Technology and the Future of Work

Experiences of informal waste workers and street vendors in Dhaka, Lima, and Nairobi

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The role and importance of technology in informal work opportunities and livelihoods is little understood or explored. Technology can be a great enabler, helping people to do more, better. But it can also threaten livelihoods and work opportunities and drive social inequality. Through a year-long project supported by the Rockefeller Foundation, Practical Action and WIEGO (Women in Informal Employment: Globalizing and Organizing) have explored the disruptive impact of technologies on informal workers, examining the technologies themselves and the influence of cities, work, and systems. At the heart of the research are the perspectives and experiences of poor urban workers in waste picking and street vending sectors in cities at different stages of development, providing a platform for their voices and issues to be integrated into global debates. This policy briefing presents evidence of the barriers to and opportunities for realizing Technology Justice for urban informal workers.

Summary

New, innovative technologies have the potential to positively or negatively impact the wellbeing of informal workers. This places the system of rules and incentives that guide technological innovation at the centre of the development challenge. Technologies are pervasive in all work sectors and in all aspects of work, including informal work, and technology upgrading is often considered a crucial means to improve the decency of work, productivity, and scale. Yet the role and importance of technology in informal work opportunities and livelihoods is little understood or explored (Casey et al., 2015).

The rapid growth of cities globally, particularly in developing countries, is placing huge pressures on governments to respond to the growing demand for decent, stable, and profitable urban work opportunities. There exist in every city huge networks of informal work, covering almost every sector, which sustain the city's economy and provide livelihood opportunities for poor urban dwellers. These livelihoods are often characterized by marginalization, vulnerability, fragility, and instability.

Through a year-long project supported by the Rockefeller Foundation, Practical Action and WIEGO (Women in Informal Employment: Globalizing and Organizing) have explored the disruptive impact of technologies on informal workers, examining the technologies themselves and the influence of cities, work, and systems. The Technology & Future of Work project explored how the working poor are able to mitigate the negative livelihood impacts of technology disruption, or harness technologies to create new work opportunities in five cities in the global South (Ahmedabad, India; Dhaka, Bangladesh; Durban, South Africa; Lima, Peru; and Nairobi, Kenya).

Technologies were not found in themselves to generate work opportunities. Rather, several sectors are seeing the introduction of technologies which – while making productivity gains and decreasing manual labour in particular work processes – have the potential to displace informal workers. Only those who are able to gain relevant skills to operate mechanized technologies, invest in technologies themselves, or harness the positive transformative power of such technology developments will be able to benefit. The workers likely to bear the biggest cost of the introduction of new technologies are those that are the most vulnerable: informal workers, in particular women.

The research uncovered hotbeds of frugal innovation in each city

However, developments in certain city-wide technologies, including improved energy access, improved telecommunications, and more inclusive transport systems, can all help to expand and improve existing work opportunities, and make them more decent and more stable. Moreover, the research uncovered hotbeds of frugal innovation in each city, as workers made the most of the resources at their disposal to improve both the efficiency and the decency of their work. The groups who were most able to capture the benefits of technologies and innovate were those that were able to organize and collectively bargain for greater technology access, or collectively invest in new technologies.

Creating stable environments in which workers can invest in new technologies is crucial to enabling more inclusive economies, supporting new, better work opportunities, and achieving Technology Justice. Characteristics of such enabling environments include secure land tenure and/or secure places of work in public areas (including for safe storage of technologies), equitable access to basic services, regulations which recognize and support informal workers, targeted skills training opportunities, and innovative financial access initiatives which target informal urban workers.

Introduction

Through a year-long project supported by the Rockefeller Foundation, Practical Action and WIEGO have explored the disruptive impact of technologies on informal workers, examining the technologies themselves and the influence of cities, work, and systems.[1] The Technology & Future of Work project explored the following questions:

1. How are informal workers choosing, using, and adapting technologies to:
   (a) create and improve incomes,
   (b) enhance productivity,
   (c) facilitate organizing,
   (d) respond to change?
2. What is influencing the presence, absence, quality, and cost of technologies?
3. What are the positive and negative impacts of technology on work opportunities, and how do they differ between women and men?

