



**Women in Informal Employment
Globalizing and Organizing**

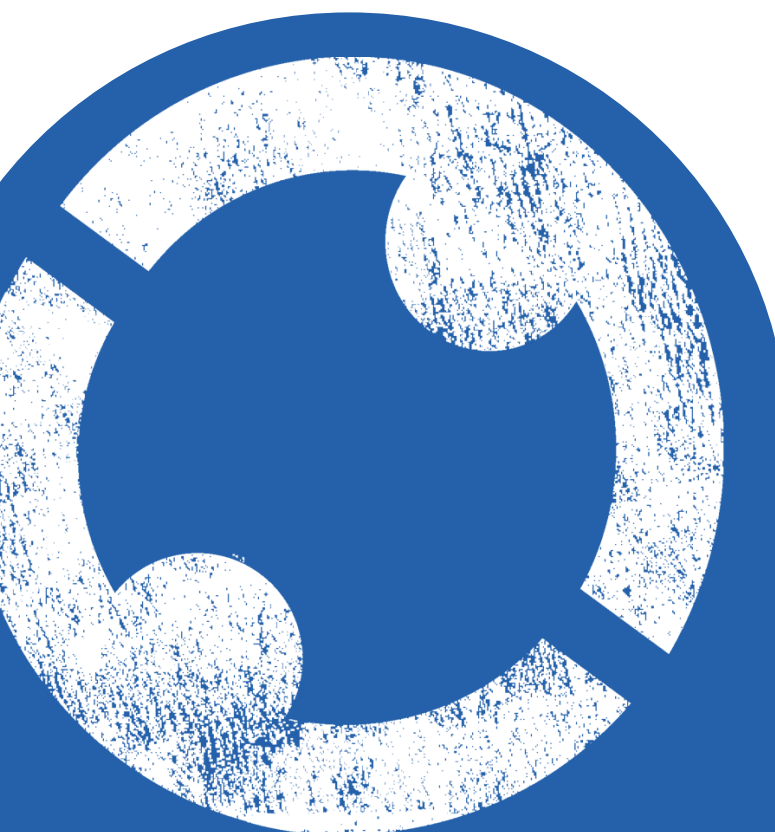
Literature Review

Technology and the Future of Work

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Practical Action

Technology Challenging Poverty

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1.1 Introduction

In cities across the globe, technologies are driving disruptions of informal and formal economies and shaping how workers interact with them. The disruptive impact of technologies is complex: it can be at once positive and negative, and will differ depending on a whole range of contextual factors. Through a year-long project, Practical Action and WIEGO will explore the characteristics of technologies, cities, work and economies that influence the disruptive impact of technologies on informal and formal economies. The Technology & Future of Work project will focus on how the working poor are able to mitigate the negative livelihood impacts of disruption, or harness technologies to create new work opportunities. It will also explore scenarios of possible future disruptions and how to ensure better outcomes for the working poor, towards a more inclusive city economy.

One of the first steps of the research for the project involved documenting existing literature and conceptual debates related to the project. With this in mind, the following document seeks to:

- review literature which explores how technology is disrupting local economies and transforming the lives of informal workers. The focus of this section is primarily on disruptive technologies within four key technology sectors – energy, waste, transport, and information and communication technology (ICTs) – with other technologies such as those relating to small-scale manufacturing discussed where relevant;
- review literature which discusses technology forecasts for the future and their potential effects on informal workers;
- review literature which describes core concepts to the research, namely disruptive technology, frugal innovation, and inclusive economies, in support of formulating a conceptual framework for the project; and
- provide some initial findings for discussion based on the literature.

1.2 Structure

This literature review takes the form of an annotated bibliography. Therefore, relevant articles are presented with a brief summary analysis of their contents, followed by a more general discussion of the main findings, arguments and issues relating to the relevant section theme. The document is laid out as follows: Section 1.3 begins by discussing the methodology used in undertaking the literature review while Section 1.4 provides a few basic working definitions of key terms. Sections 2, 3, and 4 are the research and analysis portions of the document. Within each section, annotations are provided and initial findings are then discussed. First, Section 2 discusses the impact of technology on informal worker lives and livelihoods in the four key technology sectors as listed above plus other technologies. Next, Section 3 reviews technologies of the future and their potential impacts on workers. Finally, Section 4 reviews existing debates surrounding core concepts of the research, namely, disruptive technology, frugal innovation, smart cities and inclusive economies.

1.3 Methodology

To conduct the literature review, WIEGO and Practical Action undertook a keyword search drawing upon scholarly databases and Internet news sources in order to capture academic literature, news articles and ‘grey literature’ (i.e. reports from businesses,

think-tanks, non-governmental organisations (NGOs) and other sources) on the topics of interest. Research was undertaken in three specific areas: the impact of four specific technology sectors (as listed above) and technology in general on informal worker lives and livelihoods; future technologies which might affect informal workers; and existing debates around core research concepts (disruptive technology, frugal innovation, and inclusive economies). Key search terms used included “waste technology”, “transport technology”, “informal economies” etc, plus Boolean searches of such terms. In addition, each organization consulted with research partners in the 5 project cities (Lima, Nairobi, Durban, Dhaka and Ahmedabad) to source any existing local research on the topic. Relevant publications by the Rockefeller Foundation were also included.

It should be noted that while the review aims to summarize the relevant literature on the topics outlined above, it does not provide an exhaustive representation of the literature on each topic. Rather, prominent, widely cited and insightful literature was selected to inform the wider research project.

The rationale for the selection of articles for inclusion in the review was those which intersected the issues of informal work, the focal technology sectors, and urban geographies in developing economies. Articles related to concepts and definitions (in Section 4) were limited to those with multiple citations and regularly noted as prominent pieces within their field. Articles which covered similar narratives, lines of argument or examples have also been excluded, with each included article aiming to add new insight and value to the review and findings.

1.4 Definitions of Key Terms

This section provides working definitions of some of the key terms being used in the literature review. First, what is meant by “technology”? It is acknowledged that there are many ways of defining technology. However, in this document, we will adapt Christiansen et al.’s (2011) definition of technologies. The authors classify technology into three categories: hardware, software and orgware. By their definition, hardware refers to physical tools and equipment; software refers to the skills, knowledge and processes which are involved and required in using technology; and orgware (or organizational technologies) refers to ownership of a technology or the institutional arrangements of an organization or a community where a technology will be used.

Therefore, for the purposes of the literature review, our understanding of “technology” is fairly broad - it can refer to tools or equipment of varying complexity or mechanization. It can also refer to the systems of technology promoted by a city (i.e. in the case of waste or transport). Nonetheless, the majority of technologies covered in this review fall within the hardware category, with software and orgware often seen as enabling or constricting factors in the efficacy, adoption and utility of hardware technologies.

Next, “technology justice” is a concept and analytical framework developed by Practical Action to explore and understand the ways in which technology is used by societies, the systems of control over technology choices, and the consequences of the use of technologies. It is defined as “*The right to choose and utilise technologies necessary to lead the lives people value, without preventing others, both now and in the future, from doing the same.*” Technology Justice comprises four key aspects: Access, Appropriateness, Sustainable Use, and Inclusive Innovation. Thus using the lens of technology justice, one can scrutinise the ‘pro-poor’ nature of technology and how

technology choices may enable or restrict inclusive economic approaches. Nonetheless, it is hoped that this nascent concept can be expanded and refined as a result of the research project and its meaning explored in different contexts.

Furthermore, “work opportunities” for the purposes of this research, is seen to have a broad definition. While for formal workers, the term work opportunities connotes the creation of jobs or paid employment opportunities: for informal workers, work opportunities requires a broader connotation of opportunities to earn an income or livelihood, through self-employment or paid employment. And opportunities for self-employment need to include the opportunity or right to use and access public spaces and resources in order to earn a living.

Lastly, for terminology relating to informality, informal work and informal economies, the report will use the terms as defined by Martha Chen in *The Informal Economy: Definitions, Theories and Policies* (WIEGO, 2012). Further terminology relating to slums, slum economies, and city ecosystems can be found in the Rockefeller Foundation’s *Slum Economies* intelligence report.

2 Annotated Bibliography on Technology Sectors & Informal Workers

This section begins by providing annotations on articles relating to the impact of energy, waste, transport, and ICTs, as well as other technologies, on the lives and livelihoods of informal workers and the urban poor more generally. It then discusses initial findings based on the literature presented.

2.1 Energy

Chen, Martha Alter. 2014. *Informal Economy Monitoring Study Sector Report: Home-Based Workers*. Cambridge, MA, USA: WIEGO.

This report summarizes findings from three cities that were highlighted in the Informal Economy Monitoring Study (IEMS), a multi-year research initiative aimed at revealing the working conditions and challenges faced by workers in the informal economy. This document summarizes findings from surveys and focus groups with home-based workers in Ahmedabad, Bangkok, and Lahore. This study revealed that home-based workers face many challenges that are directly linked to infrastructure and city services. Specifically, irregular energy supply and rising prices were cited as being some of the biggest factors affecting the livelihoods of home-based workers in Lahore and Ahmedabad.

In Lahore, load shedding, or rolling power outages, was cited as being a barrier to work that reduces productivity and earnings. Productivity loss from power outages affects relationships with contractors when orders cannot be delivered in time. Coping mechanisms to deal with energy shortages included working late into the night, burning candles, using flashlights and using the light from mobile phones. Candles are a safety risk for garment workers, while flashlights can represent a significant expense.

In Ahmedabad rising electricity prices were cited as being the biggest challenge for home-based workers. Expensive energy leads many workers to switch to manual machines which decreases productivity and can be physically exhausting.

Clancy, Joy, Adriana Alvarez, Olu Maduka and Feri Lumampao. 2006. “Enabling Urban Poor Livelihoods Policy Making: Understanding the Role of Energy Services” DFID KaR PROJECT R8348 Synthesis Report Revised.

This document is a report produced as part of a DFID-funded project on urban livelihoods and energy services. The premise of the study is that policy-makers often make decisions about service delivery based on the assumption that the urban poor generally have access to modern energy services. This report employs a livelihoods framework to highlight the importance of distinguishing between energy availability and access. It outlines the nuanced ways in which energy services affect the viability of informal enterprises in urban areas, particularly those that are home-based. The report seeks to influence progressive policy-making that improves service delivery and access in a way that can enhance and support enterprise development.

The authors found that there is a strong correlation between energy access and enterprise viability in the three countries studied (Nigeria, the Philippines and Brazil). Another major finding was that despite the fact that most home-based enterprises are run by women, men in the household make the decisions about energy use. The biggest factor inhibiting energy use is cost. Price increases directly affect informal enterprises in a number of ways, including an increase in input costs that is caused by more expensive transportation. Informal enterprises offset these costs by laying off workers, decreasing quality and raising prices.

Singh, R., Wang, X., Ackom, E.K., Reyes, J.C.M; 2014. *Energy access realities in urban poor communities of developing countries: assessments and recommendations: Summary for policy-makers*, GNESD & UNEP

Exploring energy access policies and technology choices across 10 developing, emerging and BRICS countries, the review indicated that poverty alleviation and urban development policies have a component on urban poverty that aims at the provision of basic needs services like housing, water supply etc. to the urban poor. However, clean energy is still not recognised as a basic urban service in these policies in most developing countries. Examples show that including clean energy sources as part of basic slum infrastructure and services not only improves living conditions and the quality of life, it also has the potential to reduce energy poverty as well.

The authors recommend that regulations pertaining to the input supply markets (e.g. LPG canisters) be relaxed, along with the recognition of the small-scale retailers and informal workers who can sell these in accessible local venues at a cost low enough to encourage wider-scale adoption among the urban poor.

They also call for an “energy plus” policy approach, which sees energy access as an enabling step, rather than an end in itself. Therefore the concept of an ‘energy plus’ approach must be viewed in a broader context, with energy services being maximised for productive uses and income generation, which consequently increases the ability of the poor energy consumer to afford reliable modern energy services and improve the socioeconomic outcomes of such energy interventions.

Szakonyi, David and Johannes Urpelainen. 2015. "Energy Poverty among Urban Street Vendors in India: Evidence from Patna, Bihar." *Energy for Sustainable Development* Vol. 24, pages 44–49.

This journal article is based on research that was done in the state of Bihar, India on energy poverty—or lack of energy access—among street vendors. A survey was conducted with 1,000 market vendors and the results revealed high levels of energy poverty, with vendors struggling to access artificial lighting that would allow them to take advantage of the evening demand from commuters for their products. Existing lighting sources used by vendors included candles, rechargeable lights, kerosene or LPG. Infrastructure does not allow for the vendors to consistently or conveniently access grid electricity. Many vendors face a trade-off between having no lighting or inadequate lighting or paying high fees for diesel-powered energy offered by local suppliers.

The article suggests that energy poverty among the vendors, and their desire to access energy in order to increase a customer base and expand their businesses, necessitates policy interventions in urban marketplaces aimed at meeting these needs. Solar panels are one possible option explored by the article, as well as interventions that increase grid access. In sum, policy-makers often fail to account for livelihood impacts, particularly the impact on informal livelihoods that lack of energy access causes.

