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Digital solutions for smarter urban infrastructure

Tags: Economic Growth, Programme Design, Digital, Urban, Infrastructure



Digital solutions are our route to better service models and better data in almost all forms of infrastructure. The affordable collection of data is having a transformative effect on modelling everything from water systems maintenance, to revenue and passenger flows in public transport, in turn enabling the design and delivery of services that are accessible for all.

However, for such opportunities to enable inclusive growth and poverty reduction, governments and donors need to: Promote open data to support design and delivery of infrastructure services; Improve inter-actor co-ordination of data collection in the urban environment; Support the use of open technology platforms that ensure long term sustainability and innovation; Support the transfer of proven technology and service models from other utilities and sectors; Provide a conducive enabling environment for new infrastructure service models; and balance financial support for new models with technical assistance to market development.

This paper therefore sets out the key challenges that digital solutions could address, provides a skeleton theory of change for how digital solutions can address the challenge of poor urban infrastructure, and then explores the four key opportunities that developing country governments and donors must consider if they wish to make their urban areas centres of inclusive and sustained economic growth. **A wide range of papers on how digital solutions catalyse inclusive urban growth can be found on the [ICED website](#).**

Poor provision of infrastructure services is constraining urban economic growth, and the ability of poor urban dwellers to run households, access work and run productive businesses. Slums are home to 880 million people, 25% without access to electricity or sanitation. Many urban dwellers spend 30-50% of their income on transport which prevents households and SMEs from increasing productivity. Poor energy supply alone is cited by 92% and 87% of businesses in Islamabad and Punjab¹ as their largest barrier, and is estimated to drag down African GDP growth by 1-3%. Costs of premature deaths from air pollution, unsafe water and sanitation in Africa are estimated at \$854 billion². In India, not only does traffic cause 150,000 deaths annually, but hours of time spent in traffic compounds productivity losses. Powering transportation vehicles also drains economic resources using 80% of fuel imported in 2015-16.³

Digital solutions have a significant role in addressing these challenges. Whilst these challenges cannot be solved with digital solutions alone, data and digital technologies can enable the more efficient planning of infrastructure to meet the needs of the poor. Solutions can enable new infrastructure service delivery models, reduce investment needs, and make services more affordable and accessible to citizens and businesses. In addition they can also enable better use of resources, fixed assets or sharing of private infrastructure, such as taxis or buildings for co-working and examples of such solutions are outlined in this chapter. For infrastructure in particular, the rewards of digitally enabled solutions in emerging countries are beginning to be analysed by the private sector, governments and development specialists, and are increasingly recognized by the public sector in tenders for new infrastructure. For instance, in 'smart' LED street lighting procurement⁴. It is often once projects are tendered that the private sector will be able to engage and provide expertise, which puts the onus on governments, development banks, donor or

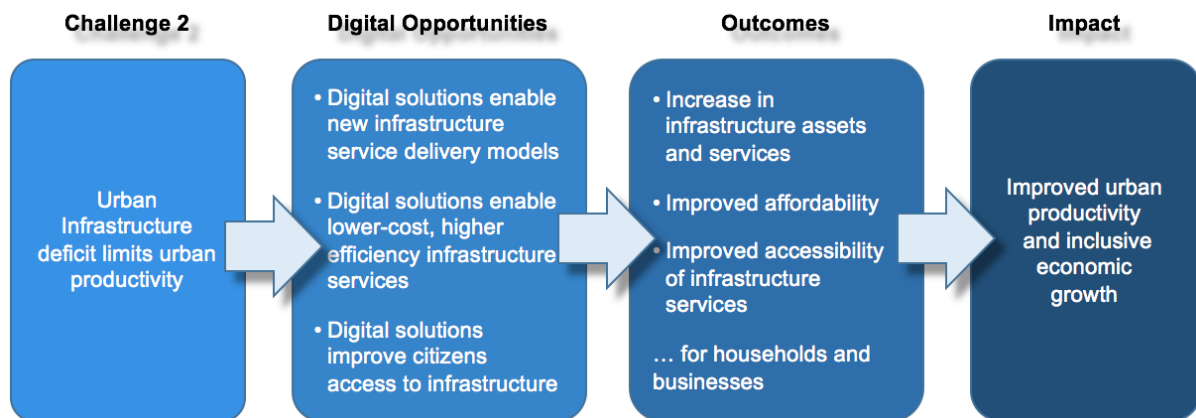
¹ World Bank Enterprise Survey 2013, Pakistan