Technologies are pervasive in all work sectors and in all aspects of work, including informal work, and technology upgrading is often considered a crucial means to improve the decency of work, productivity, and scale. Economies often face a trade-off between labour-saving technologies and labour-linking technologies to boost productivity while maintaining employment levels (Basu, 2016). While it is acknowledged that technology is less likely to change work opportunities dramatically in developing economies in the coming years – as labour costs remain lower than technology capital, running and maintenance costs (Chacko, 2013) – there are nonetheless many predictions of the transformational potential of emerging technologies to eradicate poverty (Casey et al., 2015: 30–36). Yet the role and importance of technology in informal work opportunities and livelihoods is little understood or explored. Technology can be a great enabler, helping people to do more, better. But it is also a mirror of social inequality.

The research uses the perspectives and experiences of poor urban workers in the waste picking and street vending sectors in three of the five research locations – Dhaka, Nairobi, and Lima. It uses the frame of Technology Justice (Meikle and Sugden, 2015) to analyse equitable access to technologies, means of inclusive innovation, and the sustainable use of technologies.

A total of 974 informal workers were asked to tell a story, or 'micro-narrative', of how a technology had enabled, hindered, or changed a work opportunity. Their stories were recorded in text, video, and picture formats in an analytical software programme, SenseMaker® (Cognitive Edge, 2016). Workers were then asked to signify their stories by answering a series of questions, marking their responses on a set of triads and dyads. These narratives were then aggregated for comparison purposes across different regions and sectors to interrogate the impact of different technologies, trends, and emerging patterns on worker livelihoods and opportunities. This paper is based on the results of this data, and supplemented by wider project findings detailed in Casey and Hughes (2016).

What influences technology choice?

Opportunity

The stability of work is the overriding critical factor in technology choice

Contrary to many assumptions, the choice and use of technologies by most informal workers is not driven by the potential for greater monetary returns. Rather, the stability of their work opportunities, even ones which are relatively poorly remunerated, is the predominant critical factor, with just 12 per cent of respondents strongly signifying 'income' compared to 66 per cent strongly signifying 'work opportunity' (see Figure 1). Working environments are often insecure and unstable, in part because of harassment of informal workers by local authorities. This is a major influence on the choice of technologies, with workers often choosing 'low tech' options, which are cheaper, portable, and more easily replaced in the face of loss or damage. Creating supportive environments in which workers can invest in new technologies is crucial to enabling more inclusive economies.

A male street vendor in Dhaka, Bangladesh, has to use a manual machine to process the sugar cane juice as the motorised machine was considered too bothersome by local authorities. Credit: Mary Carenbauer.

Informal workers with the least ability to invest securely in new technologies were found to be the most transient across work sectors. Thus, creating opportunities for workers to invest securely in technologies can also facilitate their ability to improve their work opportunities within one stable sector. This can foster a greater connection to that work and coerce a greater propensity to invest in relevant technologies for that sector.

For wage employees, the cost of technologies is not of primary concern compared with the productivity offered and the know-how needed to utilize technologies (see Figure 2). This is likely because the technologies are largely owned by the employers (74 per cent) rather than the employees (26 per cent). Nonetheless, the workers still make choices in their activities. This is exemplified by the following story, which indicates why 'opportunity' was the overriding factor for the group of 39 respondents highlighted in Figure 2.
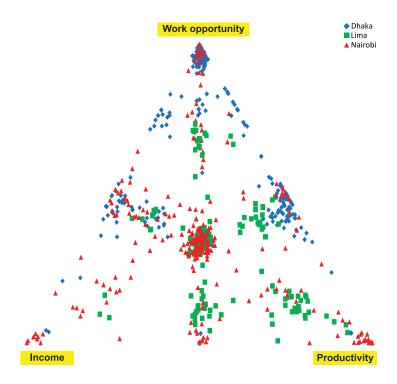
Figure 1 Factors of importance in technology choice

My name is Shaowam. I have been a city waste worker for eleven years. Before this I was a *tokai*, a person who picks waste from the street. For better income and new job opportunity, I shifted to a waste collector from household level. At first I collected waste through van. It was flexible to collect waste from household. It is easy to ride the van and it is safe for me. But if I take the van from the van owner then I have to pay 5,000 Taka (US $64). My monthly salary is 10,000 Taka with additional income from selling (non-perishable) items is 5,000 Taka. But I need an assistant for driving the van. I have to pay this assistant half of my salary (5,000 Taka). The assistant is not satisfied with his salary. However, there is no opportunity for another work for me or him. And I have no possibility to increase the salary.

