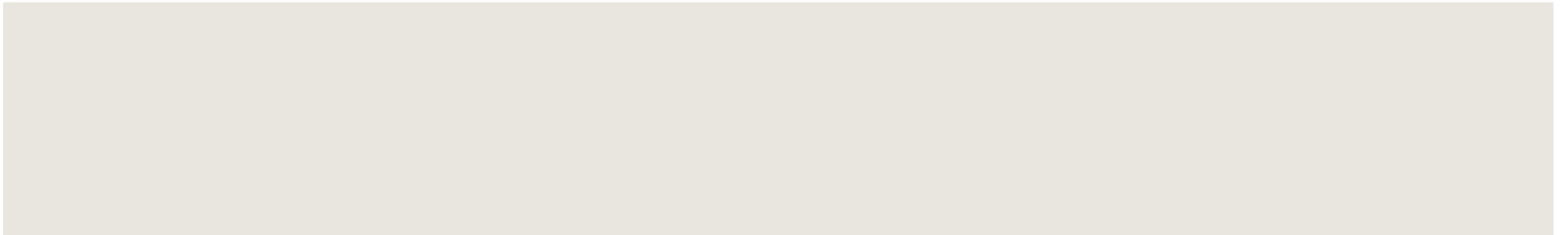


*Inclusive growth in a digital world:
Opportunities and Solutions*

Internal Briefing, DFID December 2018

*The fourth industrial
revolution*



Digital and the fourth industrial revolution

New market interactions

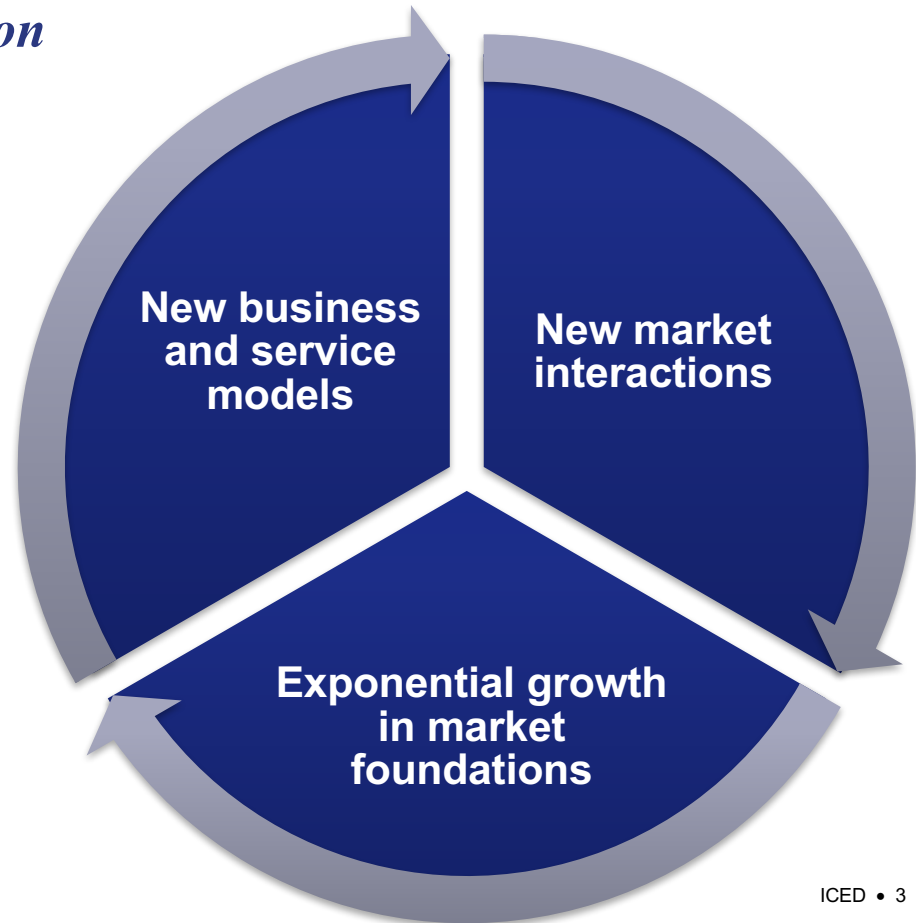
- Capital (not labour) based markets
- Cognitive surplus
- New forms of finance
- Peer-to-peer markets

Exponential growth in market foundations

- New technologies
- Faster connectivity
- Exponential growth in uptake

New business and service models

- Excess capacity utilisation
- Disruptive innovation
- Gig economy



Inclusive prosperity in a digital world

Digital exacerbates challenges

- Increases existing demographic challenges such as women's access, youth unemployment, digital divides and economic inequality
- Governments find they are surprised by new market entrants, such as Uber
- Underlying cause of problems aren't solved, such as access to natural resources, water, or basic education

Digital enables solutions

- Increase productivity by overcoming information asymmetry
- Raise revenue faster, more easily
- Provide faster access to basic services such as bank accounts, governance, infra services
- Close gaps in revenue collection from urban services to reinvest in future services
- Provide data security for private sector service innovation
- Engage citizens in decision making