² OECD, Economic Outlook 2016: Sustainable Cities and Structural Transformation

³ India Leaps Ahead, Transformative Mobility Solutions For All, NITI and RMI, May 2017

⁴ <https://economictimes.indiatimes.com/industry/energy/power/indias-smart-street-lighting-market-to-touch-1-8-bn-by-2022/articleshow/53196644.cms>

philanthropic organisations to increase capacity for cities to evaluate options for infrastructure and services that include 'digital' in the mix.



Opportunity 1: Efficient integrated transport services

Digital transport solutions can enable the planning of services with the poorest in mind, and improve the accessibility and interoperability of services. Perhaps the most visible benefits of data utilisation in a city are the mobility apps and smart cards. Smart transport cards are now in use across many major cities, and enable poor transport users to undertake complex journeys for a single integrated (cheaper) fair, and to transfer between transport modes more quickly. Transport apps are less prevalent in developing countries, but have the potential to enable users to more seamlessly navigate their transport systems and to improve transit safety for vulnerable users. Apps can be developed either by public entities, or if public agencies share data then local tech entrepreneurs have been shown to be highly capable of developing revenue generating apps which offer citizens timely access to journey information.

Behind this, better use of data to design and manage complex services, integrating and adapting transport systems to meet the needs of the poorest is increasingly viable. The Digital Matatus project in Kenya used people's mobile phones to track informal matatu (privately owned minibuses) routes. The data was then used to design formal services routes and schedules that would meet the need of the city's poorest transport users, particularly benefitting women who tend to rely on paratransit solutions.

Digital is also enabling on-demand transit – or mobility as a service – through services such as Uber and other local services. Some start ups such as SafeMoto, Rwanda are also using ride hailing technology to solve transport challenges that disproportionately affect the poor, with SafeMoto providing a motorbike ride hailing app which also tracks the behaviour of its drivers to ensure its customers get a safe ride. Similar ride hailing schemes for the disabled are in place in higher income countries and could be replicated.

Governments and donors have significant roles to play in delivering smarter transport for all. Governments can work to ensure data used to design, and resulting from, transport services is made accessible via open data, enabling the design of new transport services and information for consumers. Governments must also ensure that 'smart' control systems used in cities use open platforms enabling future innovation and service expansion. Donors, as major funders of transport infrastructure in the developing world must then commit to better donor co-ordination around data gathering, analysis and service design if countries are to truly benefit from their support, and avoid the significant levels of data duplication and incompatibility seen today, which presents extremely poor value for money for both donors and their recipients.

SafeMotos: Using Human Centred design to create safer transport⁵

Road accidents are the second biggest killer in Africa after HIV/AIDS, and in Rwanda 80% of accidents involve the motorcycles relied upon by poor city dwellers. The SafeMoto app enables motorbike ride hailing app, but also records driver's speed, acceleration, GPS and gyroscope information and customer feedback and drivers must maintain a rating of over 90%. The app was designed with both drivers and riders in mind – SafeMotos found that most drivers couldn't read apps so developed a bespoke landmark-based navigation system. The founders see their dedication to human-centred, and locally-oriented design at the heart of their success, and the app has delivered 120,000 rides to date⁶.

Transforming India's transport nightmare into an economic opportunity

India's mobility challenge is daunting. Nearly 50,000 new vehicles are registered daily. 80% of fuel is imported, and traffic causes 150,000 deaths annually. But NITI's (National Institute of Transforming India) recent report sets out how shared mobility and digitally 'connected' transport systems could save 64% of energy demand, yield economic, environmental and social benefits and enable India to leapfrog to a new mobility paradigm⁷. Key opportunity areas include: Mobility as a Service; Interoperable transport data; Mobility oriented development; Vehicle-grid integration; Product manufacturing and electric vehicle deployment. Whilst some opportunities may be decades away for the most fragile countries, mobility as a service and interoperable transport data are being trialed in Africa's larger economies⁸, and trailblazers such as Ethiopia have demonstrated that mobility-oriented development is possible.

