Women in Informal Employment
Globalizing and Organizing

TECHNOLOGY AT THE BASE OF THE PYRAMID: INSIGHTS FROM AHMEDABAD (INDIA), DURBAN (SOUTH AFRICA) AND LIMA (PERU)

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Report of the WIEGO Network Component of the Technology and the Future of Work Project undertaken by Practical Action and WIEGO with support from the Rockefeller Foundation

Technology is a key driver of change, not least in the world of work. In today's global economy, trends in technology and trade have led to changes in the system of global production and exchange and to reductions in the employment intensity of growth; and, thereby, to changes in the nature of work and the structure of labor markets; all of which have contributed to an increase in informal employment (Kanbur 2014). Yet little is known about what technologies are used by – or impact on – the working poor in the informal economy, and in what ways. With funding from the Rockefeller Foundation under its Inclusive Economies goal, Practical Action, a UK NGO which seeks to promote technology justice, and WIEGO, a global network which seeks to empower the working poor in the informal economy, partnered on a research project designed to investigate what technologies are currently impacting – and are likely to impact – on the livelihoods of the working poor in positive or negative ways; how the working poor are responding to these impacts; and what technologies they need to enable their work, enhance their production, and secure their livelihoods.

This report presents the research findings of the WIEGO network and local partners in three cities: the Indian Academy of Self-Employed Women in Ahmedabad, India; Asiye eTafuleni in Durban, South Africa; and a local research team in Lima, Peru supported by WIEGO and the Programa Laboral de Desarrollo (PLADES). Part I details the research design, including research questions, methods and sample. Part II presents the research findings; Part III summarizes the key findings. Part IV discusses future scenarios regarding technology and informal work; and presents a future vision for economic inclusion, technology justice, and empowerment of the working poor in the informal economy.

I. RESEARCH DESIGN

For the joint project, Practical Action and the WIEGO network conceptualized "technology" broadly and consistently with literature that conceives of technology along three dimensions: first, physical tools and equipment; second, the skills, knowledge and processes required to use them; and third, the ownership or institutional arrangements around their use. The project was designed to focus on those technologies that are relevant to the work process in a wide range of informal occupations.

The study was designed to explore:

- existing technologies available and used by the working poor in the informal economy, which may be innovated, adapted and used in new ways to improve the productivity, safety, or other aspects of their work
- existing technologies which are not widely accessible to and used by informal workers due to various barriers, which may be innovated upon or made more accessible; and the possible positive and negative disruptive repercussions they may have on city economies and value chains
- emerging technologies which have the potential to significantly transform the work and livelihood outcomes of informal workers in the near future, and the ways they access and organize around new and dynamic work opportunities
- existing and emerging technologies which may remain inaccessible to the working poor in the informal economy, and may create positive and/or negative outcomes for them: for example by displacing work opportunities or decreasing value chains strongly related to informal work.

Research Questions

The key research questions interrogated by both Practical Action and WIEGO were:
1. How are informal workers choosing, using and adapting technologies (a), to create and improve incomes, (b) to enhance productivity, (c) to facilitate organizing, and (d) to respond to change?
2. What is influencing the presence, absence, quality and cost of technologies as they impact on work opportunities, at the individual, sector, city and global levels?
3. What are the positive and negative impacts of technology on work opportunities, and how do they differ between men and women?

Above and beyond tools and equipment used in the work process, the WIEGO network also examined four city-wide "technological systems" known to impact on informal workers and their livelihoods, and likely to play a major role in the future of informal work:
1. Energy. How will energy shape the future of different groups of informal workers? How can we empower informal workers to participate in the emerging, alternative energy economy?
2. Transport. Will informal workers be able to challenge and sensitize transport planning to meet their needs? What role will low-energy transport play in the future of cities?
3. Waste. Will future technologies for collecting, disposing and recycling waste be pro-poor? Will informal workers be empowered to participate in emerging waste collection and treatment developments to ensure they benefit from them?
4. Information Communication Technologies: How can/do informal workers use ICTs to enhance their livelihoods? How can/do informal workers and their organizations use ICTs to organize and mobilize for improve work opportunities?

The project uses the term "informal employment" (interchangeably with "informal work") in accordance with the 2003 International Conference of Labour Statisticians definition: that is, as all employment arrangements that do not provide the worker with social protection through their work (for more on definitions see Chen 2012).

Research Methods

The WIEGO network and its partners in the three study cities developed and used the following five methods.

- **Focus Groups:** 7 tools developed by WIEGO – modified version of Focus Group tools developed by WIEGO with Caroline Moser, a well-known urban scholar, for earlier WIEGO-led study in 10 cities of changes in the urban informal economy.
- **Photo Documentation:** "4 Turns & Technological Asset" (4T & TA) – developed by urban architect-planner, Richard Dobson, of Asiye eTafuleni in Durban, South Africa.
- **Phone Survey**: developed by WIEGO – conducted with 18 organizations of informal workers around the developing world to get a wider comparative understanding of technological change and adaptation in the informal economy.
- **Micro-Narratives**: in-depth interviews with a dozen informal workers (4 from each city) chosen from the Focus Group sample; following a set of questions developed by WIEGO, to get in-depth understanding of the dynamics of technological change and adaptation at the individual level.
- **Key Informant Interviews:** with local organizers, academics, policy makers and other stakeholders to help interpret-and fill gaps in -the research findings

For write-ups of the Focus Group tools and 4T & TA documentation method, see Appendix I.

Research Sample

The ways in which technologies are inserted into the work process vary considerably by the type of work being done. Therefore, the WIEGO research team structured its sampling strategy around a few key occupational groups, or "sectors," that are common in each local economy. In each city, for each sector, four Focus Groups with five workers each were conducted: with 20 workers per sector times four sectors, the sample in each city was 80 workers and the total sample across the three cities was 240 workers (both women and men). The 4T & TA photo documentation was done of the same sample (Table 1).

Table 1
Occupational Sectors Sampled by City

Ahmedabad	Durban	Lima
construction workers	barrow operators	market porters
garment makers	garment makers	market traders
incense stick rollers	street vendors	street vendors
waste pickers	waste pickers	waste pickers

This report also draws on the findings from a 2012 study in 10 cities, including Ahmedabad, Durban and Lima, by WIEGO and local partners designed to interrogate what is driving change in the urban informal economy and how urban informal workers respond to change (WIEGO nd). This study is known as the Informal Economy Monitoring Study (IEMS).

II. RESEARCH FINDINGS

Context

The informal economy represents a large share of the urban economy in the three study countries: 80 per cent in India (Chen and Raveendran 2014), 67 per cent in Peru (INEI 2012) and 26 per cent in South Africa (Budlender 2011). And the occupational groups in the study sample represent a significant share of the urban informal workforce in those countries. In India, construction workers, home-based producers (including incense stick rollers and garment makers) and waste pickers represent around 30 percent of the urban informal workforce (Chen and Raveendran 2014). In Peru, informal traders account for 28 percent of total informal employment, of which nine per cent are street vendors; another one percent is engaged in waste picking (Herrera et al 2012). In South Africa, nearly 30 percent of the urban informal workforce is in trade, as either street vendors or market traders (Budlender 2011).[1]

To understand the study sample, it is useful to consider status in employment and place of work as well as occupation. In terms of status in employment, some of the sample are *self-employed* (most street vendors in Durban and Lima, most market traders in Lima, and most waste pickers in all three cities), some are *wage laborers* (notably construction workers and incense stick rollers in mechanized units in Ahmedabad), while others are *sub-contracted workers* (many

[1] Data on market porters in Peru and garment makers and waste pickers in South Africa are not available.

home-based garment makers and most incense stick rollers in Ahmedabad). No matter their status in employment, most informal workers are subordinated to more dominant actors in their supply chains: street vendors to wholesalers from whom they buy stock; waste pickers to scrap dealers to whom they sell recyclables; construction workers to lead firms and their recruiters; sub-contracted garment makers and incense stick rollers to lead firms and their contractors.

A defining feature of most informal workers is that they do not work in so-called "standard" workplaces – such as factories, firms, offices or shops. Rather, they tend to work in *private homes* (as home-based workers in their own homes or as domestic workers in the homes of others) or in *public spaces* (streets, open areas, natural markets, and construction sites). Many street vendors work in *natural markets*, areas of cities where vendors and hawkers have congregated over the years due to the steady flow of pedestrians – potential customers – through the area. These natural markets tend to form in and around transport nodes, residential areas or public institutions such as schools, hospitals, wholesale markets or sport complexes. These natural markets generate other livelihood activities such as, in the case of Warwick Junction in Durban, for barrow operators, transport workers, garment makers and waste pickers. Often, as in all three study cities, these open air natural markets are located around historic wholesale markets. Informal market traders operate from stalls in built wholesale or retail markets, as in the Early Morning Market in Durban.

In Lima, the relocation of the major wholesale market led to a major dislocation, not only of the wholesale market traders, but also of the street vendors and market porters. The original location of the wholesale market was very strategic: adjacent to the city's thriving garment district, and at the confluence of the city center and the major highway leading to the countryside. As such, it was the center of metropolitan business transactions and social and financial networks, and generated a wide range of work opportunities for the urban poor. While working conditions are cleaner and safer at the new market, which is located in a district well outside the city center, the impact of the 2012 relocation has meant that, even today, the commercial and social dynamics at the former location have not been entirely rebuilt, and the poorest central-city vendors and their organizations have been weakened.

Among some sectors of informal workers, there is a hierarchy of workplaces. For instance, among street vendors, some vend from baskets or mats on the ground, others from pushcarts of various types and sizes, still others from carts some of which feature display units, and yet others from kiosks or other semi-permanent structures. And, among waste pickers, some collect and source waste from homes or offices, others from the street or municipal bins, still others from collection depots or landfills. Each place of work is associated with its own opportunities, costs and risks to the workers. See photo collages of workplaces in each study city.

Photos 1
Typical Workplaces: Ahmedabad



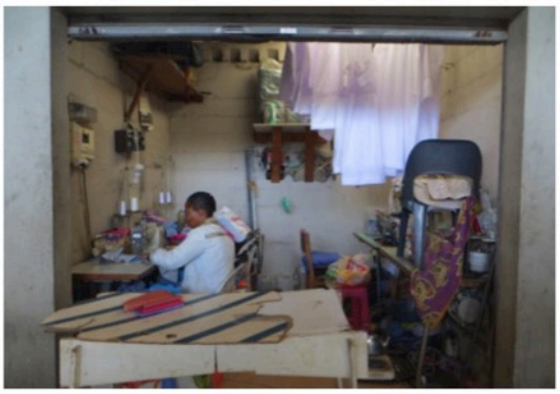





Photos 2
Typical Workplaces: Durban

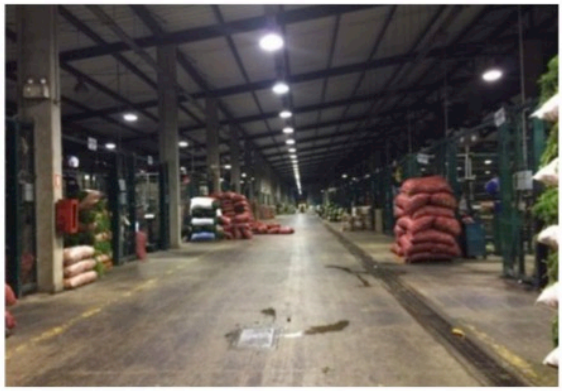







Photos 3
Typical Workplaces: Lima







Work Technologies

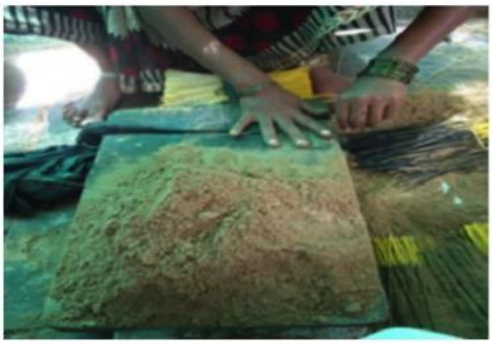
In this study, as noted earlier, work technologies are defined as the tools or equipment that workers, specifically informal workers, use in their work, and related know-how and skills. The study examined both existing technologies and new or emerging technologies, as well as technologies that are fading or being displaced. Significantly, in some focus groups, workers' initial perceptions of what the term "technology" meant was something that was unfamiliar or unattainable to them: for example, one group of waste pickers in Durban were reluctant to say what they thought the term "technology" meant (Durban, WP, FG 10); another group said "technology is for the young ones." (Durban, WP, FG 11); a group of barrow operators understood technology to be "things that work with machines." (Durban, TW, FG 14); and a group of mielie cookers said technology refers to "the use of brain or nowadays things" recognizing mobile phones as "nowadays things" but saying they did not use them in their work (Durban, TW, FG 15).[2]

Existing Technologies

The common tools used by informal workers in their work are quite basic across the three study cities (Table 2). The common tools include: a polypropylene or jute gunny *sack* to collect and transport waste (waste pickers); a shallow *metal basin* for carrying bricks and cement (manual construction workers); a *trowel* (masons); a *wooden board* for hand-rolling incense sticks (incense stick rollers); a hand-pushed *barrow* or *trolley* (market porters and waste pickers); *cooking vessel*, *stove* and *fuel* (street food vendors); a *scale* (street vendors and market traders); and an *electric sewing machine* (garment makers). In Lima, some informal workers are using slightly more sophisticated technologies; for example, some of the market porters have manual forklifts or stackers, and some market traders have been able to invest in refrigerated display cases. See photo collages of existing and emerging tools in each study sector/city.

[2] It is also worth noting that one of the groups of barrow operators was worried about sharing any information about their barrows, because they feared that the findings produced through this study would be shared with municipal authorities who would then confiscate their barrows and leave them without a livelihood.

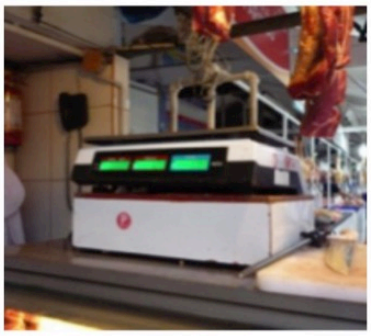
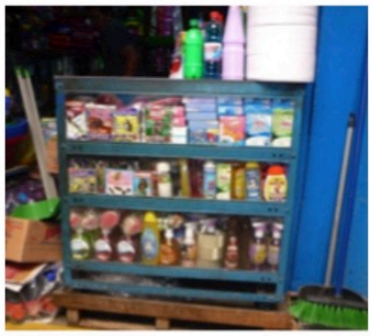
Photos 4
Existing & Emerging Technologies: Ahmedabad

Sector	Existing Tools	Emerging Tools
Garment Workers	 	 
Incense Stick Rollers	 	 

Photos 4 (continued)
Existing & Emerging Technologies: Ahmedabad

Sector	Existing Tools	Emerging Tools
Construction workers	  	  

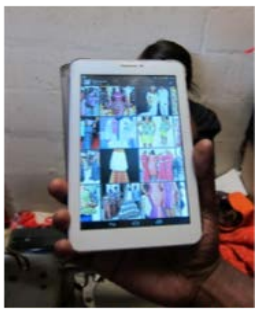
Photos 5
Existing & Emerging Technologies: Lima

Sector	Existing Tools	Emerging Tools
Market Porters	   	
Market Vendors	   	

Photos 5 (continued)
Existing & Emerging Technologies: Lima

Sector	Existing Tools	Emerging Tools
Street Vendors		
		
Waste Pickers		

Photos 6
Existing & Emerging Technologies: Durban

Sector	Existing Tools	Emerging Tools
Mobile Communication		
Shoe Making		
Recycling Carts		
Vending Scales		

Photos 6 (continued)
Existing & Emerging Technologies: Durban

Sector	Existing Tools	Emerging Tools
Vending Carts		
Sewing Machines		
Carpentry Tools		

Table 2
Top Three Tools by Sector and City, Most Common Tool by Sector (Focus Groups)

Sector	Ahmedabad	Durban	Lima	Most Common Tool in Sector
Construction Workers	**Manual Workers:** hoe sieve – for sifting sand basin/pan – for carrying bricks & cement ***Tradesmen*:** Trowel plumb line	—	—	**Manual Workers:** basin/pan *Tradesmen*: trowel
Garment Makers	electric sewing machine scissors needle & thread	electric sewing machine scissors needle & thread	--	electric sewing machine
Incense Stick Rollers	**Hand Rollers:** wooden board basin/pan knife **Machine Rollers:** rolling machine spanner/wrench bucket	—	—	**Hand Rollers:** wooden board **Machine Rollers:** rolling machine
Market Traders	—	_	scale display case knife/axe	Scale
Market Porters/ Barrow Operators	—	barrow or trolley rope spare wheels	pallet manual forklift hammer	
Street Food Vendors	—	**Mealie Cookers:** drum/water bricks/fuel protective gear	**Fruit Vendors:** scale cart + umbrella knives	
Street Vendors	—	___	scale basket hand truck/dolly	
Waste Pickers	sack rope knife	sack rope trolley	sack trolley 3-wheel cart	sack

Source: Technology and the Future of Work WIEGO Focus Groups (2015)

No matter how basic, each tool of the trade has an inherent value to its users. In Ahmedabad, a widowed waste picker stated that her sack is her "life" and a home-based incense stick roller

stated that her wooden rolling board is her "god". See Boxes 1 and 2 for what the focus groups in Ahmedabad and Lima had to say about the inherent value of the basic tools they use.

Box 1
Inherent Value of Basic Tools
Ahmedabad, India
(Focus Groups)

Construction Workers	"We cannot work without a hoe and metal basin. Since the beginning we have been earning with the use of these tools only." (Ahmedabad, CW, FG 2)
Garment Makers	"We need needle and thread. Our work cannot be done without these." (Ahmedabad, GM, FG 4)
Incense Stick Rollers	"The wooden board is god for us." (Ahmedabad, IS, FG 1); "We use the wooden board every day for rolling incense sticks. It is our livelihood." (Ahmedabad, IS, FG 2)
Waste Pickers	"The sack is our life. For me, the sack is everything." (Ahmedabad, WP, FG 3); "For us, a sack is most important." (Ahmedabad, WP, FG 4)

Source: Technology and the Future of Work WIEGO Focus Groups (2015)

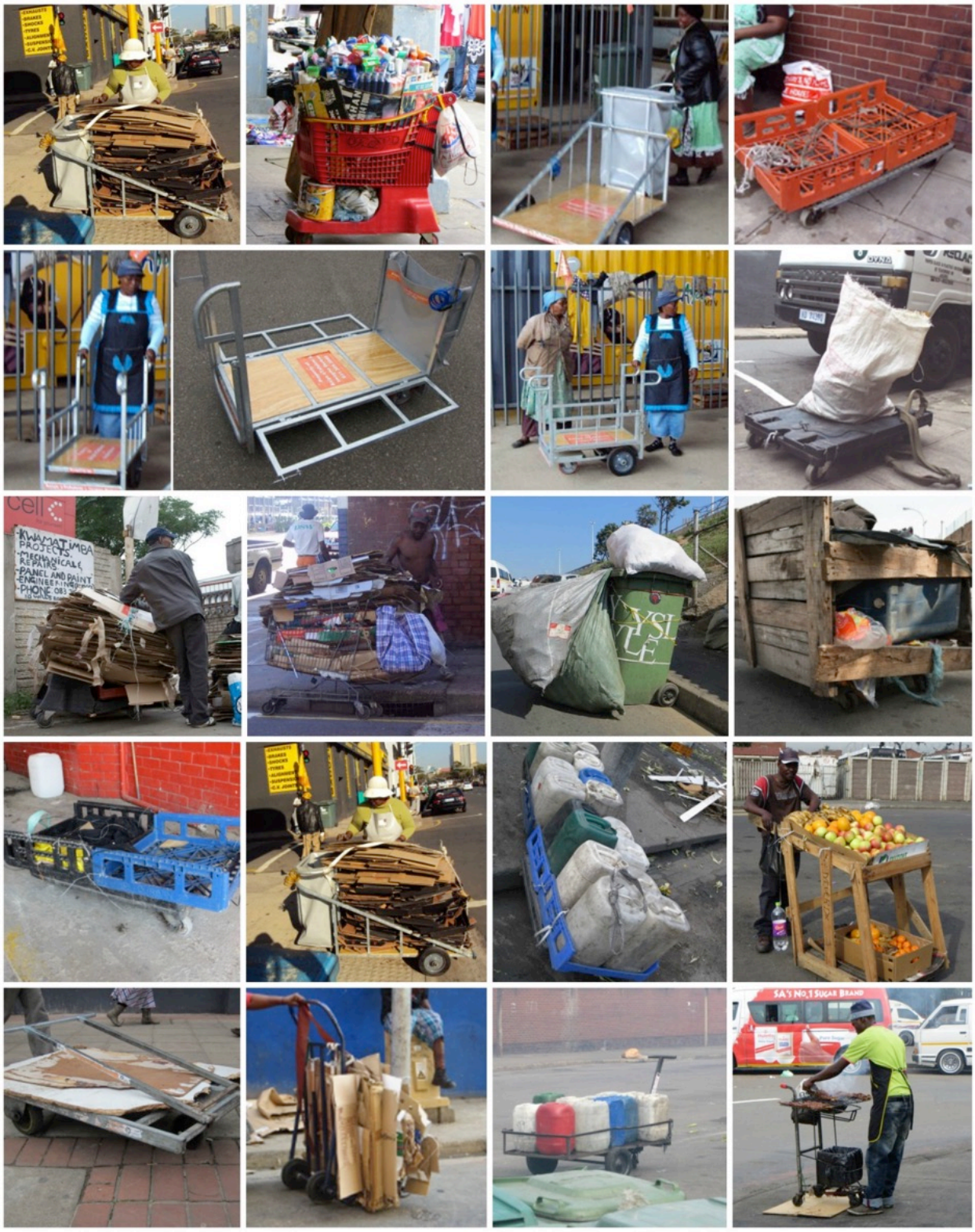
Box 2
Inherent Value of Basic Tools
Lima, Peru
(Focus Groups)

Market Porters	"Pallets and manual forklifts are indispensable. We always need them to work." (Lima, MP, FG 1)
Waste Pickers	"If it weren't for the sack, how would we carry our stuff? Without a sack we could not work." (Lima, WP, FG 6)
Market Vendors	"We all use it (scale). Maybe there are some traders without a freezer, but a scale is basic. We all have one." (Lima, MV, FG 12)
Street Vendors	"Hand trucks and dollies are useful for the same thing, selling. Some are bigger, some are smaller." (Lima, SV, FG 15)

Source: Technology and the Future of Work WIEGO Focus Groups (2015)

Explaining Basic Technology: Value Chain Dynamics - There are some differences in the basic tools used across the study cities, reflecting differences in the city context. In Durban, South Africa, waste pickers sell their recyclables to mobile waste dealers who drive around the market area looking for recyclable waste to buy, either from the itinerant waste pickers or directly from shopkeepers. The Durban waste pickers use trolleys to haul their waste around the market area: see photo collage of different types of trolleys used in Durban.