It is notable that the vast majority of wage workers (81 per cent) are male, highlighting the challenges faced by female workers in seeking regular wage employment in informal economies. Cultural norms, religion, and economic disempowerment compound to consign women to the more hazardous work in harder to reach areas, with more limited access to technologies and limited support to respond to shifts in labour skills demands within and across work sectors (Casey and Hughes, 2016).

Knowledge

In the right-hand cluster of Figure 2 are 15 responses from females, from both Dhaka and Nairobi. The stories indicate that 'know-how' primarily influenced the choice of technology – albeit mostly as a result of a *lack* of knowledge about using other technologies, for example driving vans or using waste compacting machines. This is in contrast to the 33 male respondents in this cluster, for whom knowledge was the key to enabling them to utilize a particular technology; for example stories talk of the knowledge of being able to repair waste vans and food trucks, which frequently break down.

Even though this job is difficult, I don't have the skills for another kind of work so I must do this. (Female waste worker, Dhaka)
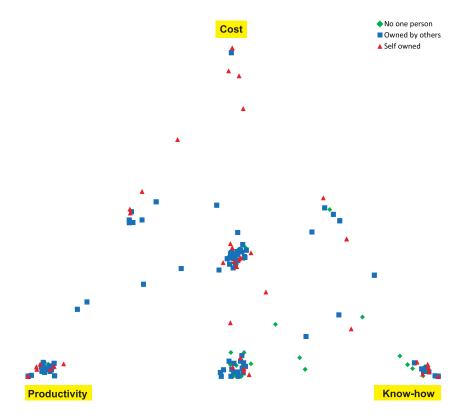
Cost

Productivity　　　　　　　　　　　**Know-how**

Figure 2 Factors influencing the choice of technologies of wage workers

This exemplifies the need to address critical skills gaps for female informal workers, who often face greater barriers in accessing basic education and skills training schemes. In doing so, this would support female informal workers to grasp emerging new work opportunities and improve the decency of their existing work by enabling them to utilize new technologies for enhanced efficiency, productivity, and innovation.

Addressing critical skills gaps would support female informal workers to grasp new work opportunities

A waste worker in Lima, Peru, using his bespoke waste collection vehicle. Credit: Bami Dagu

Safety

The ability of technologies to reduce the drudgery associated with many of the working practices of informal workers was extremely important. Ease of use and safety are critical issues in Dhaka, with over 90 per cent of all stories strongly signifying these issues (see Figure 3). Waste pickers and street vendors alike talked of the need to have technologies which were easily transportable across badly maintained roads, and to be able to move rapidly from one area to another when removed from their place of work by local authorities.

Many of these stories from Dhaka are signified as negative, and highlight the occupational health hazards associated with their work. The lack of organization among informal waste workers in Dhaka in comparison with Lima and Nairobi limits the workers' abilities to access and utilize personal protective equipment (PPE). Waste workers in Dhaka often spoke of a cultural stigmatization around the use of PPE, exclaiming those who use it 'are not friends of the waste', and that most PPE was impractical for their needs. Women waste workers in Dhaka also explained how it is a social norm that they are *tokai*, waste pickers, while men are waste collectors, often leaving the women to work in much more precarious and unsafe conditions.

This highlights the need for education initiatives among informal waste workers, and for city governments to ensure safety provisions are put in place to support the thousands of people who serve cities each day through waste collection. It also demonstrates that workers themselves need to be involved in the design and selection of technologies necessary for their work, rather than being subject to technology transfer of goods assumed to fit their needs. Moreover, the need for mobility drives technology choice

A female waste picker walks through a *dustbin* waste dumping area searching for recyclable materials in Dhaka, Bangladesh. Credit: Mary Carenbauer
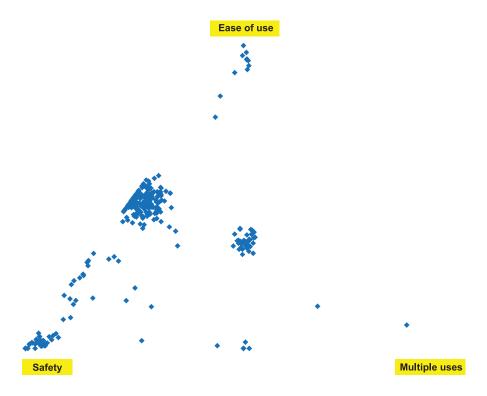
Ease of use

Safety

Multiple uses

Figure 3 Factors determining technology choice in Dhaka

among street vendors, largely because of the insecure access to public spaces to work for informal food vendors. Thus, city policies which do not accommodate informal street vendors are limiting both workers' technology choices and their ability to harness productivity and opportunity gains from newer, better technologies.

