used by over 40% of the population to improve their neighborhoods by reporting issues such as potholes and graffiti. The reports are automatically fed into the city's work order system so that they can be tracked and assigned to service teams. Users can follow the status of their request, by using a unique tracking number for each case.

Maji Voice, Nairobi

An online, sms and USSD-based service that enables Nairobi's residents to report complaints and send feedback to Nairobi Water and Sewerage Company. Complaints are entered into the work order system and feedback is provided by sms to customers.

INITIATIVE 9

Ensure citizen engagement tools are accessible to all

PILLAR

1

BUILDING BLOCK

C

CITY PROFILE

SECONDARY CITIES, TOWNS



Connectivity



Tools for citizen engagement

At secondary city and town level citizen engagement through mobile phones or mobile-adapted online services are a crucial component of the smart city (see Initiative 8). However, considering Rwanda's relatively low internet and smartphone penetration, and the existing digital divide, it is essential to ensure that some parts of the community are not left out. It is essential to invest in solutions that narrow the digital divide and the engagement gap, for example public digital billboards, accessible digital kiosks in public facilities such as schools, libraries, places of worship, health clinics, petrol stations and markets.

These solutions should be accessible in size, language and location (using data analysis to identify locations with low engagement rates) as well as provide physical guidance to promote take-up. Currently, underused digital kiosks are found in some governmental offices. It is crucial to undertake research to understand how to make these initiatives more inclusive. In addition, in some areas, digital tools should be complemented with more traditional media and engagement tools, while working towards building digital literacy and civic trust.

Case studies

Citizen Connect, Singapore

Citizens with no access to the internet can access online government services through 27 Community Clubs. Citizen Connect offers free access to the internet with staff on-hand to help citizens and residents access the eCitizen portal and perform online transactions with government agencies.

<https://www.tech.gov.sg/Programmes-Partnerships/Programmes-Partnerships/Initiatives/CitizenConnect>

Buen Comienzo, Medellin

Through the Buen Comienzo, (Good Start) program in Medellin, mothers-to-be in the city's low-income communities, where access to free Internet is scarce, get medical information online at more than 150 public areas that offer computer access, free Wi-Fi and classes. While internet access doesn't substitute for an appointment, it can reduce the need for doctor visits and provide supplemental information about pregnancy.

<http://www.americasquarterly.org/content/medellin-smart-city>



Strategic initiative

INITIATIVE 10

Digitally monitor and manage utility infrastructure

PILLAR

2

BUILDING BLOCK

D

CITY PROFILE

KIGALI, SECONDARY CITIES, TOWNS



Water and Sanitation



Energy and Buildings

At the Kigali, secondary city and town level, water and energy utilities often experience resource losses related to aging and unmaintained systems, utility stealing (uncommon in Rwanda) and low efficiency of systems. Losses can be as high as 20-30%. For example, currently only medium level power is monitored by technological systems. There is need for solutions to monitor utilities such as energy, water and sanitation and garbage collection in order to reduce losses and to manage repairs and maintenance in a short loop to minimize costs to clients and businesses. An added benefit of these systems is the potential to aggregate and analyze user data to shift and alter their behavior towards more responsible usage. This results in a win-win situation as customers get lower bills and the utility has lower demand due to reduction of losses, resulting in better service and higher client satisfaction.

Case Study

TaKaDu water management, Israel

TaKaDu is creating cloud-based solutions to connect water pipes to the Internet of Things, enabling a proactive approach to flood control and rainwater collection, and the identification of weak points or blockages in the network before major damage occurs. For example, in Queensland, Australia, Unitywater cut its direct water losses by one billion litres in one year, saving \$1.9 million; it reduced the time it took to detect and resolve network events by two-thirds, and increased availability by almost 20%.

<http://www.takadu.com>

INITIATIVE 11

Explore smart micro grids based on the prosumer model

PILLAR

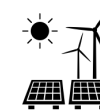
2

BUILDING BLOCK

D

CITY PROFILE

KIGALI, SECONDARY CITIES, TOWNS



Energy and Buildings

Currently Rwanda is promoting on-grid electricity connectivity in urban areas and off-grid connectivity in some rural areas. However, as energy needs grow, it may be necessary to explore new ways of producing and managing energy, mainly in urban areas, where demand is expected to grow substantially in the future. At the Kigali, secondary city and town level, smart microgrids can help meet energy needs and connect citizens currently lacking access to utility services. According to the IMF and the World Bank, microgrids have real viability and low connection costs - the average individual connection cost starts at \$50, while extending the grid to a sufficiently adjacent community can start at \$500 (IFC 2012).