Photos - 7
Trolleys in Durban



In Ahmedabad, the waste dealers are not mobile and the waste pickers have to transport their recyclables to the dealers' shops which are often at some distance from their collection routes. Most Ahmedabad waste pickers, therefore, have to hire rickshaws – bicycle rickshaws or (if they can afford them) motorized rickshaws – to transport their recyclables to the point of sale. As one waste picker group reported: "Bicycle rickshaw drivers charge thirty rupees round-trip whereas auto rickshaw drivers charge more than fifty rupees." (Ahmedabad, WP, FG 2) In Lima, waste pickers also use sacks for collection. In inner-city districts of Lima it is only recyclers higher in the value chain who have motorized transport (such as trucks) to collect recyclables. But in the outlying districts, waste pickers need vehicles to transport their recyclables to the nearest buyer, including: moto-taxis or three-wheelers that can be pedalled, pushed, or are motorized.

In addition to the use of trolleys, there are two other distinctive features of waste picking in the Warwick Junction area of Durban. First, there is a sub-set of waste pickers who recycle only cardboard which is readily available due to the presence of both wholesale markets and retail shops in the area, and because recycled cardboard fetches a good price compared to glass and plastic (McKenzie Interview). But as one group of cardboard recyclers complained: "Chinese shopkeepers, in particular, don't give us cardboard to recycle but recycle it themselves." (Durban, WP FG9). Second, the waste pickers no longer carry knives or blades for fear of being arrested under the "Nuisances and Behaviour in Public Space" law adopted by the Durban eThekwini municipal council in June 2015.[3] This restriction is particularly hard on the cardboard recyclers who need knives to break down cardboard boxes and cut rope to tie the cardboard pieces to their trolleys. One woman cardboard recycler reported that she uses a piece of glass to cut the tape that binds the boxes – and that the glass cuts her hand.

Explaining Basic Technology: Security - The lack of a secure space to store goods and equipment at night inhibits investment in tools and equipment as well as stock. This is particularly true for street vendors who need to store equipment – scales, display units – as well as stock overnight, every night. This is also true for waste pickers who need a place to store recyclables they have collected, if they cannot sell them right away. The need for storage is particularly acute in Durban-eThekwini as most informal workers live in townships at some distance from the market area.

Consider the case of Nhlanhla, a water porter in Warwick Junction, who supplies water to cooked food vendors and other street vendors in the market. Earlier, Nhlanhla transported water containers on a shopping cart that he bought from other water porters. But the police would harass him and often confiscate the cart. Since 2010, Nhlanhla has used a trolley which he has modified by adding two bread crates, salvaged from the side of the road.

[3] The law does not explicitly ban the carrying of knives but the fear is that local authorities and the police will exploit Clauses 17 and 18 to arrest or issue fines to those that carry knives and/or to confiscate the knives.

The idea for the modified trolley came from a fellow water porter who had earlier adapted his trolley in this way. Now all four of the water porters operating in the market use this particular model. The adapted trolley can carry more water containers per trip than the shopping cart, and the bread crates help to stabilize the water drums on the bumpy journey from storage facility to tap, to customer. The adapted trolley is also tough, doesn't break easily, but the wheels do require regular maintenance by way of greasing, and have to be changed about once every two months due to wear and tear.

An added advantage of these modified trolleys is that they do not draw the attention of the police in the same way the shopping carts trolley do. Unfortunately, this does not apply to the thieves in the neighbourhood. One of the biggest obstacles Nhlanhla faces in his business is the regular theft of his modified trolley. Since 2010, he estimates that his trolley has been stolen more than 20 times, three to four times per year. When this happens he is saddled with the cost of purchasing and modifying a new trolley. This takes about a week to obtain and forces him to return to the use of a shopping cart in the meantime (Durban Micro-Narrative).

Another dimension of insecurity for those who work in public space is the risk of being chased away, arrested or fined by authorities. In Lima, both waste pickers and market porters identified their uniforms – either a vest or a pullover with a logo – as important work tools because they signal that the municipality has authorized them as workers. They also bring an added protective component to work: the recyclers' vests, for example, have a reflective strip that helps make them visible at night, when many are out collecting waste from households.

The Informal Economy Monitoring Study (IEMS) carried out in 2012 in ten cities, including Ahmedabad, Durban and Lima, found the same basic tools being used with much the same issues associated with them, which together help explain why technologies remain basic for these occupational sectors. Box 3 presents what garment makers in Ahmedabad, waste pickers in Durban and street vendors in Lima had to say in 2012 about their work tools.

Box 3
IEMS Findings on Work Technology
(IEMS Focus Groups)

City & Sector	
Ahmedabad Garment Makers	"I face difficulty with my machine which has old technology. Also, my daughter has become old enough to do stitching but I don't have enough capital to buy a new machine for my daughter." (FG1) "I don't have money to buy the latest technology machine." (FG1) "If we have two machines, we can produce more. We can't pay our house rent or our electricity bill on time due to our low earnings. Sometimes we can't afford the cost of repairing our sewing machine." (FG1) "The trader asked me to do work at his shop using new improved sewing machine but I declined his offer. I have young daughters at home. I cannot leave them alone in the house or allow them to do work at the trader's shop." "My sewing machine is old but a new machine is too expensive to buy." (FG2) "Old machines are less efficient; and have to be repaired often." (FG2) "Sewing machines don't function properly in the rainy season, reducing the efficiency of our work." (FG2) "I have a second hand machine, the plywood frame of the machine has gotten loose and the cloth gets entangled in it during stitching. But I don't have money to buy a new machine." (FG4)
Durban Waste Pickers	**Sack:** "I collect copper from KwaPotsho. I put it in the sack; I take a bus to town where I go to the scrap yard to sell. We have different scrap yards where we sell, we just choose the ones that are paying well, either in Mayville or in town." (FG13) "I collect plastics from KwaPotsho. I put them in the sack. There is a woman at KwaPotsho who phones the car once we are finish packing everything together. The car from Waste Paper comes to weigh the plastics, then fill the receipts with our details like our bank account number, they then deposit our money." (FG13) **Trolley:** "I pick scrap metals from KwaPotsho and take them to the scrap yard. When taking my scraps by the trolley to the scrap yard, I have no idea how much they are worth. At the scrap yard they weigh them and give me whatever amount they are worth. I do not name the price, they do." (FG3) "I come from Kennedy Road and walk down to the dumping site where I get steel from the cars, I then carry it on my head if I do not have money to hire a person who has a trolley because they are too expensive to hire, I then sell to the scrap yard." (FG4) "I come from Mayville. I then go to Bonella to collect boxes with my trolley, I then push it to Ekuphileni clinic at Mayville where I sell. I phone Siya to come and collect it." (FG7) "I am able to go to the police station to collect the newspapers or any kind of papers which I can find, they do not give me any problem. I use my trolley to transport the goods. They are so friendly. I wish they can also provide me with empty bottles." (FG8) "I come from Clermont, I catch a taxi it drops me at Priority Zone in town, I get my working trolley I go to Blue Waters to get my items then go to Palmers Street where I sell to a car from South African Waste." (FG9) "I come from Ebhisasa. I then go to KwaPotsho to collect steel after getting a load I push my trolley to the scrap yard for selling, on the way I get tired on the road, get some rest,

	sit by the road then I walk again until I reach the scrap yard." (FG13) "We do not have trolleys to load our boxes after we have collected them. It gets so difficult when you have your loads but you are unable to carry to your work place." (FG11) **Protective Gear**: "They (Asiye eTafuleni, local NGO) have provided us with hand gloves and aprons and T-shirts. As you can see our T-shirts. Wherever we go people are able to identify us with our T-shirts and they know we are working." (FG9) "We do not have protective gloves. Bottles cut us on the hands and fingers." (FG12) **Processing Tools**: "We do not have tools to use when manufacturing our items"… "We do not have electric saw. The ones we are using are draining our energy because they are hand operated." (FG10 and 13)
Lima Street Vendors	**Expensive Tools = Risk of Theft**: "If they will pay, I will take my scissors with me. They cost 180 soles (Peruvian currency). Otherwise, I take the cheaper, 60 sol ones. It is dangerous to get around with your work tools." (FG2) "I had an expensive dryer. They stole a dryer from another guy so I don't take mine with me anymore." (FG2) **Stall**: "Things have changed for the better. Huamantanga was a precarious market before. Now it has improved. We've gotten loans to build our stalls with brick and mortar. I have a stall, but I still have to sell as a street vendor. I also support other people who are paying little by little and just have a corrugated iron roof and no more." (FG11) -"I sell from a small bag. If I sell more, the municipal police (*serenos*) come and seize my things." (FG12) **Display Stand**: "It would be great if the street vendors could have attractive kiosks (modules), but that is beyond our means. We belong to a different world". (FG4) **Stove**: "I turn on my stove on the street. I stop and light it up and start cooking, because I need to boil the quail eggs." (FG8) **Storage**: "I buy everything from the same wholesaler and I store my goods there. But I keep my tricycle somewhere else." (FG6)

Source: Informal Economy Monitoring Study Focus Groups (2012).

In the three WIEGO network study cities, a specially-designed photo documentation method, called Four Turns & Technological Asset (4T & TA), was used to document the most important technological asset and the workplace of each respondent. The photo sheets were analyzed to assess how, and why, the respondent acquired and deployed the technological asset; and to identify what external factors influenced his/her acquisition and deployment. The analysis suggests that street vendors in Durban and Lima operate under similar conditions wherein the dominant challenge is workplace harassment by local government officials, often leading to the confiscation of goods and equipment. The risk of harassment and confiscation discourages asset building and investment in improved tools or technology in both cities. Although the garment makers in Durban operate in a public space, their work places are reasonably protected and secure. In both Ahmedabad and Durban, the garment makers make prudent technology choices. In Durban, the fact that the formal garment sector regularly upgrades or disposes of machines allows the garment makers to acquire improved machines, albeit second-hand. In Ahmedabad,

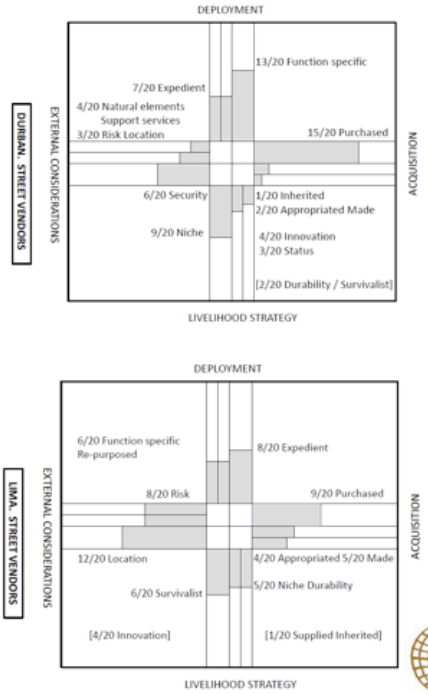
the fact that the garment makers belong to SEWA means that they can access loans to purchase improved sewing machines.

The photo documentation indicates that the situation of waste pickers is quite different in Ahmedabad, Durban and Lima. The waste pickers in Ahmedabad are quite well organized by SEWA. The waste pickers in Durban face a good deal of public prejudice and government harassment. In Lima, while the government is reasonably supportive, the waste pickers organized into cooperatives are doing better than those who are not organized. The Ahmedabad waste pickers want to invest in simple but durable technology, the Durban waste pickers fear confiscation and harassment and so avoid investing in improved technology, and the Lima waste pickers fall somewhere in between. See inter-city sector comparison charts-cum-photos and also Appendix II for additional analyses of the photo documentation with the study cities.
The photo documentation methodology generated great interest among the respondents, who showed different levels of pride in their work tools. When approached to participate in the study, one street vendor in Lima said "you want to take a photo of this old, ugly knife?" But once she was convinced, she wanted a photo taken of her knife. Some respondents were very knowledgeable about the wide variety of tools available and why workers would choose one over another; for example, the Lima fieldwork identified several types of scales, including hanging scales, manual scales, and digital scales of all ages and sizes.

Finally, it is important to note that while the common tools are quite basic, at least two are linked to the global economy: the electric sewing machines used by garment makers and the polypropylene bags used by waste pickers. A survey of the sewing machine brand names indicates that there is significant global reach by a few prominent manufacturers. The preferred industrial-grade sewing machine brand (Juki) was the same in Ahmedabad and Durban.[4] The mass production of polypropylene bags is dominated by Chinese manufacturers for the international distribution of various products. These bags are recycled after being used for the transport and marketing of different products: primarily cement in Ahmedabad, rice in Durban, and potatoes in Lima.

[4] Juki machines are also owned and used by a home-based worker cooperative in Bangkok, Thailand supported by HomeNet Thailand, a member of the WIEGO network.

Chart 1: Inter-City Sector Comparison
Durban - Lima. Street Vendors



- both communities of street vendors work under / in similar conditions and environments.
- the dominant challenge is workplace harassment by local government officials and consequential insecurity that generally results in the confiscation of goods / equipment.
- this frustrates asset building or the investment in preferred tools or technology.
- any investment in tools or technology is therefore very strategic or sacrificial.
- the screens affirm this approach through tentative decision making clustered around the hub of 4 scales.
- although there is moderately high levels of purchasing, this is hedged with: function specificity; niche; security; risk and evidence of appropriation
- aside from 2 scale variations, it is notable that in these regionally separated comparisons the screens 'mirror' one another, indicating that informal workers will respond similarly with regards to their technology choices if there is work place insecurity or harassment.

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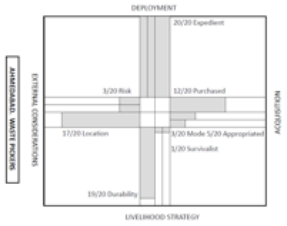
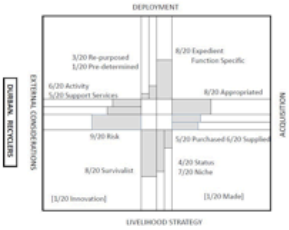
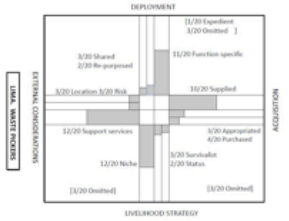
INTER-CITY SECTOR COMPARISON
DURBAN - LIMA. STREET VENDORS

Chart 2: Inter-City Sector Comparison
Ahmedabad – Durban - Lima. Waste







- the comparisons are is drawn from the same sector but distinctly different contexts. Ahmedabad informal workers are significantly well organized by an MBO; Durban informal workers are faced daily insecurity as a result of public prejudice and / or primitive enforcement; Lima exemplifies informal workers actively supported by local government or co-operatives alongside individuals who have survivalist livelihoods.
- these contexts characteristics are visibly represented in the city screens with Ahmedabad being the most 'decisive' eg clear choice of tools and the assurance that investing for 'durability' would be beneficial. By contrast, Durban and Lima are tentative with Durban being the most uncertain with measurable indicators eg. high risk and survivalist traits. Durban has the high trait for 'appropriation.'
- notwithstanding these differences the informal workers appear clear that their sector requires function specific / expedient tools ie. they are opinionated regarding their technology choice.

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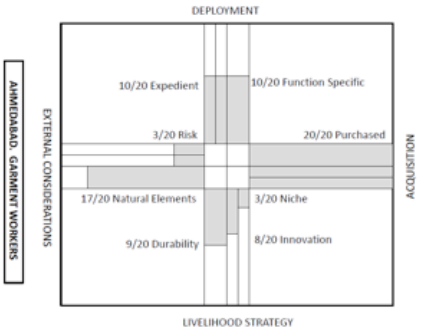
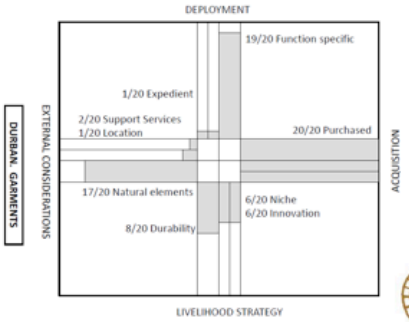
INTER-CITY SECTOR COMPARISON
AHMEDABAD – DURBAN - LIMA. WASTE

Chart 3: Inter-City Sector Comparison
Ahmedabad - Durban. Garment Makers





- notwithstanding different contexts in Ahmedabad and Durban, both groups of informal workers demonstrate similar responses to their technology choices. The summary screens reflect similar values towards investing in their technology with a controlled working environment a pre-requisite eg. strong 'purchased' and 'natural elements' traits.
- both groups have access to moderately predictable manufacturing orders thus encouraging an investment in their technology. However, the competition for these orders is fierce which is reflected in the livelihood strategies which, on the scales are distinctly more tentative than the horizontal scales, all indicating an uneasy ownership of an expensive asset and productive work to maintain it.
- the ability to invest in their technology in Ahmedabad is enabled through home based work. Loans from their effective MBO support the construction of durable dwellings and the capital investment in technology [sewing machines]. The role of organizing is therefore a defining pathway for the acquisition, operating and maintaining enabling technology.

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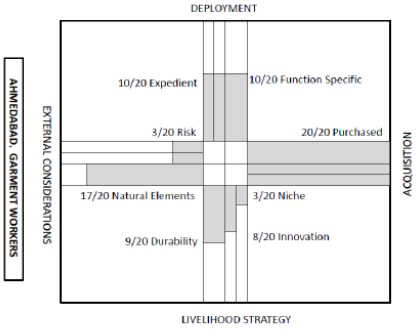
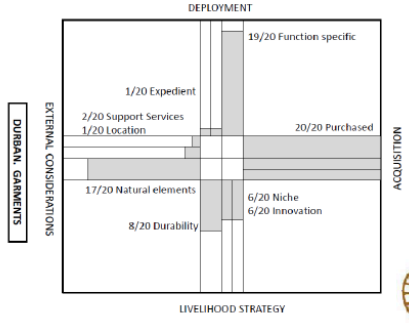
INTER-CITY SECTOR COMPARISON
AHMEDABAD - DURBAN. GARMENTS





- in Durban, the surveyed informal workers, are in a public environment but with access to reasonably protected and secure work spaces. Although not supported by an MBO, Durban has a fragile formal garment industry that, as a consequence, regularly upgrades or disposes of machines which indirectly enables informal worker to acquire machines.
- therefore, both cities have similar enabling environments which is reflected in the 'mirror' images of the screens indicating that under similar, unrelated contexts or conditions, informal workers make prudent technology choices.

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INTER-CITY SECTOR COMPARISON
AHMEDABAD - DURBAN. GARMENTS
[continued]

Emerging Technologies

Each occupational group identified new or improved tools being used in their sector: either by others doing the same tasks as themselves or others doing different tasks further up the value chain. It is important to note that, when asked about new technologies, many participants considered a tool to be 'new' if it was recently acquired by them, even if it had existed in their sector for a long time.

Consider the construction workers, home-based workers, and waste pickers in Ahmedabad. Some of the construction workers in Ahmedabad are manual laborers sifting sand, mixing cement, and carrying cement and bricks; while others are skilled masons or carpenters using tradesmen tools as well as machines owned by their contractors or the construction company. As one focus group of male construction workers noted: "We were using a heavy duty hammer to break the stones, which is an old tool but now a tile cutter machine is available." (Ahmedabad, male Construction FG 1). Some of the male waste pickers in Ahmedabad aspire to acquiring a bicycle rickshaw in order not only to transport their recyclables but also to supplement what they earn from recycling by hiring themselves out as rickshaw drivers.

Some of the incense stick rollers in Ahmedabad no longer hand-roll sticks in their homes but are employed in small workshops to operate rolling machines. The garment makers in Ahmedabad discussed newer models of electrical sewing machines; gadgets for stitching buttonholes, hemming, and interlocking; embroidery machines and cutting machines: which they need to enter the ready-made, especially modern, garment sector and to better compete in the traditional garment sector. Referring to the industrial-grade electrical sewing machine brand popular in both Ahmedabad and Durban, one garment maker in Ahmedabad stated, "The Juki machine is very expensive. It is useful for those who stitch ready-made clothes." (Ahmedabad, Garment Maker FG 4). See photo collage of existing and emerging tools in Ahmedabad.

In Lima, some street vendors and market traders mentioned new technologies or designs that are used by higher-income traders, such as digital scales, electric meat slicers and refrigerated display cases. They classified technologies as 'new' in the sense that workers like them were just beginning to use them, even if the technology itself had been around for a long time. Study participants noted that different display units are closely related to the type of product sold and the place of work; itinerant vendors of small prepared food items like cakes need a tray, vendors who sell from the ground need a strong tarp, and vendors with a fixed spot on the street can use a trolley, table, mesh display stand, basket, or mobile cart or stove – with the most sophisticated ones being outfitted with a refrigerated chamber and/or a heated chamber for food. Some market traders also noted that health regulations require them to use stainless steel equipment rather than the wood or plastic equipment they currently use; and fewer and fewer are using manual scales because the digital ones have become less expensive.