Yet city policies can also be positive and empowering. In Lima, where district municipalities such as Los Olivos have included waste picker associations as part of the waste management system, waste pickers work more safely. They have better conditions than other parts of the city: for example, they work during the daytime, wear uniforms and PPE, and have designated spaces to store their carts. This creates more decent work opportunities and greater work security.

Secure storage space for informal waste workers in Lima, Peru. Credit: Bami Dagu

Seasonality

Over 280 workers signified that the choice of technology in their stories was predominantly due to both income and work opportunity (see Figure 1). These stories were frequently related to the ability to work and to gain income throughout the year, in both the food vending and waste sectors. The technologies chosen were often of lower value, as workers were transient between different types of informal work – often moving between waste work and street vending – and thus felt less invested in specific work activities or sectors, or had no secure means to store multiple 'sets' of technologies for different types of work.

Digital divides

In Nairobi, the cultural and economic shift towards digitized services and systems is helping to drive technology change among many informal workers. Over 80 per cent of respondents from Nairobi indicated that they used mobile phones in their work, including soap vendors, water vendors, and waste workers. The availability of affordable phones and mobile operator services, coupled with innovative software platforms which utilize the SMS functionality of the basic phones owned and used by many poor informal workers, has created an enabling environment for mobile phones to emerge as a technology which is changing the nature of work in Nairobi.

A customer shows how to report an issue using the *Maji Voice* system on their mobile phone in Nairobi, Kenya. Credit: Megan Douglas

> I used to use NCWSC (Nairobi City Water and Sewerage Company) water meters, and only the staff could explain how they worked. Now, we can pay bills through the phone, and see how many units of water we have used. The technology has made it very easy to access the meter. Also, Maji Voice (SMS mobile phone app) allows me to voice a complaint, connect with customer care (at the NCWSC); your meter can be fixed, the installation of the meter can be made easier, and your complaints can be recorded for reference. The reference gives us legal safety, in case you have to raise an issue in court. There was a time that they (the city government) were making a sewage line near where we had our pipes. The city tractor broke the pipes. We used Maji Voice, and they came in five days to fix the problem. (Male water vendor, Nairobi)

This signals that, as the use of mobiles becomes increasingly prevalent among informal workers in other cities, governance systems based on information and communication technologies (ICTs) could be a useful way to enable more inclusive economies and respond to the needs of the poor. However, the Maji Voice system, in its current state, is not responding to the needs of informal water vendors and is working against inclusive economies in the water service sector; only 'registered' water vendors can be included in the system, despite the fact that 60 per cent of citizens in Nairobi are served by informal, unregistered vendors. Including informal vendors in this system could not only improve water service delivery across the city and informal settlements, but also create enhanced economic opportunities for informal water vendors and increase their work security (Douglas, 2015).

In Nairobi, ICTs are the central tools of the soap and water vendors. Mobile phones are used not only for organizing and communicating with suppliers, and indeed customers, but also crucially for digital money payments through the M-Pesa system, which has made mobile technologies a vital tool for improving work opportunities in Nairobi. As one female soap maker explained:

> I have been making soap for six months, and have been using my mobile phone for my business for one month. Before, I didn't have any customers who would use a mobile phone to contact me. Now my customers use the mobile phone to call me when they are ready for me to go to them and they can also pay me money they owe me for the soap. I also call my customers to let them know I have soap to sell, or to remind them to pay me, as most buy on credit. Having a mobile phone makes my work easier in terms of connecting with my customers. (Female soap vendor, Nairobi)

Mobile payments and digital services are only just beginning to emerge as a technology in other cities (Casey and Hughes, 2016: 13–16), and no respondents in Dhaka and Lima cited their use. But given the impacts this has had on multiple work sectors in Nairobi, in terms of increased work opportunities, increased security (by not having to handle cash), and more reliable informal credit options, as highlighted in the story, one can identify this as a key potential trend in positively changing work opportunities in other areas. But this must be coupled by the socialization of the technology, trust in the technology systems, and supportive regulations. These findings corroborate a USAID study on financial inclusion in India (USAID, 2016). Governments must also take care to ensure that a transition to digital access to services does not exclude those without ICTs, in particular women; internet usage in Nairobi was just 20 per cent among women in a recent CNN survey (Brudvig, 2016).