Wilcox, Mary, et al, 2015. *Utilising Electricity Access for Poverty Reduction*, Rugby: Practical Action Publishing

This recent DfID funded study explored the impacts of different levels of energy access across both rural and urban users in Kenya and India. While there was some evidence of positive relationships between level of electricity access and increases in enterprise revenues and profits, there was no clear, unambiguous, relationship between level of electricity access and poverty reduction.

The research reinforces messages regarding the importance of combining electricity access with other enabling factors to achieve productive outcomes and poverty reduction. Electricity solutions which provide relatively low-level access may offer the greatest value in terms of poverty impact, while matching electricity access to the particular needs of communities and linking electricity access to markets, skills and finance is critical. The findings relating to both employment and household income were mixed, indicating a complex interaction between electricity access and other factors. The technologies which appeared to have the greatest benefit for productive use were off-grid connections, with solar products also having strong impacts in rural areas.

Yaqoot Mohammed, Parag Diwan, and Tara C Kandpal. 2014. "Solar Lighting for Street Vendors in the City of Dehradun (India): A Feasibility Assessment with Inputs from a Survey" *Energy for Sustainable Development* Vol. 21, pages 7–12.

This study examines the potential for solar lantern technology to be adopted by street vendors in the city of Dehradun, India. Limited access to grid electricity has major impacts on the lives of approximately 1300 street vendors in the city who operate after sunset in the interest of benefitting from an evening customer base. This study suggests that solar lanterns would be an appropriate solution to the energy challenges faced by these vendors. The benefits of the lanterns include portability, low expense and zero greenhouse gas emissions. The lanterns themselves have no operational cost or maintenance, but do require periodical charging at a charging station.

A feasibility assessment conducted by the authors revealed that Dehradun has the capacity for enough charging stations to meet the needs of 1,000 vendors. The survey also revealed that the lantern scheme is financially viable, and that vendors would be willing to pay a small fee to be able to rent the use of the charging station. The authors suggest the Indian Government take into account this possible solution for informal vendors as part of the existing Solar Cities Programme that has been launched in 60 cities throughout the country.

2.2 Waste

Global Alliance of Waste Pickers. 2014. "Waste Pickers Respond to Uruguay's Waste-to-energy Plans." Available at <http://globalrec.org/2014/05/15/waste-pickers-respond-to-uruguays-waste-to-energy-plans/> (accessed March 3, 2015.)

This article is a response from the Uruguayan pro-waste picker initiative, "Coordinadora Pro Clasificadores (CPC)" to a public bidding process that would bring waste to energy technology to Uruguay. The article outlines the reasons that waste pickers represent a more sustainable alternative to expensive incineration technology. The article explains that without the vital recycling services that waste pickers provide, materials recycled by them would no longer be on the market. In addition, waste to energy technology only provides a solution for disposal, but does not provide for collection and transport—services provided by waste pickers. The alternate plan proposed by CPC involves the inclusion and the mass formalization of waste pickers with the objective of re-using and recycling solid waste as part of a long-term waste management plan.

McDermott, Mat. 2008. "Dubious Waste-to-Energy Incinerator Project to Put Delhi Waste Pickers Out of Business." Available at <http://www.treehugger.com/renewable-energy/dubious-waste-to-energy-incinerator-project-to-put-delhi-waste-pickers-out-of-business.html> (accessed 3 March 2015)

In Delhi, estimates state that 59% of waste is recycled through informal systems of collection carried out by waste pickers. However, despite the importance of waste management contributions of waste pickers, incinerators are growing in popularity across India, fuelled in part by the provision of carbon credits in return for the establishment of these "waste to energy" plants. This article states that an incinerator being planned in Timarpur, Delhi has caused waste pickers to be banned from the landfill that they depend on for their livelihoods. This technology will affect the livelihoods of the 1% of Delhi's population that depends on the landfill to make a living, and according to environmentalists, will likely have negative environmental implications as well.

Mendoza, Hannah Rose. 2014. "Indian Waste Pickers Produce 3D Filament with ProtoPrint." Available at <http://3dprint.com/9552/protoprint-3d-print-filament-waste> (accessed March 3, 2015).

Despite significant environmental contributions in the form of recycling and waste disposal services, waste pickers in Delhi are threatened by increasing numbers of

initiatives that reduce supplies of trash. This is largely due to the introduction of incineration facilities and the contracting of private waste disposal companies. To combat these threats, the startup Photoprint aims to support waste pickers' livelihoods by providing them with the technology to convert waste plastics to a valuable product—3D printer filament. Photoprint connects waste pickers with low cost equipment and training on how to clean, shred and process plastic into 3D printer filament. This initiative has allowed waste pickers to earn 15 times more than they would if they were selling the raw plastic material alone.

Raghupathy, Lakshmi; Chaturvedi, Ashish, 2013. *Secondary resources and recycling in developing economies*, Science of the Total Environment, Volume 462, pp830-4

Covering the myriad informal recycling systems in India, this report concentrates on the e-waste recycling sector, over 95% of which is conducted by informal workers. Highlighting the hazardous and toxic nature of the recycling processes for informal workers and the wider environment, the authors call for inclusive formalisation of the informal workers, to improve their health, minimise environmental degradation, and provide expanded private sector involvement in the processing of e-waste, using modern and safer technologies.

However, the authors fail to note that the biggest gains and value-added areas of the value chain in waste reprocessing would then be captured through regulation by the large private sector processors who are able to employ modern technologies. This would make e-waste recycling far less lucrative for poor informal workers, despite offering improved health and environmental outcomes.

Shrestha, Upendra M, 2015, *Poverty Reduction of Informal Workers in Solid Waste Management Sector (PRISM): Final Narrative Report*, Kathmandu: Practical Action South Asia

This large project in Nepal worked with thousands of informal waste workers to leverage new technologies to improve their work opportunities and livelihoods. It took an integrated approach in order to address the structural barriers which had prevented waste workers from achieving sustainable livelihoods and decent work opportunities. This included providing family healthcare services, improved safety equipment, and business skills training, all in partnership with local businesses and local government structures.

New technologies included machinery for sustainably and safely sorting, shredding and processing recyclable materials. This, in combination with other approaches, gave informal waste workers access to new and participatory value chains.

Nonetheless, although significant livelihood outcomes were recorded, incomes for waste workers remain low, and scaling up the project without substantial government or donor investment remains difficult.

Garside, Ben; Lines, Kate; 2014. *Innovations for inclusivity in India's informal e-waste markets*, Sustainable Markets Briefing Papers, IIED, London

This study of a number of regulatory and policy changes in India governing e-waste management, alongside examples from China and elsewhere, demonstrates that a much more nuanced approach to regulations is needed to ensure that the livelihoods of informal workers are safeguarded, while still striving for improving occupational health and safety and reducing environmental impacts of e-waste management.

It calls for 'hybrid' informal-formal systems, whereby the most dangerous processes of metal stripping and performed safely by regulated private sector enterprises, while the majority of other tasks, including collection, separation and other processing activities, are conducted by informal workers. They highlight examples where intermediary companies buy separated waste from collectors, process the materials, and sell back processed materials.

Vrynhoek, Leslie. 2012. *First Global Strategic Workshop of Waste Pickers: Inclusive Solid Waste Management*. Narrative report prepared from the Global Strategic Workshop, Pune, India, 27-29 April.

At this global workshop, waste pickers from Asia, Africa, Latin America and Europe convened in Pune, India to share experiences and discuss common challenges and goals. The major threats identified by the participants were privatization of waste processing, waste to energy/incineration technology and government corruption. It was discussed that although waste to energy technologies are marketed as being a safe, environmentally-friendly choice, gases produced by waste pumps are harmful to the atmosphere, and make recycling a "greener" option than incineration.

In an inclusive system, flammable items such as paper, cardboard and plastics could be more easily and sustainably recycled by waste pickers, while other materials could be burned after the sorting process is done. This would allow waste-pickers to retain their role in the waste-management system, and to be able to co-exist with waste to energy technology. However incineration technology and the technology being offered by private companies does not provide for the inclusion of waste pickers. The participants agreed that it is important to push back against these initiatives quickly and aggressively. Inclusion was identified as the biggest goal for group, and strategies and ideas for how to achieve inclusion were discussed and shared.

White, Naomi, 2015. *Nairobi Turns Human Waste Into Energy*, Forum for the Future, <http://thefuturescentre.org/signals-of-change/2979/nairobi-turns-human-waste-energy> (accessed 11th April 2015)

A short report on Practical Action's innovative waste-to-energy bio-centres. Using modern processing technology, informal waste workers and pit latrine emptiers are able to sell their collected human and organic waste to the plant, which then processes it to produce methane. The gas is then sold back to informal workers and other slum dwellers for use in powering everyday activities, from cooking to water heating. The bio-centres offer hygiene services and safety equipment for the informal sellers of the raw materials.

This approach creates new value chains for informal waste workers, offers new, sustainable and low-cost energy supplies to slum dwellers, and treats waste in an environmentally sound manner. There are now over 50 bio-centres across Kenya.

2.3 Transport

Flint, Anthony, 2014. *Is There a Medellín Hype Machine?*, The Atlantic City Lab, <http://www.citylab.com/design/2014/04/medellin-hype-machine/8856/>, (accessed 10th April 2015)

This article explores how improved technology choices for transport for poor citizens of Medellín, Colombia have transformed the city and created increasingly inclusive economies. The cable cars connecting peripheral areas to the main city and elsewhere have dramatically reduced both transport time and costs, and were also a significant attribute in reducing crime. They also spurred the start of other inclusive economic planning from the city government, engaging citizens in jobs which help to reduce erosion for example. The article also highlights that a main factor for success was cooperation with the local energy firm, along with taxation reforms which ensured revenue was directed towards inclusive spending priorities.

However, along with the criticisms mentioned in this article such as the system's limited effect on violence, lack of relevance to urban poor communities and lack of transferability beyond Medellín, this approach has also been critiqued (by M.A. Chen and others) for lacking further inclusivity in the planning and design. For example, informal vendors cannot bring and sell their goods on the cable cars.

Khayesi, Meleckidzedeck, Heiner Monheim, and Johannes Michael Nebe. 2010. "Negotiating 'Streets for All' in Urban Transport Planning: The Case for Pedestrians, Cyclists and Street Vendors in Nairobi, Kenya." *Antipode* Vol. 42(1), pages 103–26.

This paper uses as its analytical base a "streets for all" model to show how certain urban populations have been left out of urban transport planning in Nairobi, Kenya. While the emphasis has been on planning for motorized transport, street vendors and pedestrians are increasingly exposed to harassment and insecure working conditions. The authors propose a model that considers the spatio-temporal nature of street vending and that creates more inclusive, secure conditions for vendors. The example of Bogotá, Colombia is highlighted as a case where policy-makers were able to reduce car-usage and create more equitable conditions for urban residents.

Inclusive planning in Nairobi would take into account the unique needs of vendors in designing roads, zoning for land use, investing in transport infrastructure and changes in urban policy and services. This article underscores the varied, nuanced and interconnected ways that city planning policies—and in particular transport planning policies—can impact the livelihoods of street vendors. A 'streets for all' approach should be taken to support informal street vendors and non-motorised transport workers, making the streets of Nairobi 'living places', rather than simply channels between destinations.

Klopp, Jacqueline M; 2014. *Cities in motion: how we mapped the matatus of Nairobi*, The Guardian, <http://www.theguardian.com/cities/2014/feb/19/cities-motion-how-we-mapped-matatus-nairobi> (accessed 11th April 2015)

This news report covers the digital mapping of the informal *matutu* transport system in Nairobi, Kenya. A team of local and international data specialists mapped the entire

network of buses and created an easily readable map, which was officially adopted by the city government. The map can enable users of the network, largely (although not exclusively) poor urban workers, to more effectively and efficiently navigate the complex routes and streets of the city. It is also a first step toward a 'smart city' approach to transport planning in Nairobi (although such an approach has been criticised elsewhere). Hotspots of accidents, congestion and crime are also highlighted.

Mahadevia, Darshini, and Suchita Vyas. 2014. Informal Economy Monitoring Study: Home-Based Workers in Ahmedabad, India. Manchester, UK: WIEGO.

This particular study was conducted in partnership with the Self-Employed Women's Association in Ahmedabad India. Focus groups with home-based workers revealed that technology is having an impact on informal livelihoods in several different ways. For "agarbatti" (incense) workers technological displacement is a major concern. Among garment workers, lack of capital to purchase new technology was the major concern. The workers explained that sewing technology is changing fast and they need assistance with training and loans to be able to access and use it.

Both groups' livelihoods are closely tied with transportation access as well. Trips to obtain goods and raw materials from contractors represents an opportunity cost of time and money. Workers reported that inadequate or irregular public transportation results in long trips, and that high fares eat into earnings. Garment workers surveyed who rely on public transportation spend 379 additional rupees each month (approximately 16% of monthly turnover). Because of this, many of the survey respondents lose time and face physical risk walking to obtain raw materials and orders.

In addition, transportation and housing are related issues for many of the workers. Women who had been relocated to the city periphery in relocation programs were even more disadvantaged in terms of transportation access. Some of these women had seen work orders decrease as contractors are unwilling to travel to relocation sites and the expense and distance is too great for the women to travel.