Trade offs



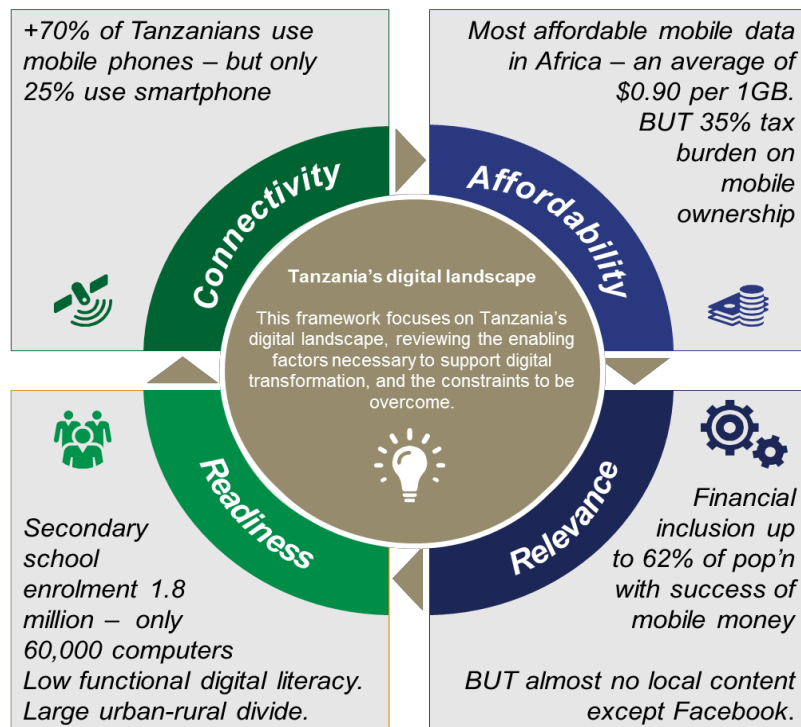
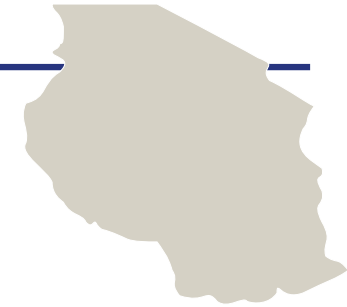
Case Studies



Case Studies

Digital economy
benchmarking in Tanzania

Case Study: Digital economy benchmarking in Tanzania



Skills and productivity

- Significant digital skills gap – need for education and training
- Low levels of innovation – need for greater ecosystem support

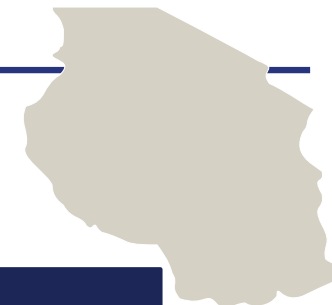
Adding value

- Digital services for SMEs and informal sector (marketing, finance, access to information)
- Value addition in traditional sectors
- Growing consumer markets

Creating new markets

- Potential ITES / BPO
- Strong market and need for local content creation
- Potential for digital products and service innovation

Benchmarking existing digital services



Transport

- Dar BRT leading innovation in TZ transport sector with **electronic ticketing**, bus-tracking system.
- Digital use in **traffic management** nascent; initiatives include CCTV traffic monitoring in Arusha, vehicle jam-sensing traffic lights in Dar.
- Uber and local Twende entered **on-demand transport** space.
- Opportunity for more real-time customer-facing transport information and **data-sharing** among transport providers.

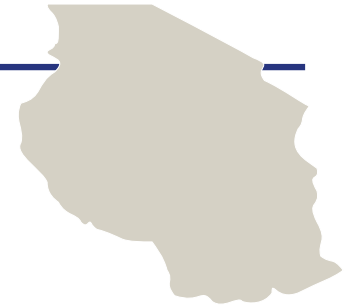
Energy

- LUKU **prepaid electricity metres** since 1997, further plans by TANESCO to automate, track customer data and load rates at power stations.
- **GIS mapping** used to assess potential for renewables, incl. wind and solar; more public info made available via Ministry of Energy's Mini-grid Information Portal.
- Opportunity to consider more **off-grid** (solar) energy services for peri-urban dwellers based on pay-as-you-go mobile subscriptions, now main focus rural Tanzania.

WASH

- Water utilities around country introduced **prepaid water meters** similar to LUKU to improve revenue collection and curb theft.
- **Digitally-enabled water services** piloted in Zanzibar to increase information on the state of water and sanitation services and improve citizen-interaction.
- Opportunity to utilise more **digital solutions in solid waste management** and recycling, e.g. for informal plastic collectors to find jobs – current use limited to low-tech mobile reporting systems.

Opportunities for new digital services: Governance



Cities for citizens

- Accessing info on local services
- Designing new services for citizens
- Supporting gov-citizen engagement

Supporting decision making

- Big data for decision making
- Service Design
- Open data and data demand

Managing Investments

- Improving procurement
- Enabling PPP design / management
- Asset management & O&M planning

Case Studies

Whitepaper: Urbanisation in
a digital world

Urbanisation in a digital world

Cities face a range of challenges / opportunities...