When asked what is driving change in equipment, one trader in Lima said, "they (the municipal government) are requiring everyone to use stainless steel." A recent municipal ordinance mandates that street vendors must use stainless steel, rather than wooden, carts if they want to get their licenses renewed. Once the ordinance was issued, street vendors began to look for good stainless steel carts at an affordable price. Many went to an area called Yerbateros in La Victoria district where there is a cluster of steel workshops which have been making and selling carts for

over twenty years. The workshops make carts to order to match the design preferences of the street vendors, including: number and size of shelves, storage areas or glass panels. As one workshop owner explained: "Everything is doable, the thing is for them (the customers) to be satisfied". The workshops and their customers work together to come up with a joint design, often referring to photos in design catalogues. The workshops can then advertise and offer these "improved" designs to new customers.



Among market porters in Lima, the technological trends depend on how different products are packaged and transported from the delivery trucks to the wholesale market stalls. Goods may arrive at the wholesale market in plastic or wooden crates, bundled, or in bags or sacks of different sizes and weights. Porters are increasingly using woven plastic bags instead of jute/burlap bags: this means that the tools formerly used to repair jute bags – such as iron needles – are no longer needed. Only certain products, including tomatoes and green beans, arrive in wooden crates, so only porters who transport those products still use hammers or crowbars.

In the waste sector in Lima, the most significant emerging technologies are related to the transport of recyclable materials. Moto-taxis have been around for a long time, but recently some users have begun to modify them to carry materials instead of passengers. These have begun to replace motorized three-wheelers which have been banned as too dangerous: a motorized three-wheeler places all the cargo in the front, which can obstruct the driver's vision and otherwise cause accidents, whereas a modified moto-taxi places the cargo in back. However, only a few waste pickers can afford a modified moto-taxi, and they are mostly men. One female waste picker said she owned one but "I still haven't learned how to drive it" (Lima, 4T-TA). In general, though, the informal workers in Lima are using old technologies far more widely than new technologies. See photo collage of existing and emerging tools in Lima.

In some cases, technological change is driven by market transactions in combination with local ingenuity. Consider the case of Juliet Michunu who makes and sells grass mats in Warwick Junction in Durban. Around 2011, Juliet bought a weaving frame for 200 rand from a man who came round the market selling them. This was the first time she had seen such a device, but it quickly caught on, and today most of the traders at her market who make mats have one too. Whereas a hand woven mat takes two full days to make, a mat made on the weaving frame can be produced in one and half days, or even a single day, halving the time required.

The frame works manually, and is fairly simple to operate. It consists of a wooden frame, almost like a picture frame to which wooden bobbins are added. These bobbins hold the various pieces of string or cotton that are needed to join together the strands of dried grass. Juliet added the wooden bobbles herself, but otherwise the device did not require any modifications, and she has been satisfied with its functioning. The frame is also easy to maintain. If it gets loose, the joints can be re-nailed together again.
In addition to the weaving frame, Juliet Mchunu's business has also benefitted from the use of other technologies. Like seamstress Sizakele Ncube in the Berea Station market she uses a cell phone to confirm orders and make appointments with her customers (Durban Micro-Narrative).

The energy crisis in South Africa today has prompted those at the bottom of the economic pyramid to diversify their energy sources. Those who sell cooked food using electrical stoves have resorted to using salvaged wood, charcoal and petroleum gas. Those who operate other electrical appliances – for example, music vendors, street barbers and cobblers – have resorted to using rechargeable batteries and inverters. This has given rise to secondary businesses, including re-charging services utilizing high-tech equipment, and the transport of heavy deep-cell batteries.

The need for appropriate and cost-effective transport has spawned technologies such as the market barrow (modelled on those used in Covent Garden in the UK); the ingenious addition of wheels to a chassis made from salvaged items to form a conveyance; and the appropriation of commercially available equipment (notably supermarket trolleys). Operating or owning a conveyance is a risky activity as it is routinely confiscated by authorities or stolen, thus the ingenuity evident in the salvaging and adapting of technology has significant economic logic. See photo collage of Durban trolleys.

Informal garment makers in Durban produce low-cost and often unique products, including: pinafores that are worn as protective work gear and ceremonial attire for both cultural and religious functions. These products are both mass produced and tailor-made: some have artistic embellishments which require particular types of sewing machines and equipment. There is ample evidence that the informal garment makers make fit-for-purpose decisions in selecting and using technology. It is also significant that some of the options are global technologies as evidenced by the fact that both Durban and Ahmedabad garment makers prefer the same brand (Juki) of industrial grade sewing machine. See photo collage of existing and emerging technologies in Durban.

South Africa has high mobile phone and internet costs. Although internet-based mobile messaging applications are becoming popular, the most pervasive communication technology used by informal workers is still the basic model mobile phone. What is intriguing are the ways in which informal workers maximize the capability of their phones for phone calls and text messaging, not least of which is to own sim cards from various networks. By using these various sim cards interchangeably informal workers are able to access the preferred or discounted rates competitively offered by the networks. This reflects an astute understanding and exploitation of one aspect of IT.

Table 3
Emerging Tools by Sector and City,
Most Common Emerging Tool by Sector
(Focus Groups)

Sector	Ahmedabad	Durban	Lima	Most Common Emerging Tool in Sector
Construction Workers	machines for skilled trades	--	--	differs by trade: mixer grinder cutter
Garment Makers	electrical sewing machines/new models embroidery machine cutting machine	embroidery machine cutting machine	--	embroidery machine
Incense Stick Rollers	mixing machine rolling machine	—	—	
Market Traders	—	food warmer gas stoves	digital scales refrigerated display cases meat slicers	display cases
Market Porters/ Barrow Operators	—	Trolleys	manual forklifts	manual forklifts
Street Vendors	—		stands designed for food prep stainless steel surfaces	stands designed for food preparation
Waste Pickers	rickshaw: bicycle mechanized	digital scales plastic bins for storing waste barrows bigger sacks health & safety equipment:: gloves, face masks, rain coats mobile phones. forklifts	3-wheel carts: pedal-operated motorized modified moto-taxi	improved carts or vehicles

Source: Technology and the Future of Work WIEGO Focus Groups (2015)

Explaining Improved Technologies: Cost-Benefit Analysis - Many of the focus groups of informal workers were quite clear about the costs and benefits of new or emerging technologies in their sector. Consider the cost-benefit analysis of modern electrical sewing machines by the garment makers in Ahmedabad (Box 4); of different types of barrows by the barrow operators in Durban (Box 5); and of manual forklifts by market porters in Lima (Box 6).

Box 4
Cost-Benefit Analysis of Modern Sewing Machines: Garment Makers in Ahmedabad (Focus Groups)

Benefits	
Productivity	"A fully electric machine is useful because we can work fast and do more work with it." (FG 3)
Earnings	"I can do more work and earn more money." (FG 2)
Competitiveness	"The Juki machine… is useful for those who stitch ready-made clothes." (FG 4)
Costs	
Capital Investment	"Juki machines cost between 35 to 40 thousand rupees." (FG 4)
Skills Acquisition	"If one does not have the skills to operate the machine it can go in reverse and injure your hand." (FG 4)
Electricity	"The electricity bill increases." (FG 3)
Repairs	"The machine cannot be repaired by us, even if the needle breaks we have to carry it to the repair shop." (FG 3)

Source: Technology and the Future of Work WIEGO Focus Groups (2015)

Chandaben Dipakbhai Chetwani, a garment maker in Ahmedabad, bought a Juki, an industrial-grade electric sewing machine, in 2011. Using the Juki machine has increased her productivity and decreased her maintenance costs. Work that would have taken one whole day with an ordinary machine can be done in five to six hours on the Juki machine. Moreover, the simpler electrical machine used to get damaged quite frequently (once every two to three months) but the Juki machine requires maintenance only once a year. Also, using the Juki, Chandaben can stitch different types of fabrics (silk, thick plastic) using different types of stitches. Chandaben is proud that she can replicate new designs or patterns on her own and is keen to learn new techniques. An additional benefit of the Juki machine, noted by Chandaben, is that it is fairly low maintenance: it requires regular oiling but servicing only once a year (for about 200 rupees) and otherwise is problem free. She and her husband have invested in an industrial-grade steam ironing machine to iron garments at home (Ahmedabad Micro-Narrative).

One of the garment makers in Berea Station in Durban, Sizakele Ncube, bought a second-hand Juki which came with a table and foot pedal, for 2600 rand. It proved to be a worthwhile investment, sewing faster, straighter and neater than her old Singer machine, thereby enhancing her productivity. As Sizakele explained: "You can't work properly on a smaller machine." With the Juki model she can make up to six garments per day and earn between 3000-4000 rand per month, whereas with her Singer machine she was only able to produce two garments daily and to earn around 1000 rand per month. Sizakele cleans her machine on a regular basis with a brush, because dust can cause problems if it gets into the working parts of the machine. Sizakele supports her mother, five siblings and three children: so the additional income that she earns with the Juki is very welcome. Each night, Sizakele stores her machine and its accessories plus her cloth and finished garments in a storage facility within the train station which she rents for 10 rand per month (Durban Micro-Narrrative).

Box 5
Cost-Benefit Analysis of Barrows: Barrow Operators in Durban (Focus Groups)

Benefits	
Productivity	"No matter how big the load is, the *isigadla* (a type of barrow) can handle it." (FG 14)
Earnings	"It carries a heavy load, which allows for better profits." (F 13)
Competitiveness	"When there are people who need to transport things like a fridge when they are moving from one house to another, *isigadla* is useful because you just load and tighten it with the rope." (FG 14)
Costs	
Capital Investment	"We buy second hand barrows that have been used by certain shops…It costs about R1200…we often save as a group to buy it." (FG 16).
Health	*"Inqola* (another type of barrow) is not heavy without a load but when the water container is loaded it is very heavy to pull and it drains your body…You are the engine of *inqola*…sometimes we even fail to come to work or only work five days and consequently that reduce profit." (FG 14) "If you use *isigadla* you suffer from back pain." (FG 14)
Safety	"Sometimes accidents happen on the road, for instance you scratch or damage a car while using this barrow- you need to pay for damages (repair). That is really bad, as it causes unhappiness, and we become stressed and get sick and then work stops." (FG 16)
Repairs	"We need strong spare wheels to replace old ones in case they are broken." (FG 16)

Source: Technology and the Future of Work WIEGO Focus Groups (2015)

Box 6
Cost-Benefit Analysis of Manual Forklift: Market Porters in Lima (Focus Groups)

Benefits	
Productivity	"We move the products slower, because it takes more time to be more careful to place the wooden boxes and pull them, but all the work is faster and with less effort." (FG 4)
Health	"Before work was one sack by one in our shoulders from the truck to the stands. That changed here in the market because we started to use manual forklift and pallets." (FG 4)
Competitiveness	"Since we started using them good things happened, we carry more weight, more boxes at once. We work faster because we have more than 20 to 50 boxes per trip." (FG 1)
Costs	
Capital Investment	"The manual forklifts are expensive, cost more than 1,000 soles each. We get a better price by buying wholesale." (FG 1)
Skills Acquisition	"Little by little, gradually you learn." (FG 1)
Repairs	"All need maintenance because they get dirty in their set of wheels and start gorging and not running fast. However, now all the unions already have their own manual forklift and can give them more often when they need maintenance." (FG 1)

Source: Technology and the Future of Work WIEGO Focus Groups (2015)

Impact of Technological Change on Quantity and Quality of Work - The study explored not only why workers adopt certain technologies or tools, but also what their perceptions are about the impact of technological change on the quality and quantity of work opportunities available to them. Most tools were viewed as having a positive impact on both quality and quantity of work opportunities. In terms of quality, all were seen to help make the work easier or more efficient in some way, but several tools were also known to present occupational health and safety hazards. In terms of quantity, the focus groups noted that several tools make them more productive but are not easy to afford or maintain and that when other workers are able to buy these tools their own work opportunities are threatened.

Here is what the Durban focus groups said about technologies which have both positive and negative impacts:

- Glue: improves quality of work but comes with hazards related to fire and fumes
- Needle and knife: facilitate work but unsafe to use
- Electric sewing machine: enhances productivity but causes eye strain, aches and pains
- Improved electric sewing machine: increases productivity but not earnings, unless customer provides cloth as modern fabrics are expensive
- Modern fabric treated with chemicals: preferred by customers but causes health hazards (e.g. swollen hands and dust in the air)

- Barrows and trolleys: safe to use but displace head loaders; subject to theft by shop owners and others

Table 4 summarizes the positive and negative impacts of emerging tools and equipment in each sector across the three study cities as perceived by the focus groups in that sector. As a general rule, improved tools are seen as important but expensive and also, in some cases, requiring skill acquisition. There is also a perceived risk of theft, confiscation or loss to investing in improved tools. The focus groups see two broad categories of machines emerging in their sectors: one set owned and operated by individual workers is seen as enhancing productivity while not displacing workers (such as modern electrical sewing machines); the other set owned by dominant actors up the chain is seen as both enhancing productivity but also displacing workers (e.g. rolling machines in incense stick sector; diggers and lifters in the construction sector).

Table 4
Impact of Changes in Tools & Equipment by Sector

Sector	Positive Impacts	Negative Impacts
Construction Workers	**Improved Tools & Skills**: facilitate shift to skilled jobs **Machines**: enhance productivity	**Digging & Lifting Machines:** displace workers
Garment Makers	**Modern Sewing Machines & Specialized Gadgets:** enhance productivity enhance ability to make modern garments	**Modern Sewing Machines & Specialized Gadgets:** cause eyestrain & body aches costly to use
Incense Stick Rollers	**Mixing Machines:** make dough more quickly **Rolling Machines:** make sticks more quickly	**Mixing & Rolling Machines**: displace workers
Market Traders	**Digital Scales:** more precise in weight, cost makes adding costs go more quickly/easily for clients **Refrigerators**: easy to clean new models getting cheaper	**Digital Scales**: break easily few good technicians; easier to buy a new one expensive ones get stolen **Refrigerators**: attract cockroaches underneath hard to find parts for repairs
Market Porters/Barrow Operators	**Improved Carts**: help get materials to buyer help collect more quickly **Wooden Pallets**: move more goods at once	**Improved Carts**: costly to repair attract thieves – costly to replace **Wooden Pallets**: hurt their backs and kidneys
Street Vendors	**Improved Displays & Scales:** attract customers **Improved Carts**: can be used both to store and display goods	**Improved Displays**: more work because you have to load and unload them daily **Improved Carts**: get broken, stolen
Waste Pickers	**Improved Carts**: help get materials to buyer help collect more quickly	**Improved Carts**: costly to repair attract thieves – costly to replace

Source: Technology and the Future of Work WIEGO Focus Groups (2015)

Study participants reported a variety of ways to cope with the negative aspects of technology. For example, waste pickers in Durban respond to the theft or confiscation of their carts by resorting to head loading, which they do not consider to be ideal: “We use head loading to carry cardboard…that is very tiring and results in body pains.” (Durban, WP, FG11). Resorting to head loading both slows their work and, if their body pain is severe, forces them to take time off work. On the other hand, some of the waste pickers in Durban noted that carts and trolleys allow a single person to collect more waste but displace other people, notably head loaders, involved in waste collection and transport. Barrow operators respond to the costs of repairs to old barrows by always trying to buy new barrows where possible, despite the expense (1200 rand). They use savings groups (*stokvels*) to fund the outlay.

Market traders in Lima buy the cheapest Chinese brands of digital scales, so they do not have to worry about their investment and the fact that it is difficult to find good technicians: “They are disposable, but for that price it is affordable.” (Lima, MV, FG 11). Market porters are interested to learn how to repair their manual forklifts, they have learned some basic maintenance procedures and try to keep their tools in good condition. Waste pickers who have acquired three-wheelers reported that they have to keep an eye on them because “they are attractive and well maintained and, therefore, are wanted” by thieves (Lima, WP, FG 8).

Fading Technologies

Given the emerging technologies and other changes in the sample sectors, some existing technologies are fading or disappearing. Consider the technological changes reported in Ahmedabad. Perhaps most notably, incense stick rolling is being mechanized. This mechanization has the advantage of increasing production (the machines can produce 120-140 sticks per minute) and decreasing pollution and occupational hazards. However, the owner of an incense stick factory estimated that this mechanization has resulted in 8 out of 10 workers losing their jobs (Chandak Interview). Also, there is competition in the sector from a different longer variety of incense sticks imported from China and Vietnam. So the future for women who hand-roll incense sticks is uncertain. As one hand-roller commented: “One machine can replace five to six women.” (Ahmedabad, IS, FG 3).

The construction sector is also being mechanized. Manual construction work – especially tasks like digging and lifting – is being replaced by diggers, bobcats, and other machines. So there is less demand for manual laborers who use hoes to dig and basins to lift and carry. And in the garment sector, few garment makers use manual pedal- or hand-operated sewing machines anymore; although some have held onto their manual machines for when there are power outages or when another member of the family can use the manual machine to help meet work orders.

The mechanization of sewing machines has impacted on garment makers in Durban. A few older workers continue to use hand and foot powered machines, but younger workers have switched to the more expensive electric machines. However, whilst the new machines allow for increases in production, they also increase competition, particularly from foreigners who are able to afford the higher end machines. “Machines create jobs for people from other countries” complained one garment maker (Durban, GM, FG 7).

In the waste sector, the primary collection and transportation of waste is increasingly being done by garbage workers with trucks. But the modern garbage collection system does not sort out or reclaim recyclables. The informal waste pickers continue to do this important task using the same basic tools – but their task is made more difficult because they have to compete for waste with the private garbage collection companies who are paid by the ton for hauling waste to landfills or incinerators and with the garbage collection workers who syphon off some recyclables for themselves. Whilst co-operatives of informal waste pickers in India may theoretically apply for local government waste management tenders, in Ahmedabad they are required to first deposit a large sum of money. This effectively excludes such organizations from the tender process (Mahadevia Interview). Also, the waste that is available is no longer in open spaces, but in large bins, depots or landfills, making access more difficult.

Market porters in Lima noted that products like onions and fresh corn are no longer shipped to the wholesale market in burlap sacks; therefore, iron needles – previously an important tool – were no longer necessary to secure and repair the sacks. Nails and hammers are also less commonly used now than before, because products are increasingly being transported in plastic or cardboard boxes.

Little, if any, consideration is given in mainstream technology design to the production of tools for informal traditional crafts or trades because of their unique requirements and presumed limited demand. This means that informal workers, on their own or through their own organizations, must adapt or change technologies in response to changing demands and circumstances. But sometimes they work with local manufacturers to design new equipment: as with the regulation-driven changes in street vending carts in Lima.

Examples of adaptation from Durban include:

1. Traditional shoe repairers cannot repair moulded/bonded shoes using their traditional stitching techniques so now use adhesives.
2. Clay pots used for drinking beer are being replaced with fibreglass replicas.
3. Electronic inverters are being used to convert direct to alternating current, enabling conventional electrical appliances (e.g. barbers` clippers) to operate with rechargeable batteries.
4. Hammer handles made out of hickory wood are being replaced with metal tubing or bamboo.
5. Plastic commercial trays/crates are being re-purposed for seats, tables, carts etc.
6. Basic model phones are being maximized for their text messaging capabilities as opposed to using expensive internet mobile messaging applications: e.g. in Ahmedabad and also (as Practical Action found) in Nairobi.

Users of Technologies

Who are the main users of the various technologies - existing, emerging and fading - in the study cities? The picture is not very clear as, within each occupation, the users differ by class, skill level and/or sex. Consider the sample in Ahmedabad. Only the incense stick traders and contractors, not the workers, can afford to buy and house the new rolling machines. Some women are not willing to work as employees in workshops owned by the traders due to gender norms which restrict women’s mobility and interactions outside the home and put competing

demands on their time; or because they prefer to work from their own homes and set their own work schedules. Construction workers need skills training as masons, tile layers, carpenters, electricians to be able to graduate from manual to skilled labor. While the Self-Employed Women's Association (SEWA) is training women in these trades, there are few such training opportunities for women manual construction laborers in India. Moreover, even women trained by SEWA in the skills of the trade face financial and cultural barriers to acquiring the tools of the trade. As one group of women construction workers reported: "Although there are many other technologies in this sector none of them are in the hands of women workers." (Ahmedabad, Female CW, FG 2). Also, in Ahmedabad, only men waste pickers can aspire to owning and driving rickshaws: as women would be discouraged by their families and communities from operating a rickshaw.

Consider also the sample in Durban. The waste pickers reported that middlemen use vans and trucks to transport recyclables and that the waste dealers use digital scales: but waste pickers do not use either of these preferred technologies. One group of waste pickers complained that the waste dealer manipulates his scale when weighing the recyclables that they sell to him: " He lowers (the weight) by a kilogram; his scale is being manipulated by him, it does not move…He manipulates the scale and it is very bad for us and especially our survival." (Durban, WP, FG 7). The shoe repairers noted that only those who make shoes use a cobbler's last (foot-shaped form) – not those who repair shoes.

The focus groups were asked to specific the main users of emerging versus fading technologies. In general, across the cities, the focus groups participants identified many more fading technologies than emerging ones; and reported that workers like them used mostly fading technologies whereas workers unlike them used mostly emerging technologies. In Durban, for instance, one garment maker said, "many garment makers use cutting machines, but we don't have one – we use scissors," and another replied, "we don't use one because we don't have one – it is expensive but many people use a cutting machine." (Durban, GM, FG 8). The same was true with embroidery machines, "we pay people who have the machine to do designs for us"; "foreigners usually have the machine and it is only a few of them." (Durban, GM, FG 8). Also in Durban, waste pickers indicated that they do not own scales; only the middlemen do (Durban, GM, FG 9).