Several initiatives, including the collaboration between Rwanda's Energy Development Corporation and Ignite Power which aims to connect 250,000 people to solar energy by 2018 are already underway, although mainly focusing on rural areas. A project funded by the World Bank is also providing smart meters, communications networks, and data management services to Rwanda Energy Group, providing a platform for the development of smart grid functionality.

The "prosumer model" (joint producer and consumer) is an even more innovative model that could have a large impact on energy supply in urban areas. In this approach, a prosumer is a consumer of electricity who also

produces it and can sell it back to the grid. For many cities in Rwanda, the prosumer could help meet the growing need for electricity. A model that takes into consideration issues related to management, maintenance and regulatory frameworks needs to be developed. A key factor in promoting the microgrid prosumer model is investment in testing within existing and new communities.

A possible pilot-site for microgrids may be the Kigali Innovation City, but similar pilot projects should be implemented in other existing neighbourhoods which experience high outage rates due to unreliable infrastructure. Due to high costs, these projects usually utilise PPP models.

Case study

Brooklyn Microgrid, USA

A community microgrid in Brooklyn, New York. The aim of the project is to achieve a sustainable, secure, and cost-effective energy system by providing long-term, locally generated power security within a community. The Brooklyn Microgrid is structured as a benefit corporation, (a for-profit corporate entity that can positively impact society), owned by LO3 Energy.

<http://brooklynmicrogrid.com/>

INITIATIVE 12

Introduce regulatory frameworks regarding virtual power plants and other demand based management solutions

PILLAR

2

BUILDING BLOCK

E

CITY PROFILE

NATIONAL



Energy and Buildings

At the national level, as part of the collaborative revolution in utilities and services, large and organised energy customers can participate in managing the grid by lowering or shifting demand depending on availability. This is done by informing customers, as well as creating public awareness around managing infrastructure, for example by asking people to reduce the use of AC, shifting working hours or running unmanned machinery at night. In return for reducing peak hour demand on utilities, customers receive the benefit of dynamic fees and higher network stability.

Introducing these kinds of solutions require less up-front investment than new microgrids, as they are less technology-intensive and focus mainly on a small number of high-use customers such as factories, industrial parks and office buildings, but the savings can be substantial. By creating networks of energy-efficient buildings, solar installations and batteries managed by ICT, additional savings can be made, and potentially sold back to the grid. Such concepts, sometimes called 'virtual power plants', need fine-tuning by regulators regarding utility pricing and localized utility distribution as well as digital networks to manage them. The Rwandan Energy Utility Corporation initiated a new electricity tariff system in January 2017, relating rates with consumed units, increasing the viability of such a system.

Case study

Stem Inc., California

A startup which uses batteries to help major retail and service industry companies reduce their electricity bills. Stem installs battery systems, sometimes combined with solar energy systems, in large buildings in California. Batteries are charged when electricity rates are low. A cloud service then analyzes the building's energy use along with information on utility rates. When power prices are most expensive, the system automatically reduces the use of utility-provided electricity and instead draws from the battery. (Source: the Guardian).

<http://www.stem.com>



Strategic initiative

INITIATIVE 13

Promote smart data-led 'door-to door' mobility solutions

PILLAR

2

BUILDING BLOCK

E

CITY PROFILE

KIGALI, SECONDARY CITIES, TOWNS



Transportation and mobility

Although some work is underway to make public transport more efficient, for example through the Kigali smart card system, at the Kigali, secondary city and town level, the issue of efficient and widely accessible mobility is a real barrier for eliminating inequality and for creating sustainable growth. One of the main issues, especially in secondary cities, is not only the lack of transport but of the lack of connectivity, reliability and efficiency of public transport. This is due to a lack of information regarding needs and lack of financial viability of current services. Therefore, most of the public transport options outside Kigali only run on the main national and regional roads. To deal with this, connectivity composed of different modes of transport provide citizens door to door mobility options.

This could include (gradually, starting in Kigali and secondary cities):

1. Data collection regarding needs (from where to where and when) via aggregation of data from transport operators, municipal apps and accessible citizen engagement tools.
2. Definition of mobility routes, including large buses/ minibuses and taxi-moto and finally safe and accessible walking routes.
3. Creation of a multi-mode mobility app to coordinate:
 - Pricing, availability and safety of transport

- On demand taxis and dynamic stops for large buses and minibuses
- Feedback from clients regarding convenience of routes, route hazards and complaints regarding operators

An integrated transport app will help to enhance reliability of public transport, while also acting as a strategic tool for designing routes and intervals to assist in route maintenance and to assist with public safety. This is a highly comprehensive proposal but the growing need for transport will call it. The initiative may be initiated by the private sector and funded as part of new transport tenders/ new license costs and by additional public transport users.