Patel, Sheela; Sharma, Kalpana, 1998. *One David and three Goliaths: avoiding anti-poor solutions to Mumbai's transport problems*, Environment and Urbanization, Vol. 10, No. 2

This article examines the technological and organisational approaches to inclusive transport planning in Mumbai. The choice to upgrade and expand the rail network - on which 88% of all commuters depended - posed significant improved livelihood opportunities for both formal and informal workers through reduced travel times, new markets, job locations and expanded networks for traders to sell their wares. However, the informal settlements which lay as close as 1 metre from the track - and whose inhabitants depended upon trading with the slow-moving trains - were under threat.

The authors examine the roles played by a range of actors in creating organisations to lobby the implementing agencies and government to ensure that the system upgrading was inclusive. This successful process enabled the technology upgrading and expansion to happen, while providing safer housing for the slum dwellers. However, many of those that depended on trading with passengers of the slow-moving trains were deprived of a livelihood opportunity.

Senthilingam, Meera, 2013. *Brazil's idea for future mobility: the good old bus*, CNN, <http://edition.cnn.com/2014/09/22/living/curitiba-buses/index.html> (accessed 10th April 2015)

This article discusses the use of bus rapid transport (BRT) technology in 33 cities across Brazil. It demonstrates how this system has managed to overcome congested city car road networks and has enabled people to move about the city more freely and rapidly. It also notes how in some cities, the technology has been adapted to reach the growing number of people living on the periphery of the city, opening up new job opportunities and significantly reducing their transport time, which is often spent walking. A similar example from Peru can also be found here: (Vigo, 2011, <http://nextcity.org/informalcity/entry/slow-jam>).

2.4 ICTs

Given the number of articles presented in this section, it has been divided up into four categories for easier readability: mobile phones, applications, cross-cutting, and Internet.

Mobile Phones

Ayesha Zainudeen, Rohan Samarajiva, Nirmali Sivapragasam, 2011. *CellBazaar: Enabling M-Commerce in Bangladesh*, Information Technologies & International Development Journal, Volume 7, Issue 3, pp61-76

Exploring the success of the *CellBazaar* e-commerce system, the authors look at the factors which have contributed to its success in comparison to other similar services. They point to the focus of the technology on the SMS-based platform, which is most accessible to the poorest users owning basic handsets, and the minimal transaction costs. Importantly, they also note that the system allows only minimal functionality – that of listing items and services for sale, and searching for such items and services – meaning that all actual transactions and negotiations are facilitated outside of the system. The authors' research suggests this has enabled previously sceptical users to use the system and still utilise traditional negotiation and payment methods, and retain the important element of trust in the transaction. They also note the importance of the association of the system with the well-established pro-poor micro-credit institution, Grameen.

The system has enabled small-scale producers, informal workers, and others to list their goods and services and find new markets, customers and employers. Equally, contractors of informal workers have been able to source labour with significantly reduced transaction costs. The highly localized system has also encouraged use and fostered a stronger relationship with the technology, as it has direct relevance to people's lives. The report suggests that with the potential addition of m-payment into the *CellBazaar* system, further market disruption could accrue and generate greater income expansion potential.

Bansal, Manju. 2012. "Creating Entrepreneurs at the Bottom of the Economic Pyramid." <http://www.forbes.com/sites/sap/2012/01/12/creating-entrepreneurs-at-the-bottom-of-the-economic-pyramid/> (accessed 25 March 2015).

This article discusses the inefficiencies in the supply chain process for street vendors in India, and how these can be improved through the use of mobile technology.

Specifically, ordering products from distributors can be made more cost-effective and efficient by using SMS to submit orders through enterprise resource planning systems (EPR) that manage distributor merchandise. The authors suggest that this technology should become increasingly accessible to vendors with the start of India's uniform identification number project, which aims to issue ID numbers to all citizens. As a lack of identification or credentials has been a barrier for vendors in directly placing orders with distributors before, both the new system and the proliferation of mobile phones have the potential to increase profit margins for vendors. In addition, the new 35 dollar tablet being offered in India could increase and facilitate the use of mobile-based EPR systems by vendors.

Foster, Christopher; 2014. *Does quality matter for innovations in low income markets? The case of the Kenyan mobile phone sector*, Technology in Society, Volume 38, pp119-129

This research article explores how quality issues impact technology choice and the productive functioning of mobile technologies in Nairobi, Kenya. It highlights the myriad opportunities for new low-cost value chains in supplying cheaper but lower-quality goods – mostly manufactured in China – undercutting more advanced and robust brands due to their vastly lower costs and informal retailing. This is a near perfect example of 'disruptive innovation', as defined by Clayton Christensen (see section 4.1).

Such disruptive innovation leads to increased access to ICTs and creates new job opportunities for informal workers, both as retailers of handsets and of SIM cards and other complementary goods, but also for repairers. Indeed, if the goods were better made, there would be less need for repairmen. However, the low quality of goods has undermined trust in the mobile market and of goods retailed by informal workers. Customers returning faulty and malfunctioning handsets after purchase has also left many informal retailers out of pocket, as they are unable to return the goods within the warranty period for various reasons.

Ultimately, the findings indicate that quality is fundamental in affecting the disruptive potential of a technology, and how inclusive innovations are for low-income groups.

Heikkila, Pia. 2015. "Finnish Technology Empowers Indian Street Vendors." Available at <http://www.goodnewsfinland.com/archive/news/finnish-technology-empowers-indian-street-vendors/> (accessed 26 March 2015).

Bank deposits can represent an opportunity cost for street vendors who live or work far from banks. Finnish co-operative Mfore has created an automated SMS-based receipt service aimed at facilitating financial management among street vendors through an app that allows for bank deposits and withdrawals to be made using mobile phones. Through the system, bank representatives collect money from market vendors at the end of the business day and deposit their earnings in the bank, notifying vendors of the deposit through a text message. Approximately 2500 vendors in Delhi had signed up for the Mfore service as of April, 2015. The company is currently looking to expand operations beyond India.

Johnson, Stephen C. and Dhanaraj Thakur. 2015. "Mobile Phone Ecosystems and the Informal Sector in Developing Countries- Cases from Jamaica." *The Electronic Journal of Information Systems in Developing Countries* 66(6), pages 1-22.

This study analyses how ICT has created new opportunities and positive socio-economic outcomes for informal entrepreneurs in both rural and urban Jamaica. The authors use an "ICT ecosystem" framework, which looks at the diverse factors—policies, processes and stakeholders—that make up the "technology environment."

The authors found that urban informal ICT providers (phone card vendors, parts traders, repairmen) in Jamaica, who are often poor but possess knowledge and skills in IT, have created a niche for their services within the larger ICT ecosystem. These entrepreneurs engage in self-teaching and information sharing despite competition between them. This finding draws attention to the incidence of high-skilled workers in the informal sector and the potential for ICT to facilitate learning (through YouTube, online articles) and sharing, (through social media, online communities).

The authors suggest that a strong ICT ecosystem is a good development policy, as these technologies can have an impact on the socio-economic mobility of the poor. In Jamaica the ICT ecosystem has been enabling for the informal sector, and has allowed for exchange of information and creation of new relationships. Policy implications are that a competitive regulatory environment is important to facilitate the provision of low-cost services that are affordable and accessible.

Lund, Francie and Laura Alfes. April, 2014. "Informal Workers and the Use of Mobile Technology and Communications: *Findings from Key Informant Interviews*", WIEGO

This article examines how ICTs are used for facilitating communication and organizing among informal workers. Surveys with key informants in membership-based organizations of informal workers revealed that mobile phone usage among workers was found to be high, even among very poor workers. Mobile phones are commonly used by organizations to communicate information about meetings. In addition, mobile technology is used by workers themselves to communicate about bargains, or advise about impending evictions. The voice function was the most commonly used by the workers, with text being used far less because of time involved in writing and sending messages. Similarly, Internet, email and Facebook were not commonly used by the workers.

The study found that mobile phones are benefitting workers in unexpected ways. For example, waste pickers in Bogota are able to manage their payments from the municipality through their mobile phones. Also, the filming function of mobile phones was reported to have been used by waste pickers in Bogota to record government statements on areas of interest, and police abuses. The article calls for continued research on the use of mixed-method communications by informal workers, as this will likely increase in the future.

Moloney, Thomas; *The Role of Mobile Phones in Tanzania's Informal Construction Sector: The Case of Dar es Salaam*, Urban Forum, 2008. Volume 19, Issue 2, pp175-186

This article reveals that ownership of mobile phones is divided along employment lines in Tanzania: between a stratum of employers and middlemen (who in Dar es Salaam's informal construction sector are also mostly using mobile phones), and a stratum of employees, apprentices, family labourers and marginal-owner operators (who are generally not using mobile phones).

Less than one fifth of the representative sample of respondents owned and used a mobile phone within the context of their work, and no respondents had ever used the Internet for their work. Those with ownership of or easy access to a mobile phone were predominantly the 'leaders' of worker groups, suggesting a 'digital divide' of status and income-generating potential between the haves and have-nots.

Mramba, Nasibu. 2004. "Survey of Mobile Phone Usage Patterns Among Street Vendors in Dar es Salaam City, Tanzania." *International Journal of Information Technology and Business Management* Vol. 28 (1), pages 1-10.

This survey-based study with 174 street vendors in Dar es Salaam Tanzania reveals that mobile phone usage is very high among street vendors as are the perceived benefits of usage. 98% of usage among vendors is for contacting friends and family, but a small percentage is also business related—such as mobile banking, calculations and business communications. Perceived difficulties of mobile phone usage among vendors is low.

The authors conclude that mobile phones present an enormous opportunity for transforming the street vending business through training and registration. The authors suggest that there is a need for youth training in the application of mobile phones to a business context and that additional research should be directed towards understanding this potential.

Roxana Barrantes Cáceres, Aileen Agüero, Martín Caverro, César Huaroto, 2012. *The Impacts of the Use of Mobile Telephone Technology on the Productivity of Micro- and Small Enterprises: An Exploratory Study into the Carpentry and Cabinet-Making Sector in Villa El Salvador*, Information Technologies & International Development Journal, Volume 8, Issue 4, pp77-94

The research focuses on the carpentry and cabinet-making microenterprises based in an urban zone of Lima, Perú. The authors found that mobile technology is primarily used as a mode of contact between the micro-entrepreneurs and customers. There is little evidence that the technology has disrupted the working model of the producers or the wider value chain, but there was notable increases in repeat and new customers, and has improved producer-consumer trust, as each are able to remain in contact more frequently.

Little effect beyond this was noted, with the producers still undertaking personal, face-to-face meetings with input suppliers, largely due to mistrust over prices and quality. This suggests that the disruptive nature of mobile technology is highly dependent upon the sector, context, location and work process.

The Mobile Economy 2014, GSMA,

[http://www.gsamobileeconomy.com/GSMA ME Report 2014 R2 WEB.pdf](http://www.gsamobileeconomy.com/GSMA_ME_Report_2014_R2_WEB.pdf)

This report provides global data on mobile uptake at various levels, including key trends and areas where barriers to access persist. Key statistics include 49% of developing-world users lacking mobile access, and a rapid tail-off in subscription growth rates in such areas from 50% annually to 10%.

Data also indicates that the vast majority of infrastructural investment is aimed at upgrading existing networks to 4G and even now 5G connections, with comparatively little investment aimed at broadening the breadth of networks or improving the reliability of 2G networks – those most commonly used via the basic handsets most commonly owned by poorer users.

Applications

Carr, Carlin. 2015. “Mapping Bangalore’s Waste.” Available at <http://urb.im/ca1503bge> (accessed April 1 2015).

A new digital initiative seeks to track the way that trash is collected and handled throughout Bangalore. The technology firm Mindtree has developed a website and database called I Got Garbage (IGG), which allows waste pickers—referred to within the system as recycling managers—and the greater urban community to connect through an online marketplace. Through the website, households and businesses can request trash collection with waste pickers, who are then connected with scrap dealers across Bangalore. IGG is involved in a continuous process of mapping where waste is coming from and where it goes—specifically monitoring locations of scrap dealers and data about the amount and types of waste these shops take in. This information has the potential to be beneficial for both waste pickers and municipalities across India in creating more inclusive waste management strategies.

Laya, Patricia. 2015. "Mexican Vendors Bypass Banks With Mobile Applications." Available at <http://www.bloomberg.com/news/articles/2015-03-12/mexican-vendors-bypass-banks-with-mobile-applications> (accessed 29 March 2015).

New mobile-based payment methods are changing the way that vendors do business in Mexico’s enormous informal economy. Specifically, a new app called Sr. Pago makes it easy for vendors to offer clients the opportunity to pay with credit cards, even if the vendor does not have a formal bank account. By using this app the client simply has to swipe his or her credit card on a small terminal attached to the phone, and the vendor is able to redeem the cash at Oxxo convenience stores. The mobile service provider Nextel is marketing directly to informal workers by offering a 29-dollar a month plan that includes a smartphone and unlimited access to the app.

Offenhuber, Dietmar and David Lee. 2014. “Putting the Informal on the Map – Tools for Participatory Waste Management.” Available at http://senseable.mit.edu/foragetracking/PDCpaper_final.pdf (accessed March 20, 2015).