In Lima, a higher percentage of market porters and waste pickers than of street vendors and market traders identified new technologies (Figure 1). But the street vendors and market traders placed a good deal of importance on new technology, especially digital scales and ICTs.

Figure 1
Use of Old vs. New Technologies by Sector, Lima
(Focus Groups)

Source: Technology and the Future or Work WIEGO Focus Groups (2015)

Technological Systems

The technological choices made by cities in regard to large infrastructure systems have major, but not well understood, impacts on the livelihoods of informal workers: as does the decision by some cities to privatize these systems. In the focus groups, each occupational group was asked to discuss three city-wide technological systems – energy, transport and waste; and to rank which system had the biggest, medium and least impact on their livelihoods and whether the impact was positive, negative or mixed.

The results of the focus group discussions of these city-wide systems are summarized in Table 5 and Boxes 7-9. Table 5 summarizes the focus group findings on which technological system had the biggest impact on the different sectors; and whether the impact was positive, negative or mixed.

Table 5
Technological Systems with Biggest Impact on Livelihoods, by Positive, Negative or Mixed Impact (# of Focus Groups)

Sector	Transport	Waste	Energy	Biggest Impact on Livelihoods
Waste Pickers				
Ahmedabad		4 (2-, 2+)		
Durban		4 (1-, 3 mixed)		
Lima		4 (4-)		
Total		12 (7-, 2+, 3 mixed)		Waste
Construction Workers				
Ahmedabad	4 (all+)			Transport
Street Vendors				
Durban	4 (2-,1+, 1 mixed)			
Lima	4 (3-, 1 mixed)			
Total	8 (5-, 1+, 2 mixed)			Transport
Market Traders				
Lima	4 (4-)			Transport
Market Porters & Barrow Operators				
Durban	4 (2-, 2 mixed)			
Lima	4 (4-)			
Total	8 (6-, 2 mixed)			Transport
Garment Makers				
Ahmedabad			4 (all mixed)	
Durban	2 (both -)		2 (both -)	
Total	2 (both -)		6 (2-, 4 mixed)	Energy
Incense Stick Rollers				
Ahmedabad			4 (all +)	Energy

Note: Table shows total number of FGs per city that ranked the system as the one with the biggest impact on livelihoods in the sector.
Source: Technology and the Future of Work WIEGO Focus Groups (2015)

In terms of *degree of significance*, the city-wide systems were ranked quite similarly across the study cities. The energy system was ranked as most significant by garment makers in both Ahmedabad and Durban, as most use electric sewing machines, and by incense stick rollers in Ahmedabad, who need electricity to be able to work at night. The transport sector was ranked as most significant by street vendors, market traders, market porters and transport workers; and was also significant for garment makers in Durban who operate at a train station. The waste sector was very significant to the waste pickers and of limited significance to the other sectors.

But in terms of *whether the impacts were positive, negative or mixed* the rankings varied a good deal across the study cities, depending largely on the status of the sector in each city, as follows:

Energy

There is a national energy crisis in South Africa today with frequent unpredictable load shedding and power outages which are having significant negative impacts on all sectors in the Durban sample.

- Garment Makers: "Electricity is a problem due to the existence of load shedding: while we are in the middle of our work electricity just shuts down." (Durban, GM, FG 6); "Customers blame us for incomplete work when the electricity goes off." (Durban, GM, FG 8)
- Waste Pickers: "When there is load shedding, the shops from where we collect recyclable materials close and we do not have access." (Durban, WP, FG 10); "In winter, if the street lights are not on, we hesitate to arrive before the DSW workers due to the risk (of operating in the dark)." (Durban, Female WP, FG 11)
- Street Vendors: "Electricity is used in the production of petrol. If there is no electricity there will be no petrol; and there will be no transport." (Durban, GM, FG 6)

Regular electrical supply is of critical importance to the productivity of garment makers who use electrical sewing machines. At Berea Station in Durban, electricity supply regularly overloads and cuts out, on average twice a week. Sizakele Ncuba and her fellow seamstresses suspect that the music sellers, who operate in another part of the Berea station area playing their wares full-blast, are responsible. As a result the power can be out for the whole day and there is nothing the seamstresses can do except cut material while they wait. This leads to a loss in business, as if a garment is not ready for collection by the agreed upon date and time, the customer will often cancel the order all together and demand a refund (Durban Micro-Narrative).

In marked contrast, Ahmedabad City is known for regular electrical supply and high unit rates since electrical supply was privatized over 15 years ago. Despite the cost, the regular supply of electricity is a great boon to the home-based garment makers, most of whom operate electrical sewing machines, and to the incense stick rollers who operate rolling machines powered by electricity. While the supply of electricity was steady and widespread across Ahmedabad City, the presence of street lighting was spotty. One waste picker noted that street lighting along her route helped her sort and collect recyclables during the early morning; while some street vendors compensate for the lack of street lighting at night by running solar-powered lanterns, hours and at night. But alternative energy sources cannot always be accessed or afforded by informal workers. Key informants in both Durban and Ahmedabad made the point that such products, whilst allowing workers some independence from the city electrical supply, generally require a large upfront investment which is often unaffordable to the poor (McKenzie Interview, Solanki Interview).

The energy sector was restructured in Peru after state enterprises were privatized in 1972. This process began with the sale of the distribution companies in 1994 and continued with the sale of the generating companies in 1995 and 1996. Since the current study started in mid-2015, there has been a rise in prices; however, this has not caused too much concern because the electricity coverage in the city is greater than 95 percent. But market traders and street vendors, especially,

pointed out their concern about the increase in gas prices.[5] Consider the following two contrasting quotes:

> "Almost all the market needs electricity, but as we have it and the prices remain the same, there is no major impact on our work, there are no changes. If we didn't have it, sure, there would be concerns because without electricity we wouldn't have water." (Lima, SV, FG 12)
>
> "The gas does not reach us, we have not connected. The president said that we will get gas, but nothing. There is no benefit to anyone." (Lima, SV, FG 14)

Transport

In the study cities, as in most cities around the world, public transport systems are not designed for the working poor in the informal economy.[6] Public transport between their place of residence and place of work is costly and infrequent or unreliable. Moreover, transporting goods on public transport is typically banned. Most informal workers have to resort to private transport of different kinds; or commute and transport goods on foot. A 2012 study by the WIEGO network found that home-based workers in three Asian cities (Ahmedabad, Bangkok and Lahore) spent 30 per cent of their earnings on transport; and of those who spent on transport one-quarter operated at a loss (Chen 2014).

Other problems with city transport systems were mentioned by the focus groups. In Durban, one group of cardboard recyclers noted: "We share the road with motorists as not all roads have pedestrian pavement (i.e. sidewalks); while we are pushing our trolley (*inqola*) full of cardboard, motorists swear at us." (Durban, WP, FG 11). Although Durban has recently developed a non-motorized transport policy, it caters only for recreational cyclists and pays no attention to the needs of the barrow operators who are estimated to transport approximately 100 tons of goods around the city on a daily basis, often risking their lives on busy highways to do so (Dobson Interview).

Given the spatial legacy of apartheid in South Africa, whereby the poorer black population still lives in townships at some distance from cities and business centers, transport is a key system for the informal workers in Durban. Here is what the different groups of informal workers in Durban had to say about the importance of transport to their livelihoods:

- Street Vendors: "Without transport we can't reach our workplaces." (Durban, SV, FG 1); "To us, transport is the most important system." (Durban, SV, FG 3); "We cannot go anywhere without transport: it is the main key system." (Durban, SV, FG 3); "If there are no customers come to town, we are not able to sell or have work. It is important for customers to come to us." (Durban, SV, FG 3).

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[5] In the 1980s, Camisea Gas in Cusco was discovered as a vast energy reserve for the country. Its exploitation began in 2004 but, even now, its use is very limited even in Lima. But it is expected that, in the future, the Camisea Gas will change the energy system of the whole country.

[6] An urban expert in Bangkok refers to the BTS SkyTrain and subway systems as "class-transit", not "mass-transit", as the poor cannot afford to ride on them. In fact, the poor cannot afford the more-informal modes of transport in Bangkok: the two-wheel and three-wheel motorized taxis. The poor tend to walk and take public buses or, if they can save enough money, buy their own motorcycle or car. (Apiwat Ratanawaraha, personal communication January 2014)

- Transport Workers: “If we don’t have transport to come here, we won’t be able to provide for our families.” (Durban, TW, FG 13); “We deliver items of people who use transport; we take the goods of people from a certain point to a taxi or bus rand.” (Durban, TW, FG 16)
- Mielie Cooker: “Where we collect mielies is too far; we need a car to collect them.” (Durban, MC, FG 15)

Despite the critical importance of transport, public transport in South Africa is inadequate, unreliable and very costly: forcing the informal workers to use private vans and taxis. The informal workers in Durban reported that taxi fares are on the rise. As one street vendor group noted: “When the fares go up, we end up working to cover transport costs, not to earn a profit.” (Durban, SV, FG 4). Several focus groups also noted that strikes by local taxi drivers have a major, negative, impact on them.

In Lima, transport is considered the second most important problem in the city, after insecurity. The public transport system was privatized in the 1990s and since then, transport services have been provided by a chaotic mix of small and medium private companies. In addition, road infrastructure has been insufficient, resulting in increasing congestion, chaos and paralysis. In recent years, the government built two subway lines and a metropolitan bus line in Lima. However, these investments have proved to be insufficient to meet demand. The previous municipal administration began a reform of the transport sector that the current administration has not continued. The central government is now building a third subway line.

Nowhere in urban planning or public transport administration has the notion of allowing people to transport loads of goods been contemplated. “Busses are not designed for that sort of carting”, stated a Durban transport planner (Estevez Interview), but this is precisely the demand in all sectors studied in this project: waste pickers, street vendors and market traders especially have to resort to using taxis or private cars to transport their goods.[7]

Another problem is that the schedule of the trains and buses does not meet the needs of informal workers. Waste pickers, for example, said, “(The transport system) does not help us. Sometimes the buses do not want to pick us up.” Another said, “Sometimes I might wait until very late [in the night] and they (buses) do not pick us up.” (Lima, WP, FG 6).

Market traders also discussed how the transport system affects their productivity: “If I work eight hours, I spend five more in a bus.” (Lima, MT, FG 11). And, “It is not likely that (taxis) will pick me up with products and packages, and especially at the time I want to go.” Another said, “They (taxi drivers) do not want to tell us how much they can charge us because we will accept any

[7] In an interview, Gustavo Guerra-García, former Vice Minister of Transport and former adviser to the Management of Urban Transport of the Municipality of Lima, pointed out that the user profile of the public transport system did not include goods of any type or amount. Responding to the information found in the study, he noted that specific services would be required to transport goods in the municipality: “Not being able to find a suitable way of solving the normativity of freight instead of change the nature of public transport. This could lead to the design of a corrective measure as another urban public transport that allows heavy loads. (…) the logic of a freight bus is very different from a passenger bus where you need to think about providing comfort, you would have space big enough in case someone gets on with a big package because the problem is the movement and that includes a risk factor. It’s not easy finding one solution.” (Guerra-Garcia Interview)

charge; [the issue is] simply that they do not want to take us with our packages." (Lima, MT, FG 12). And a street vendor said: "The transport system is chaotic, it is out of control." Another added, "The worst thing is moto-taxis because they crash and drive away; they do whatever they want. People are walking and motos do not care." Also, the mass transit schedule does not match the working hours of the vendors: "(t)he metro works until 10 pm. So when I am done there is no metro." (Lima, SV, FG 14).

Urban infrastructure projects, including transport projects, have major impacts on the livelihoods of informal workers. Consider the case of Ahmedabad. In recent years many urban development and infrastructure projects including a Bus Rapid Transit system (BRTS) (2006), a model roads scheme (2011), a riverfront development scheme (2004), and road widening have been implemented in Ahmedabad City. In the design and preparation of these urban infrastructure projects, natural markets of street vendors and the vendors and hawkers themselves have not been considered. Many natural markets have been destroyed or dispersed through a series of evictions by the Ahmedabad Municipal Corporation. In many cases, the alternate space provided to vendors is not suitable as it does not attract customers. With the extension of the BRTS in one market area, the vendors were forced to relocate on a side service road where it is difficult to accommodate all of the dislocated vendors. Municipal authorities have planned to develop around 27 model roads where all vendors and hawkers will be banned. Under the model roads scheme, many natural markets of vendors have been completely shut down. The Self-Employed Women's Association (SEWA) estimates that over 5000 vendors were displaced during the first phase of the model roads scheme.

The implementation of a Bus Rapid Transit (BRT) system is currently in its early stages in Durban. The municipality is aware that the system will realign urban space and potentially disrupt natural markets throughout the city (Estevez Interview). With the collaboration of Asiye eTafuleni a paper plan of a model transport node which incorporates informal traders has been developed, although whether this will be implemented is questionable (Estevez Interview, Dobson Interview). Asiye eTafuleni continues to be critical of the BRT system, arguing that it is based on a model which views "frictionless" public transport, which minimizes interactions with public spaces, as the ideal, rather than promoting friction as way to increase economic opportunities (Dobson Interview).

Waste

In Ahmedabad, around 2010, the city began to privatize waste management; today, the private waste collection system now covers about 70 per cent of the city (estimate of Indian Academy of Self-Employed Women). In those parts of the city where there are municipal waste bins, the waste pickers can reclaim waste from those bins. But not all areas have municipal bins and in some areas that do, the municipal street cleaners or the private garbage collection workers reclaim waste for themselves.

In Durban, solid waste management is still a public sector function: through the department of Durban Solid Waste (DSW). One group of waste pickers reported: "The DSW often comes early and takes all the waste including cardboard, so it is important for us that we arrive before the DSW." (Durban, WP, FG 11)

In Lima, solid waste management is a public sector function but the municipalities are able to hire private enterprises for specific activities. Metropolitan and district municipalities share this function, so the quality of service differs from one municipality to another or between metropolitan and district avenues. A few municipalities work well with the waste picker associations and include them as part of the waste management system. In these cases, such as the district of Los Olivos, the conditions of waste pickers are better and safer: for example, they receive recycled materials from neighbors, work during the daytime, and wear uniforms and safety gadgets. In other districts, such as Surco, the conditions of the waste pickers are more difficult: they work during the night and have to search for materials in trash bags. Another challenge is whether the municipal garbage truck "comes on time, does not come, or is late" as the informal waste pickers try to come first. "I find materials, but only a little" reported one waste picker (Lima, WP, FG 7). A more recent challenge is that "(t)he municipality is installing underground containers for recycled materials." (Lima, WP, FG 6). Also, there are no sorting or recycling centers in either Los Olivos or Surco.[8]

Boxes 7, 8 and 9 summarize how each technological system affects livelihoods in the different sectors and whether these changes were negative (increased costs or displaced workers/ livelihoods) and/or positive.

Box 7
How the Transport System is Affecting Informal Livelihoods
(IEMS and Technology Project Focus Groups)

Impact	Ahmedabad	Durban	Lima
Cost (-)	"The price of oil is going up, so the price of going someplace by rickshaw goes up too." (Ahmedabad, HBW, FG 1)	"Transport fares increase all the time." (Durban, GM, FG 8) "We are working for the transport fare only; transport takes all the money that we earn." (Durban, GM, FG 8) "High cost affects transportation of our material; transport charges us more, therefore we need to increase prices of our products and this damages our relationship with customers." (Durban, GM, FG 5)	"It is not about the price. The buses see us with our sacks and they do not stop to pick us up." (Lima, WP, FG 6)

[8] Oswaldo Cáceres, a specialist in solid waste management, highlights that "There will be no change in the technology as long as there are no sorting centers. But [the challenge is that a sorting center] cannot be built just anywhere, due to the zoning regulations established by the Metropolitan Municipality. It would have to be built in the industrial area [zone] and any small industry is going to have a lot more capital to invest in the property than an association. (…) As long as there are no sorting centers all the technology is going to continue being individual technology." (Cáceres, Interview).

Displacement (-)	"When they widened the road, they destroyed the market where I buy my inputs. Now I have to go further." (Ahmedabad, HBW, FG 2)		"Before it was more comfortable. Get to market with all deviations from the construction of the Metro means taking 3 or 4 more buses." (Lima, MP, FG 2)
Convenience (+)		"Now I can get from one end of Durban to the other. The price is not bad and it saves me time." (Durban, SV, FG 3)	"Some day it (Metro) will be positive for some people." (Lima, MP, FG 4)

Sources: Ahmedabad and Durban, IEMS Focus Groups (2012); Lima, Technology and the Future of Work WIEGO Focus Groups (2015)

Box 8
How the Energy System is Affecting Informal Livelihoods
(IEMS and Technology Project Focus Groups)

Impact	Ahmedabad	Durban	Lima
Cost (-)	"The price of oil is going up, so the price of going someplace by rickshaw goes up too." (Ahmedabad, HBW, FG 1)	"Due to the existence of load shedding, electricity is a problem, because while you are in the middle of your work electricity just shuts down. " (Durban, HBW, FG 6) "Customers blame us for incomplete work (when electricity goes off) (Durban, HBW, FG 8)	"The problem is that at the time when prices were raised there were shortages." (Lima, MP, FG 2
Displacement (-)			
Convenience (+)			"The gas does not reach us. We don't have a connection. The president said he was going to do it, and nothing. There is no benefit to anyone." (Lima, SV, FG 14)

Sources: Ahmedabad and Durban, IEMS Focus Groups (2012); Lima, Technology and the Future of Work WIEGO Focus Groups (2015)

Box 9
How the Waste System is Affecting Informal Livelihoods
(IEMS and Technology Project Focus Groups)

Impact	Ahmedabad	Durban	Lima
Cost (-)	"Municipal corporation workers collect waste door to door in the housing societies and even take away our filled bags. We fear losing what we have collected so keep it near us in a bicycle rickshaw or take it to a safe place." (Ahmedabad, WP, FG 1)	"Even where we work, it is not clean. We sweep for ourselves – we clean where we work." (Durban, GM, FG 8) "Customers won't come to a dirty area; and even us, we will get sick and not be able to work." (Durban, GM, FG 6)	"The trucks pass but is not working very well because the streets are dirty. While here in the district of Los Olivos garbage is collected, in the district of San Martin de Porres, they are not picking up the trash so the avenues linking the districts are getting worse and get dirty." (Lima, WP, FG 5)
Displacement (-)	"It is difficult to find many recyclables in the dustbins as the municipal workers sort out and take the recyclables, so we have to go to nearby villages to find recyclables." (Ahmedabad, WP, FG 2) "Municipal workers sort out and collect recyclables which gives them a daily income of around 300 rupees. They leave only paper and recyclables of less or no value for use." (Ahmedabad, WP, FG 1)	"When municipal cleaners come before us we are not able to get recyclables." (Durban, WP, FG 9) "The Durban Solid Waste (DSW) department workers come early and take all the waste including cardboard, so it is important for us that we arrive before the DSW." (Durban, WP, FG 11) "We leave the materials that we have collected on the street; sometimes when we come back we find that the DSW workers have taken the material that we collected." (Durban, WP, FG 10) "Sometimes the municipal workers burn what we have collected." (Durban, WP, FG 12)	

Convenience (+)	"Nowadays the municipality keeps a big waste bin. So we have to go inside to collect the recyclables. It is slightly uncomfortable but we get recyclables in one place." (Ahmedabad, WP, FG 1) "The municipality dumps waste into large containers. So we collect recyclables from that container." (Ahmedabad, WP, FG 1)		"Now there is more discipline in Surco, there are areas where there are many people who do not throw their trash. The Municipality is putting underground containers for recycled materials, so neighbours only take away trash. Another thing that is happening in the district is that increasingly there are places where you can bring recycled materials as donation campaigns for different sick children and other problems. The municipality has formalized as and makes us to find less recycled materials in the street. (Lima, WP, FG 5)

Sources: Ahmedabad and Durban, IEMS Focus Groups (2012); Lima, Technology and the Future of Work WIEGO Focus Groups (2015)

The phone survey of 18 organizations of informal workers in Asia, Africa and Latin America confirmed the focus group findings on the impact of city-wide technological systems on the livelihoods of informal workers. In terms of the energy system, around three-quarters of the organizations reported that lack of electricity reduces the productivity of their members. Solar power was seen to be the main emerging energy technology for informal workers; but solar energy is still quite expensive according to several MBO leaders surveyed. In terms of the transport system, the organizations of workers reported that buses, both public and private, are the most important form of transport for their members. The organizations confirmed several common problems associated with the existing bus transport systems: high cost (relative to earnings), lack of frequent and regular services, and bans on transporting goods. All of the organizations confirmed that affordable transport is essential to the livelihoods of their members; and half reported that their members cannot afford the existing transport options.

In regard to the waste system, the majority of organizations with waste picker members reported that privatization of waste management impacted waste pickers in negative ways: reducing their access to waste and effectively banning them, even if they are organized into cooperatives, from bidding for solid waste management contracts. The organizations were also against incinerators and waste-to-energy plants as these reduce access to recyclables by the waste pickers. On the

other hand, the organizations viewed mechanization in waste processing and treatment quite favorably as it can enhance the dignity and earnings and reduces the physical labour of waste pickers, provided the mechanized technology is in the hands of waste pickers rather than in the hands of the dealers they sell to.