Case study

Mobility Shop, Hannover

The world's first 'mobility as a service' initiative. Users are given an integrated workflow that includes registration, routing, booking and invoicing for several transport modes (public transport, taxis, station-based and free-floating car-sharing). All services are invoiced via a monthly 'joint mobility bill'.

<http://www.uitp.org/news/maas-hannover>

INITIATIVE 14

Collaborative multi-ministry one-stop platform for e-services

PILLAR

2

BUILDING BLOCK

E

CITY PROFILE

NATIONAL



Citizen services



Business services

On the national level, in order to create a real knowledge based society, citizens and businesses need to have access to a digitally integrated e-government service. While many services are connected in Rwanda, there are still need for coordination and consolidation of services in one place and in a user-friendly manner. Irengo is a great first step and has many e-services available but some services are found on different websites or are still manual.

A fully integrated e-government platform will reduce bureaucracy and create better understanding of trends, service needs and common profiles of users and communities. Creating a full one-stop digital service hub will create better trust and connectivity between the public and local authorities.

Such a system should be organised nationally but should be tailored to act as a local authority platforms - connecting all local and national services in one location.

Case studies

Centrelink, Australian

A one stop for payments and public services, designed to offer all services and information organised by sector, personal situation or stage of life (i.e student, families, job seekers, elders, disabled, refugee etc), The website includes clear and intuitive search options, as well as simulators, guides, registrations and payments.

<https://www.humanservices.gov.au/>

eCitizen, Singapore

Launched in 1999, eCitizen is an initiative by the Ministry of Finance and is managed by the Government Technology Agency of Singapore (GovTech). It is the first-stop portal for all Government information and services, eCitizen is organised to serve citizens' needs without the need to know which government agency is responsible for a particular service, policy or program.

<https://www.ecitizen.gov.sg>

INITIATIVE 15

Digital access points for rural villages

PILLAR

2

BUILDING BLOCK

E

CITY PROFILE

VILLAGE



Education



Connectivity



Citizen services



Business services



Healthcare

While the government is aiming to make 4G LTE internet connectivity available countrywide, at the village level barriers to social inclusion include unreliable energy and lack of finance to access internet. This worsens digital divides and entrenches inequality levels and access to services such as education and health. To help solve this problem, create multi-service, solar and battery-backed access points in each village. These access points will provide internet connectivity in the form of free Wi-Fi, digital billboards for community and national notices, educational content and access to e-government services and digital banking and payment services. Where possible, water purification and solar battery charging stations can be added.

Case studies

Mobile Charging Kiosk, Rwanda

A Rwandan company, African Renewable Energy Distributor, produces mobile phone solar charging kiosks on a franchise basis. Customers visit the kiosk, drop off their phone, take a ticket and return a few hours later when the phone is fully charged.

BRCK, Kenya

A Kenyan startup that provides a variety of technology solutions dealing with poor connectivity and lack of electricity in Africa. The SupaBRCK is a solar and battery powered mobile Wi-Fi hub and connected microserver that can serve both cached and local content. A network of SupaBRCKs can provide infrastructure-as-a-service and storage capacity through a distributed, off grid content delivery network.

INITIATIVE 16

Use sensor networks to collect environmental data

PILLAR

2

BUILDING BLOCK

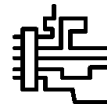
F

CITY PROFILE

KIGALI, SECONDARY CITIES



Information and Open Data



Sensing the city

In Kigali and in secondary cities, wireless sensor networks spread out over relatively small areas can provide a variety of environmental data to support policy making and inform the public. Urban environmental risks are often site specific – for example related to geographical or morphological features of the city or to the location of the hazards themselves. Air pollution from industry and transportation, as well as noise and water pollution can be monitored using a variety of low-cost sensors, as is currently being tested by the Rwanda Climate Observatory. Once analyzed actions can be taken to, for example, reduce pollutants or their effect or decide on permitted land uses or activities.

Creating municipal environmental maps based on data will allow for better knowledge regarding the physical and environmental state of the city and will help local governments with resilience planning. Data can also be shared with citizens to help them make better informed decisions on where to live, work and move in the city and how to adapt to environmental risks.