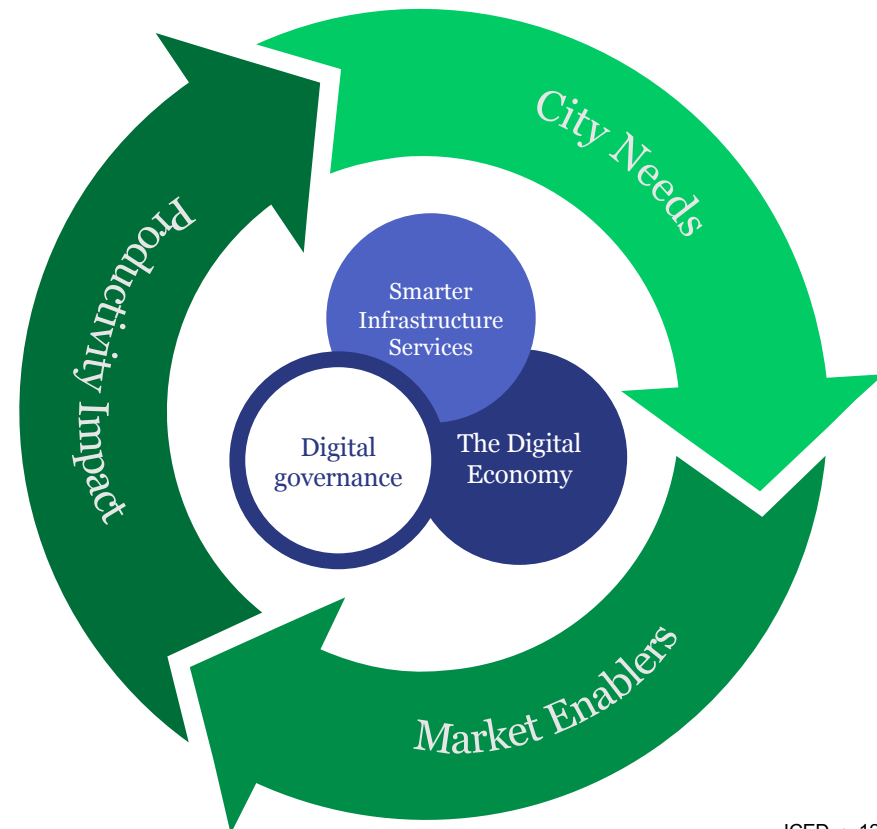
- Promoting economic productivity
- Managing resource utilisation (energy, water)
- Representation and inclusion of citizens
- Improving quality of life (congestion, pollution)

Urban Markets enable....

- Create demand for new services
- Support skills and training
- Support innovation ecosystems and R&D
- Increase access to finance
- Offer new digital market services

New digital solutions facilitate improved productivity via...

- Reduced costs of urban service delivery
- Productivity gains in existing sectors
- Job creation in new markets
- Engagement and included citizenry
- Efficient and effective government



Urban Infrastructure – The business case for smart infrastructure



€1.56bn: Average value of cumulative return – direct + indirect benefits – from smart energy measures across 5 cities

4x: Average return on investment (ROI) from energy measures across 5 cities

\$4.2bn : Cumulative benefits from smart building investments

14x: Average ROI from building efficiency across 3 cities



20 GWh: Average annual energy savings from smart street lighting

€110 million: Average net direct benefit from smart street lighting

32x: Average ROI on smart camera/lighting/security investments by avoiding economic costs of crime and policing



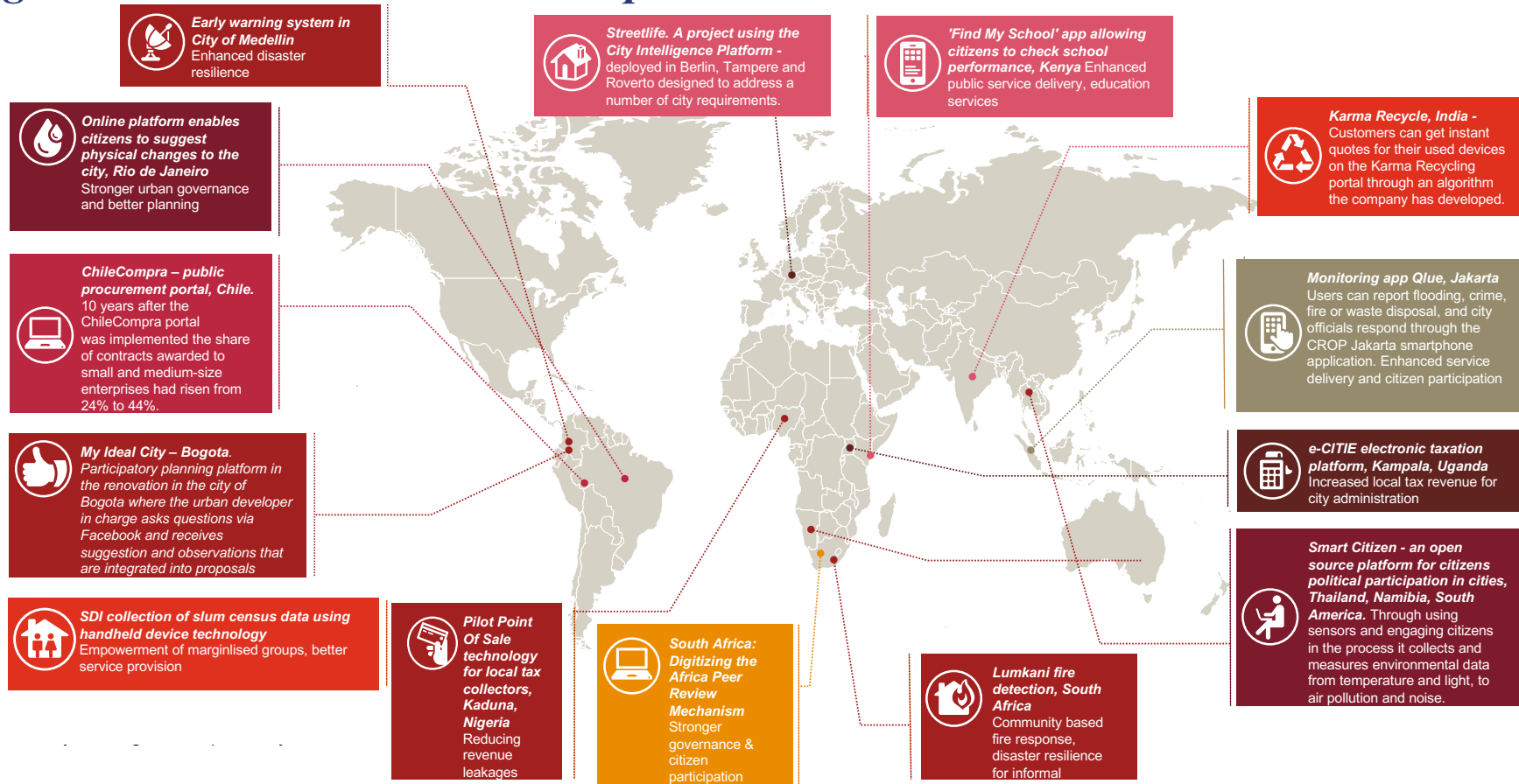
€566m: Average value of total cumulative return from smart transport systems across 4 cities