The Informal Economy Monitoring Study (IEMS) carried out in ten cities in 2012, including Ahmedabad, Durban, and Lima, also interrogated the impact of city systems on informal workers and their livelihoods. In 2012, the national energy crisis in South Africa had not started: so the informal workers did not rank energy supply as a major problem. In Ahmedabad, by contrast, the electrical supply was less regular in 2012, than in 2015, and the focus groups of home-based workers ranked the irregularity and high cost of electrical as major problems. In all three cities, across all sectors, the transport system was seen to have major impacts on their livelihoods. Box 10 presents what street vendor focus groups in Lima had to say about transport in 2012:

Box 10
Street Vendors on Impact of Transport System, Lima
(IEMS Focus Groups)

Transport Costs: Time & Money
"There are small cottage industries that grind *kiwicha* but they are far from where I work and I have to spend more (money) but I already have permanent clients for these products." (Lima, SV, FG 1)
"It takes me about 3 hours to go to where I keep my goods. And to sell, I get on the buses. I start downtown and I end my trip in San Borja, San Isidro. It's a long trip. The city tells you where to go. I follow the flow until I sell all I can. Other times I get on the bus in Lima and I end up in San Juan de Miraflores (in Lima's southern tip). It's very far and then I have to come back home." (Lima, SV, FG 1)
"If they call me on my cell phone from Surco (a south Lima neighborhood) that is very far from me asking for a book, I would still have to go so that I can keep my client. But that means more transportation expenses and time." (Lima, SV, FG 2)
"Prices at the Huamantanga market are not so high. If I buy elsewhere I make nothing. For example, fried corn sells for four soles elsewhere and it sells for 3.80 soles at Huamantanga. The same goes for other products. There's good quality. You can choose. La Parada is even cheaper. I can buy fried corn for 3.50 soles. The difficulty there is transportation, the bus fare, the time you waste. It would be a good idea to buy from wholesalers. We should agree and buy a sack as a group and distribute among us all." (Lima, SV, FG 11)
Transport of Goods:
"When you have packages, you have to pay for your packages." (Lima, SV, FG 10)
"When we have many packages, it's better to catch a cab." (Lima, SV, FG 10)
Private Transport:
"They (private truckers) own their cars and they give us a good service. They don't charge too much." (Lima, SV, FG 3)
"I leave very early in the mornings and the moto-taxis don't want to take me. It takes me very long because they would rather first pick up the schoolchildren going to school. And when I finish my workday, that's even worse because I have to take down my small stall. "(Lima, SV, FG 3)
"Sometimes they don't want to pick you up, they say they don't go where you want to go." (Lima, SV, FG 8)
"It is expensive and they won't take us where we want to go." (Lima, SV, FG 8)
"We need better transportation." (Lima, SV, FG 8)
Transport Infrastructure Projects:
"When they built the bridge, they pushed us away. They evicted us. That hurt us. When we came back

they were already ten of us in one single place." (Lima, SV, FG 6)
"The electric train has brought more public, more business, but the whole project actually means there will be a mass eviction, as they have announced." (Lima, SV, FG 10)
"I think the train has brought clients. There's more public now." (Lima, SV, FG 15)
Traffic/Congestion:
"Traffic is a nuisance, you can't move, you can't arrive at the time you planned to start working, there are too many strikes and demonstrations, for instance, down Abancay Avenue, and you are loaded with packages, you can't imagine that, can you?" (Lima, SV, FG 9)

Source: Informal Economy Monitoring Study Focus Groups (2012)

Finally and importantly, the focus group discussions during this research and the earlier IEMS research in the same cities, revealed that, in addition to changes in these city-wide systems, the unpredictable, often hostile, policy and regulatory environment serves to inhibit the livelihood strategies of informal workers, including their choice and use of technologies. The lack of legal recognition and protection means that informal workers often face demands for bribes, confiscation of goods and equipment, evictions, and other forms of harassment: which inhibit their ability or willingness to invest in improved technologies or enhanced stock. For instance, street vendors without secure vending sites are inhibited from investing in expensive or heavy technology as they have to be able to pick up and move their equipment and stock when they see the police coming. Additionally, the lack of a secure workplace and a secure storage space, high costs for permits and rents, and high costs of transport inhibit investments in both technology and stock. See Box 11 for a set of quotes from the 2012 IEMS study on the impact of government policies and practices on informal work in Ahmedabad, Durban and Lima.

Box 11
Impact of City Government Policies and Practices on Informal Work (IEMS Focus Groups)

Slum evictions and relocations►residences far from workplaces:
"It is true that the Ahmedabad Municipal Corporation has given us houses, but what is the use when there is no work to do?" "The AMC forcefully demolished our hutments, and pushed us to the city's periphery. Commuting is difficult, and work has decreased as there are no work contractors near the rehabilitation site." (Ahmedabad, HBW, FG 5)

"The sad part is that when we travel coming from home to town, we need to pay the taxi fares, and sometimes you struggle to get the taxi fare. Most of the time I have to walk from Mayville to Durban to be able to work if I do not have taxi fare. I am forced to walk as sometimes there is nothing to eat for the day so the only solution will be to go to work." (Durban, WP, FG 11)

Workplace evictions:
"Municipality officers chase us away from KwaPotsho (a dump), saying it is their place." "They should permit us to get inside to take dumped items so that we can make a living." "We need permits." (Durban, WP, FG 10)

"When we try to get in or closer to the dumping site, security guards beat us or even chase us away by guns." "Police fine the cars and trucks that come to dump when those cars allow us to take their loads." (Durban, WP, FG 2)

"We can't buy large amounts of merchandise, because we don't know what will happen. If you knew what the eviction date was, you'd be able to buy more." (Lima, SV, FG 1)

"It's a daily concern. I come to work and I don't know what will happen that day." (Lima, SV, FG 10)

"The municipality can declare any area off-limits. Nobody can work there. That makes work difficult." (Lima, SV, FG 13)

"You want to put some order among people, clean a little bit. But other vendors won't. They say, Why should I spend my money, why should I invest if might be evicted?" (Lima, SV, FG 14)

Regulations that constrain work:
"If we have a permit for sweets, we can only sell sweets. I wanted to sell juice, but the municipality would not allow me to do so, and they raided me." (Lima, SV, FG 13)

"There is a rule that you can only have two benches. This is an obstacle for selling; they will give you a ticket, and they will fine you." (Lima, SV, FG 9)

"I have an area from which I can't move. Only I can be there, because if I leave that place they will confiscate everything from me." (Lima, SV, FG 11)

Lack of workplace amenities:
"We do not have a proper place where we can conduct our business after collecting; we go and wait on the street for the middleman to come, and if it is raining we get wet with our goods." (Durban, WP, FG 11)

"There are no shelters and it is not safe there. Our items are exposed to bad weather conditions and they get spoiled." "There are no toilets. We use the bush to when nature calls." "There is no water. We fetch water very far by the road." "Storage and thieves [are a problem]. We do not have a safe place to keep our goods." (Durban, WP, FG 3)

"Our goods are kept in an open space where people and thieves can see them, that is why they are exposed to theft." (Durban, WP, FG 6)

"We do not have water and there are no toilets but we are next to the roads. I had a very bad experience due to the lack of toilet facilities." (Durban, WP, FG 9)

Harassment and confiscations:
"They Police confiscate our goods." "While confiscating our goods, they take our trolleys too. This forces us to work without trolleys and carry our goods on our heads." (Durban, WP, FG 14)

"Police come at night and confiscate our goods. They throw them away and sometimes beat us." "Police say your trolley is not permitted on the roads and then they confiscate it." (Durban, WP, FG 15)

"They confiscate our goods, and you have to pay 900 *soles* (to get them back)." "If they confiscate your goods and you want to get them back, you end up paying more than your capital; it's not worth it." "This is theft; the Municipality steals. There are no regulations; we don't know how much they charge for the goods." "There is a regulation; 900 for each cart, but what if it isn't worth that much? You have to start all over again." (Lima, SV, FG 4)

"If you don't pay what they [guards hired by the municipality] ask for, sometimes they will even beat you, throw your merchandise on the street, kick you, take your stuff away and the Municipality will not do anything. They are on their side." (Lima, SV, FG 5)

"Municipal police are charging you all the time, but they will evict you anyway. You just give them their money and that's it." "When you give them nothing, they seize your merchandise." "They tell me: 'come on, madam, give us something.'" (Lima, SV, FG 11)

"[I sell only] small things. You can't sell large things." "If you sell a jacket, anything valuable, they seize it at once, but they are not interested in small stuff." "I sell with a small bag. If I sell more, the municipal police come and confiscate my things." (Lima, SV, FG 12)

Lack of support:
"Councilors are very selective when providing services. They only serve those places that have committees. Places that do not have committees do not get services." (Durban, WP, FG 3)

"The authority is indifferent. There are proposals for local development, but nothing has been done. Our members do not believe in formalization proposals. They know that as time goes by, things will once again be in disarray and then they do nothing." (Lima, SV, FG 10)

"When we report thefts, they say it is not their job to protect street vendors." "We call for help but it never comes." (Lima, SV, FG 8)

Source: Informal Economy Monitoring Study Focus Groups (2012)

Consider, for example, the situation of Benedict Matlalo and other metal scrap recyclers in Durban. The essential tools of their trade, used to break down appliances and other sources of metal, are a hammer, a chisel, a screwdriver or spanner, and an axle saw. In an ironic twist of fate, possession of these tools - which are essential for their livelihoods - also make them vulnerable to police harassment and confiscation. As Benedict explained, the tools they use in their scrap metal recycling business are the same ones that criminals use to break into houses. The police therefore assume that they possess and use these tools because they *are* criminals and are plotting to use them to carry out burglaries. This is further aggravated by the fact that their job requires them to walk around local neighborhoods looking for scrap mental and cardboard, in an environment where there are already heightened fears of crime. The police response is to confiscate their tools or to surround them at the park where they work, forcing them to run off and hide. On occasion, they have even been shot at with rubber bullets: one of Benedict's colleagues lost his eye, but being a migrant he chose not to report the incident as he was afraid of being deported. On other occasions the police have loaded them up 'like sardines' into police vans, and taken them somewhere to be 'hosed down', or driven them far away to a dump in Springfield, from where it has been difficult to get back to their work site (Durban Micro-Narrative).

In sum, how a city perceives and approaches the informal economy and what a city does in terms of infrastructure services are critical determinants of whether the working poor are able to take advantage of technology. As Richard Dobson of Asiye eTafuleni put it: "Provision of infrastructure is a defining pathway for the uptake and use of higher-order technology." See Appendix III for full-length interview with Richard Dobson.

ICTs, Work and Organizing

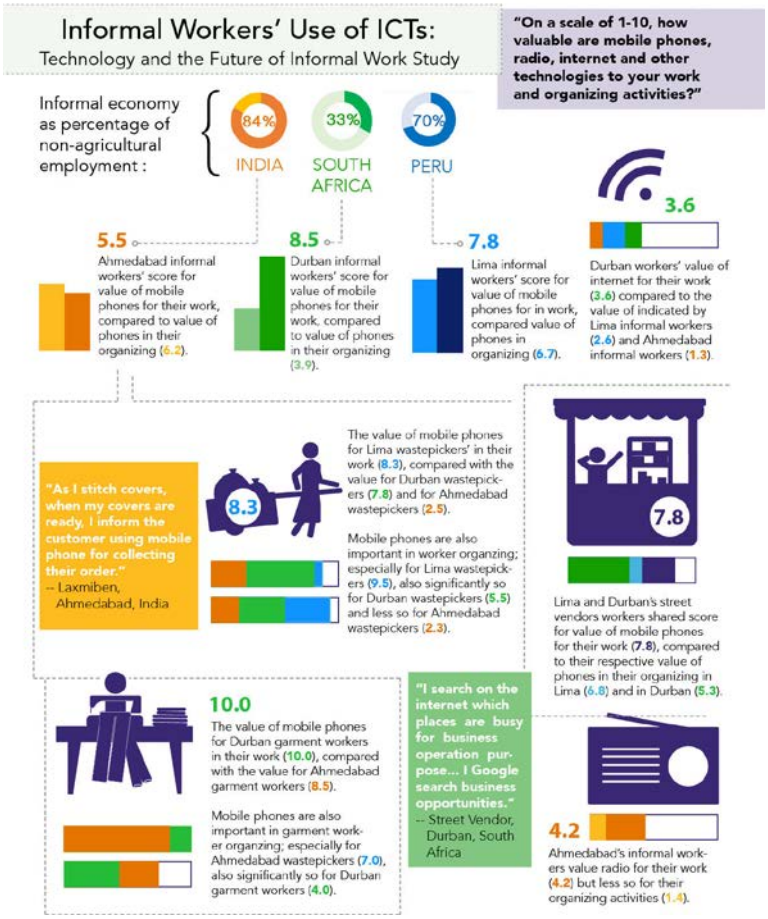
Information communication technologies (ICTs) can have - and are having - major impact on the livelihoods and organizing efforts of informal workers. But how reliant are informal workers on ICTs in their work and in their organizing? Are ICTs having a positive or negative impact?

The focus group discussions revealed that informal workers are using mobile phones in their work and in their organizing efforts more than any other ICT: see Table 6 and Infographic. In terms of intensity of use of ICTs in *work*, on a scale of 1-10, mobile phones ranked 5.5 (Ahmedabad), 8.5 (Durban) and 7.8 (Lima) And, in terms of intensity of use in *organizing*, mobile phones ranked 6.2 (Ahmedabad), 3.9 (Durban) and 6.7 (Lima).

Table 6
Intensity of Use of ICTs
(Focus Groups)

ICTs	Ahmedabad	Durban	Lima
Mobile: Use in Work	5.5	8.5	7.8
Mobile: Use in Organizing	6.2	3.9	6.7
Internet: Use in Work	1.3	3.6	2.6
Internet: Use in Organizing	1.0	1.1	5.7

Note: Respondents were asked to rate the importance of mobile and Internet technology on a scale of 1-10, where 1 is not at all important and 10 is very important.
Source: Technology and the Future of Work WIEGO Focus Groups (2015)



Some informal workers – waste pickers and barrow operators – do not possess or are not even aware of ICTs other than simple mobile phones, radios and television. A male waste picker in Ahmedabad, when asked whether he used the internet, replied: "I do not know what the internet is or how to use it." (Ahmedabad, WP). In Durban, a street vendor thought that internet is used by people who work in offices and a barrow operator thought that internet is used by young people. Among the handful who do use internet, the usage is mainly restricted to "WhatsApp", which allows them to communicate with customers. Some groups of informal workers do not own even simple mobile phones because they share phones owned by other members of the family or they fear their phone will be stolen. As a waste picker in Durban reported: "While we rest or are sleeping, people who are passing by come and steal our cell phones." (Durban, WP, FG 15). In Ahmedabad, a group of women construction workers noted that their husbands would not allow them to own a phone as they did not want them to communicate directly with the male recruiters and contractors.

Despite these constraints, many informal workers reported that they used mobile phones, and other basic ICTs in their work, even if they don't own them. First and foremost, informal workers use these mobile phones to get market information: on whether suppliers have stock available, whether contractors have work available, and what the prevailing price or wage rate is. A garment maker in Ahmedabad reported: "The covers that I stitch have the mobile number of the person who collects the stitched covers. I get orders for stitching covers over the phone." And a street vendor in Durban reported: "(A mobile phone) enables us to contact customers about their orders. It allows me to convey information in a speedy manner." (Durban, SV, FG 1).

Consider the case of Sizakele Ncube, the garment maker at the Berea Station in Durban, South Africa. Sizakele uses her mobile phone to take orders from clients and to make appointments without meeting them face to face. And when orders come in from further afield, like Cape Town, she asks her clients to SMS their measurements so that she can make their garments to order, an arrangement which has enabled her to expand her client base beyond her immediate geographical reach (Durban Micro-Narrative).

In Lima, some street vendors and market traders also use phones to contact their suppliers and place orders for supplies so that they can save time and money related to transportation (Lima, SV, FG 12 and 16). Cell phones are used to provide better services, as the case of Mario Quispe, who sells vegetable at Rosa de las Américas Market in the district of San Martin de Porres. In the last few years he has changed the way he trades and now offers a "to go" service for his most loyal clients, his *caseros*. Mario realized that his clients are always in a hurry and have very little time to shop for groceries. So one day he decided to give his cellphone number to his steady customers so that they could call him and place an order for groceries. He takes the orders, calculates the cost, and packs the groceries for his clients who drop by to pick up and pay for and their orders. This way he saves them time. His clients consist of restaurants from the surrounding areas as well as steady customers (*caseras*) (Lima Micro-Narrative).

Secondly, some informal workers use mobile phones to advertise their products or their selling hours. Thirdly, informal workers use radios or televisions to learn more about their trade. A group of waste pickers in Ahmedabad said they listen to the radio and watch television to get information on how to store and recycle waste. Waste pickers in Lima use mobile phones to

generate extra work opportunities: for example, to arrange contracts to use their three-wheelers to transport furniture or materials.

In Lima, there is a pilot project between the Municipality of Santiago de Surco and a local waste pickers organization (Asociación de Recicladores Ambientales de Santiago de Surco). The objective is to enable the waste pickers, who work at night in certain parts of the district, to alert the municipal security force (the *Serenazgo*) of any incident or suspicious activity that they encounter on their routes. The Municipality has created two direct phone lines to their public safety call center for the waste pickers to use but only one is free for the caller (Lima Micro-Narrative).

The phone survey of 18 organizations of informal workers in Asia, Africa and Latin America, conducted by WIEGO, confirmed the focus group findings on the use of ICTs, and mobile phones in particular, by informal workers in their work and also their organizing efforts. Ninety per cent of the organizations reported that their members use a mobile phone; forty per cent said their members use smart phones and social media; one third reported that their members use "apps" or other internet technologies. Only five per cent of the organizations reported that their members do not use ICTs on a regular basis in their work. In terms of what ICTs are used for, seventy per cent of the organizations said that their members use ICTs to contact suppliers (e.g. to check the availability and price of supplies or stock they need); and over half of the organizations said that their members used ICTs to contact customers and for organizing purposes. However, in many cases, MBO leaders acknowledged that low levels of literacy or lack of skills and knowledge still represent significant barriers to their members being able to use ICTs in their work. In South Africa there is also a significant cost barrier because of high network prices (Dobson Interview).

Ninety per cent of the organizations reported that their organizers use some type of ICTs to help organise members; and there was unanimous agreement that ICTs improve their ability to organize. Two-thirds of the organizations use mobile phones and social media in their organizing work; and half also use smart phones, email/internet and websites as organizing tools. While the majority of MBO leaders surveyed said they found ICTs useful, many indicated that traditional forms of organizing still remain important, particularly to reach people in remote rural areas where there is limited cell phone or internet access or older members who do not use ICTs.

It should be noted that the use of basic technologies can have an impact on organising. A key informant in Durban observed that work technologies (rather than ICTs specifically) play a role in bringing workers together: "particular sorts of technologies start to develop a sector of informal workers, which in themselves slowly start to aggregate out into a larger group of people doing the same thing. And therefore there would be common interest and they would organize around that. So, definitely the cohort of garment makers are a result of people who use sewing machines, similar sewing machines that have similar challenges of getting electricity, they have similar challenges of needing to get them serviced, maintained and stored. There is a kind of rallying point…definitely the technologies as in the past start to form guilds of people that are doing similar things" (Dobson Interview).

Some organizations of street vendors use mobile phones to warn or inform their members about police raids. A home-based worker in Thailand, member of HomeNet Thailand was able to use

an App called Line as a source of evidence in court against a subcontractor who refused to pay an HBW for an order. The home-based worker had received an order from a subcontractor who subsequently refused to pay her for the work done, indicating he/they had never placed an order with her. The home-based worker had received legal training from HomeNet Thailand so she knew she required evidence to prove the subcontractor had made the order. She could not find any written documents but found in her Line messages with the contractor that showed that he had in fact placed the order. She was able to use this as evidence in her claim against the contractor.

But it should be noted that more advanced internet-based ICTs may not be practical or useful. During a joint pilot project of Asiye eTafuleni and WIEGO in Durban, funded by the Rockefeller Foundation's Centennial Fund, two digital technologies to empower street vendors in urban disaster risk management were tested. The first of these was the Ushahidi Platform (www.ushahidi.com), and the second was Frontline SMS (www.frontlinesms.com). The Ushahidi Platform, developed as a means to map information from multiple sources, was used in this project to develop a digital map of fire and sanitation hazards in Warwick Junction. Frontline SMS, a web-based tool which allows for sending and receiving of bulk SMS's, was used in this project to reinforce messages about health and safety to individual vendors who had attended an occupational health and safety training course.

The Ushahidi Platform proved to be a useful way to record hazards in the market but only when used with an Android phone, to which very few vendors had access. In response, project staff attempted to connect Ushahidi and Frontline SMS, so that text messages could be "pushed" to Ushahidi via Frontline. However, it proved difficult to connect the two pieces of software, especially because there were no IT specialists on the project team. Vendors also struggled to compose SMSs which accurately reflected the nature and location of the hazard that they were reporting. Using Frontline SMS to send health messages to traders was more straightforward and successful. One message per day was sent to traders for a period of three weeks. The project evaluation revealed that these messages had been well received by traders, who felt a sense of being cared for in their workplaces. Moreover, 89 per cent of vendors interviewed in the evaluation reported that the SMSs provided a valuable reminder of what they already knew they should do to reduce health risks and led to a change in their behaviour.

There are several important lessons to be taken from these experiments with digital technology. The use of digital technology can certainly add value to a project, particularly when it provides relevant information to the beneficiaries. However, there are limitations. In the Durban case, vendors did not have smart phones, which limited what could be done with Ushahidi. Vendors also require sustained capacity building programmes if they are to be able to engage with this technology successfully – it cannot be assumed that this will happen naturally or immediately. Finally, and perhaps most importantly, digital technology does not exist in isolation from the systems in which it is embedded. In the case of the health messages, traders who had attended the occupational health and safety course offered by Asiye eTafuleni and WIEGO were found to be more likely to change their health behaviours than those who had not attended the course. With the Ushahidi platform traders were quickly disappointed when their hazard mapping did not result in direct action from the municipality to address the hazards. The technology alone

could not address the complex socio-economic factors which have led the city to neglect the infrastructure in Warwick Junction.