Case study

Kigali Pollution Mapping, Rwanda

The Rwanda Climate Observatory and MIT partnered with Safe Motos to use low-cost sensors to measure air quality in Kigali. Each day, a Safe Moto driver would pick up an air quality sensor and drive it around the city. The data from the sensors was then mapped to assess air quality across Kigali.



Strategic initiative

INITIATIVE 17

Smart and resilient buildings and neighbourhood pilot projects

PILLAR

2

BUILDING BLOCK

F

CITY PROFILE

KIGALI, SECONDARY CITIES, TOWNS



Energy and Buildings



Water and Sanitation



Transportation and mobility

Led by the recently established Rwanda Green Building Organisation at Rwanda Housing Authority, pilot projects on smart and resilient buildings and neighbourhood pilot projects should be established at the Kigali, secondary city and town level. Such projects can include all or some of the following: new building technologies and techniques, green and smart buildings, smart infrastructure and multi-utility microgrids based on renewables (Initiative 11), smart mobility plans (TOD projects), full scale broadband internet solutions (fiber or wireless), environmental sensing, local innovation and co-working spaces and beta innovation sites.

This should involve investor or developer-led initiatives, including the construction of large buildings, new urban developments, urban rehabilitation and slum upgrading projects. These communities can be dynamically planned (Initiative 4), with continuous community engagement and digital monitoring. The buildings and communities (new and upgraded) should be showcased as examples of better planning and building ecosystems, including continuously evaluating the cost of construction, maintenance and market value.

Case study

Hammarby Sjöstad, Sweden

A neighborhood in southern Stockholm with about 25,000 inhabitants. The design and execution of the neighborhood, including integration of several infrastructures in the including technical infrastructure, mobility and communication infrastructure, building infrastructure, including highly visual and innovative environment technology solutions have significantly reduced energy consumption and waste. Compared to other neighbourhoods of Stockholm, there were significant reductions in solid waste (90%), liquid waste (35%), energy consumption (40%) and water use (40%)

<http://www.aeg7.com/assets/publications/hammarby%20sjostad.pdf>

INITIATIVE 18

Designate some public buildings as smart and green buildings and educational labs

PILLAR

2

BUILDING BLOCK

F

CITY PROFILE

KIGALI, SECONDARY CITIES, TOWNS



Energy and Buildings

To promote smart and sustainable living at the Kigali, secondary city and town level, designate some public facilities as smart and green buildings. These will act as good practice examples that can be used for information and education purposes, while saving energy. Connected to this, develop educational labs that can present the techniques, details and data regarding the performance of these buildings.

This initiative has added value by creating stable energy and internet connectivity in schools, especially considering that only 47% of public schools have electricity coverage, and only 6% of primary and 18% of secondary schools are connected to the internet (MYICT 2012, Rwanda ICT Sector Profile). Such projects can be linked with the ongoing Green Building Organization work at Rwanda Housing Authority.

Case study

HSB Living Lab, Sweden

A sustainability research and demonstration arena which includes homes for students and guest researchers. The building is a collaboration between HSB Housing Corporation, Johanneberg Science Park and Chalmers University. University students live in the building and form part of the sustainability research project.

INITIATIVE 19

Innovation in education, from primary school to higher education

PILLAR

3

BUILDING BLOCK

G

CITY PROFILE

NATIONAL



Education

At the national level, innovation is key to creating a knowledge based society. In order to equip students with the skills, expertise and knowledge that they will need in the future, the school system needs to teach innovation from a young age. Research shows that learning through real projects has a significant impact on student's engagement and development and all courses should be connected to real problems, ideally those found in the local community.

By embedding innovation in the curriculum, for example through innovation courses in primary schools or teaching design thinking and linking with innovation labs at high school and university level, Rwanda will ensure that it has the tech-savvy and innovative workforce required for prosperity in the 21st century.

Case studies

The Young Entrepreneur Programme, Ireland

A Programme that teaches secondary school students to explore and develop entrepreneurial skills through workshops, case studies and interactions with key business people.

<http://www.youngentrepreneur.ie>

MIT Senseable City Lab, USA

An academic innovation programme at MIT that explores urban imagination and social innovation through design and science. It's multisectorial and explores real problems faced by industry, governments, citizens and disadvantaged communities.

<http://senseable.mit.edu>

INITIATIVE 20

ICT skill training in education, for local authorities and the general public

PILLAR

3

BUILDING BLOCK

G

CITY PROFILE

NATIONAL



Education

Although Rwanda has come a long way in promoting digital literacy, for example through the One Laptop Per Child programme, at the national level, there is still a substantial need for ICT skills education and training in order to reduce the digital divide. Basic computer, software and coding skills should be offered at primary school level and through free courses to the general public. Multi level training in coding, programming, data science and web design should be compulsory at secondary school and higher education level. ICT skills training, including data analysis, basic coding, and the use of professional software should be offered to staff at local and national authorities.