This project summary highlights how participatory design and ICT can be used with informal groups of waste pickers to increase the efficiency and legitimacy of their work. Specifically, the researchers worked with COOPAMARE, a waste picker cooperative in Brazil on a project called Forage Tracking, which aimed to provide a platform for

community-based recycling. The project built on the waste pickers' knowledge of the city by using ICT to collect data about the waste collection process. Specifically, waste pickers carried GPS loggers that mapped their waste-collection routes, allowing them to spatialize and visualize their work, and to strengthen their case with the municipality.

The second phase of the project involved the creation of a participatory platform where "clients" could request waste collection services through websites and text messages. This platform allowed clients to schedule pick up times and inform the waste cooperative of the type of material to be picked up. The project highlights the unique logic and organizational structure of informal waste infrastructures and waste cooperatives. The authors suggest that technological solutions must work within this unique context to be effective.

Internet

Graham, Mark; 2014. *A Critical Perspective on the Potential of the Internet at the Margins of the Global Economy*, In: *Society and the Internet: How Networks of Information and Communication are Changing our Lives*, M. Graham & W. H. Dutton (Eds.). Oxford: Oxford University Press, pp301-318

This book chapter notes the potential Internet connectivity provides for connecting small-scale producers to new markets and reducing disintermediation, in addition to the ability of producers to compare prices against other market prices to ensure they are getting a fair deal for their goods. However, the research finds that actually the benefits are mostly being captured by intermediaries, with little benefit being felt by the producers themselves. Often this is due to a lack of competency with Internet use among the producers, but also a lack of literacy (both lingual and technical) among the producers, which leads them to rely upon the middlemen as brokers of the knowledge gained via the Internet.

The author concludes by stating that the evidence from his research indicates that "*Internet-access alone is rarely sufficient to fundamentally reconfigure entrenched, and often unfair, economic networks and relationships in the world's economic margins.*" Thus disruption occurs higher in the value chain, and can actually compound the vulnerability of poor small-scale urban producers.

***Offline and falling behind: Barriers to Internet adoption*, McKinsey, 2014.**
http://www.mckinsey.com/insights/high_tech_telecoms_internet/offline_and_falling_behind_barriers_to_internet_adoption

This report examines why Internet access remains at only 40% globally, and identifies four key barriers: Incentives, in particular relevant, localized content; Affordability, both of access via service providers and access to or ownership of technologies which enable Internet connectivity; User Capability, including both digital and language literacy; and Infrastructure, including mobile network coverage, physical connection lines, bandwidth limitations, and energy services for powering both networks and devices to connect.

The report suggests a multifaceted approach to tackle the digital divide which simultaneously addresses each of these barriers with a range of actors. However, the list of actors does not include poor people or users themselves. This lack of participatory planning may lead to further interventions failing to address the specific needs of poor offline communities and could lead to market failures.

Orcutt, Mike; 2015. *The Online Language Barrier*, MIT Technology Review, <http://goo.gl/hAoP9x>

Over half the content on the Internet is produced in English, which is understood by only 21% of people globally. A further 30% is produced in 9 other languages, spoken by roughly 30% of the world's population. That leaves half of the world able to understand at most 20% of the content available on the Internet.

Therefore, the potential benefits of the Internet in developing world economies are likely to be captured by the best educated who are able to understand and utilise Internet information.

***Use of the Internet and Productivity of Micro-businesses: Evidence from the Peruvian Case (2007–2010)*, 2012. Information Technologies & International Development Journal, Volume 8, Issue 4, pp113-128**

This econometric study used a range of metrics to build an Internet Adoption Index, to more accurately explore the impact of Internet technologies on the productivity of micro enterprises in Perú. The study found that Internet use had a positive but marginal impact on productivity of such enterprises, of just 1.5%. Most respondents used the Internet – where available – to obtain market information and to communicate, with comparatively few purchasing or retailing online.

The limitation of this study is that it only explores the productivity impacts of Internet use, and does not include the other potential disruptive impacts, such as changes in incomes, shifts between sectors, disruption to larger businesses, the number of people in work, and so on.

Cross-cutting

Birgen, Sheilah; 2015. *Top 10 List of Most Disruptive Technologies in Kenya in the Last 5 Years*, iHub and M:Lab, <http://community.ihub.co.ke/blogs/21974/top-10-list-of-most-destructive-technologies-in-kenya-in-the-last-5-years>

This article lists ten technologies the author – a member of two of the leading digital startup incubator organisations in Kenya, iHub and M:Lab – believes to have been the most positively disruptive across the country in recent years. However, the list is populated largely by technical coding systems and high-tech infrastructure, with little about technologies which have made an impact across a spectrum of the Kenyan population.

It is important to note however that the highest-ranked technology, Mobile Money, has been completely transformative in the Kenyan economy, and is arguably the most disruptive technology in the last decade. It has created entirely new value chains, given payment and banking options to millions of previously un-served users, and monetized actions and processes which were formerly conducted on a reciprocal basis.

Esselaar, Steve, Christoph Stork, Ali Ndiwalana, and Mariama Deen-Swarray. 2006. "ICT Usage and Its Impact on Profitability of SMEs in 13 African Countries." 2006 *International Conference on Information and Communication Technologies and Development*.

This paper analyses access to ICTs among small and medium enterprises (SMEs) in 13 African countries, and is aimed at highlighting how ICT's can positively contribute to this sector. In each country, 280 SMEs were sampled and classified as formal, semi-formal or informal. The authors found that ICTs represent an important input for both formal and informal SMEs, but that high investment and usage costs represent a major constraint. In addition, they found that mobile phones surpass computers as the main ICT used by SMEs, due to access and availability.

Key policy recommendations include encouraging the reduction of ICT costs (especially computers), and to drive the development of resources for SMEs that can be used on mobile phones. Specifically, the authors suggest that encouraging cooperation between banks and mobile phone operators to offer products specifically designed for SMEs on mobile platforms could increase the profitability and efficiency of SMEs. Costs could be driven down by facilitating competition between ICT providers through the establishment of an enabling regulatory environment.

Jiyane, Veli; 2010. "Use of Information and Communication Technologies by Women Hawkers and Vendors in South Africa." *Afr. J. Lib, Arch. & Inf. Sc* Vol. 20(1), pages 53–61.

This study examines the role of ICT in business communications among informal women workers in South Africa. Given the emphasis on ICT development through the national ICT penetration strategy in South Africa, this study aimed to uncover whether ICTs were having an impact on the lives and work of women informal workers. The study found that ICTs were not playing a major role in the acquisition of business information by women workers. The authors recommend that additional ICT related training be made available so that women vendors can take full advantage of the capabilities and information-gathering possibilities of ICT usage.

Judith Mariscal, J. Ramon Gil-Garcia, Armando Aldama-Nalda; 2011. *Policies on Access to Information Technologies: The Case of e-Mexico, Information Technologies & International Development Journal*, Volume 7, Issue 2

The authors examine an ICT access initiative across Mexico which used digital community centres to provide internet and ICT access to local residents. The report finds that issues related to slow and intermittent connectivity, a paucity of training and a limited knowledge of what is available to do and discover on the Internet meant that the project had limited impact on improving work opportunities and incomes. It did however improve the skills and educational attainment of young people who accessed the centres, which is likely to lead to their improved work opportunities in the future.

Lugo, Jairo & Sampson, Tony; 2008. *E-Informality in Venezuela: The 'Other Path' of Technology*, Bulletin of Latin American Research, Volume 27, Issue 1, pp102-118

The report explores the use of mobile phones and Internet access in Venezuela. The report finds that although telecommunications companies are legally obliged to operate public 'cyber centres' – essentially Internet cafés – there was a proliferation of informal workers offering lower cost services, without any of the overheads incurred by the formal cyber centres. This has significantly disrupted the formal telecoms industry, as operating such public cyber centres is a legal requirement for operating in the country.

Significantly, in the field study, informal actors demonstrated an ability not only to adapt to technological changes and challenges, such as the trend towards on-demand media services, but also to create novel service infrastructures that their counterparts are legally unable to offer. However, none operated on a commission-earning basis, which limits the flexibility with which the informal cyber workers operate in terms of negotiating prices and services.

Nair, Sumitra; Rangaswamy, Nimmi; 2010. *The PC-aided Enterprise and Re-cycling ICT: An ICT for D Story?, ICTs and Development: An International Workshop for Theory, Practice, & Policy*, Microsoft Research, New Delhi

This study examines how ICTs, particularly personal computers, act to support or constrain work opportunities in urban slum areas in India. The findings suggest that infrastructural access to and maintenance of hardware and software technology, and to a lesser extent the internet, affects livelihood potential and enterprise growth possibilities. The authors find that technology consumption, use, adoption and skilling opportunities are all increased when a focal enterprise owns computer technology and offers locally relevant opportunities and services through it. They also find that strong recycling practices ensure that ICT ownership, access and adoption are affordable, usable and serviceable to populations marginal to mainstream and global ICT markets.

One key aspect the authors find is that local networks of knowledge, both of servicing and adapting technologies, and of business opportunities linked to computer ownership, was fundamental in the studied communities for realising the potential transformative aspects of ICTs. Learning from others experience and spotting new opportunities was thus seen as critical to successful and inclusive adoption of technology.

Omole, Duncan Wambogo; 2013. *Harnessing information and communication technologies (ICTs) to address urban poverty: Emerging open policy lessons for the open knowledge economy*, Information Technology for Development, Vol. 19 Issue 1, pp 86-96

This article assesses five case studies of successful ICT projects and companies across African nations which have focused on economic empowerment and skill development in urban slum areas. Of note are low-cost services which link informal workers to employment opportunities via SMS messages and a similar referral service. Each case study has shown sustained success and scale.

These technologies demonstrate the potential for increased access to mobile phones to provide new work opportunities and new information sources. The proliferation of such schemes could thus lead to divisions between those with access and control of mobile

phones and those without, causing a disruption to the ways in which one connects to and organises around work opportunities.

The article highlights that the success of such technologies is dependent upon the appropriateness of the platform used – in this case, SMS messaging – as this is low-cost, operates on all levels of mobile network systems and can be used in local languages.

Opiyo, Romanus; and Owiti K'Akumu. 2006. "ICT Application in the Informal Sector: The Case of the Kariokor Market MSE Cluster in Nairobi." *Urban Forum* Vol. 17(3), pages 241–61.

This study examines the spatial distributions of ICTs among informal micro-enterprises within Nairobi's Kariokor Market cluster. The objective of this analysis is to assess how ICT's within this environment can be used to facilitate information exchange, marketing and overall business development.

The authors found that ICT ownership among the market vendors was low, with only 30% owning some form of ICT (88.5% of which was attributed to mobile phones). None of the vendors surveyed owned higher end ICT such as fax machines or computers. The authors recommend that an ICT planning proposal for the market provide a framework for the introduction of an ICT service provider for use by the vendors. The authors argue for the promotion of ICT strategies to be used by the informal sector through access and training.

2.5 Other Technologies

Fox, Stephen; 2015. *Moveable factories: How to enable sustainable widespread manufacturing by local people in regions without manufacturing skills and infrastructure*, Science in Technology, Volume 42, pp49-60

This article explores the supposed untapped potential of 'moveable manufacturing' - the ability to rapidly shift factory location (usually in a shipping container) to different areas to meet local demand, utilise local skills and labour forces and significantly reduce transaction and transport costs. The study focuses on areas in West Africa and the Horn of Africa. As the techniques involved usually require minimal training, working on principles of process task design, they are able to focus employment opportunities on those workers at the 'base of the pyramid'. The author also points to evidence of increasing sustainability through such approaches, as they minimise waste, do not concentrate activities in one area, and reduce transport mileage.

However, the report fails to address many issues - that such ad-hoc manufacturing does not create stable or sustainable employment or economic value chain opportunities. Nor does the approach build the skills and capacities of workers, beyond the specific task they are asked to undertake. The temporary nature of work may thus increase vulnerability.

Makri, Anita; 2015. 'Water ATMs' deliver liquid assets in India's capital, SciDev.Net, <http://www.scidev.net/global/water/multimedia/water-atms-liquid-assets-india.html> (Accessed 11th April 2015)

The article presents the story of an entrepreneur who has installed 24 pay-per-litre water dispensing units across slum areas of Delhi. The company treats the groundwater supply by filtering it to twice the level as would be normally required for groundwater sources, due to the water's pollution. It has adapted and scaled up basic household water filtering technology, and combined this with real-time reporting of water quality and feedback from each 'ATM'. The dispensing units are solar powered and filled daily by the company. Users are provided with a pre-pay topup smart-card for paying for the water, minimising the need for women and children to carry cash and risk muggings. Water is available at a fraction of the cost of bottled water.

Technology in Development: Engaging with people in emerging markets, 2014. Accenture and NetHope, <http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-ADP-Technology-In-Development.pdf>

This report surveyed a range of business leaders, NGOs and thought leaders across the globe to assess the role of technology in tackling poverty in emerging markets. They highlight the need for technologies to be created specifically for developing country markets, or adapted to suit the differentiated needs and conditions, and the role that partnerships between international companies and local businesses will play in this.

It notes that the areas of significant investment, both in developing countries and internationally, are in (mobile) web interaction services, smartphone applications, social media, and supply chain automation tools. While energy, engineering and telecoms dominate the areas where technology is expected to create new jobs, there were marked differences regionally, for example consumer goods and construction featured highly in Africa, with agriculture topping the list in South America. The examples presented include mostly those which would benefit educated and trained workers, although the potential of mobile-connectivity-facilitated 'impact sourcing' and 'micro-work' is also noted.