The potential to leapfrog to digitally-enabled next generation transport services is therefore possible, and would yield huge inclusive growth benefits if governments are willing to take on the challenge. Though many innovations may be developed by private sector entities, city governments can be part of the solution by supporting foundational digital skills and access, supporting city infrastructure upgrades, and engaging with private sector on apps and shared mobility solutions to ensure these more 'disruptive' solutions continue to improve social outcomes such as reducing pollution, increasing safety and ensuring productive jobs.

Smarter Transport on the horizon in Dar es Salaam, Tanzania

Supported through a mix of donor and private sector funding through a PPP, the BRT in Dar es Salaam is a forerunner in digital service delivery. It is already using an intelligent transportation system (ITS), an automated fare collection system (AFCS) and traffic control for its 140 buses, supporting live tracking of buses, route planning and scheduling. Some 75% of the BRT drivers are former local bus, i.e. daladala, drivers who have been trained up in the use of ICT systems as well as of the new, bigger bus platforms. Amid network expansion plans, improvements are still required in the BRT passenger information system and in broader traffic information sharing among operators in Tanzania's commercial capital. Other examples of digital solutions being rolled out in Tanzania include CCTV traffic monitoring in Arusha and vehicle jam-sensing traffic lights in Dar es Salaam, while Uber and local competitor Twende provide on-demand transport. Tanzania is also exploring the opportunity for more real-time customer-facing transport information and data-sharing among transport providers.

Opportunity 2: Securing reliable energy access

Digital energy solutions can enable new service models and improve the efficiency and connectivity of grids. Smart energy needs differ dramatically by country, and urban areas tend to be more connected

⁵ <http://www.huckmagazine.com/perspectives/reportage-2/safemotos-rwanda-tech-startup-taking-africas-second-biggest-killer/>.

⁶ www.safemotos.com

⁷ India Leaps Ahead, Transformative Mobility Solutions For All, NITI and RMI, May 2017

⁸ Examples include Nairobi's digital Matatu project, evolving smart transport solutions in Dar and the success of EasyTaxi and Uber in Lagos.

than rural. For instance, fossil fuels comprised over 52% of Ghana's total energy consumption in 2014. Access to energy has doubled in 20 years to 2014 so that over 70% of the population is connected. In contrast to Ghana, average national electricity access in Tanzania is 15%, but just 4% in rural areas. In India, overall access is near 80%, or 70% in rural areas. What the statistics hide are the emerging initiatives by the private sector to provide access to energy directly to consumers, through a range of services from pay-as-you-go home solar services, to more continuous access provided by microgrids. Digital plays a crucial role in energy access, mainly through digital payment and distribution systems and new off or on-grid energy monitoring and management.

Government and donors have significant roles to play in providing a conducive enabling environment for new service models - regulations in many countries, for instance, prevent energy sales between 'peers' rather than via a licensed electricity supplier, which would prevent some of the new blockchain-enabled business models. Where private companies do find a way around regulation, as seen with shared taxis, governments may need to respond to the innovation rapidly. Donors then need to tread a fine balance between subsidising radical new business models and creating market imbalances, by being cognizant of the tipping point at which business models become self-sustaining, and tailing off subsidies accordingly.

Ecoligo rolls out digital energy for businesses in Ghana

Ecoligo, founded in 2016, finances and operates solar projects for industrial and commercial customers, managing all financial transactions, asset management, operation, maintenance and administrative measures through its fully digital, 4G connected platform to ensure a safe and reliable operation of the PV plant to its customers. Beyond the intended business case of resolving brownouts and increasing reliability of power on site, installing their solution yields 10-15% efficiency savings alone, as tracking software enables the customer to measure the energy they buy from the utility.

'Smarter' digitally-enabled infrastructure solutions offer value for money

Installing smart meters in 75% of Lima-Callao residences cost \$60 million, and paid back in energy savings within one and half years. Industrial sites paid back the cost of smart meter installations in just a few months. In Kolkata, the most cost effective investment the city could make to save carbon emissions is 'smart' parking demand management⁹ due to its strong revenue raising capacity, ranking higher than purely infrastructure solutions such as automobile energy efficiency standards, industrial waste heat recovery or solar PV installations. Opportunities are therefore diverse, and this is an area where innovation is rapid, with ever more opportunities for forward thinking emerging economies to leapfrog to new solutions, such as pay-as-you-go home energy systems leapfrogging large scale electric power grid infrastructure.