Technological Adaptation

The available evidence suggests that individual informal workers adapt or invest in technologies to increase productivity and incomes, to address occupational health and safety concerns, and to compensate for wider structural constraints. But the adaptations or investments are quite modest, as follows:

To Increase Productivity and Income

- construction workers: seek training in specialized skills & invested in tradesmen tools
- garment makers: invest in improved electric sewing machines & specialized gadgets
- street vendors: invest in improved displays & digital scales to attract customers
- street vendors & waste pickers: invest in improved barrows, trolleys and carts
- all workers: use simple mobile phones to contact suppliers, buyers, contractors

To Address Occupational Safety and Health Risks

- construction workers: use top knots woven out of string or plastic to cushion weight of headloads
- market porters; use boards, as ramps, to cushion weight when loading/offloading heavy bags or boxes
- street vendors & waste pickers: put reflection strips on their trolleys, barrows or carts

To Compensate for Lack of Basic Infrastructure Services

- street vendors: use solar lamps to extend selling hours

To Compensate for Lack of Accessible/Affordable Public Transport

- all workers: hire private transport, sometimes jointly

The evidence also indicates that organizations informal workers can and do help their members to make technological choices, to jointly acquire expensive technology, and to negotiate the wider environment. Organizations of informal workers have helped their members negotiate a) access to raw materials (including waste); b) secure workplaces and storage spaces; c) basic infrastructure services at their homes and workplaces; d) accessible and affordable transport services; e) permits or licenses to work; and f) contracts to provide public goods and services – all of which make it more likely that informal workers can invest in improved technologies.

III. TECHNOLOGY AT THE BOTTOM OF THE PYRAMID

The research findings presented above shed much-needed light on the reality of work and technology at the bottom of the economic pyramid. The findings suggest that both existing and emerging work technologies, in all the sectors across the three cities, are quite basic (see Box 12).

Box 12
Summary of Key Findings:
Work Technologies

- **Existing Technologies are Very Basic**
  - construction workers: hoe, sieve, basin
  - garment makers: electrical sewing machines
  - incense stick rollers: board, basin
  - street vendors: bowls, scales, display tables/stands, carts
  - waste pickers: sack plus rope to tie the sack
- **New or Emerging Technologies are Also Quite Basic**
  - construction workers: tools common to tradesmen
  - garment makers: newer models of sewing machines
  - incense stick rollers: mixing & rolling machines
  - street vendors: improved displays & digital scales
  - transport workers: improved trolleys
  - waste pickers: better forms of transport + space for storage
- **Costs & Risks of New Technologies are Well Understood**
  - multiple direct costs: capital investment + energy requirement + maintenance/repairs + replacement if lost/confiscated/stolen/broken beyond repair
  - lack of necessary know-how or skills: to use and maintain technologies
  - lack of basic infrastructure services: electricity + storage
  - portability/lightness: especially for street vendors who have to move on when police arrive and for home-based workers whose homes double as a workspace
  - storability: especially for street vendors & waste pickers but also for all informal workers whose homes double as storage spaces
  - fear of theft: by the general public
  - fear of confiscation: by local authorities

The findings also suggest that informal workers and their organizations are beginning to use ICTs in their work and organizing: but informal workers use mainly simple mobile phones while organizations of informal workers are beginning to use internet and online platforms (see Box 13).

Box 13
Summary of Key Findings:
Information Communication Technologies

- **Current Use of ICTs by Individual Informal Workers in Their Work is Quite Limited**
  - current use of ICTs is limited to simple basic mobile phones in most sectors
    - some home-based workers: listen to radio or TV while working
    - some informal workers: use radio or TV to get information about their sector
    - some garment makers use cameras to document their designs or previous work

        - some construction workers use cameras to document their previous work,
    - but many informal workers do not own or use mobile phones due to various constraints:
        - illiteracy: many informal workers are illiterate or otherwise not comfortable using mobile phones
        - gender norms: some women informal workers reported that their husbands did not want them to own or even use mobile phones to deal with contractors, suppliers or other men outside the home
        - fear of theft: many informal workers reported that mobile phones get stolen
- **Use of ICTs by Organizations of Informal Workers is Expanding**
    - two-thirds of the organizations interviewed use mobile phones and social media in their organizing work
    - half also use smart phones, email/internet and websites as organizing tools
    - but there are limits to using ICTs as
        - many members do not own smart phones
        - many organizations do not own smart phones or computers
        - many members are not literate
        - many members live in remote areas without internet access
    - also, ICTs alone cannot address the wider systemic constraints faced by informal workers

In regard to technological change, what is driving change, and whether/how informal workers respond, the findings suggest that emerging technologies impact the working poor in several ways – both positive and negative; that informal workers can and do adapt to technological disruptions; but their ability to do so is helped or hindered by a variety of external factors (see Box 14).

Box 14
Summary of Key Findings:
Technological Change and Adaptation

- **Technology can and does disrupt the livelihood activities of the working poor in several ways: it can**
    - displace old tools/know-how
    - displace activities/people
    - create new tools/know-how
    - create new earning opportunities
- **The working poor in the informal economy can and do adapt to technology disruptions, usually with little external assistance.**
- **But many factors *enable or disable* the livelihoods of the working poor and, thereby, *drive or inhibit adaptation* by the working poor**
    - economic trends
    - city-level systems
    - city policies and practices
    - private sector: competition & linkages
    - social norms & social stigma/status
    - financial services & business development services
    - education & skills training
    - climate change & seasonality

Finally, and most importantly, the findings suggest that city-level systems and city-level policies and practices have significant impact on informal workers, their livelihoods and their ability to adapt to technological change. An unpredictable, often hostile, policy and regulatory environment serves to inhibit the livelihood strategies of informal workers, including their choice and use of technologies (see Box 15). This reality is summed up succinctly by a street vendor in Lima: "I sell from a small bag. If I sell more, the municipal police (*serenos*) come and seize my things." (Lima, SV, FG 12)

Box 15
Summary of Key Findings:
City Systems, Policies & Practices

- **City-Wide Technology Systems have Significant Impact on Informal Livelihoods**
  - most significant system:
    - electricity for garment makers & incense stick rollers
    - transport for street vendors & transport providers
    - waste for waste pickers
  - current systems: largely negative
    - electricity: irregular supply (Durban) & high cost (Ahmedabad)
    - public transport; inadequate and unaffordable & cannot be used to transport goods, especially waste
    - waste management: not inclusive, sometimes exclusive, of waste pickers
- **City Policies and Practices have Significant Impact on Informal Livelihoods**
  - city policies and practices are unpredictable and often hostile
    - informal workers face bribes, confiscation of goods and equipment, evictions and other forms of harassment
    - informal workers lack secure workplace and storage space
    - informal workers face high costs for permits and rents
  - basic infrastructure and transport services are unreliable or unaffordable
  - all of these factors inhibit investments in both technology and stock

To date, little, if any attention, has been given to development of technology for the working poor in the informal economy. Meanwhile, informal workers have been adapting their existing work technologies to match new work opportunities and adapting their existing work to meet new technological challenges: but largely on their own in a negative policy and regulatory environment. As one street vendor in Lima observed, informal workers belong to "a different world": a world that is either invisible to or stigmatized by government, the private sector and the general public. To make cities more inclusive and technology more just for informal workers, governments and other key stakeholders need to recognize and value informal livelihoods and workers; to take them into account – to listen to their needs – when designing systems, policies and regulations.

IV. FUTURE SCENARIOS

Fast and fundamental technological change is impacting the nature of work and the structure of labor markets around the world. The basic nature of work – where people work, who they work for under what arrangements, what goods and services they produce or provide, and how they are compensated – is fast changing. Workers are contracted by employers, buyers and customers in

new ways driven by technology. Workers are linked through production and distribution chains to employers and customers in other countries, driven by both trade and technology. These technological changes have contributed to the persistence of informal employment in many places and the emergence of informal employment in new guises and unexpected places.

The informal economy today represents more than half of non-agricultural employment in most developed regions and as much as 82 per cent of non-agricultural employment in South Asia (Vanek et al. 2014). If data on informal employment in agriculture were included in these estimates, the proportion of informal employment in total employment would be even higher in heavily agricultural regions, especially in sub-Saharan Africa and more so in South Asia. Though they face a wide variety of working conditions, all informal workers are excluded from basic labor and social protections through their work, and most do their work in public space or private homes.

Yet we know relatively little about how technology impacts individual informal workers at the bottom of the economic pyramid. Little, if any, attention has been paid to the tools or technology needed by informal workers to pursue their livelihoods or to the impact of new technologies on their livelihoods: This research project has begun to bridge this gap. While there is a widespread belief in technology as a driver of dynamism and growth, not enough attention is paid to the winners and losers of technological change and economic growth. Further, little attention has been paid to informal units and activities in technology development and design. See Appendix IV for a summary analysis of the review of literature on informal employment and technology carried out by Practical Action and WIEGO at the start of the joint project.

There is growing interest in innovation within the informal economy but most of the studies focus on the behaviour or resources of the individual informal worker (i.e., whether s/he is willing to take entrepreneurial risks and/or has cash to invest); the role of informal institutions (family, community, networks); and linkages with formal firm (Daniels 2010; Harriss 2014). Few of the studies focus on the impact of the formal policy and regulatory environment on the behaviour and activities of informal workers, especially as they relate to technology.

Yet those who forecast changes in the formal economy look at wider vectors of change, including demographic, political and economic trends, as they intersect with the development of technology.[9] These change vectors also impact the informal economy. Informal workers in Asia and Africa have much to learn from the experience of informal workers in Latin America, where more countries are middle income and where more cities have undergone "modernization", including large urban renewal and infrastructure schemes. As a region, compared to Asia and Africa, Latin America has a wider variety of markets along the continuum from informal to formal – with a lot in between - and more privatized waste management systems (and also more organized waste pickers). The relatively modernized economies, like Peru, demand more modern technologies: for instance, stainless steel vending carts with display stands. In Latin America, more waste pickers are organized into cooperatives which have struggled for access to waste and for sorting sheds and processing equipment; and a few waste picker cooperatives have won municipal bids to sort, reclaim and transport waste.

[9] Webbmedia Group, 2016 Trend Report, p. 10, vectors 1, 3 and 7

The findings from this current project, and from the earlier research cited in this paper, suggest that three "change vectors" are likely to impact and can help forecast technology trends within the informal economy, including: wealth distribution, government policies and practices, and value chain dynamics In cities where wealth distribution becomes more even, and/or government policy and practices become less punitive, and/or workers lower in the chain become better protected in the value chain, we would expect to see more widespread investments in technological assets that increase productivity. In cities where the opposite trends occur, we would expect to see more limited adoption of or investment in the types of technological change that increase workers' productivity. This is especially the case for the informal self-employed and sub-contracted workers who are responsible for making investments in their own tools and equipment. We would also expect changes in investments in, and adoption of, new technologies to be sector specific, as the research presented here shows that constraints tend to be sector-specific.

For the foreseeable future, the responsibility for ensuring that technology trends will help – not hinder – the working poor in the informal economy rests with the informal workers themselves, their organizations and their supporters. The ground level realities examined by the current research and documented in this report considered together with the joint normative frameworks of the project partners suggest a way forward.

The following scenario is premised on the central role of informal workers and their organizations in navigating their uncertain technological future.

Focus on Basic Technologies & the Wider Environment

The way forward requires a focus on basic technologies that can be sourced locally and built, appropriated, modified and repaired by the working poor in the informal economy. The way forward needs to address the unpredictable and often hostile policies and practices of local government, which create risks for informal workers and thereby inhibit their investment and innovation potential.

Organizing as Key to High Road Outcomes

High road outcomes are most likely when informal workers are organized; and when their organizations can advocate for a supportive policy and regulatory environment, develop appropriate technologies and skills, and support informal workers to acquire collectively-owned technological assets, which would be difficult for individual informal workers to acquire and manage.

The research findings suggest that specific groups of informal workers might collectively own and manage sector-specific technologies as follows:

- construction workers: coops with trade-specific equipment and machines
- garment makers: production units with cutting machines, embroidery machines, specialized sewing machines
- incense stick rollers: collective units with jointly-owned dough-mixing and stick-rolling machines
- waste pickers: collective units with space and equipment for storing, sorting, bundling and processing recyclables

- street vendors: self-managed natural markets with basic infrastructure services
- waste pickers: coops with contracts from city; coops with 3-D printers

The WIEGO network and our partners in the current research study have experience in supporting informal workers with acquiring collective assets and/or engaging in collective bargaining and negotiations. The largest, oldest and most comprehensive organizations, SEWA, engages in collective bargaining with its members on an on-going basis and has developed multiple collective assets, including a shop that sells thread, needles and other supplies at reasonable prices to garment makers; a trade facilitation unit the provides design and marketing services to home-based workers; and a training center that trains women construction workers in masonry and other construction-related skills. Asiye eTafuleni has designed not only improved stalls or stands for individual street vendors and improved trolleys for individual waste pickers in Durban but also portable first-aid stands that are collectively owned and managed. And WIEGO team members in Lima, together with local NGOs like PLADES, have trained multiple informal worker leaders in collective bargaining and advocacy skills; and supported local campaigns for more enabling laws and regulations.

A Better Future

In conclusion, each of the partners in the overall research project seeks to promote a better future for the working poor in the informal economy. The Rockefeller Foundation, through its Inclusive Economies goal, seeks to promote an enabling environment for the working poor. Practical Action seeks to promote technology justice – fair access to appropriate technology – for the working poor. And the WIEGO network seeks to empower the working poor through organization to demand an enabling environment. These three goals – inclusive economies, technology justice, and empowerment of the working poor - are mutually reinforcing: each is necessary but not sufficient without the other two. Promoted jointly, through this research project and beyond, these interrelated goals promise a better future for the working poor in the informal economy. But this will also require a change in mainstream assumptions about the informal economy: notably, that most informal workers are not plucky entrepreneurs trying to avoid taxes and regulations or deal in illegal goods and services but working poor trying to earn a living against great odds.

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APPENDIX I
RESEARCH METHODS

FOCUS GROUP TOOLS

Tool # 1 – which technologies do you use in your work, and to do what? (participants draw technologies/tools on cards, sort the cards, and discuss them)

Tool # 2a – what technologies are emerging and disappearing in your sector? (answers listed on chart)

Tool # 2b – who uses existing and emerging technologies, workers like you or other workers? (answers put in a 2x2 matrix)

Tool # 2c – which are the first, second and third most important technologies, how do they impact, and how do you respond? (participants draw causal flow diagram; ranking recorded in a matrix)

Tool # 3 - which city-wide system (energy, transport or waste) has the biggest, second biggest and third biggest impact on your work? (participants draw circles of varying sizes and insert 1, 2 or 3 of plus or minus signs within circles)

Tool # 4 - how important are different ICTs in your work and for organizing? (participants rank intensity of use of different ICTs)

Tool # 5 - does the 1st, 2nd and 3rd ranked technology have a positive or negative impact on the quantity or quality of work in your sector? (facilitator inserts positive or negative answers in 2x3 matrix)

Guide to Tools

TOOL 1	QUESTION OR QUESTIONS
SORTING OF CARDS	1. Which technological assets in the photos (from 4T-TA) are used in the work process in your sector? 2. How are these technological assets used in the work process?

- Photos from 4T-TA
- Cards with drawings or words describing each technological asset used in the work process
- Categorising of cards by how each tool is used (for what – for preparing material, for processing, for communicating, etc)

This tool is an ice-breaker. Encourage people to take blank cards and write or draw each technological asset they use in their work. Some of the technological assets they write or draw may be the same as those in the 4T&TA photos but participants can add additional tools and equipment used in the work process for their sector which were not captured in the photos. The idea is to capture any and all examples of technologies used in the work process in the sector. Make sure *everyone* adds at least one card. Do not spend too much time on this.

Then ask them if they see any patterns in the answers, and ask them if they would arrange the cards in a way that makes sense. They can use whatever logic they like.

Time: About ten minutes.

TOOL 2a	**QUESTION OR QUESTIONS**
DYNAMICS IN THE SECTOR	1. What new technologies are being introduced in your sector? 2. What existing technologies are changing or disappearing in your sector?

This tool is intended to produce a list of technologies in the sector that are changing. This can include both new technologies that are being introduced and existing technologies that are changing somehow. The exercise should generate a discussion of how participants see things changing in their sector.

Time: About five minutes.

TOOL 2b	**QUESTION OR QUESTIONS**
STONE DIAGRAM OF TECHNOLOGY USERS	1. Who are the main users of **new** technologies being introduced in the sector: are they mostly workers like you, or are they other people who are doing different kinds of work in the same sector higher up the value chain? 2. How widely used are these technologies: are most or all (workers/others) users, or are only a few (workers/others) able to use them? 3. Who are the main users of **existing** technologies that are changing in the sector: are they mostly workers like you, or are they other people who are doing different kinds of work in the same sector higher up the value chain?

	4. How widely used are these technologies: are most or all (workers/others) users, or are only a few (workers/others) able to use them?

This tool is designed to get participants talking about how technological changes are related to accessibility (how accessible the technologies are to workers). It first asks participants whether the main users of the technologies identified in 2a are other workers like them (in other words, the new technologies are accessible to workers who are similarly positioned in the value chain), or are others who are doing different kinds of work higher up the value chain in the same sector (this could be workers, contractors, suppliers or others). The tool then asks how widespread is access to these technologies: are most or all people users, or are they accessible to only a few? The idea is to get participants talking to each other so that they reach a consensus on where to place the dot/circle representing each technology identified in 2a on a 2x2 space.

Time: About ten minutes.

TOOL 2c	**QUESTION OR QUESTIONS**
RANKING MATRIX AND CAUSAL FLOW DIAGRAM	1. Considering all technologies identified in Tool 1, as well as all technologies identified in Tool 2a, which technology is the most important in your work? Which is the second most important? Which is the third most important? 2. Considering the **most important** technology as identified by the group, what are the impacts of this technology on the livelihood, and how do workers respond to those impacts? 3. Considering the **second most important** technology as identified by the group, what are the impacts of this technology on the livelihood, and how do workers respond to those impacts?

Ask each of the five participants to identify which technology or technological asset — considering both those identified through the 4TTA exercise and new or changing technologies identified in 2a – is the first most important, the second most important, and the third most important in their work. The first most important technology gets three strokes (hash marks) (III) under the "Ranking" column, the second most important gets two (II) and the third most important gets one (I). Each participant should vote, and should use all three votes. Once each participant has voted, all the strokes are added up and the technology with the most strokes gets a number 1, the technology with the second most gets 2 and third most gets 3 under the "Priority" column.

Once the group has ranked the technologies, participants are asked to consider the top ranked technology and draw a diagram of its impacts on livelihoods, and the ways in which workers respond to those impacts. Impacts of the technology go on the left side of the diagram and responses on the right. Again all focus group members are asked to contribute and the result should reflect consensus among the group members. As in all tools the note taker should be writing down direct quotes from the discussion among the group.

Time: About fifteen minutes.

TOOL 3	**QUESTION OR QUESTIONS**
DIAGRAM OF CITY-WIDE SYSTEMS	1. Which city-wide system has the **biggest impact** on livelihoods in the sector: the transport system, the energy system or the waste system? How **positive** or **negative** is that impact? 2. Which city-wide system has the **second biggest** impact on livelihoods in the sector: the transport system, the energy system or the waste system? How **positive** or **negative** is that impact? 3. Which city-wide system has the **third biggest** impact on livelihoods in the sector: the transport system, the energy system or the waste system? How **positive** or **negative** is that impact?

The facilitator shifts the focus of the discussion to the city-wide transport system, the energy/power system (electrical grid), and the waste management system. Participants are asked to discuss which has the biggest impact (and second biggest, and third biggest) on livelihoods in their sector and whether that impact is very positive (+++), somewhat positive (++), a little positive (+), a little negative (-), somewhat negative (--), or very negative (---) OR a mix of positive and negative (+/-). The idea is to generate and record a discussion of how these broader technological systems feed into the work process and how any changes in them (e.g. the privatization of a system) are affecting workers.

Time: About ten minutes.

TOOL 4	QUESTION OR QUESTIONS
DIADS: IMPORTANCE OF ICTS IN WORK AND IN ORGANIZING	1. How reliant are workers in your sector on **personal mobile phones** for their **work**? 2. How reliant are workers in your sector on **personal mobile phones** for **organizing**? 3. How reliant are workers in your sector on the **Internet** for their **work**? 4. How reliant are workers in your sector on the **Internet** for **organizing**? 5. How reliant are workers in your sector on **other ICTs**—including radio, TV, cyber cafes, tablets, audio recorders, cameras, or modes of electronic banking—for their **work**? 6. How reliant are workers in your sector on **other ICTs**—including radio, TV, cyber cafes, tablets, audio recorders, cameras, or modes of electronic banking—for **organizing**?

The facilitator shows the focus group participants a scale diagram with 10 empty cells. At the left end of the diagram is “not at all reliant / don’t use at all.” At the right end of the diagram is “totally reliant / use all the time.” Participants are asked to consider how reliant workers in the sector are on mobile phones, Internet, and other ICTs for their **work**, and then how reliant they are on each separately for **organizing**. Participants are to negotiate an answer among themselves that reflects the group's consensus response for each type of ICT. The result is then shaded in to show where each consensus result falls on each scale. The idea is to generate a discussion around how salient each type of ICT is for informal workers in that sector. For the “other ICTs” category, the facilitator should label which ICT the discussion revolves around.

Time: About ten minutes.