Case study

BBC Schools Computing, UK

An online resource for primary and secondary school teachers to teach coding and other computer skills to their students. A variety of lessons and links to other online resources are available.

<http://www.bbc.co.uk/schools/0/computing>



Strategic initiative

INITIATIVE 21

Provide a national fund for startups and innovation accelerator centers

PILLAR

3

BUILDING BLOCK

G

CITY PROFILE

NATIONAL



Financing

In order to deliver the Ministry for Youth and ICT's ambitious aim of creating a large Rwandan technology startup ecosystem, it is crucial to motivate and promote Rwandan entrepreneurs, innovators and startups at the national level. However, access to financing is generally highlighted as one of the main obstacles to entrepreneurs in Africa. While the challenge for entrepreneurs in other parts of the world generally consists of convincing investors about the viability of their idea, a lack of available startup funding in Africa is a serious problem. A report by Ihub Research found that venture capitalists are seldom seen in Africa and getting seed funding for small startups is therefore difficult. However, providing financing is not simply enough, an enabling environment of incubators, accelerators and science parks also needs to be supported. This supporting network can provide capacity building, mentoring and support to entrepreneurs, startups and SMEs.

While some localised startup funds exist in Rwanda, for example the Bank of Kigali Urumuri tech innovation fund, the innovation ecosystem in Rwanda could be greatly strengthened through a national fund. Such a fund can provide seed funding to startups and SMEs as well as support for a national network of innovation accelerators, with innovation spaces in each secondary city. The aim should be to provide sustainable and long-term (five year+) funding and capacity building for

startups and SMEs. The fund could combine financing from the government, the private sector and development partners.

Case studies

Ohio Third Frontier, USA

A series of pre-seed funds to grow regional and state-wide clusters of excellence in targeted areas of technology. The funds are monitored by the state, and are expected to co-fund (50:50) and mentor companies towards capitalisation.
https://development.ohio.gov/bs_thirdfrontier/default.htm

The National PreSeed Accelerator Fund, New Zealand

Programme designed to support early stage technology commercialisation activities which were developed in publicly-funded research organisations. Grants of up to \$250,000 are available to improve the commercial capability and skills of public research organisations and promote business linkages.
www.mbie.govt.nz/info-services/science-innovation/investment-funding/current-funding/pre-seed-accelerator-fund



Strategic initiative

INITIATIVE 22

Establish innovation teams in ministries and local authorities

PILLAR

3

BUILDING BLOCK

G

CITY PROFILE

KIGALI, SECONDARY CITIES



Cross agency collaboration



Governance

At the Kigali and secondary city level innovation in local and national government can be difficult to promote. The language and characteristics of innovation can be confusing or impose a perception of suspicion and threat to existing staff and managerial teams. In addition, municipal and national government staff, often have creative ideas but no clear way of implementing them. To get around this problem, create innovation teams that can support staff in innovation processes.

These teams can be connected to the mayor's office or the general director's office and linked to the Joint Action Development Forum (JADF), with two main goals:

1. Promote innovational ideas within the public sector, including supporting workers with ideas to improve services.
2. Screen and enable community led innovation by coordinating with ministerial and local authority departments, and lead trials and experimentations for the local authority.

The innovation teams should be multidisciplinary, with a variety of skills related to innovation, IT, leadership, urban and public policy. The should be mandated by management to lead and execute projects, test new approaches, and working alongside other municipal and governmental innovation teams, create a national public sector innovation network.

Case study:

The City of Boston "New Urban Mechanics", USA

The City of Boston's civic innovation team, part of the mayor's office, experiments with pilot projects that offer the potential to significantly improve the quality of city services. Through an agile approach focused on delivering transformative city services to Boston's residents, they work on a broad range of projects from increasing civic participation, improving city streets, to boosting educational outcomes.

<http://newurbanmechanics.org>

INITIATIVE 23

Promote local digital business platforms

PILLAR

3

BUILDING BLOCK

H

CITY PROFILE

KIGALI, SECONDARY CITIES, TOWNS



Business services

At the Kigali, secondary city and town level, a digital local business portal can allow SME's and local business to advertise their services. By getting online, businesses can also find opportunities for collaboration and correspondence with potential clients and partners. The portals could also connect regional digital billboards and other digital opportunities including billing and marketing platforms. Opportunities enabling local companies to participate in regional and national procurement processes may also arise.