74% of the benefits from transport measures come through reducing delays and time savings

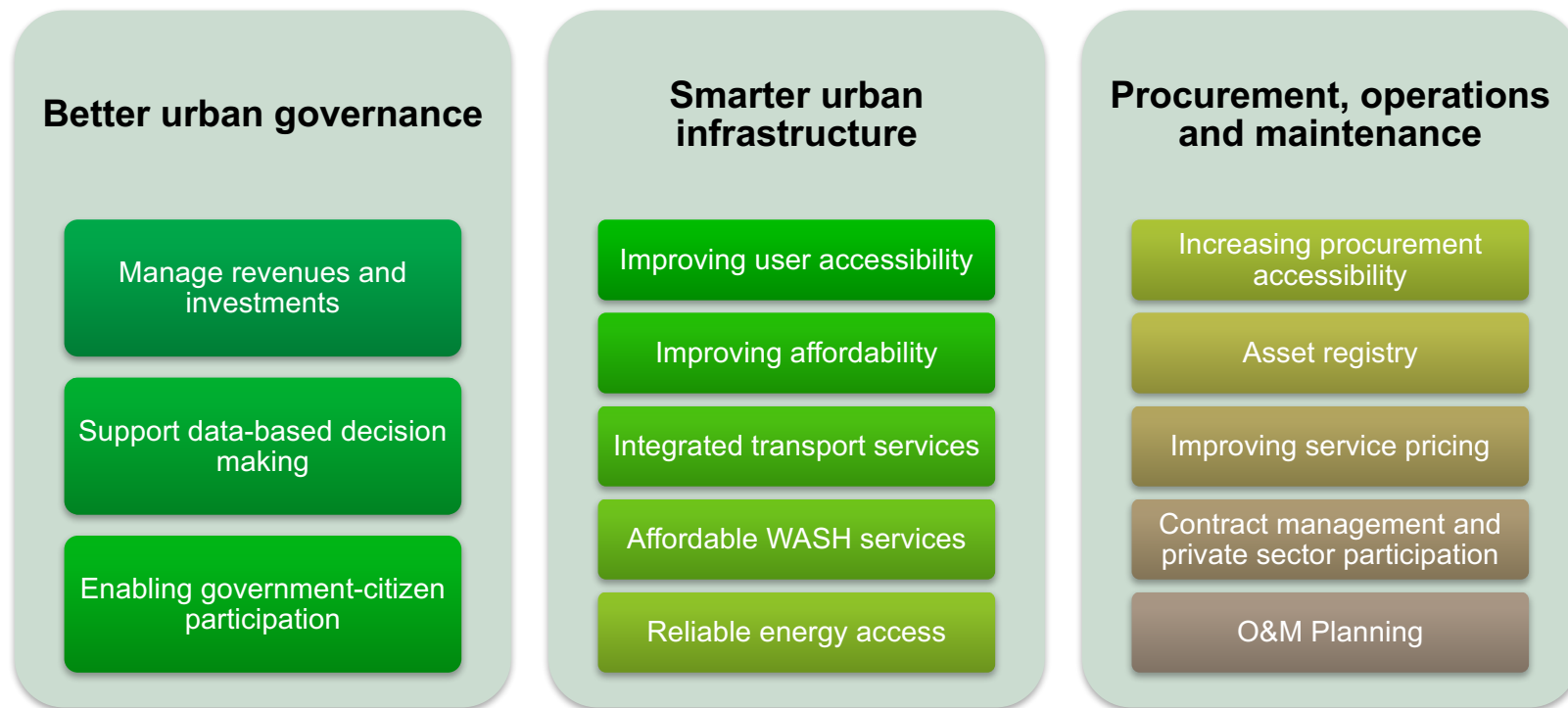
7 years: Average payback time on investment in smart on-street parking



Digital Governance and Citizenship Solutions in action



Opportunities



Case Studies

Inclusive Smart City design
in Krygyzstan



Case Study: Policy-based approach for Inclusive Smart Cities in Kyrgyzstan

Bishkek 2020 Projects

- Municipal library revitalisation, e-queue for schools, increasing targeted social assistance

Catalytic initiatives

- 6.1 'Smart Cities for All' trailblazer
- 6.2 Digital Skills Training
- 6.3 On-demand disabled transport