2.6 Key findings

This section provides preliminary findings based on the annotations discussed in Section 2.1-2.5 above in order to stimulate further discussion at the inaugural Convening of Partners (April 2015). The findings have been organized around the four draft research questions of the project. In this way, we aim to directly address the issues pertaining to these key questions, and provide useful context and framing for the second and third phases of the research.

i) What are the positive and negative impacts of technology on work opportunities ?

Energy

- Lack of electricity access through rising prices, shortages and load shedding affect home-based workers and home-based enterprises in several ways:
 - High cost of energy can negatively impact the viability of home-based enterprises - there is a correlation between energy access and enterprise viability;

- Electricity shortages and load shedding negatively affect home-based workers as they can lead to decreases in productivity and earnings when machines cannot be run or there is no light to be able to continue working. A drop in productivity puts a strain on relations with contractors, and results in lower pay or fewer future orders.
- Similarly, lack of energy access causes street vendors to lose out on opportunities to take advantage of an evening customer base and expand their business.
- Workers and employers respond to energy access deficits in a variety of ways:
 - they may lay off workers, decrease quality or raise prices;
 - they forego having lighting or pay high fees to local suppliers for diesel-powered energy;
 - they work late into the night, use alternative light sources (candles, etc); and
 - they switch to manual machines which decrease productivity and can be exhausting to use.
- Different levels and types of energy access are needed to meet the needs of diverse enterprising activities and require enabling environments, particularly inclusive market systems, to realise their full potential.
- Low-cost, “green” energy sources such as solar panels or solar lanterns have the potential to address energy poverty and lack of grid or off-grid access among street vendors and other workers, enhancing their profitability
 - However, viable market systems for these products are currently stymieing greater uptake. Although companies such as M-Kopa are innovating with gradual payments systems, the overall cost remains prohibitive for many workers, and the level of energy achievable is often insufficient to improve work opportunities

Waste

- Incinerators and waste-to-energy technology have shown both positive and negative impacts to waste pickers’ livelihoods at different scales:
- In Kenya, a project has created a new value chain for informal waste workers and pit latrine emptiers who have been able to sell their waste to a waste-to-energy bio-centre. The energy generated also provides a low-cost energy source for slum-dwellers.
- In other cases (India, Uruguay, and internationally), costly, large-scale incinerators have had a negative impact on livelihoods as they have displaced waste pickers by cutting them out of municipal waste management systems and denying them access to landfills. They were also deemed to be one of the largest threats to waste pickers’ livelihoods at a global level.
- It is apparent from the literature that where informal waste workers are included in planning processes for new waste management systems, the balance of impacts is weighted more positively
- However, simply shifting dangerous and hazardous processes to regulated enterprises does little to address the environmental damages of e-waste management as enforcement is often poor, and erodes livelihood and work opportunities for informal workers
- Systems which try to circumvent informal workers in favour of centrally managed processes focusing on processing technology often fail to achieve the same levels of collection and effectiveness as informal workers
- As cities look for new ways to adapt to climate change and decrease energy usage, new energy technologies could continue to pose a threat, or create opportunities for informal workers. Although incinerators are marketed as a “green” energy strategy, the literature highlights how waste pickers provide recycling services that are more

sustainable in the long-term than waste-to-energy technology. Waste pickers will likely need to continue to, and find new ways to organize to defend their livelihoods and promote their status as environmental agents in this context.

Transport

- Affordable, reliable public transportation is important for all informal workers, as transport represents a major input and potential opportunity cost of time.
- Inefficiency in the transport system, high costs or lack of access have several negative impacts on home-based worker livelihoods:
 - High costs of transport cut into earnings for workers who must travel to contractors for raw materials; and
 - Inefficiency or lack of access means long travel times which reduce earnings and increase risks to workers.
 - In response to high transport costs, home-based workers often walk to contractors to obtain raw materials and orders. In doing so, they lose valuable productive time and face physical risk.
- Policies adopted in municipal transportation planning can negatively affect street vendor livelihoods through displacements/relocations because they do not consider urban land use in the planning process.
- The introduction of rapid transport systems can undermine the role played by informal transport workers, reducing their income opportunities
- But equally BRT systems can also free-up otherwise congested spaces, improving transport options and retailing spaces and cutting travel times for everyone.
- The considerations of how poor city citizens seek work opportunities and the spaces in which they operate are vital in creating successful transport plans which cater for the needs of the whole population, and give poor workers opportunities to grow rather than be continually disrupted

ICT

- Different types of ICTs are being developed to support workers in many facets of their work including accessing financial services, communicating with clients, connecting to job opportunities and self-teaching for informal workers. ICTs have also been used by members of membership-based organizations to exchange information and organize.
- Specialized applications which make supply chains more efficient and banking more accessible have also been used to enhance informal workers' productivity and profitability.
- Documentation varies in terms of the positive or marginal impacts of ICT technology on workers:
 - While the ICTs discussed in the studies should serve to have positive impacts for informal workers through simplification of work processes and improved access/communications with clients and markets, in several cases the studies or news stories did not discuss or measure the impacts of said technologies on this sector as yet.
 - There were few if any documented cases of the explicitly negative impacts of ICTs on informal workers. However, one study discussed how differences in access and ownership of mobile phones can create a 'digital divide' between those who are able to converse with suppliers, customers and work providers and those unable to do so.
 - There are however more 'passive' negative impacts of ICTs on work opportunities: there are patterns of exclusion on the basis of language, technical ability, access and factors such as age and gender

- Increasingly accessible and affordable ICTs will likely continue to create disruptions across all of the focal work sectors in the coming years. While many new applications for mobile banking and platforms for connecting with consumers and suppliers are in initial phases or being launched in specific areas, it is possible that these applications could be scaled up or replicated to reach more informal workers across different sectors and regions.

ii) What is influencing the presence, absence, quality and cost of technologies as they impact on work opportunities, at the city level?

The city ecosystem - defined by aspects including policies, infrastructure, zoning, and the regulatory framework - affects workers across sectors and can either mitigate or exacerbate the negative impacts of disruptive technology. An enabling ecosystem can also facilitate the positive disruptive nature of technologies through inclusive policies grounded in an understanding of the unique needs of informal workers.

- The literature shows that low-cost, simple interventions can have significant positive impacts on the lives of informal workers by increasing efficiency and profitability and improving work conditions. Examples of this include technology used by waste pickers to process plastic into 3D printer filament, or solar lanterns that allow street vendors to work in the evening. Increased support for these incremental interventions could create better opportunities for workers across sectors over time.
- Technologies which incorporate the characteristics of *frugal innovation* (discussed in Section 4) – those which are crafted to respond to the local context and offer affordable price points, among other factors – are seen to be more widely adopted and utilised by low-income urban workers.

Energy

- Access to reliable and affordable sources of energy both at home and in informal workers' place of work are important in promoting informal livelihoods.
- Policies of regulation, technology standards, tariffs, subsidies and retailing of inputs all shape - and often constrain - the ability of poor urban workers to access sufficient and reliable forms of energy for productive uses.
- Policies which favour the expansion of grid-based electricity solutions often ignore the needs of informal workers and other sources of clean energy
 - A focus on grid-based access and fixed tariff payments often means that lower levels of energy access, which could be transformative for work opportunities, are not accessible to poor workers. City customers who have higher and more regular usage are the focus of city energy systems due to the agglomeration benefits afforded.
- The special challenges of integrating energy infrastructure in slum areas also poses difficulties, with governments often unwilling to invest in areas which require higher capital costs and minimal returns, due to lower demand (although noting here that this demand is limited by the ability to pay, rather than the need for the service)
- Proximity to input markets and 'trust' in technologies is also seen to shape technology choices – poor quality, but goods can often undermine the nascent markets for such products – somewhat challenging the notion of disruption posed by Christensen (see later section)

Waste

- The type of waste management system selected by cities have impacts on waste picker livelihoods.
 - The deployment of incineration/waste-to-energy technologies have been shown to be a threat to waste picker livelihoods as they decrease their access to waste.
 - Privatization of waste also threaten livelihoods of waste pickers as it can limit access to waste.
- Waste management systems which recognize and include waste pickers and promote recycling have positive livelihoods impacts.
- Some policies which aim to promote waste worker safety and reduce negative environmental impacts can also conversely limit work opportunities and value chain participation for waste workers.

Transport

- Transportation planning policies which do not take into account the multiple uses of streets, sidewalks and transportation systems can negatively impact street vendor livelihoods through displacement/relocations/insecurity;
 - planning for alternative livelihoods instead of relying on relocation of street vendors can create more inclusive and less congested city streets.
- The choice of transportation systems promoted by cities affects workers in different contexts in different ways:
 - New or improved transport systems can create access to new job opportunities, and reduce transport time; and
 - They can also lead to the displacement or relocation of the urban poor as a result of the new infrastructure project.
- Often priority is given to meeting the needs of higher income earners, business owners and 'middle class' citizens, with a focus on improving the speed and ease of inner-city journeys. Connectivity for those living in marginal areas and city peripheries is marginalised in planning, often due to higher costs to reach such areas, and the lower tariffs required to meet the needs of such citizens, resulting in reduced profitability for operators.

ICTs

- Governments can promote the use of ICT by creating competitive regulatory environments among ICT providers to keep costs low for the urban poor.
- Although governments may have ICT promotion strategies, studies highlight how ICT has not yet reached its potential to empower informal workers. High rates of mobile phone ownership, even among urban poor workers, present opportunities for learning, exchange and organizing. However, studies highlight that additional training and specialized applications are needed for ICT to more positively benefit this sector.
- Investments in ICT infrastructure are increasingly focused on upgrading to more modern signal transfer systems (i.e. 4G, 5G), with limited investment in increasing the reach and reliability of 2G and 3G networks utilised by most low-income mobile users.
- Technology developments and investments are significantly skewed towards smart-phone based solutions and apps; yet most poor workers own or have access to more basic handsets offering only SMS and call options, or feature phones with basic internet access, but lacking the power and features of smart-phones.
- Emphasis on smart-phone use fails to recognise the increased energy demands, technical expertise and literacy demands of such devices, rendering them somewhat incompatible with the context in which they are purported to soon be used.

- Nearly all the articles suggested that technology alone was not sufficient to create positive outcomes, but needed to be accompanied by training, facilitation, etc – factors which might also provide a safeguard against the negative effects mentioned above.

iv) How are workers choosing, using and adapting technologies: to create and improve incomes; to enhance productivity; to facilitate organising; to respond to change?

Energy

- Rather than deploying energy technology to enhance their production, street vendors and home-based workers struggle to gain reliable access to electricity to work at all. In response to inconsistent access, workers deploy a variety of alternative sources of energy and light ranging from high to low tech (i.e. candles, rechargeable lights, kerosene, LPG, flashlights or lights from mobile phones.)
- Often the electricity access technologies available and affordable to poor urban workers do not provide sufficient power for income-generating activities, but rather offer other livelihood benefits
- Many workers attempt to illegally connect to existing power lines, but in doing so run the high risk of prosecution for their actions, placing their work opportunities in a more precarious situation

Waste

- Based on the literature reviewed, there was little information which documented informal workers' uses of waste technologies. The exceptions were the case in Kenya where informal waste workers and pit latrine workers have benefitted from selling waste to waste-to-energy bio-centres; and waste pickers partnering with entrepreneurs to turn processed municipal waste into 3D printer fillaments

Transport

- The digital mapping of the matatu system in Nairobi has enabled those running the buses to achieve improved routes, reach hotspot areas, and for pedestrians (often the most poor workers) to avoid areas where incidents occur frequently
- The mapping of the matatu system has also enabled workers to better identify locations for retailing their goods and find more direct routes to markets

ICTs

- In discussing how workers and the urban poor are using ICTs, several studies in fact document that they face barriers to accessing and using mobile phones and the internet. Barriers and constraints cited include high investment and usage costs, language, user capability, appropriate infrastructure and incentives.
- Mobile phones and applications are being used in different ways by different worker groups and to varying degrees. Examples include (among others):
 - Carpenters and cabinet makers in Peru using phones for regular communications with clients;
 - Informal workers using them to organize, communicate information on meetings or alert each other about evictions;
 - Waste pickers in Colombia using phones to manage payments they receive for services from the municipality, to document policy abuse or record important government statements;

- Different informal worker groups from Tanzania, India, Kenya using mobile banking applications
- Anecdotal evidence from partners in Kenya also suggests that mobiles have offered waste workers the opportunity to obtain the market value of their waste products, to help ensure they receive a fair deal for their goods.
- Waste pickers have deployed ICTs to cut out middlemen, increase efficiency and legitimacy and grow profits. Examples include:
 - ICT platforms that connect waste pickers with customers; and
 - GPS mapping technology that presents opportunities for participatory design and planning. By allowing waste pickers to visualize their routes and map their work they increase their legitimacy and bargaining power.
- While articles included in the literature review discuss how workers are using technology, they do not *clearly* demonstrate any specific innovations or adaptations by end users or complementary actors. Though there are examples of frugal innovations throughout the literature, the adaptations and new technologies have been created elsewhere in the product cycle
- This could possibly indicate a particularly ‘closed’ type of technology is available for poor urban workers, with little opportunity for end-user adaptation or augmentation
- Alternatively, it could point towards end-users lacking the skills, capacities or tools to innovate technologies to improve their work opportunities.