Case study

Digital Main Street, Canada

The City of Toronto developed an online business support platform called 'digital main street' to connect Main Street businesses with the digital world. The municipality was joined by the Toronto Association of Business Improvement Areas (TABIA), Google Canada, MasterCard, Rogers Communications, Shopify and Yellow Pages and main street businesses, project facilitators and vendors. Businesses (currently over 200) register for free to get a digital assessment that identifies technologies and service providers and provides business mentoring. The platform was funded by Mastercard, Rogers, Shopify, Yellow Pages and Google, while other companies contribute services.

<http://www.digitalmainstreet.ca/>

INITIATIVE 24

Create collaborative community co-working spaces and digital excellence centers

PILLAR

3

BUILDING BLOCK

H

CITY PROFILE

SECONDARY CITIES, TOWNS



Education



Business services

While co-working spaces such as The Office and Impact Hub exist in Kigali, at the secondary city and town level, local authorities should support — through regulation, space and financing — the creation of co-working spaces enabling the local community access to internet, work spaces and collaboration opportunities. These spaces make it easier for entrepreneurs and small startups to access necessary services while creating benefits for local businesses.

Linked to co-working spaces, local governments should promote the establishment of digital excellence centers for training, demonstration projects and experiencing digital innovation opportunities. This could also take the form of creating collaborative community spaces out of unused spaces or public spaces. The public spaces may be used as conference rooms, meeting rooms or for parties, thus reducing costs but also allowing for better utilization of urban spaces. These centers can be initiated by the community or local authorities but due to the wide urban and national value, entrepreneurs should be incentivised to contribute.

Case study

The City of Sydney “Venue to Hire” Initiative, Australia

This initiative allows private use of community venues include rooms, halls and auditoriums that are suitable for either community meetings, conferences, functions or weddings. Rooms may be booked directly through the municipality website using various search criteria including area, size and use. The site also includes online booking, fees (if relevant) and compulsory insurance. Students may book a space to rehearse music or other arts for free.

http://www.cityofsydney.nsw.gov.au/explore/facilities/venues-for-hire#ac=hp_e_toptasks_Book+a+venue

INITIATIVE 25

Establish collaborative urban innovation labs with academy, community and industry

PILLAR

3

BUILDING BLOCK

H

CITY PROFILE

NATIONAL, KIGALI, SECONDARY CITIES



Education



Business services

At the national, Kigali and secondary city level there is need, to be open to change and actively enable innovation, research needs and testing of new solutions. For this purpose, urban innovation labs (in several shapes and themes) should be created. These centers should be created through collaboration between academic institutions, the private sector and local authorities, with the aim of connecting academic research, municipal know-how and public feedback. These labs should reflect the unique factors of the region and aim to solve real urban problems, while creating enabling environments and data for real urban technology businesses as well as ongoing mentoring of student related innovation. One such lab, Kigali Innovation City, is already being planned in Kigali.

The labs may be situated within academic campuses or in a publicly accessible area, such as the city center, or in transportation hubs. They may be funded by the national government, local authority, the private sector or funded internally by academia (when located within such institutions).

Cities and districts that do not have a research organization, but has a strong business base, may create a partnership with an academic “back office”.

Case studies

InnoZ, Germany

InnoZ was founded in 2006 as a cooperative venture between a variety of private sector and research institutions with a wide partner base of local and international universities, national and local authorities and business leaders. InnoZ is located in central Berlin and pioneers the development and implementation of systematic, social, and digital innovation in the mobility market, focusing on core sectors of transport, energy and ICT.

<https://www.innoz.de/en>

European Network of Living Labs

The international federation of benchmarked living labs in Europe and worldwide with over 170 active members. Founded in 2006, ENoLL provides co-creation, user engagement, test and experimentation facilities targeting innovation in many different domains such as energy, media, mobility, healthcare, and agrifood.

<http://www.openlivinglabs.eu/>

INITIATIVE 26

Introduce a one-stop e-payment platform for all life-time services

PILLAR

3

BUILDING BLOCK

I

CITY PROFILE

NATIONAL



Citizen services



Business services

At national level, create a one-stop portal for all payments and fees. While Irembo is a great start, it does not yet consolidate all e-payment services. The portal can be managed by the Rwanda Revenue Authority or directly by local authorities, but needs to be dynamic and responsive to create trust and reliance. For example, every change in the tax code or service payment structure must be immediately reflected in the platform. The aim of the platform is to reduce journey time and bureaucracy for citizens, while making government more efficient.