Bishkek 2020 Projects

- E-trading system; PPPs; budget and revenue optimisation

Catalytic initiatives

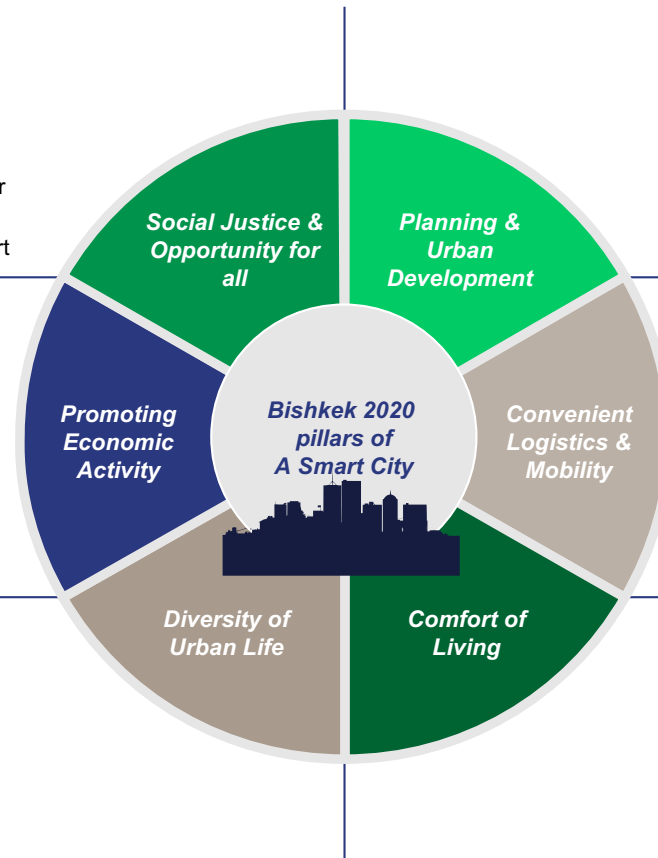
- 5.1 Smart Economic Plan
- 5.2 Open Budget
- 5.3 E-business window
- 5.4 E-Investment promotion
- 5.5 Smart City Lab

Bishkek 2020 Projects

- Promote cultural revival with support of modern technologies and infrastructure

Catalytic initiatives

- 4.1 Smart Tourism
- 4.2 The inclusive city



Bishkek 2020 Projects

- Developing Bishkek's planning frameworks and spaces with technology

Catalytic initiatives

- 1.1 Spatial plan for Bishkek
- 1.2 'Smart' Municipal policy
- 1.3 e-building control
- 1.4 Smart City Implementation Support

Bishkek 2020 Projects

- Route optimisation, smart traffic management, e-tickets, smart parking, fleet renewal

Catalytic initiatives

- 2.1 Integrated transport plan
- 2.2 Transport sector co-ordination group
- 2.3 Providing transport information

Bishkek 2020 Projects

- Smart street lighting, water meters, single payment window, major repairs/upgrades

Catalytic initiatives

- 3.1 Payment window co-design
- 3.2 Publishing GIS data
- 3.3 Smart lighting and buildings
- 3.4 Smarter operations and maintenance

Case Studies

Digital Innovation and the
Built Environment in Low
Income Countries (LICs)

Objectives

Better understand
the potential
economic
development and
poverty reduction
benefits

Examine the
barriers that hinder
adoption

Identify
implementation
opportunities for
DFID programmes

Methodology

Literature review of
academic papers and
industry reports

Semi structured
interviews with built
environment
professionals and
researchers working
in LICs

Survey distributed to
several communities
of practice (e.g.
DFID, ALNAP, ICE)

Context / Why is this important?

Potential benefits

– economic, social and environmental

Slow adoption in AEC industry

- low productivity

Leave no-one behind

– global digital divide

Leapfrog opportunities

– avoid mistakes

Path dependencies

- unsustainable

Technologies reduce total project life-cycle costs by almost

20%

World Economic Forum, 2016

Internet users as proportion of population

LICs*	7.3 %	→	8.4 %
	2014		2016
Globally	45.5 %	→	48.1 %

InternetLiveStats, 2016 (* no data available for Democratic People's Republic of Korea)