In all, one can point to a significant paucity of relevant research in answering this research question. This suggests there exists an opportune research gap, which the *Technology and the Future of Work* project can help to fill.

v) Additional Findings

- The literature suggests there are many ‘nexus’ issues to be found across the different technology and work sectors, with strong links between levels of access, types of technologies and enabling environments. Such nexus issues serve to highlight the interdependence between technology sectors, and the likely need for integrated approaches for achieving inclusive economies. Examples include:
 - Energy and Waste
 - ICTs and Waste
 - Transport and Energy
 - Market systems cross-cutting each sector
 - Issues of sustainable use
- Beyond basic handset mobile phones, and latterly M-Pesa, there are limited examples in the literature of truly widespread disruptive innovations, particularly those which have positively benefited low-income urban workers.
 - This may indicate that the often optimistic heralding of new technologies for poverty reduction may be little more than hype when the barriers to first accessing (and then extracting the full benefits of) technologies remain prevalent.
 - It could also indicate that poor urban workers face capacity constraints to realising the full potential of technologies in their work environments.
 - It may also connote that technology development insufficiently considers and incorporates the needs of poorer users and to fails to provide sufficient opportunities to innovate technologies beyond their original design or use
- Similarly, there is a paucity of examples of inclusive innovation practices to be found in the literature; suggesting that technology developers are missing out on

tapping into high-growth potential markets due to reliance on technology transfer processes over facilitating local production and adapted technologies to meet contextual needs.

- Inclusive economies remain largely elusive as the benefits promised by various technologies are unable to be fully captured by those at the 'base of the pyramid'.
- This appears to arise from a diverse range of constraints, although mostly emanating from the city ecosystem with regard to policy and city-level technology choices.

3.1 Annotated Bibliography on Technology Forecasts of the Future

In this section, annotations will summarize the broad technology trends which are forecasted to affect both poor formal and/or informal urban workers. The annotations cover a range of forecasts relating to the technology sectors of the study, the future of work, and global trends which are shaping patterns of disruptive innovations and technology choices.

Chacko, Roy; 2013. *ILO Symposium for Employers on the Future of Work: Report*, ILO, Geneva

This report summarising the ILO facilitated symposium outlines two major trends shaping the future of work: the polarization of jobs and the decline of the permanent employment contract; and one very important driver of change: technology, which is seen to impact future work in many ways. It noted that technology was less likely to change work opportunities in developing economies in the coming years as labour costs remain lower than technology capital, running and maintenance costs; but that this could change as workers demand improved pay and conditions.

There was clear evidence presented in a range of different contexts which points towards the shifting of jobs to high-skilled and high paid opportunities, and low-skilled and low paid opportunities, with mid-level jobs increasing squeezed – and low-level jobs and work increasingly vulnerable, particularly for young people. The most successful technology-led transformations which induced job transformation had occurred when workers were involved in planning and implementing the transition and made full use of their tacit skills.

The concentration of the symposium on employment and formal labour does limit the analysis and there was little discussion of the impacts on work opportunities for poor and informal workers.

Anderson, Mark; 2014. *Internet.Org App Gets East Africans Online For Free*, The Guardian, <http://www.theguardian.com/global-development/2014/dec/27/internet-org-app-east-africa-online>

A new app enables owners of smart-phones to gain free access to a limited range of Internet services and websites. The article states that increased roll-out of this technology could generate \$2.2 trillion in additional GDP and over 140 million new jobs in Africa.

However, the technology is only available to users of smart-phones, which are significantly more costly to purchase and run than the more basic handsets used by

many poor urban workers. And although the stats of potential growth presented are impressive, the limited number of potential new jobs created are minimal compared to the 4.3bn (globally) people who currently lack Internet access, challenging the assumption that such a technology could genuinely break down digital divides in Africa.

The disruptive potential of this technology may therefore be in improving the work opportunities of some poor urban workers, albeit not the very poorest, although there remains potential for other spill-over benefits and negative impacts.

CNN, 2013. *Creating new space for Dhaka's millions*, CNN, <http://edition.cnn.com/videos/business/2012/05/07/future-cities-dhaka-bangladesh-traffic-a.cnn> (accessed 10th April 2015)

This video report explores the technology choices of future transport systems in Dhaka, which it estimates to grow to over 25m people by 2025 (bigger than Beijing and Mexico City). The report talks of the 'blight' of rickshaws, over 400,000 of which operate in the city, mostly by poor informal workers. They are described by urban planners as detrimental, and such government planners claim their use should be limited in place of high speed rail and bus services. They also note that currently over 60% of all journeys are made by foot, almost entirely by the urban poor. Rather than trying to improve this situation, the planners and reporter talk of creating walkways away from the main streets 'for the poor'.

This appears to demonstrate that Dhaka is not looking to create inclusive economies, and that in fact its technology choices will not only constrain the poor to walking across the increasingly sprawling city, but also remove the vital livelihood opportunities provided through rickshaws - for drivers, mechanics and scrap metal reclamation workers. It will also drive a spatial divide between those able to access and afford modern technological transport options, and those confined to trudging across the ever-busier streets of Dhaka.

European Commission, 2006. *Scenarios for future scientific and technological developments in developing countries 2005-2015*, European Commission, ftp://ftp.cordis.europa.eu/pub/foresight/docs/ntw_scenarios2_report_en.pdf

This report, which covers four world regions, highlights specific needs, challenges, opportunities and risks in each. Broadly, the assessment found that distorting trade regulations and subsidies from developed 'Western' economies significantly stifled technological advancement and research in each region, and deterred further private sector investment and development, which suggests this is undermining poverty reduction strategies.

The report notes that the 'closed' and 'packaged' nature of imported technology places constraints on local actors adapting, re-using, recycling and servicing imported technologies, particularly in Sub-Saharan Africa (SSA) and Latin America; thus creating exclusionary 'technology transfer' systems of dependence, rather than fostering innovation and vibrant economies. In SSA, a lack of sound regulatory standards has led to low-quality products, mostly from China, flooding markets, undermining local producers and degrading confidence in new technologies.

Forum for the Future, 2015. Megacities on the Move: The Future of Sustainable Urban Mobility in 2040, Forum for the Future,
<http://www.forumforthefuture.org/sites/default/files/project/downloads/megacitiesfullreport.pdf>

Exploring the options for megacities to plan their urban transport systems in the coming 25 years, this report highlights some of the factors shaping those decisions, including resource constraints, increased competition for city space from different actors, sustainability issues, and technological development. They highlight the likely role that non-fossil fuel technologies will play, along with ICT-enabled 'smart systems' for tracking and planning routes.

The report also notes the potential disruption caused to informal housing areas, particularly those in potential pathways which connect two or more large cities, and the challenges of expanding transport networks to 'sprawling' slum areas without displacing other informal dwellers. The report advocates for lower-density zonal cities, with city cores replicated into wider areas to be more inclusive of those living on the fringe and potentially merging into proximate urban centres. However, the authors note the pressures this may place on rural land and livelihoods.

Greene, Laura & Mamic, Ivanka; 2015. *The future of work: Increasing reach through mobile technology*, Asia-Pacific Working Paper Series, ILO, Thailand.
http://www.ilo.org/asia/whatwedo/publications/WCMS_342162/lang--en/index.htm

The authors of this report examine the potential disruptive impacts of mobile technologies in developing and emerging economy work sectors in the coming years. Their analysis finds that although there is a strong likelihood that increasingly powerful mobile technologies will proliferate and overtake more basic handsets, leading to expanded opportunities, the biggest change may come from the new types of work available, in particular through impact sourcing and job listing/searching.

They caution that a consequence of this is that there is an increasing gap between 'the standard employment contract' and the reality in the world of work. This contributes to the rise of precarious work, meaning that workers are more vulnerable and worker organizations are weaker, creating a social class they term the *precarariat*, a class of people who lack the traditional forms of labour-related security, strongly correlated with ICT-related working.

The report also summarises specific work opportunities, such as job sourcing platforms for young people (who are also most likely to own and use a mobile phone), and financial transactions services like M-Pesa. They note the rise of feature phones - a bridge technology between basic handsets and smartphones - which are becoming widely available and affordable, opening up new low-bandwidth mobile data services. It also covers some specific case studies of donor-led projects utilising mobiles for improved working conditions.

Lee, Dave, 2014. *Old Laptop Batteries Could Power Slums*, IBM Says, BBC News,
<http://m.bbc.co.uk/news/technology-30345221> (accessed 13th April 2015)

IBM India development lab has worked with local users to create an inexpensive proprietary unit, UrJar, which is able to take power from several used laptop batteries

and convert this combined power into low-level energy supply for small lighting and device charging uses, for example.

At present, however, the technology is still in a pilot stage, so little is known about its impacts. Yet it promises to provide potential small-scale lighting and power provision to low-income users, which could enable both new work opportunities, but also new value chain opportunities for e-waste workers.

McAfee, Andrew, 2014. *What Will the World Look Like in 50 Years?*, WEF, <https://agenda.weforum.org/2014/11/what-will-work-look-like-in-50-years/> (accessed 12 April 2015)

Bloggng for the WEF, the author claims that over the course of the next half-century, around 50% of all jobs will become automated or obsolete. McAfee highlights disruptions arising from the increasing investment in technology over labour, creating increased efficiencies and scale but ‘displacing’ manual workers, particularly in developing economies.

The author takes a controversial stance that we should simply let this change happen, and that having “enough jobs for everyone” should not be the goal of societies. Rather, he calls for societies ‘rich’ with technology, which remove the toil of work, and that technology will, in some as yet unknown way, create ‘new opportunities’, but not necessarily good, decent, safe and rewarding jobs.

McKinsey, 2014. *Disruptive technologies: Advances that will transform life, business, and the global economy*, McKinsey, http://www.mckinsey.com/insights/business_technology/disruptive_technologies

This flagship analysis report picks out 12 ‘economically disruptive’ technology types which may change the nature of business and societies in coming years, according to the metrics employed by the authors. While such technologies are at the cutting edge of science and offer many advances on current practices, the nature of the changes identified in the study are largely targeted at high-end value chains and markets almost exclusively in high-income developed nations. Very little analysis is given to the impact potential of technologies in other markets or value chains, nor at all on the workforces involved.

The result is a dozen supposedly disruptive technologies which appear thoroughly disconnected with the lives of billions of people, potentially driving a further divide between unequal societies. Even the one technology type which could be considered to be of significant relevance to poor urban workers, mobile internet, is considered from the perspective of high-grossing apps, digital marketing and analytics.

Simonite, Tom; 2015. *Microsoft Starts Slashing African Internet Prices with White-Space Networks*; MIT Technology Review, <http://goo.gl/TWxJb1>

A new technology pioneered by Microsoft and partners in Ghana utilises unused radio frequencies to provide faster, more reliable and cheaper internet access. This is particularly useful for those accessing the Internet via mobile phones, and can be used to provide connectivity to people and areas where installation of physical cabled connections is difficult or expensive. The cost of connection is 80% cheaper than

existing methods and thus could enable poor workers to access and transmit necessary information more rapidly.

The article suggests there will be opportunities for other workers to act as sales representatives retailing small bundles of data, increasing work opportunities. However, it appears that this may disrupt the sales opportunities of those retailing mobile data top-ups and SIM cards. Partnerships with the Kenya and Botswana governments to introduce this technology have also been struck.

Thomas, Robert J; Klass, Alex; Davarzani, Ladar; 2014. *From Looking Digital to Being Digital: The Impact of Technology on the Future of Work*, <http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-Impact-of-Technology-April-2014.pdf> (Accessed 11th April 2015)

This report highlights the changing nature of work processes and practices as a result of increasing proliferation of and advancement in digital technologies. The report suggests that such technologies will enable manufacturing and engineering firms in particular to 'augment' many aspects of their work.

While likely increasing the efficiency, precision and productivity of the work, this increasingly digital and automated type of work is likely to lead to significant shifts in labour requirements - leading to far fewer low-skilled jobs, but potentially more high-skilled jobs, particularly in the area of analytics. There is also the potential for numerous pieces of machinery to be remotely controlled from anywhere in the world. This poses many potential risks for poor and/or informal workers in developing countries, as such technologies diffuse to companies located around the world.

Townsend, Anthony; Jeffrey, Lyn; Fidler, Devin; Crawford, Mathias; 2011. *The Future of Open Fabrication*, Institute for the Future, http://www.iftf.org/uploads/media/SR-1390_FutureOfOpenFab.FINAL_sm.pdf

This report has a strong focus on the role of 3D printers in future work processes and opportunities. Compared to other similar reports, it takes a more conservative view of the potential of such machines and processes, highlighting the likely long timescale before cheap printers, components and designs are readily available worldwide. They also note that size and time constraints mean applications for 3D printers will likely reside in modelling, testing, and specialised small-batch production, rather than being the highly-disruptive innovation heralded by other proponents. In particular, the authors see the limited access to high-bandwidth internet for many poor workers in developing countries as a medium-term barrier for widespread adoption of the technology.