In addition, it could be possible to use the portal as a financial management tool, by for example allowing individuals and SMEs to manage all financial issues online, including financial profiles, expenses, pensions, government benefits and loans. E-payment systems exist in many versions (including the successful Irembo), but in order to create a change in the national economy based on growth of the middle class, personal financial tools are needed. Such tools should help promote financial planning, reduce risks and encourage investment and entrepreneurship. This system may be created by private sector companies, banks or mobile companies, with guidance and licensing from the government due to privacy and cyber-security issues

Case study

BankID, Sweden

Leading electronic identification in Sweden with 7.5 million active users. BankID was developed by a number of large banks and is used by citizens, government bodies and private companies. With BankID, individuals can access both their private financial data held by financial institutions, as well as government financial data such as pensions, tax liabilities and benefits.

<https://www.bankid.com/en>

INITIATIVE 27

Enable electronic due-diligence and business loan systems for SMEs

PILLAR

3

BUILDING BLOCK

I

CITY PROFILE

NATIONAL



Financing



Business services

At the national level, there is a need to support business development, especially SMEs. Create a portal which will provide SMEs with fast and streamlined business financing, including digital loans, fast track business registration, business plan formats, electronic due diligence services and other guidance essential for new or growing businesses without complication and high cost. This initiative will need to consolidate many existing initiatives and others that have yet to be created. The portal can be created by the private sector, particularly banks, but the government needs to create the necessary regulations and legal frameworks, including standards and guidelines.

4.3. PRIORITIZING THE INITIATIVES

A long list of 27 initiatives can be difficult to start at once. Issues related to local preparedness, culture, costs and external barriers have great affect on implementation and success. A prioritization system is therefore essential.

A. Strategic value (high=10) Is it of national or regional importance? Is it directly influenced by national policies? Does it have a direct impact on reducing urban challenges?

B. Feasibility (high=5) How mature are the existing tools and solutions? Do they need substantial regulation? Might there be cultural or political resistance? Can it be done without unique skills? Can it be done within the existing public mindset?

C. Implementation (high=5) Can the project achieve success in the short term? Can it be rolled out fast? Is it a long-term project?

D. Finance (high=5) Is it costly to promote? Can it be achieved through direct private or joint public-private initiatives? Does it have a clear ROI? Can it be led by the local communities? Does it promote local business?

Considering that every city and town face unique challenges and opportunities and has different capacity levels, each local authority needs to set its own priorities. Using the prioritization list above, local authorities preparing their own smart city masterplan should choose initiatives from each of the three smart city pillars to ensure maximum value from the smart city process.