Mobile money account as % of adult population

LICs	9.9 %	→	17.6 %
	2014		2018
Globally	2.1 %	→	4.4 %

World Bank, 2018

Average annual global labour productivity growth

1.0%

Construction

2.8%

Total world economy

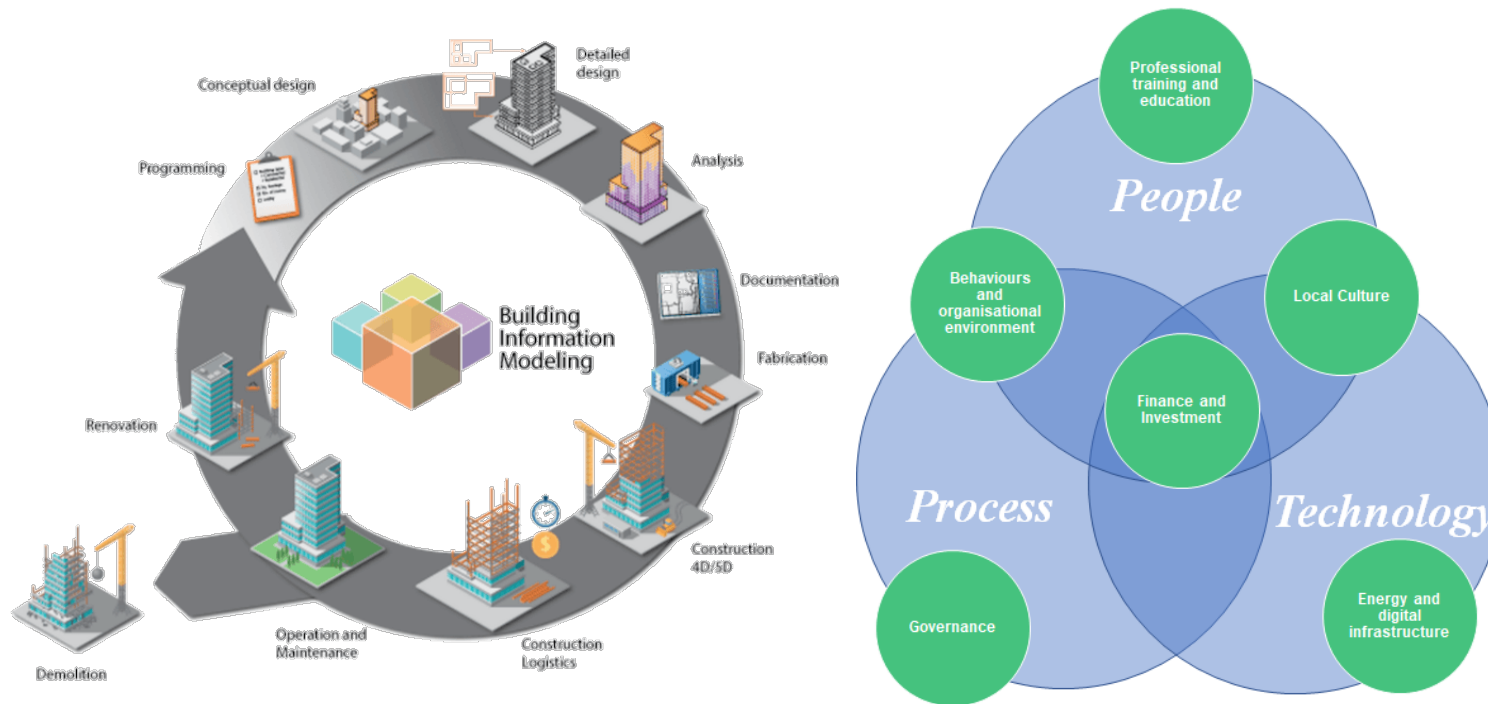
3.6%

Manufacturing

over the last 20 years

McKinsey, 2017

Project Cycle & Enabling Environment



13 July 2017

Enabling Environment

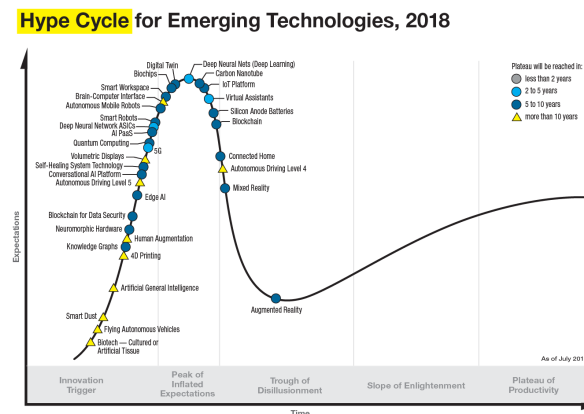
Innovation Enabler	Definition	How this enables digital innovation in LICs?	Enabler Readiness	Constraints to the innovation enabler
Energy and Digital Infrastructure	The network of energy and digital communications infrastructure needed for use of digital technologies.	Enables digital technologies to be used. Continuous connection supports productivity. Improving infrastructure can often increase the impact. For example, evidence suggests greater productivity and economic growth can be achieved by substituting basic mobile services with advanced 3G connections (GSMA, 2012).	High	<ul style="list-style-type: none"> Dependant on geography - Some LICs may be located close to strategic economic areas (e.g. the 'Digital Silk Road' or strong links to higher income countries for example through intergovernmental and trade organisations like the East African Community). Investment - Local infrastructure investment needed. Requires asset management - Digital resilience should be considered as the result of combining digital and physical infrastructure leads to growing interdependence. Consideration of independent energy sources (e.g. solar energy) should be considered.
Governance	Establishment of policies and appropriate authority for managing digital assets.	Encourages local innovation. Moving beyond creating short-term visions and establishing projects that empower people on the long-term is needed to enable sustained digital innovation.	Med	<ul style="list-style-type: none"> Dominance of international organisations - If not carefully managed, the dominance of international organisations in some LICs can undermine governance to develop local innovation in the built environment. Relationship between governments and firms - According to Fu et al. (2014) although firms in LICs are innovative and government is regarded as important innovation partner, they go largely unsupported. On the one hand firms have scarce knowledge of policy instruments in place, on the other hand innovations are rarely recognised and innovation efforts within the firms are not properly underpinned.
Local culture	Local context and way of life including customs and values.	Communicating with local communities on all levels on how such innovations will impact on their lives may make local people more open to changes, participate in their developments and help adaption of these technologies to local contexts.	n/a	<ul style="list-style-type: none"> Satisfaction with the status quo - [Many professionals are] satisfied with traditional methods to design their projects and are incredulous of the new functions and advantages (Yan & Damian, 2008). Digital divide - the unequal distribution of who has access in the built environment of digital competences and skills are raising critical questions in the LICs. Access and implementation to new innovations has been seen between i) local and foreign firms and ii) projects based on their scale. Perception that it is expensive - There is a lack of client demand as there is a perception that digital innovation is too costly.
Professional Education and Training	Skills and training in the built environment	Skills and training in digital innovation in the built environment is a key enabler and helps support understanding and enables behaviour and organisational change.	Med	<ul style="list-style-type: none"> Tiered construction industries - Many LICs run small but tiered construction industries – as such there is a wide range of skill and technology. Appropriate knowledge materials – There is a lack of appropriate education materials (Affleck & Freeman, 2010). However, digital knowledge products (e.g. Massive Online Open Courses) could help develop this area. Lack of national experience retention was also mentioned as being an issue. 'A lot of those using tech will be expats/contractors', so therefore it is difficult for expertise/knowledge to remain in situ. Networks for knowledge dissemination - Need for centres for higher education and local institutions to help disseminate knowledge.
Behaviours and organisational environment	Values and activities possessed and typically undertaken by a group	Willingness to try new tools and processes will help change processes and support adoption of digital innovation.	Low	<ul style="list-style-type: none"> Professionalism - A lack of professional standards and responsibility in engineering consultancy firms makes innovation difficult to achieve. Evidence - Clear evidence required to educate the benefits to all parties in the production chain. Requires a system that rewards and enables appropriate behaviour to change across industry and client bodies. Need for major projects - Major infrastructure and building projects are more appropriate incubators developing skills and innovation. At a smaller scale, this might be achieved if similar projects are grouped enabling collaboration to develop skills and innovation to flourish.
Finance and Investment		The application of innovations in the AEC sector will require a large investment capital at the start, despite evidence of long-term savings.	Med	<ul style="list-style-type: none"> Access to capital - A 'lack of access to credit, as well as market constraints, are the main challenges firms face when adapting knowledge and innovations' (Fu et al. 2014)