TOOL 5	QUESTION OR QUESTIONS
STONE DIAGRAM ON IMPACT OF TECHNOLOGY ON WORK OPPORTUNITIES	1. For the #1-ranked technology in the sector (from tool 2c), does this technology or technological asset have a **positive** impact on the **quality** of jobs (easier/safer/more efficient) or does it have a **negative** effect on the **quality** of jobs (harder/less safe/less efficient)? 2. For the #1-ranked technology in the sector (from tool 2c), does this technology or technological asset have a **positive** impact on the **quantity** of jobs (does it create more work opportunities in the sector or linked to the sector) or does it have a **negative** impact on the **quantity** of jobs (does it destroy jobs or take away work opportunities in the sector)? 3. For the #2-ranked technology in the sector (from tool 2c), does this technology or technological asset have a **positive** impact on the **quality** of jobs (easier/safer/more efficient) or does it have a **negative** effect on the **quality** of jobs (harder/less safe/less efficient)? 4. For the #2-ranked technology in the sector (from tool 2c), does this technology or technological asset have a **positive** impact on the **quantity** of jobs (does it create more work opportunities in the sector or linked to the sector) or does it have a **negative** impact on the **quantity** of jobs (does it destroy jobs or take away work opportunities in the sector)?

Wrapping up and FG Report

Before you leave the venue, photograph all the worksheets. Make sure the whole worksheet is clearly visible and legible. Keep the original worksheets for reference when you are writing the FG report. **The FG report should be written the same day as the discussion**.

The FG report should follow the format of the example that was provided. The report should include the following:

1. All relevant information about the time, date, location of the FG as well as participation and who was facilitator and note-taker.

Repeat for each tool:

2. A translated version of the tool output. (Table, diagram, etc.)

3. A summary of the discussion and events related to the tool WITHOUT ANY ANALYSIS. Include QUOTES, who said what, substance of discussion, observations, etc.

4. A short analysis of the tool discussion (optional).

5. Conclusion: Please provide any overall observation, impressions, notes, analysis that you would like to share about this focus group. Does not need to be more than a paragraph or two (but feel free to make it longer if you like!)

PHOTO DOCUMENTATION: 4 T & TA

The 4T&TA is a participatory photographic method designed to understand how technology is being used by informal workers and the context in which they are using the technology. As part of this method, researchers will interview workers and have them self-identify their "most valued technological asset" (NOTE: our working definition of technology is tools and equipment used in the work process, know-how, and ways of organizing around the use of tools and equipment). They will then photograph the worker's surroundings to capture the context in which the work takes place. For each worker visit, researchers will be asked to put their photos into a template (shown below) and do a brief one-page summary of their discussions with the worker.

Before taking the photograph, the researchers should ask the workers to identify their most valued technological asset by asking this question:

- What is the most important tool or equipment you use in your work process?

Before or after taking the photographs, the researchers should ask the following questions:

- Why is this tool or piece of equipment the most valuable to you?
- Why did you choose/why do you use this particular technology?

How do you use that tool or equipment in your work? Does your use of the tool vary (i.e. by time of day? season?)?

The overarching research questions this method hopes to answer (per our research plan) are: 1) How are workers choosing, using and adapting technologies? and 2) What are the positive and negative impacts of technology on work opportunities?

General Information to be recorded for the method:

For each participant of the 4T&TA method, the researcher should record the following information:

- Full name of worker (we will record the name of the respondent but their name will be kept confidential when we write our final report);
- Their location
    - (i.e. where you interviewed them. For example: for street vendors, it could be the market they vend in, for home-based workers, it could be their neighbourhood, for waste pickers, it could be at a sorting facility, buy-back centre or where they are currently picking waste);
- Type of activity
    - (i.e. food cook, juice vendor, incense stick roller);
- GPS location (if possible);
- Name of the worker's most valued technological asset and a brief description:
    - Why is the technology important to them, how they use it in their work process, etc.
- Observations by the researcher about how technology is used in the work process:
    - For example: does the worker's use of technology vary throughout the day? Did the worker identify other technologies they use in their work?
- Other researcher comments/observations (including any observations about the worker's context).

Types of photos to be taken for the 4T&TA method:

For the 4T&TA photo documentation method, the researcher must capture (at a minimum):

1) 1 photo of the worker's most valued technological asset (TA). Some examples:



2) 4 photos which capture the context of the worker's environment (i.e. photos of their location). To do this, the researcher is asked to do "four turns" of the compass, capturing a photo at each turn of the worker's environment - this is the "4T" part of the methodology. In other words, take

a photo of the worker's context in the directions of 3, 6, 9 and 12 o'clock on a clock. See examples below:

The 5 photos will be placed in the PowerPoint template created by Richard with the technological asset placed in the center and the "four turns" photos placed around it. When inserting the images into the grey highlights in the template, click on the numeral box and select ‘bring forward’ to identify the inserted images 1 - 4.

Researchers should also ensure they have filled out the written information on the template (name of worker, location, activity, GPS, sheet number). To record the sheet number on the template, please follow this format: SV/01 (for the first street vendor you visited) or CW/20 (for the last construction worker you photographed). When you have completed the 4T&TA, you should have 20 completed sheets for each sector (80 workers total).

Additional ideas for photos (if the worker is willing):

These photos could be used to help better understand how workers are using the technology. The photos could also be used in the micro-narratives to be written for a selection of workers later on:

3) A more close-up photo of the worker (preferably facing the camera) using their technological asset.

4) A wider angle shot of the worker at their place of work. Some examples of each:

APPENDIX II:
ANALYSIS OF FOUR TURNS & TECHNOLOGICAL ASSET
PHOTO DOCUMENTATION

With the exception of the garment workers, all 3 remaining Durban sectors of informal workers surveyed are extremely vulnerable and harassed. They work in public space and only the street vendors have a measure of protection through a site permitting arrangement with the local government. The recyclers and non-motorized transport operators are harassed, disrespected and criminalized. In comparison with the Ahmedabad, the Durban screens record traits that clearly reflect this instability eg 'appropriated' and are conceptually shrunk around the scale intersections. An extreme view is that for some informal workers possessing technology is a liability rather than an asset. This is a clear indication that organizing, representation and an enabling environment are a defining pathways for the productive deployment of technology.

Garments

- the screen has interesting comparisons with Durban's colleagues in Ahmedabad despite the different work environment and that there is a nominal MBO presence. The significance of the similarity is therefore in the availability of work – relatively predictable income can inform decisions to acquire responsive tools for production. Informal workers' deployment of tools is therefore not necessarily an indication of their technological acumen but rather their vulnerability to attract work.
- it is nevertheless a sector that demonstrates technological acumen because the operation and maintenance of modern sewing machines is sophisticated.
- in addition, competition for work fosters a keen understanding of the various machine's functionality and a continual awareness of emerging technology in order to maintain an innovative advantage.
- as owner-operators they demonstrate significant capacity to engage with technology that is generally associated with the formal mass production garment industry.

Recyclers

- due to their extreme vulnerability traits of this sector are expediency and functionality with high levels of appropriation. The livelihood strategy is survivalist.
- however, within the apparent marginalization there is a high degree of niche and status decision making

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DURBAN CITY SUMMARY

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- considering that many recyclers use conventional tools, there is a notable absence of the valuing of the tools eg. no visual evidence of tool boxes.
- all this suggests that this sector's technological ambitions are artificially constrained and thwarted because of their vulnerability and harassment by a prejudiced public and enforcement agencies. Punitive enforcement denies the acquisition of appropriate technology.
- inappropriate tools for hazardous work results in occupational health and safety risks eg. cardboard recyclers are reluctant carrying knives for fear of being accused of criminal behavior resulting in them using razor blades with exposed edges instead of box cutters, designed for the purpose

Transport Operators

- the working circumstances of this sector are similar to those of their recycler colleagues. It is therefore significant that the summary screens of these 2 sectors are a virtual mirror image of one another.
- all the traits of vulnerability collate with each other eg. appropriated, function specific, re-purposed and risk. This is contrasted with high levels of innovation and self-manufacture which suggests that this is a sector that could flourish if it wasn't victimized.
- anecdotally, it is believed that non-motorized transport operators move 100 T of goods a day around the inner city. Within an emerging appreciation for 'green' technologies and low carbon systems, this represents an unrealized opportunity.

Street Vendors

- in contrast to their aforementioned sector colleagues, this sector has a measure of protection through the local government permit system.
- this results in moderate work place certainty but in a highly competitive trading environment.
- it is therefore consistent that the summary screen exhibits high values for functionality, niche, innovation and purchased because tools that respond with these traits are differentiators and attract customers.
- the high level of investment is off-set by concerns for security, risk and location. This suggests that appropriate infrastructure eg. shelter and storage are another defining pathway to the investment in and deployment of enabling technology.
- South Africa's electrical energy constraints generally but specifically a conservative policy regarding its reticulation in public spaces for the use of street vendors is a further limitation o the more persuasive use of higher order street technology. This has however, given rise to a substantial business opportunity in battery charging and DC current technology eg. music vendors and street barbers.

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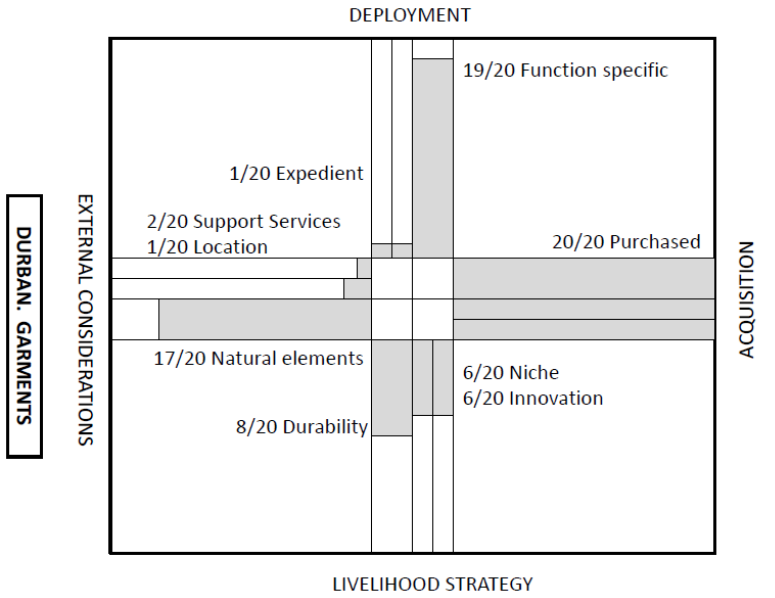
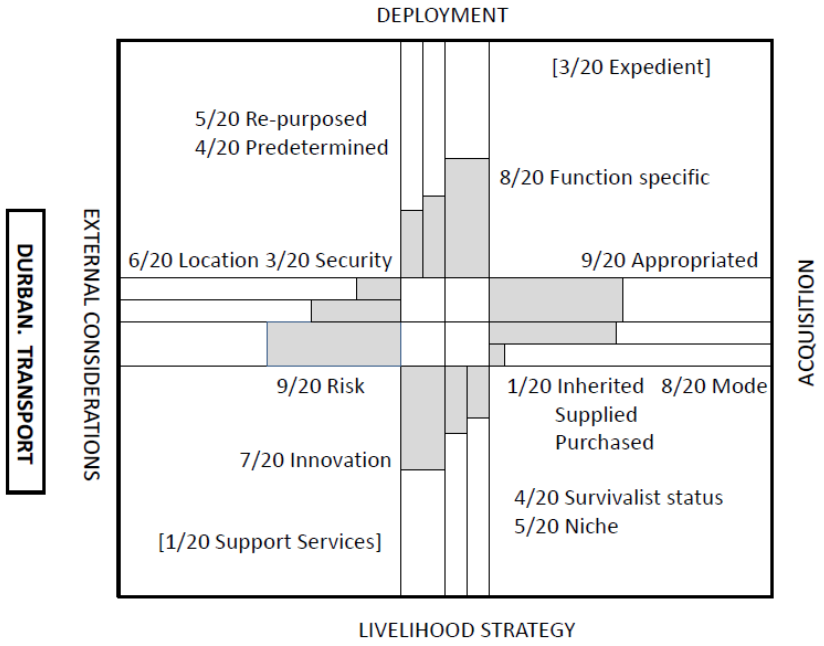
[continued]


DURBAN. GARMENTS
DEPLOYMENT
EXTERNAL CONSIDERATIONS
ACQUISITION
LIVELIHOOD STRATEGY
19/20 Function specific
1/20 Expedient
2/20 Support Services
1/20 Location
20/20 Purchased
17/20 Natural elements
8/20 Durability
6/20 Niche
6/20 Innovation


DURBAN. TRANSPORT
DEPLOYMENT
EXTERNAL CONSIDERATIONS
ACQUISITION
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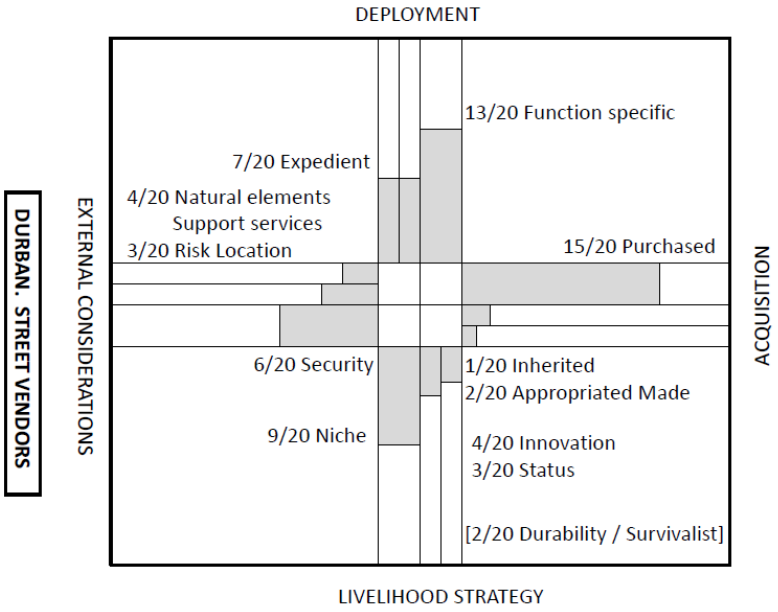
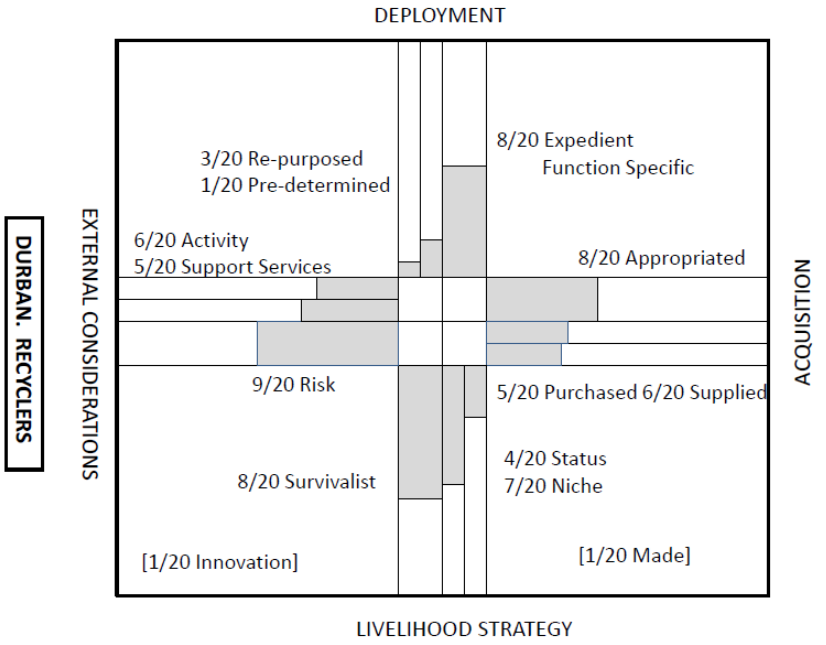
[3/20 Expedient]
5/20 Re-purposed
4/20 Predetermined
8/20 Function specific
6/20 Location 3/20 Security
9/20 Appropriated
9/20 Risk
1/20 Inherited 8/20 Mode
Supplied
Purchased
7/20 Innovation
4/20 Survivalist status
5/20 Niche
[1/20 Support Services]


DURBAN. STREET VENDORS
DEPLOYMENT
EXTERNAL CONSIDERATIONS
ACQUISITION
LIVELIHOOD STRATEGY
13/20 Function specific
7/20 Expedient
4/20 Natural elements
Support services
3/20 Risk Location
15/20 Purchased
6/20 Security
1/20 Inherited
2/20 Appropriated Made
9/20 Niche
4/20 Innovation
3/20 Status
[2/20 Durability / Survivalist]


DURBAN. RECYCLERS
DEPLOYMENT
EXTERNAL CONSIDERATIONS
ACQUISITION
LIVELIHOOD STRATEGY
3/20 Re-purposed
1/20 Pre-determined
8/20 Expedient
Function Specific
6/20 Activity
5/20 Support Services
8/20 Appropriated
9/20 Risk
5/20 Purchased 6/20 Supplied
8/20 Survivalist
4/20 Status
7/20 Niche
[1/20 Innovation]
[1/20 Made]

- the Ahmedabad sectors were drawn from informal workers who are members of a strong and effective membership based organization. The confidence, empowerment and assurance that this affords the workers is evident in the decisive traits recorded on the scales on all 4 screens. This is in sharp contrast to Durban and [within sectors] to a lesser extent, in Lima. The decisive traits translate into a considered set of technology decisions and a proportionately high investment in tools to undertake seemingly menial work.

Construction Workers

- the tools and the sector are specific, attributing to a screen with decisive extremes.
- the nature of the sector is such that many of the informal workers are labourers utilizing tools supplied in the employer. A notable finding is that many informal workers choose to remain in this relationship rather than up-skilling to artisan trades because the availability of work in the latter trades are erratic ie. the preference is for lesser paid but regular work. This reality suggests that research confined simply to the presence / deployment of particularly technology can mask significant underlying considerations.
- the labouring tools are context appropriate for confined and restricted construction sites, but carry significant human factors considerations eg. head-loading and the pervasive use of the short-handled hoe. The latter was outlawed in the civil rights movement in the US because of its debilitating impact on human posture.
- in addition, some of the tools are gender appropriate and whilst carrying significant human factor risks do facilitate greater access to male orientated work.
- this is a sector in which tools define status eg. between a labourer and an artisan.

Garment Workers

- notwithstanding the precarious availability of outsourced work, this is a sector where the technology is acquired to attract and perform specific work. The consequence is a trait that indicates high investment [purchased] but because of the competition for the work, equally high levels of functionality, expediency and innovation. The latter is driven by the fashion trends within the garment industry.

WIEGO
Women in Informal Employment Globalizing and Organizing

AHMEDABAD CITY SUMMARY

Rockefeller Foundation Technology and the Future of Work

- to participate in this livelihood, the informal workers require a secure and controlled environment . This is pre-requisite to invest in the technology. The home based workers in the survey are all members of a strong and effective MBO, known for worker savings and banking. These activities have resulted in loan finance that enables both supportive infrastructure [workers' homes] and capital for the technological asset. Therefore, the presence and performance of tools cannot be evaluated without recognizing the importance of organizing and responsive support structures.
- it is not accidental that the photographic record illustrates the sewing machines having pride-of-place and the screen's 'risk' trait is low. Even recognizing the strong competition for work, the scales on the screen present a sophisticated and positive set of technological choices.

Incense Stick Rollers

- this sector is also strongly represented by an MBO and handcrafted incense stick rolling is very activity specific.
- the comparative screen is seemingly counter-intuitive in that despite its low capital outlay, there is universal ownership of the tools and interviews reveal huge significance and, personal attachment to their boards. It is more than a 'tool'.
- low barrier to entry, but an occupation with significant occupation, health and safety consequences.
- this represents a practice that is under threat of mechanization eg. hand made production of approximately 4000 sticks / day compared to machine manufacture of approximately 1000 / hour.
- the hand made board is a niche, incisive tool comparable to the low capital grass mat making jig identified amongst Durban street traders. [D.SV.18]

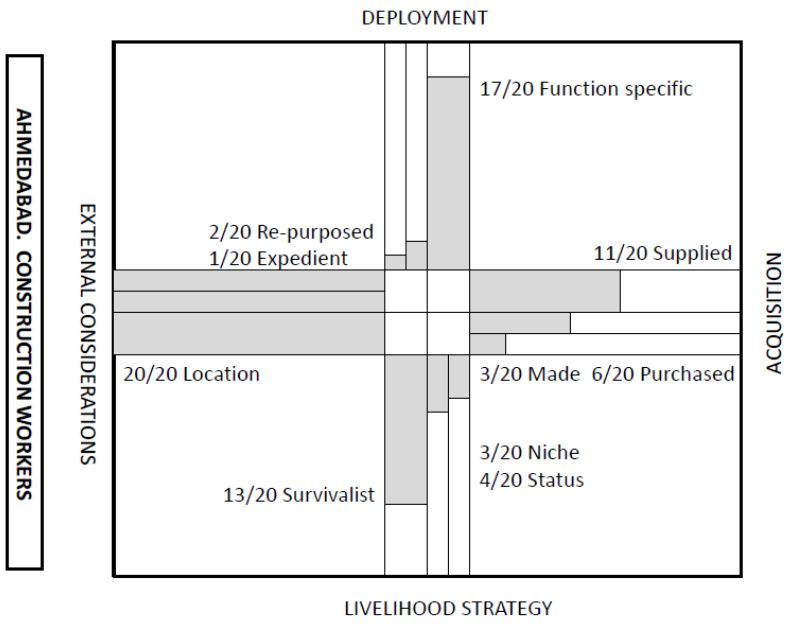
Waste Pickers

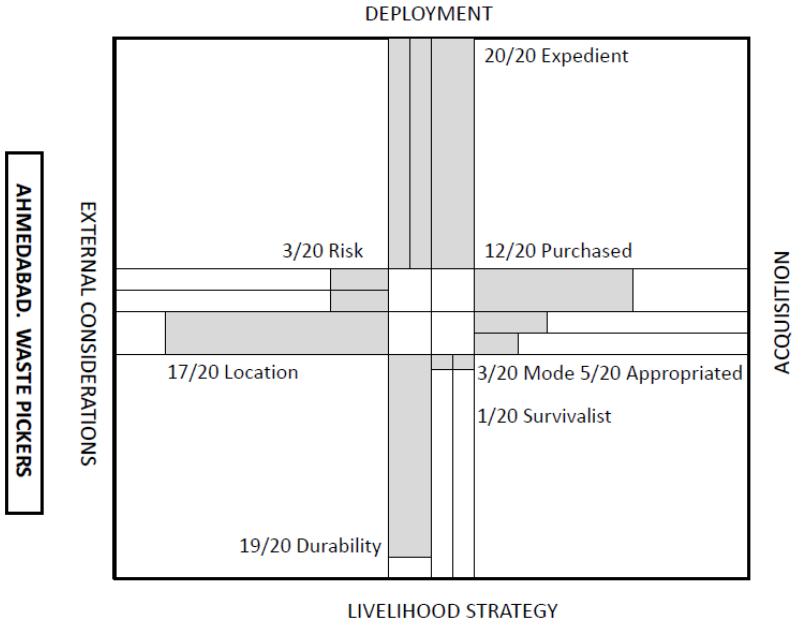
- arguably the most interesting screen that 'mirrors' the traits of the other sectors but for menial and vulnerable work. The technology choice is decisive eg. expedient and durable. The majority of the survey examples show that this tool is the poly-bag.
- this decisiveness and dignity is in sharp contrast to the Durban waste picker eg D.RE. 15 who are harassed and not represented by an MBO. The pride, in contrast with the tattered Durban polybag is startling.
- there is a synergy between the simple functionality of the clean white bag and the dignified service it provides . Interesting attributes for a tool.