Workshop, Rwanda @ UN-Habitat

05

CONCLUSION

From Smart Rwanda to Smart Africa



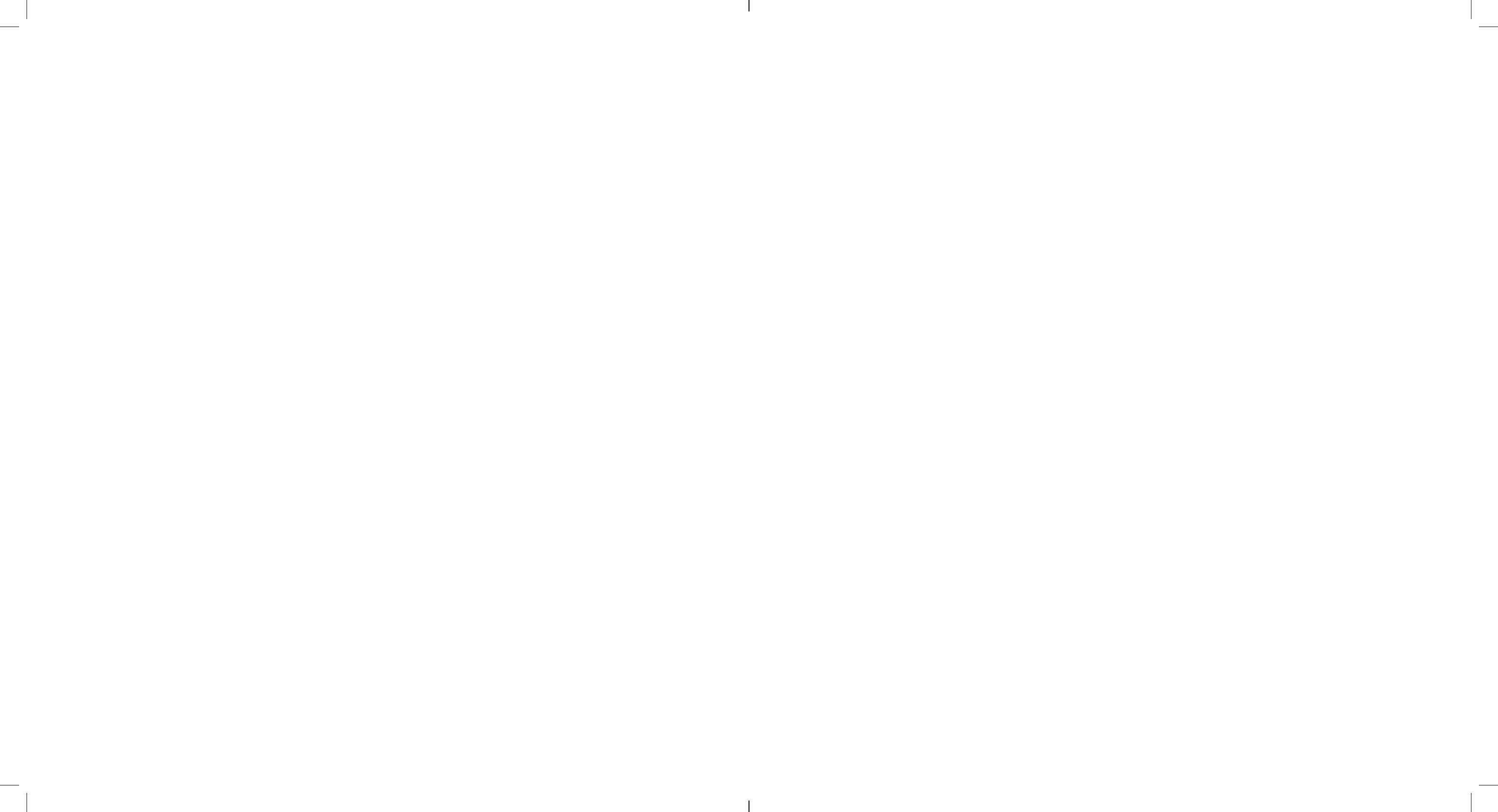
The Rwandan Smart City Masterplan is part of a wider vision for Africa, harnessing the ongoing twin processes of digital transformation and rapid urbanisation across the continent to make African cities more inclusive, safe, resilient and sustainable. Its starting point is that digital technologies, civic participation and innovation can enhance urbanisation processes to make urban areas better for citizens and businesses.

This Masterplan, the first of its sort in Africa, attempts to create a comprehensive smart city framework based on three smart city pillars, nine strategic building blocks and 27 action initiatives. The Plan recommends the implementation of technology solutions, data platforms, internet of things and smart grids, but also the further development of processes in urban planning, governance and finance. Considering Rwanda's status as a Least Developed Country, it also makes recommendations related to education, digital literacy, innovation and business development.

The Masterplan is not a "one-size-fits-all" plan, but call for evaluation, prioritisation and fine tuning to ensure that it meets the dynamic and changing nature of Rwandan towns and cities. The recommendations found in this document, along with the Smart Africa Alliance Smart and Sustainable Blueprint for Africa, can be used to provide guidance for future national and local smart city masterplans throughout the continent.

This document is not intended as a rigid and unalterable document, but as a dynamic plan - ever changing and adapting based on the results of each pilot project, one city at a time, and as Rwandan and African cities develop and evaluate their own smart city masterplans. The initiatives that have been recommended will be fine-tuned and changed as evaluations are done, new datasets are established and technology develops. The best way to stay smart is to learn and adjust to the times based on the needs of present and future generations.

Rwanda © Kyle Taylor



The transformation of Rwanda from an agrarian economy into a knowledge-based society is taking place in the context of two of the biggest drivers of change in the 21st century — rapid urbanisation and the increased application of digital technologies in all sectors of society. To meet these challenges, and take advantage of the opportunities of the digital world, Rwandan society is being transformed. Citizens are increasingly moving to towns and cities, acquiring new skills and demanding better services. Cities are growing and require better planning, governance and new financing.

Smart cities, in which leaders and citizens use data, information and knowledge to ensure a co-created resilient and sustainable future, can play a large role in the transformation of Rwanda. By ensuring inclusive data-led management and planning, efficient community-based infrastructure and services and localized and shared innovation, cities can be drivers for economic development and sustainable development.

This Smart City Masterplan is intended as a guide to help Mayors and urban managers go through the process of developing their own smart city strategies and masterplans, as well as providing a strategy for the government to promote the development of smart cities in Rwanda on a national level.