Note: Readiness - Low - Little evidence of development in the 'enabler' in LICs **Med** - Some evidence of the 'enabler' already being achieved in LICs **High** - Widespread adoption of the 'enabler' already in LICs

13 July 2017

Profiled Innovations

1. Digital communication technology
2. Computer Aided Design (CAD) and modelling
3. Imagery – including drones and Unmanned Aerial Vehicles (UAVs)
4. Management Information Systems (MIS) and tools
5. Internet of Things (IoT) and big data
6. Modular construction
7. 3D/4D printing
8. Virtual/Augmented Reality (VR/AR)
9. Distributed Ledgers and Blockchain
10. Artificial Intelligence and Machine Learning (AI/ML)



Benefits

 Career progression

 Community engagement

 Efficient data collection

 Energy efficiency

 Flexibility

 Hazards identification

 Improved communication

 Improved ecosystems

 Improved information management

 Improved quality control

 Informed decision making

 Investment opportunity

 Outcomes measured

 Productivity

 Reduced waste

 Transparency

ENVIRONMENTAL

SOCIAL

ECONOMIC

Analysis

Technology	Stage					Benefits - High Medium Low	Constraints - Low Medium High	Readiness	
	High	Medium	Low						
3D/4D printing	P	D	C	O	E		Time-to-market Flexibility Immediate community engagement	Cost Infrastructure required Scale of fabrication	Near Future
Artificial Intelligence and Machine Learning (AI/ML)	P	D	C	O	E		Higher accuracy Integrated information system	Energy/ e-technology infrastructure Processing power Policy/governance	Long term
Blockchain	P	D	C	O	E		Transparency Data Security	Resources/Cost/Energy-use	Long term
Computer Aided Design (CAD) and modelling	P	D	C	O	E		Higher accuracy, reduced coordination Improve construction safety Greater participation/inclusion More cost and schedule certainty	Training IT licenses Interoperability Poor physical environment understanding E-technology infrastructure	Immediate
Digital communication technology	P	D	C	O	E		Supports integrated information systems Increases productivity and collaboration Community engagement – particularly with marginalised groups/ people with disabilities	Widely available but lack of e-technology infrastructure in some locations	Immediate
Imagery – including drones and Unmanned Aerial Vehicles (UAVs)	P	D	C	O	E		Inexpensive (source dependant) Retrospective or real-time Evidence-base Accessibility – can be used in remote areas	Cost (source dependant) Equipment Policy/governance Modelling integration	Immediate
Internet of Things (IoT) and big data	P	D	C	O	E		Rapid evidence based Scale Inclusion/ community engagement	E-technology infrastructure Policy/governance Processing power	Immediate
Management Information Systems (MIS) and tools	P	D	C	O	E		Integrated information system - reduce delays & mistakes, lowering project risk Low barrier to entry Reduce waste	Organisational/ behaviour challenge Energy/ e-technology infrastructure	Immediate
Modular construction	P	D	C	O	E		Safety Reduced waste Quality control and speed of construction	Local supply chain Poor transportation Poor physical environment understanding	Near Future
Virtual/ Augmented Reality (VR/AR)	P	D	C	O	E		Safety Reduce mistakes Maintenance Community engagement	Modelling integration Equipment	Near Future

Note: P=Planning, D=Design, C= Construction, O=Operation & Maintenance, E=Evaluation & Monitoring.

Readiness - Long-term - Little evidence of use in LICs. Near Future - Some evidence of the technology already being used in LICs. Immediate - Widespread adoption already in LICs.

Benefits - High rating given to innovations with a wider variety benefits **Constraints** – Low rating given to technologies with evidence to show the constraints are not a major barrier to adoption.