Frugal innovation

Street vendors in all three cities faced constraints in investing in new technologies, particularly in relation to spatial limitations. Water vendors and soap makers in Nairobi complained of both a lack of space to store and use new technologies, as well as insecurities over land tenure and theft (Douglas, 2015). As informal settlements are frequently torn down, and many residents in slums and informal settlements have no land titles for their properties, they shied away from investing in new technologies which could easily be removed or destroyed as they are forced from place to place. Equally, the lack of adequate housing and secure storage options posed a threat to those wanting to invest in new technologies over fears they could be easily stolen.

The awareness of new technologies, the far greater role of local entrepreneurs, and the great deal of technology innovation and adoption of newer technologies in Nairobi and Lima

(see Figure 4) appears in large part to be due to the far greater role played by intermediary or 'meso-level' organizations – researchers, NGOs, community-based organizations, youth groups, and others. This is exemplified by the story of a waste worker from Nairobi:

The community used to dump their trash in the river. So we came together (Viwandani Pamoga Youth Group), and our *kijiji* (village) elders supported us. We started in 2008, and partnered with Jhpiego, Ministry of Health, PS Kenya and the Viwandani Comprehensive Community Organization to fund our work. The shredder breaks down the waste plastics. Every community now has garbage sorters for metals, plastics and organics. The aim of the project is to empower youth. We work with 20 youths weekly, rotating each week, and train them in the process and how to use our three shredders. The shredded plastic is then sold at the market for around 40 shillings (USD 0.40) per kilogram. We hope to someday get a pelletizer, because plastic pellets sell for 120 shillings per kilogram. (Male waste worker, Nairobi)

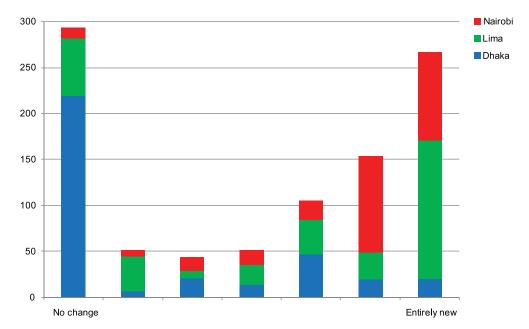A waste worker in Nairobi uses a plastic shredder. Credit: Megan Douglas

Figure 4 'How has technology changed in your work in recent years?'

While Nairobi provides a snapshot of a city bustling with innovation and entrepreneurship, the structural difficulties faced by informal waste workers and street vendors (and others alike) highlight that without supportive institutions and contexts, opportunities to craft inclusive economies will be stifled. In Lima, where market vendors and many waste workers have space to store their technologies securely and the right to work and operate in certain locations, there is greater investment in higher technologies and more workers earn higher incomes: 79 per cent of participants in Lima earned over USD 6 (PEN 20) per day, compared with 41 per cent in Nairobi and just 33 per cent in Dhaka.

Urban migration

Special considerations need to be made to provide targeted support to new urban migrants

The issue of urban migration intersecting with poverty and work opportunities was particularly prevalent among street vendors in Dhaka. All of the stories signified as 'negative' came from recent migrants to the city, and workers signified that their stories had negative impacts on themselves and 'others like them'. This highlights that special considerations need to be made to provide targeted support to new urban migrants, who face challenges in integrating into their new environments and have comparatively fewer resources than their incumbent city counterparts. Initiatives which build their social capital and facilitate access to financial services could be critical to ensuring that these new workers are included in decent work opportunities in their new cities.

Conclusions

This research leads us to a number of conclusions about the conditions that drive and shape the nexus between technology change and the future of informal work opportunities. It reinforces our understanding that informal workers, and the world's poor more generally, lack equitable access to existing technologies. It helps us to understand some of the reasons underlying this, and the systemic barriers that need to be dismantled in order to achieve Technology Justice and realize the potential of technology to contribute to improved livelihoods and work opportunities.