Street lighting catalyses internal investment in Lagos

Iyana Ipaja and Oke-Odo markets, situated in the largest local government in Lagos State, are home to 4,000 businesses, and are visited by >80,000 people each day. Lagos State Electricity Board (LSEB) and local stakeholders designed and implemented a market-wide lighting scheme which resulted in extension of market operating hours, over 16% increase in incomes for market traders and new jobs created by 1 in 7 MSMEs. Improved security in the marketplace particularly benefits women shoppers, who benefitted from more flexible shopping hours and safer markets and transport interchange.

Local energy trading improves urban resilience

Urban households and businesses in low-income countries spend significant proportions of their income on energy. If power can be generated and bought locally this income can remain in the local economy enabling re-investment and growth. A startup LO3 Energy has developed the Brooklyn Microgrid, making it possible to directly buy power from your neighbour and to 'island' the community off the grid during storms, like Hurricane Sandy, improving resilience. LO3's solution relies on a set of technology layers

⁹ Climatesmartcities.org The Economics of Low Carbon Cities: Kolkata, India 2017

including distributed ledger technology, blockchain, (the underpinning of crypto-currency Bitcoin), which allows for 'smart' verified contracts without the need for a utility or bank to settle the transaction.

'Smart' lighting investment enables multi-sectoral benefits

100 Smart Cities initiative has invested in a significant number of Smart Lighting services across India. Projects involve installation of LED lighting and smart controls on 'smart poles'. Revenues are generated by leasing space on poles to advertisers and telecoms, and cost-savings are accumulated due to energy efficiency. One important lesson noted however is the relative short lifespan of revenue models, as some wifi providers leasing space have become quickly displaced by improved 4g mobile services. It is therefore important to conceptualise adaptive business models for smart lighting projects to guarantee financial viability.

In Los Angeles, 80% of the 215,000 public street lights have been replaced with low energy LED lighting at a cost of £57 million, with an annual payback of £9 million. Because circuits have been upgraded, and lights consume less energy, the city has been able to install 30 new electric vehicle charging points. Working with mobile phone carriers, LA will replace 600 poles with 4G LTE (Long term evolution) wireless technology 'smart poles' that carriers lease from the city for \$1,000, improving mobile coverage. These early investments will enable the city to install solar panels on the smart poles, sell power back to the grid, and introduce smart parking and safety features for citizens.¹⁰ Not limited to developed countries, the Indian Smart City projects also include many smart lighting LED projects where revenue for the city comes partly from shared savings on consumption, and partly from smart poles with leased facilities for advertising and internet connectivity. Cities must be prepared for fast changing technology that quickly makes the system redundant, unless it is possible to replace the smart pole facility with mobile connectivity upgrades, for instance, from 3G to 4G.

Opportunity 3: Delivering affordable, reliable WASH services

Digital innovations are creating opportunities for more affordable water services, and are key to enabling private sector waste, water and sanitation services (WASH). Whilst the water sector has not seen the scale of innovation demonstrated in the energy sector, the pace of innovation in the sector has increased rapidly in the past 2-3 years. The sector is benefitting from the relative maturity of the smart energy metering market, with mobile operators introducing water metering and digitally enabled customer services in South Africa. Smart hydraulic modelling in Antofagasta, Chile, has enabled significant improvements in water delivery through detection of leakages. Digitally-enabled water services are being piloted in Zanzibar, Tanzania to increase information availability on water and sanitation services and to improve customer service. Meanwhile India is at the forefront of digitally enabled solid waste services with 'I Got Garbage', Let's Recycle and Karma Recycle alone employing over 6,000 workers and serving 26 cities across India. Governments and donors have the opportunity to embrace new ways of working in this traditionally slow-moving sector. Embracing technology transfer in the utilities space and promoting knowledge transfer around new PPP or private sector led models for solid waste management and sanitation services.

For more information on how digital solutions can catalyse inclusive urban growth, or support in programme design please consult the ICED website or contact the ICED Facility at connect@icedfacility.org

¹⁰ Need a more academic reference? <http://www.techrepublic.com/article/how-la-is-now-saving-9m-a-year-with-led-streetlights-and-converting-them-into-ev-charging-stations/>

Digital Infrastructure Solutions in action