13 July 2017

Recommendations

Computer Aided Design (CAD) and modelling;
Imagery – including drones and Unmanned Aerial Vehicles (UAVs);
Management Information Systems (MIS) and tools;

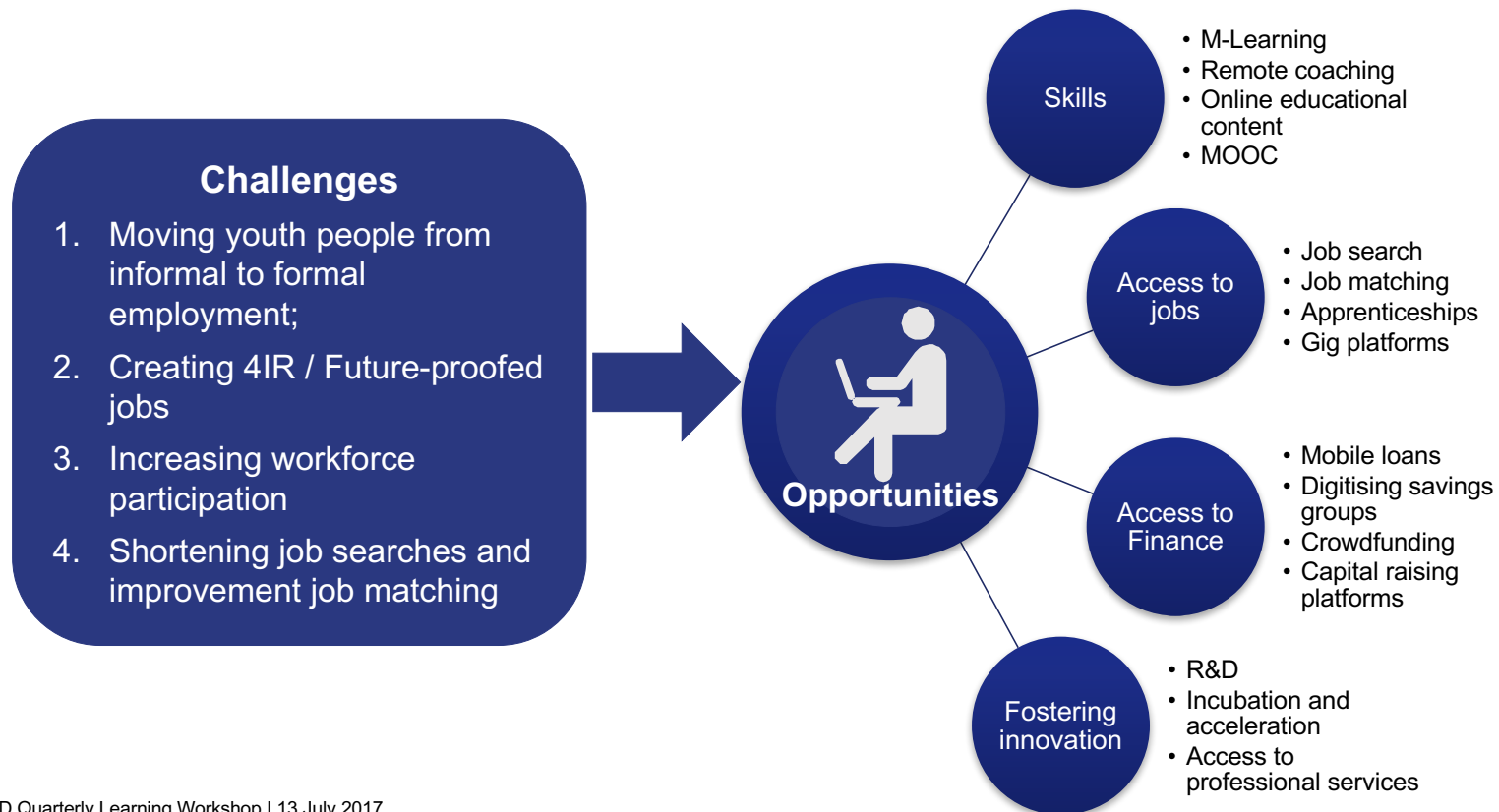
3D/4D printing;
Virtual/Augmented Reality (VR/AR);
Distributed Ledgers and Blockchain;
Artificial Intelligence and Machine Learning (AI/ML);

Modular construction

Case Studies

Youth Employment: Digital
solutions review

Case Study: Reviewing evidence base for digital solutions to youth unemployment



*Inclusive Prosperity in a
Digital World*

Opportunities for HMG

Opportunities for HMG



ICED Support

Programme scoping

- Poverty / vulnerability assessments
- Evidence reviews
- Digital readiness assessments
- Local scoping
- Business case design support
- ICED Learning sessions

ICED Tools

- Digital country benchmarking tools
- Urbanisation in a digital world report
- Frontier technology matrix
- ICED Gender, Disability and Inclusion Framework
- ICED Online Library (icedfacility.org)

Disclaimer

Infrastructure and Cities for Economic Development ("ICED") is a project funded by the UK's Department for International Development ("DFID") and is led and administered by PricewaterhouseCoopers LLP, working with organisations including Adam Smith International, Arup, Engineers Against Poverty, International Institute for Environment and Development, MDY Legal and Social Development Direct.

This document has been prepared only for DFID in accordance with the terms agreed with DFID and for no other purpose. PricewaterhouseCoopers LLP and the other entities delivering ICED (as listed above) accept no liability to anyone else in connection with this document.

[160805-092353-KK-UK]