Nonetheless, they also highlight the potential opportunities in emerging economies for distributed manufacturing, which would cut down on transport costs and challenges to get products to market faster and cheaper, potentially opening opportunities for increased and localised work opportunities. The opportunity to reverse-engineer and then replicate goods could ignite new value chains, reduce the dependence on imported goods, and increase servicing opportunities - also minimising waste.

Vota, Wayan; 2014. *Hey Google, Forget Smart Cars, Think Smart Matutus for Kenya*, ICT Works, <http://www.ictworks.org/2015/01/07/hey-google-forget-smart-cars-think-smart-matatus-for-kenya/>, (accessed 10th April 2015)

This blog post draws upon participatory research led by the IFRC in Nairobi to explore new technologies for disaster response and improved livelihoods. The participants highlighted the potential for integrating the technology pioneered by Google in its 'smart cars', and the big data analytics potential of transport planning championed by smart city enthusiasts, into Nairobi's informal *matutu* transport network. The article highlights the potential for such a system to improve the connectivity of informal workers, reduce transport costs, and improve the safety and livelihoods of *matutu* drivers, passengers and pedestrians. However, the author notes that this is speculative and may be some years - if it all - before it becomes reality.

Weaver, Abi *et al*, 2015. *A Vision for the Humanitarian Use of Emerging Technology for Emerging Needs: Strengthening Urban Resilience*, IFRC, <https://drive.google.com/file/d/0B1vf6TLGIC0yZk9UU2t2UGFmNIE/view>

A summary report of a large-scale international exploration of the potential impact of emerging technologies which may or may not improve or undermine urban resilience in the coming years. 8 specific technologies were selected for further analysis. Those relevant to this review include:

3D printers, which were seen as having potential for improved job creation among poor workers, once costs drop further in the near future and a greater volume of open-source designs are available for users, reducing the need for advanced manufacturing skills. This could potentially disrupt a whole range of markets and value chains, as goods are made locally, at lower cost and adapted for specific needs.

Robotics were considered less likely to be disruptive in developing economies, either at firm or consumer levels, due to their high costs, complex technical operation, expensive and limited maintenance options, and because beyond a select few industries, they were believed to offer limited added value over other technologies and manual labour in production processes. Smart cars, particularly autonomous vehicles, were seen to possibly pose a threat to existing informal transport systems, but only if regulations favoured their use over other forms of transport, for example giving them priority road status.

3.2 Key Findings on Technologies of the Future

- Many of the emergent technology trends documented in the literature assume a process of either significant 'technology leapfrogging' in developing economies, or simply eschew the issue of the basic needs of poor urban workers through dogmatic belief in the power of innovative technologies alone to drive positive social change, despite the predicted disruptive nature of such technologies on work opportunities, with potentially negative as well as positive outcomes.
- Common across the reports surveyed is a lack of foresight as to the interdependent nature of complementary technologies necessary for the benefits of technological advancements to 'trickle down' to the working poor. This includes:
 - The need for increasing access to improved electricity supplies to charge more power-hungry ICTs;

- Significantly expanded and improved transport linkages and options to connect workers to job opportunities across cities, despite rapidly increasing pressures for land and transport access in the face of unprecedented rates of urbanisation; and
- The need for inclusive market approaches for facilitating more and decent work opportunities within inclusive economies, where labour drives growth enabled by technologies, as opposed to technologies alone driving macro growth through improved production efficiencies; ultimately creating wealth and prosperity for the few rather than for the many.
- Workers may need to increase their collective voice and actions in cities to ensure their technology needs for improved work opportunities are both heard and met by city stakeholders
 - Some technologies may also enable this, particularly ICTs
- Global trade systems continue to focus on technology transfer of ‘packaged’ and ‘closed’ technologies, which stymie opportunities for highly disruptive local innovations and adaptations
 - Some technologies, such as 3D printing, could offer a way around this. But 3D printers themselves are a product of the same systems, so may face similar barriers to achieving wide-scale adoption and disruption

4 Debates on Key Concepts

This section provides annotations of literature which debate some of the key concepts of the project, namely, disruptive technology and innovation, frugal innovation and inclusive economies. The intention of this section is to advance our understanding of these concepts based on the debates in the literature.

4.1 Disruptive Technology and Innovation

Caballero, Ricardo; *Creative Destruction*, MIT, <http://economics.mit.edu/files/1785>

Creative destruction refers to the incessant product and process innovation mechanism by which new production units replace outdated ones. It was coined by Joseph Schumpeter (1942), who considered it ‘the essential fact about capitalism’. The process of Schumpeterian creative destruction (restructuring) permeates major aspects of macroeconomic performance, not only long-run growth but also economic fluctuations, structural adjustment and the functioning of factor markets.

Christensen, Clayton; *Disruptive Innovation*, <http://www.claytonchristensen.com/key-concepts/> (accessed 12th April 2015)

Disruptive innovation, coined by Clayton Christensen, describes a process by which a product or service takes root initially in simple applications at the bottom of a market and then relentlessly moves up market, eventually displacing established competitors. An innovation that is disruptive allows a whole new population of consumers at the bottom of a market access to a product or service that was historically only accessible to consumers with a lot of money or a lot of skill.

Characteristics of disruptive businesses, at least in their initial stages, can include: lower gross margins, smaller target markets, and simpler products and services that may not

appear as attractive as existing solutions when compared against traditional performance metrics. Because these lower tiers of the market offer lower gross margins, they are unattractive to other firms moving upward in the market, creating space at the bottom of the market for new disruptive competitors to emerge.

Lepore, Jill; 2014. *The Disruption Machine: What the Gospel of Innovation Gets Wrong*, The New Yorker, <http://www.newyorker.com/magazine/2014/06/23/the-disruption-machine> (accessed 12th April 2015)

In a polarising article, Lepore critiques Christensen's model of disruptive innovation, and finds little evidence of such processes, or that the examples of 'disrupted' firms Christensen refers to remain leading companies in their respective fields. She criticises disruption as a dogmatic pursuit of change or a catch-all term to make processes which have been in existence for decades or longer seem more progressive and to whet the appetite of potential investors. Lepore claims that "innovation is the idea of progress jammed into a criticism-proof jack-in-the-box".

Lepore asserts that disruptive innovation is a theory of why some businesses fail, and not a theory of change, nor a mantra for progress and continual improvement and efficiency. While her article was widely championed, from sources including the Economist and Business Insider, many others challenged her analysis, including Christensen, and pointed to the evolution of the theory (and the analysis of the case studies) since Christensen's first publication.

The Economist, 2014. *The Third Great Wave: Special Report on the World Economy*, The Economist, <http://www.economist.com/news/special-report/21621156-first-two-industrial-revolutions-inflicted-plenty-pain-ultimately-benefited> (accessed 7th May 2015)

This analytical think-piece describes that the world is undergoing a third industrial revolution, driven by the increases in efficiencies and productivity and the wide range of new types of work as a consequence of ever more pervasive and more complex technology. But it warns of a worrying trend of a decoupling of growth and development, where technology is no longer used to increase wages and new work opportunities through improved output and performance, but rather a "yawning chasm" between the highest skilled workers who are well placed to grasp new opportunities and harness the power of new technologies, and the vast number of low and unskilled workers whose work opportunities will be marginalised or destroyed as a result of new technologies.

It suggests that it is likely that the best developing economy governments can do is to regulate to ensure that new technological advances and changes in work activities and opportunities leads to "broad benefits to society". It finds through a range of global evaluative studies, that "technology isn't working" to improve jobs, productivity and realise development. It concludes that "most workers are therefore being forced into competition both against each other and against machines. No wonder their share of the economic pie has got smaller, in developing economies as well as in the rich world."

Summary

One can see that there is a contested notion of disruption. This is also reflected in the literature reviewed in Section 2 of the report. It must be noted that in most terms, disruption is thought of at a firm level – i.e. new processes, products and technology disrupting established business models. But the concept is beginning to be used to

understand and describe disruption across value chains and sectors too, particularly in relation to work opportunities through indirect changes to the means by which work is undertaken and how business takes place, often catalysed or exacerbated by technologies.

4.2 Frugal Innovation

Harris, John, 2014. *The confounding influence of urban informality on innovation and production specialisation in production clusters: evidence from Nairobi*, African Journal of Science, Technology, Innovation and Development, Volume 6, Issue 6

This report finds that the composition of informal economies, individualistic competition arising out of 'subsistence light manufacturing' - negating agglomeration effects - and high levels of entrepreneurial risk, stifle innovation. Very few informal workers or businesses responded that they had adopted or adapted new technologies in recent years, compared to much greater positive responses about adopting or developing new designs or products.

These results suggest that the high density of activity offered by cluster (slum) locations does not correspond to high degrees of new technology development or new design production. Not only do informal firms appear to innovate or adopt technologies at lower rates than formal firms, but even those which do have constrained opportunities due to informal market policies.

Larkin, Martina; 2014. *Davos Briefing: Disruptive Innovation*, WEF, <https://agenda.weforum.org/2014/01/davos-briefing-notes-disruptive-innovation/> (accessed 12th April 2015)

The author argues that Disruptive Innovation's key benefit is often that of making previously out-of-reach products affordable to a broader audience, in a "job-creating" way for those at the 'base of the pyramid'. Larkin also points to the unsettling outcomes of disruptive innovations, such as changing the business needs of its labour force, necessitating different skills. Thus disruptive innovations may not only disrupt a value chain, but potentially also entire education and training systems.

The author is staunchly positive about the impacts of disruptive technology innovation, particularly in poverty reduction, but provides no examples of how this may actually occur.

Pansera, Mario; 2013. *Frugality, Grassroots and Inclusiveness: New Challenges for Mainstream Innovation Theories*, African Journal of Science, Technology, Innovation and Development, Volume 5, Issue 6, pp469–478

The objective of this paper is to provide an overview of the alternative innovation paradigms that are emerging in the developing world, and explore the potential for 'innovation blowback' - where frugal innovations spread to become disruptive in developed economies. The author suggests that truly disruptive frugal innovation has to be designed to do more with less and for more people; rather than simply undercutting an existing commodity.

Pansera finds frugal innovation initiatives are mostly carried out by small enterprises where informality and personal contacts are very important. They tend to be more unstable and unpredictable than formal networks but also more resilient.

Pavan Soni, Rishiksha T. Krishnan; 2014. *Frugal innovation: aligning theory, practice, and public policy*, Journal of Indian Business Research

The paper has three key findings. First, frugal innovation comprises of a frugal mind-set, a frugal process and a frugal outcome, which may be practiced distinctly. Second, frugal innovators are of three types: grassroots-level, domestic-enterprise level, and MNC-subsidiary level. Each has their distinctive incentives and styles of frugal innovation. Third, a frugal mind-set is encouraged by resource-scarce environments, weaker institutional intermediaries, and a higher tolerance for uncertainty.

Rao, Balkrishna C; 2013. *How Disruptive is Frugal?*, Technology in Society, Volume 35, Issue 1, pp65-73

This article examines a range of frugal innovations and frugal innovation processes in India to explore their disruptive nature in relation to other innovations. It describes a frugal innovation as an iterative change in a product or business model which occurs in a scarcity-induced context, covering scarcities of knowledge, finances, institutions and socio-economics. They are also defined as minimalist, and often reverse-engineered improvisations, emerging out of necessity rather than desirability.

What differs in the cases highlighted in this article is that these frugal innovations are also often high or good quality. Disruptive innovations are considered by Christensen to be of lower cost *and* quality in the first instance, but which can rapidly proliferate markets. This quality issue is challenged by the author. Rao also finds that in many cases, frugal innovations are more environmentally sustainable and have a more 'open' nature than other technologies.

Summary

The notion of frugal innovation (or *jugaard*) has developed over time and is now a prominent term in understanding new modalities of technology development. What the literature in Section 2 suggests though is that often this frugal innovation is created not by the end users, but others elsewhere in the sector or value chain who have better access to inputs, resources, skills and knowledge.

The notion of iterative design, a focus on needs (including especially cost) over aesthetics, and functionality over productivity, helps define frugal innovations. What is yet to be seen is many larger technology developers adopting such principles to reach new audiences globally, with most frugal innovation occurring through re-engineering at local levels, which helps provide highly contextualised innovations.

4.3 Inclusive Economies

David Fine et al, 2012. *Africa at Work: Job Creation and Inclusive Growth*, McKinsey

This macro report on African countries' potential for creating inclusive economies points to some of the barriers and issues facing many countries. In particular, it highlights the

potential 'demographic dividend' of a young and increasingly educated population, but also that the continent would need to grow jobs faster than anywhere else in the world to realize this. It also suggests nations should take a somewhat utilitarian approach and focus on specific high-inclusive-growth potential and labour-intensive sectors, rather than attempting to achieve inclusive growth across the entire economy.

The report suggests focusing on removing regulatory barriers to enable SME's in such sectors to grow, and focusing investment on improving vocational training schemes for all which will provide the necessary skilled labour force needed to fulfil the emerging job opportunities. It argues against a focus on GDP growth alone, as this is likely to lead to increased focus on investments and policies in resource extraction industries, which employ less than 1% of the workforce across the continent.