Ultimately, city and national governments must make choices between pursuing a dogmatic drive towards rapid, maximised GDP growth utilizing high technologies, and inclusive growth with targeted support for poor informal workers. There are trade-offs to be made either way, but if ending poverty in all its forms is truly a priority, then a focus on supporting workers at the base of the market pyramid and facilitating their ability to utilize new technologies is critical to achieving this.

Equitable access to basic services

The presence or absence of equitable access to public goods and services shapes work opportunities, livelihoods, and informal workers' ability to use or adapt technology. Where they have access to public spaces, such as the market vendors and *emolienteros* (vendors of traditional herbal tea products) in Lima, they are more likely to invest in 'high' technologies and tools, versus those that lack access, such as other street vendors in Lima.

Similarly, equitable access to public or basic services such as affordable and reliable electricity is essential to informal livelihoods and directly affects how, when, and whether certain informal workers, for example street vendors in Dhaka, choose to use particular technologies in their work, including rechargeable batteries and lighter stoves rather than cleaner LPG stoves (Casey and Hughes, 2016).

Inclusion of informal workers in public policy

The inclusion of informal workers in the delivery of public goods and services, such as water and waste management, is critical to enabling workers to sustain livelihoods, while also providing services to populations unserved or underserved by public means. Informal workers often represent the majority of the urban workforce in developing cities but are frequently excluded from public policies and laws. Therefore, they face myriad problems including confiscations, harassment, and arrest, creating a vicious cycle where they face instability and insecurity in their income and livelihoods and are unable to accumulate any form of capital or savings to be able to invest in technology or other items with the potential of improving their livelihoods and work opportunities.

The critical role of organizing

The research has shown that organizing is a key pathway to facilitating informal workers' ability to access technologies, to capture the full benefits of technological change, or to mitigate the negative impacts of particular technologies. Organizing supports workers not only to act together to advocate for regulatory change towards greater work stability and inclusion in more formal work systems, but also to share technical knowledge, jointly adapt and innovate technologies, and collectively invest in more modern or 'high'

> Organizing helps workers to share knowledge, innovate, and collectively invest in new technologies

technologies and/or storage space for them. Both help workers to act together to progress beyond basic tools and precarious livelihoods.

Access is driven by responsiveness of city systems

The research indicates that, in most cases, justice in access to the technologies workers need to live decent and improving lives and to enable them to undertake decent and secure work, is not being achieved. Informal workers are limited in accessing technologies by a range of compounding and interlocking determinants: a lack of opportunities to attain the necessary skills and knowledge to operate new technologies, a lack of adequate resources (safe storage, means of transport, know-how) to utilize technologies, and often above all else the cost of new or improved technologies in relation to the workers' incomes and 'room' to take risks and investments, which is compounded by the exclusion of informal workers from many financial systems.

Workers' potential for creating sustainable economies and utilizing technology sustainably is curtailed by their systematic exclusion from central policies and regulations. For example, street vendors are being denied the opportunity to utilize more sustainable technologies, such as clean cookstoves, as they are kept constantly mobile by their lack of secure public spaces to operate.

Empowered workers can be not only vital providers of key city services, but also dynamic drivers of change for inclusivity and economic growth, operating at the crux of multiple value chains. As the informal economy grows in each city, particularly with new urban migrants seeking better livelihoods and better incomes, a focus on empowering workers to harness the potential of technologies could be important to ensure those city economies develop and grow in inclusive and equitable ways.

Achieving Technology Justice

To truly achieve Technology Justice, to create empowered and decent livelihoods, and to craft inclusive, growing economies, measures should be taken to be inclusive of the needs, realities, and innovative, entrepreneurial potential of informal workers, rather than focusing on technology transfer of already created and non-modifiable technologies from elsewhere. This can to a great degree be achieved by improving and supporting worker knowledge systems and peer-to-peer learning platforms.

Note

1. For terminology relating to informality, informal work, and informal economies, the paper will use the terms as defined by Chen (2012).

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Cover photo: An *emolientero* serves his traditional herbal tea in Lima, Peru *Credit*: Bami Dagu

Keywords: informal work, innovation, inclusive economies, urbanization, technology

ISBN 978-1-85339-949-7