Dobbs et al, 2012. *The world at work: Jobs, pay, and skills for 3.5 billion people*, McKinsey, http://www.mckinsey.com/insights/employment_and_growth/the_world_at_work (accessed 12th April 2015)

This report highlights the challenges facing developing countries in ensuring that they are able to create inclusive and prosperous economies in the coming years. The report notes the challenges deriving from global megatrends such as 'youth bulges', particularly in urban areas, and growing needs for skilled labour coupled with reduced demand for low and unskilled labour, often in areas with populations where education and training will be insufficient (at current rates) to meet the needs of business and industry.

The report places a strong emphasis on the need for improved education and training opportunities for new labour market entrants, but says little about crafting policies to structure economies to be more inclusive and responsive to the available labour forces. Thus their vision of inclusive economic planning is one where the state creates workers in response to perceived business needs, rather than vice-versa. But the slow nature of such educational transformation could leave an entire generation jobless and excluded from the benefits of predicted growth.

Klasen, Stephan; 2010. *Measuring and Monitoring Inclusive Growth: Multiple Definitions, Open Questions, and Some Constructive Proposals*, ADB Sustainable Development Working Paper Series, Number 12, Asian Development Bank

This study is a literature review of "inclusive growth" terminology within the Asian Development Bank and beyond. Klasen seeks to create a more refined and coherent definition, and following this, a framework to monitor inclusive growth across Asian economies.

Klasen proposes to define an income growth episode as "inclusive" when it allows participation and contribution by all members of society, with particular emphasis on the ability of the poor and disadvantaged to participate in growth; and is associated with declining inequality in non-income dimensions of well-being that are particularly important for promoting economic opportunities, including education, health, nutrition, and social integration. Growth rates for predefined, disadvantaged groups (e.g. ethnic minorities) to be at least as high as growth rates for per capita incomes, and expansions of non-income dimensions of well-being should exceed that average rate for pre-defined disadvantaged groups. Non-income dimensions include schooling achievements; improvements in survival rates; improvements in nutritional status; and access to

transport, communications, and household services (e.g., clean water, electricity, refuse removal); this would ensure that an income growth episode was disadvantage reducing.

Rockefeller Foundation, 2013, *Constrained Opportunities in Slum Economies*, Rockefeller Foundation

A thorough report on the role of slum-based economies, the impacts of slum economies on livelihoods, and the barriers to improving the situation of slums. It includes a useful glossary of terms and key facts and figures on the role and composition of cities, slums and informal economies. It analyses the systemic enabling environment and areas where there are dynamic movements towards sustainable solutions. In particular, improved data and analytics for informed urban planning and mobile technologies enabling new work opportunities are highlighted, alongside inclusive transport systems such as cable cars connecting slums with productive areas. It also notes the drive of city governments to pursue 'world-class' and 'smart cities', rather than focusing on 'inclusive cities'.

It highlights a range of private-sector led approaches to creating more inclusive economic opportunities, such as micro-franchising and SMS-based job listings, but states that little is being done at a policy level to support more inclusive economies, and that resilience-building activities for slum dwellers have yet to have significant impact. The success of integration and formalisation of waste pickers across Latin American countries is noted as a trailblazing example of inclusive approaches. Interventions for inclusive economies are categorised as: community organizing, advocating for policy or institutional change, promoting access to quality jobs (for example via information sharing, value chain integration, or skill upgrading), and promoting access to resources for enterprises.

Summary

These articles point towards a notion of inclusive economies being characterised by decision-making which puts the interests of all citizens central, and focuses on growth at all levels of sectors, rather than focusing on headline output and GDP growth. Creating policies and taking decisions which enable the poorest workers to grow their enterprising activities and crafting enabling regulations for firms to grow to increase jobs appears vital in creating inclusive economies. What remains less clear are the ways in which new work opportunities are ensured to be decent, reliable and provide sufficient incomes.

4.4 Smart Cities

Datta, Ayona; 2014. *India's smart city craze: big, green and doomed from the start?* The Guardian, <http://www.theguardian.com/cities/2014/apr/17/india-smart-city-dholera-flood-farmers-investors> (accessed 7th May 2015)

This article analyses the current state of development of one of the planned 24 'smart cities' in India, Dholera. It finds that there is little that is currently 'smart' about the city, beyond the planned integrated public systems. It highlights that the geography of the land is unsuitable for large built urban development, that it will exclude many of the poorest and least advantaged, and provide opportunities (post construction) almost exclusively for those with higher education.

The author also point towards the uprooting of thousands of people who currently live on the planned development land, and the eradication of their livelihoods and homes. The analysis highlight the contestation of “smart, but for who?”

Caldaza, Igor; Cobo, Cristobal; 2015. *Unplugging: Deconstructing the Smart City*, Journal of Urban Technology, Volume 22, Issue 1, pp 23-43

The author poses a new framework for conceptualising Smart Cities, which encompasses “investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure, which fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance”. Thus a smart city entails the coupling of digital technologies and political governance systems in a deeply entwined way. The author notes that thus far, the social adoption of technology and technological evolution occur at highly dissimilar rates, suggesting significant socio-technical misalignment in so-called Smart Cities.

The author critiques current plans of Smart Cities as non-inclusive, top-down, master-planned visions shaped around the needs of elites, rather than the needs of ordinary citizens, often driven by visions of connected and centrally managed communities by corporate companies. The author raises the question that in many current Smart City plans, there is little articulation of how citizens can engage with and control the information generated by their daily activities, and that they are rather subjects to be managed by city governments and local enterprises; thus exacerbating a ‘digital divide’.

Sethi, Mahendra; 2014. *India needs to be clever about smart cities*, East Asia Forum, <http://www.eastasiaforum.org/2014/10/02/india-needs-to-be-clever-about-smart-cities/> (accessed 7th May 2015)

The author states that current models of creating smart cities are too standardised, and do not reflect the local context, cultures and compositions of city locations; both the technologies used and the system of utilising them. They argue that investments in smart cities are coming at the expense of basic infrastructural needs of millions of India’s urban citizens, and that work opportunities will be largely limited to many strata of society.

The author sees many potential benefits of smart cities in creating responsive and informed decision-making and governance processes, but only if smart cities are founded on sustainability, metrics, adaptiveness, reporting and technology for inclusiveness (a new acronym for SMART).

Anderson, Mark; 2015. *Kenya's tech entrepreneurs shun Konza 'silicon savannah'*, The Guardian, <http://www.theguardian.com/global-development/2015/jan/05/kenya-technology-entrepreneurs-konza-silicon-savannah> (accessed 7th May 2015)

This article examines the pros and cons of Konza, a new smart city focused on creating ‘digital jobs’, on the outskirts of Nairobi, acting as somewhat of a ‘satellite city’. The aim is to create a hub for digital innovation and over 100,000 new jobs. But many commentators worry that the city is driving investment away from supporting burgeoning technology innovation systems in Nairobi, and equally that infrastructural investments at Konza are coming at the expense of providing basic services to the millions of slum dwellers in Nairobi. And while the assumed creation of jobs is generally welcomed, the

lack of inclusion of workers and citizens not involved in technology-focused jobs is alarming. Thus it would appear that the challenge for Konza and other ‘tech cities’ and ‘smart cities’ will be in creating inclusive economies, not just new jobs.

Béllisent, Jennifer; 2010. *Getting Clever About Smart Cities: New Opportunities Require New Business Models*, Vendor Strategy, Forrester Publishing

This report covers a range of characteristics of smart cities, as well as some of the issues and challenges inherent in their design and application for businesses, government, and poor citizens. It highlights that truly smart cities not only leverage the power of ‘big data’ analytics to optimise systems and services, but craft the application of these systems and services to meet the varied needs of its constituent members as best as possible. It notes how energy systems and power loads can be managed to control output, and how energy-deprived areas can be mapped to better focus interventions.

The thrust of the report though is to highlight the myriad opportunities for private sector organisations to integrate into smart cities. However, this throws up questions of legitimacy of such an approach, in particular worries about how business motives may supersede motives of governance.

McQuillan, Dan; 2014. *Smart slums: utopian or dystopian vision of the future?* The Guardian, <http://www.theguardian.com/global-development-professionals-network/2014/oct/06/smart-slums-smart-city-kenya-mapping> (accessed 7th May 2015)

This report explored how technologies often associated with smart cities impact, both positively and negatively, upon poor slum dwellers in Nairobi. It highlights how taking the best elements of smart city approaches, particularly those which focus on citizen-driven decision-making processes, could both empower slum dwellers and also improve service support and delivery in those areas. But the author cautions that projects that simply add visibility without agency risk reinforcing the (negative) status quo. It may also be that sensors and smartness paradoxically limit citizenship rather than extending it, if citizens just participate by generating data, and real decisions are made elsewhere.

The article highlights that technology alone does not make a location – city or slum – smart. It takes concerted effort, planning, support, training and a thorough re-imagining of governance and decision-making, facilitated by technologies. The article does not however address the issue of ownership of technology, or issues around data security.

Summary

The notion of Smart Cities has rapidly gained traction as the technologies which underpin them – micro-sensors and big data analytics – have become increasingly pervasive and affordable in recent years. The notion of improved decision-making by being more informed, more rapidly responsive and the automation of many actions and decisions through such technology is extremely appealing to city governments.

What these articles highlight are that smart cities are only truly smart when technology is combined with participatory planning, and concerted support and facilitation to enable all citizens – and not just the government – to utilise the data and decision-making potential of the smart technologies.

5 Conclusion

This literature review set out to assess the broad range of published literature pertaining to the key issues and technologies being addressed with the forthcoming *Technology and the Future of Work* research project. The aim of the review was to get a deeper understanding of what is currently known about this relationship between technologies and work opportunities, how these contribute towards creating inclusive economies, and how visions of the future and key concepts are shaping decisions in cities.

It is evident from the literature reviewed here that technology has the potential to disrupt work sectors and value chains in powerful and often unexpected ways. But who 'wins' and 'loses' from such changes often appears to be dependent upon the degree to which workers are involved in the design and governance of the technology changes and systems. Moreover, the degree with which workers can adapt and innovate technology to better meet their needs appears to be strongly associated with the ability to improve work opportunities and wellbeing.

From the many articles espousing visions of the future reviewed here – and those in the accompanying compendium of related articles – it is apparent that technology, in particular 'hi-tech' hardware, is at the forefront of many stakeholders' visions of future cities and future work opportunities, often manifesting in the moniker of creating smart cities. Yet reflecting upon the above evidence, these grand visions of a technologically enabled, smart, efficient and prosperous world cannot be achieved if the masses of poor urban workers are excluded from the processes which bring about change, if work opportunities are squeezed to provide high quality jobs for only the highly skilled and educated and low quality and insecure work for those at the 'base of the pyramid', and if technologies are not created and used in sustainable ways.

This literature review has highlighted that there is a significant gap in the research which truly examines how technology enables or hinders decent work opportunities for poor urban citizens, and a clear lack of analysis of how various systems at city, national and global levels shape technology choices and how these manifest as inclusive or exclusionary equalities. This provides a clear window of opportunity for the *Technology and the Future of Work* to contribute towards answering these unknowns, furthering understanding of what is needed to craft inclusive economies, and putting the voices, experiences and perceptions of poor urban workers at the forefront of debates and decisions which will shape the future of cities.

Glossary of Key Terms

Disruption: the process by which a new innovation - be it a technology or business model - root initially often at the bottom of a market and then rapidly proliferate a market and transforms established 'business as usual' practices, usually to the detriment of the work practices of those firms involved in established processes and markets, but which may create new value chains, work opportunities and products. An innovation that is disruptive allows a whole new population of consumers at the bottom of a market access to a product or service that was historically only accessible to consumers with a lot of money or a lot of skill.

Frugal innovation: an iterative change in a product or business model which occurs in a scarcity-induced context, covering scarcities of knowledge, finances, institutions and socio-economics. They are also defined as minimalist, and often reverse-engineered improvisations, emerging out of necessity rather than desirability. They are often characterised by being of lower cost and lower quality than established technologies.

Informal economy: the diversified set of economic activities, enterprises, jobs, and workers that are not regulated or protected by the state and the output from these activities, enterprises, jobs, and workers.

Informal employment: informal employment refers to employment without legal and social protection—both inside (i.e. in informal enterprises) and outside the informal sector (i.e. for formal firms or households) (Chen, 2012).

Informal sector: the term refers to the production and employment that takes place in unincorporated small or unregistered enterprises (Chen, 2012).

Technology: broadly speaking technology refers to the tools and equipment used in the work process, know-how, and ways of organizing around the use of tools and equipment. Technology is classified into three categories: hardware, software and orgware. *Hardware* refers to physical tools and equipment, *software* refers to the skills, knowledge and processes which are involved and required in using technology while *orgware* (or organisational technologies) refer to ownership of a technology or the institutional arrangements of an organization or a community where a technology will be used.

Technology justice: The right to choose and utilise technologies necessary to lead the lives people value, without preventing others, both now and in the future, from doing the same." Technology Justice comprises four key aspects: Access, Appropriateness, Sustainable Use, and Inclusive Innovation.

Work opportunities: While for formal workers, the term "work opportunities" connotes the creation of jobs or paid employment opportunities, for informal workers, "work opportunities" requires a broader connotation of opportunities to earn an income or livelihood, through self-employment or paid employment. And opportunities for self-employment need to include the opportunity or right to use and access public spaces and resources in order to earn a living.