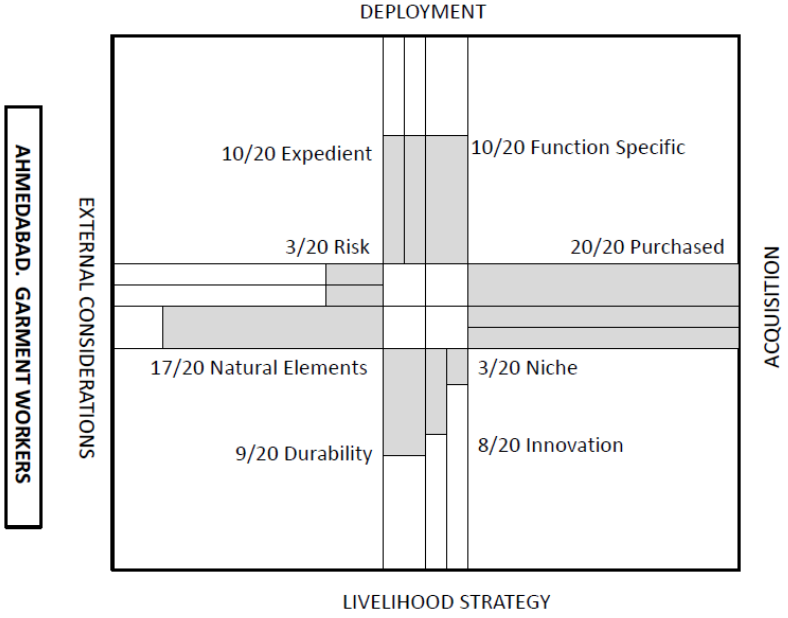
WIEGO
Women in Informal Employment Globalizing and Organizing

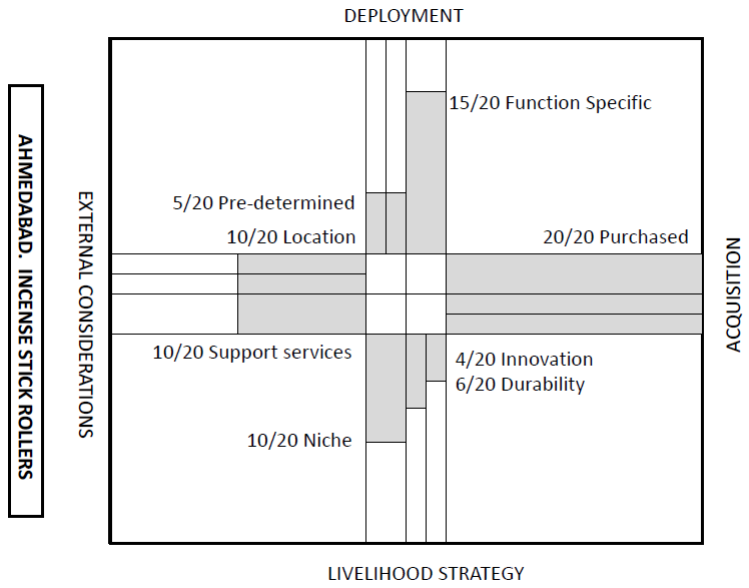
AHMEDABAD CITY SUMMARY

Rockefeller Foundation Technology and the Future of Work
[continued]


AHMEDABAD. CONSTRUCTION WORKERS
DEPLOYMENT
EXTERNAL CONSIDERATIONS
ACQUISITION
LIVELIHOOD STRATEGY
17/20 Function specific
2/20 Re-purposed
1/20 Expedient
11/20 Supplied
20/20 Location
3/20 Made 6/20 Purchased
3/20 Niche
4/20 Status
13/20 Survivalist


AHMEDABAD. WASTE PICKERS
DEPLOYMENT
EXTERNAL CONSIDERATIONS
ACQUISITION
LIVELIHOOD STRATEGY
20/20 Expedient
3/20 Risk
12/20 Purchased
17/20 Location
3/20 Mode 5/20 Appropriated
1/20 Survivalist
19/20 Durability


AHMEDABAD. GARMENT WORKERS
DEPLOYMENT
EXTERNAL CONSIDERATIONS
ACQUISITION
LIVELIHOOD STRATEGY
10/20 Expedient
10/20 Function Specific
3/20 Risk
20/20 Purchased
17/20 Natural Elements
3/20 Niche
9/20 Durability
8/20 Innovation


AHMEDABAD. INCENSE STICK ROLLERS
DEPLOYMENT
EXTERNAL CONSIDERATIONS
ACQUISITION
LIVELIHOOD STRATEGY
15/20 Function Specific
5/20 Pre-determined
10/20 Location
20/20 Purchased
10/20 Support services
4/20 Innovation
6/20 Durability
10/20 Niche

The Lima sampling represents an informative mix of informal workers who utilize enclosed infrastructure and exposed public space. The enclosed market environments circumscribe both the activities and the technology . In contrast, the work in public spaces is precarious which is clearly reflected in the contrasts between the screens. The scales indicate tentative and conflicted choices with regards to technology deployed in at-risk environments.

Market Porters

- the primary work activity in the Market is dictated by warehousing techniques and palletization with the evolution of complimentary mechanized handling equipment. Some fresh products however cannot be handled with these techniques resulting in the retention of manual sorting and distribution.
- this results in a market environment with an unusual mix of modern technologies and manual process, the latter often highly skilled and traditional eg. corn sorting. There is evidence of readily available warehousing equipment eg timber pallets being appropriated to form ‘corrals’ to segregate the grades of fresh corn demonstrating a creative deployment of a technical asset for a traditional practice.
- the mechanized work is serviced primarily by porters utilizing pallet stackers / trolleys. the equipment is specialized and expensive. The technology is therefore the
- pre-requisite to the work opportunity which results in groups of porters innovatory co-owing the equipment. So, not unlike garment workers, work opportunities dictate the technology that responds to a process or product. Where work is outsourced, the cost of the equipment often devolves onto the worker.
- investment is very work specific, high cost equipment can result in the constraining of the informal workers’ personal development or mobility ie. they are effectively indebted to servicing their obligations attached to acquiring the equipment. So, there are examples where technology is not necessarily the pathway to fulfilling work.

WIEGO
Women in Informal Employment Globalizing and Organizing

LIMA CITY SUMMARY

Rockefeller Foundation Technology and the Future of Work

- the head-loaders fulfil a niche function handling products that are [currently] not suited to mechanization. The baskets are purposed made and the porters mitigate some of the human factor risks with simple and effective interventions eg. the 'big board' which is the use of a long timber plank used to access the trucks at the correct loading height but because of its flexibility, it absorbs some of the body impact when accepting and carrying the basket.

Market Vendors

- this sector demonstrates the clear collation between supportive infrastructure and the resultant deployment of diverse technologies. In the Market there is shelter, security and support services eg. electricity.
- because of the high investment in technology, security is essential. The developmental pathway is the progressive upgrading of the infrastructure to keep pace with the technological developments or owners ambitions. In the survey example the Market has reached its electrical capacity which unless upgraded, will constrain the deployment of the additional technology.
- further with supportive infrastructure and its facilitation of near universal access to various work specific supporting technology, competition between workers increases and the appearance of niche equipment is evident. This reinforces the significance of supportive infrastructure and work place tenure.

Street Vendors

- by contrast this is a sector that does not enjoy supportive infrastructure or work place tenure.
- the scales on the summary screen reflect this insecurity eg. appropriated, made, expedient, risk, survivalist and below average investment in technological assets.
- however, within this unstable work environment, competition for custom is high resulting in workers making very careful technological choices to obtain a competitive advantage eg. an orange peeler **and** juice extractor to obtain maximum return from the raw material. Niche technology appears on the screen scales.

Waste Recyclers

- through MBO and co-operative support structures, shared and / or supplied technology is available to enable and dignify the waste collection. This is evident in the images that capture those enjoying purpose-made equipment compared with those who are not part of this collective..

WIEGO
Women in Informal Employment Globalizing and Organizing

LIMA CITY SUMMARY

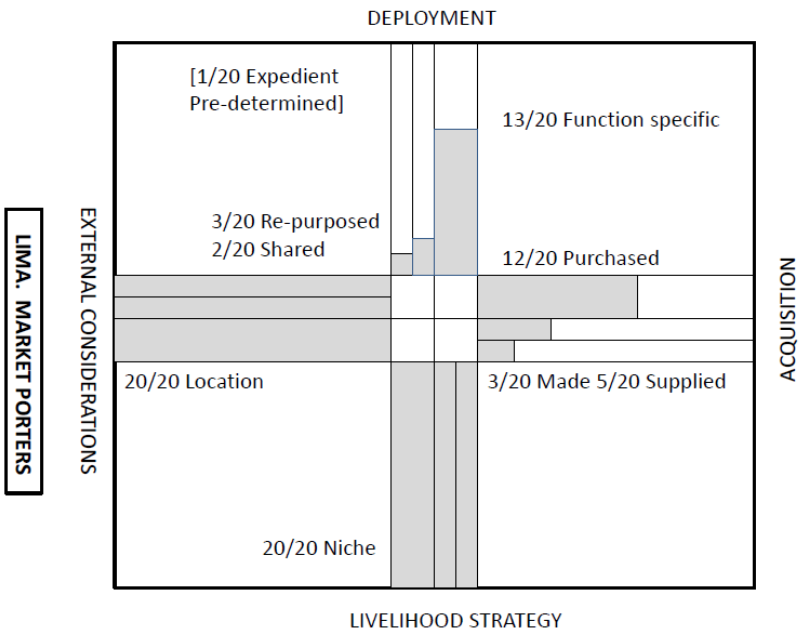
Rockefeller Foundation Technology and the Future of Work
[continued]

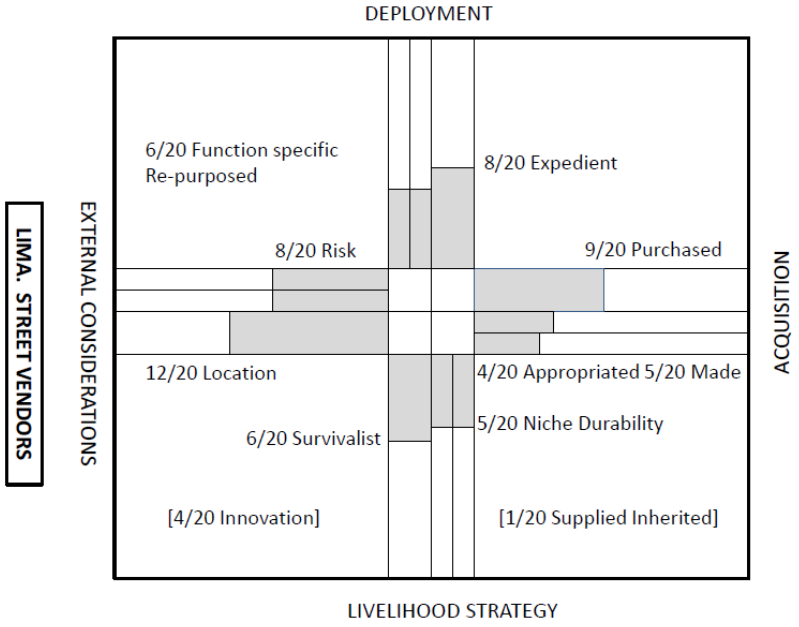
- however, the summary screen is not dissimilar to that of the street vendors, reflecting all underlying insecurity. There is speculation that the technology provides paradoxical advantage and disadvantage; the equipment is available to enhance and dignify the work, but those who directly own their equipment appears limited thus perhaps contributing to a diminished feeling of empowerment ? This is further exemplified when comparing the screen to the comparable Ahmedabad example, which despite the minimal resourcing, display a more confident and engaged relationship with their technology
- an undoubted attribute of the technology is the aspiration and professionalism it engenders in the portrayal of the workers. These images are in sharp contrast to those of their Durban colleagues who are alienated from their work and any dignity.

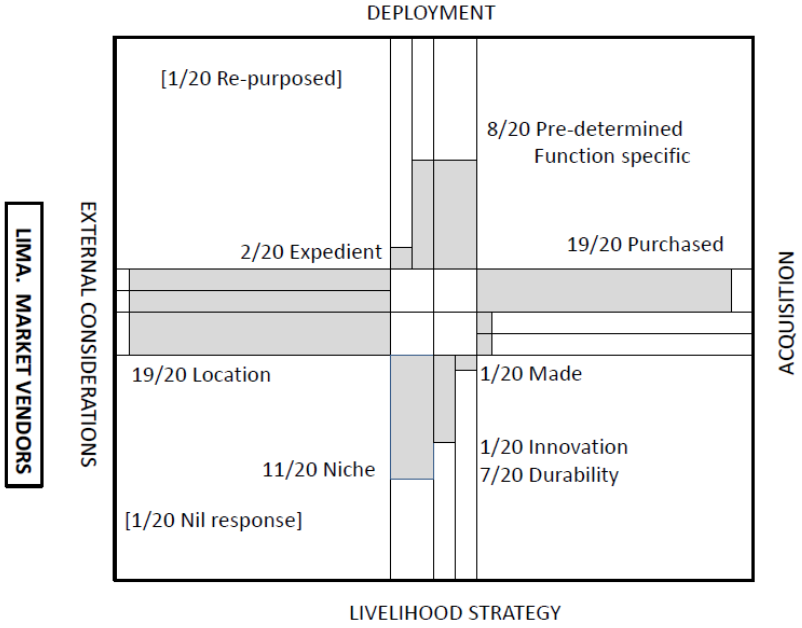
WIEGO
Women in Informal Employment Globalizing and Organizing

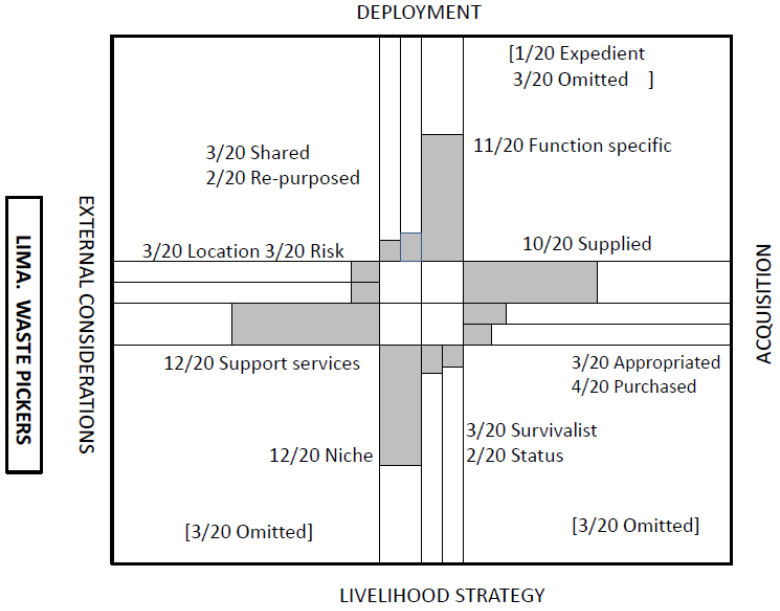
LIMA CITY SUMMARY

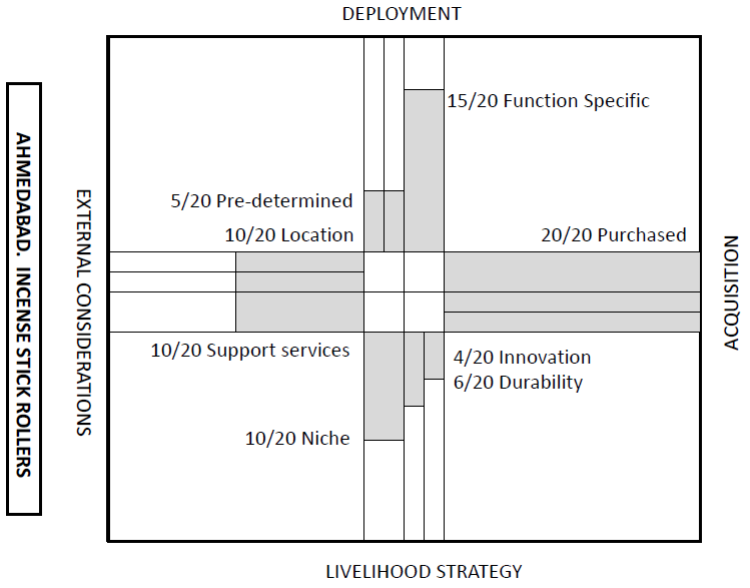
Rockefeller Foundation Technology and the Future of Work [continued]

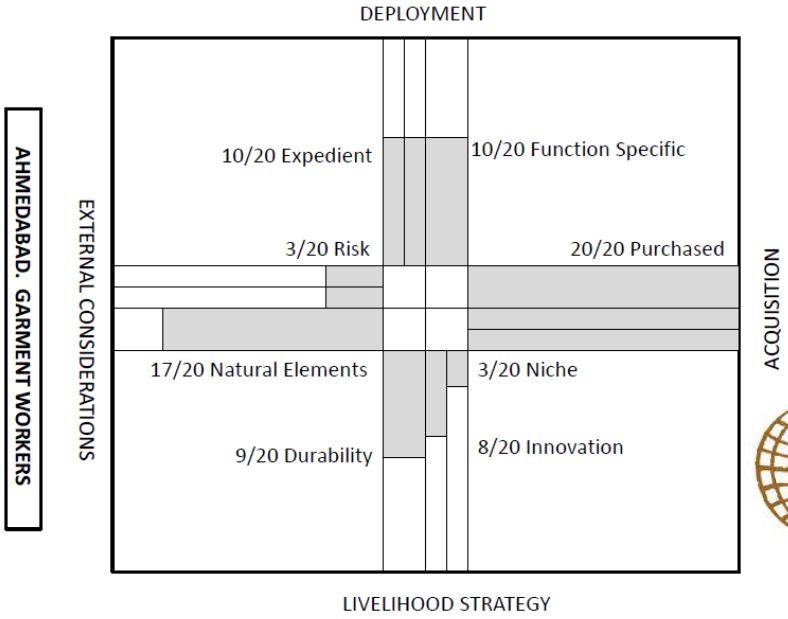

LIMA. MARKET PORTERS
DEPLOYMENT
EXTERNAL CONSIDERATIONS
ACQUISITION
LIVELIHOOD STRATEGY
[1/20 Expedient
Pre-determined]
13/20 Function specific
3/20 Re-purposed
2/20 Shared
12/20 Purchased
20/20 Location
3/20 Made 5/20 Supplied
20/20 Niche


LIMA. STREET VENDORS
DEPLOYMENT
EXTERNAL CONSIDERATIONS
ACQUISITION
LIVELIHOOD STRATEGY
6/20 Function specific
Re-purposed
8/20 Expedient
8/20 Risk
9/20 Purchased
12/20 Location
4/20 Appropriated 5/20 Made
5/20 Niche Durability
6/20 Survivalist
[4/20 Innovation]
[1/20 Supplied Inherited]


LIMA. MARKET VENDORS
DEPLOYMENT
EXTERNAL CONSIDERATIONS
ACQUISITION
LIVELIHOOD STRATEGY
[1/20 Re-purposed]
8/20 Pre-determined
Function specific
2/20 Expedient
19/20 Purchased
19/20 Location
1/20 Made
1/20 Innovation
7/20 Durability
11/20 Niche
[1/20 Nil response]


LIMA. WASTE PICKERS
DEPLOYMENT
EXTERNAL CONSIDERATIONS
ACQUISITION
LIVELIHOOD STRATEGY
[1/20 Expedient
3/20 Omitted]
3/20 Shared
2/20 Re-purposed
11/20 Function specific
3/20 Location 3/20 Risk
10/20 Supplied
12/20 Support services
3/20 Appropriated
4/20 Purchased
3/20 Survivalist
2/20 Status
12/20 Niche
[3/20 Omitted]
[3/20 Omitted]





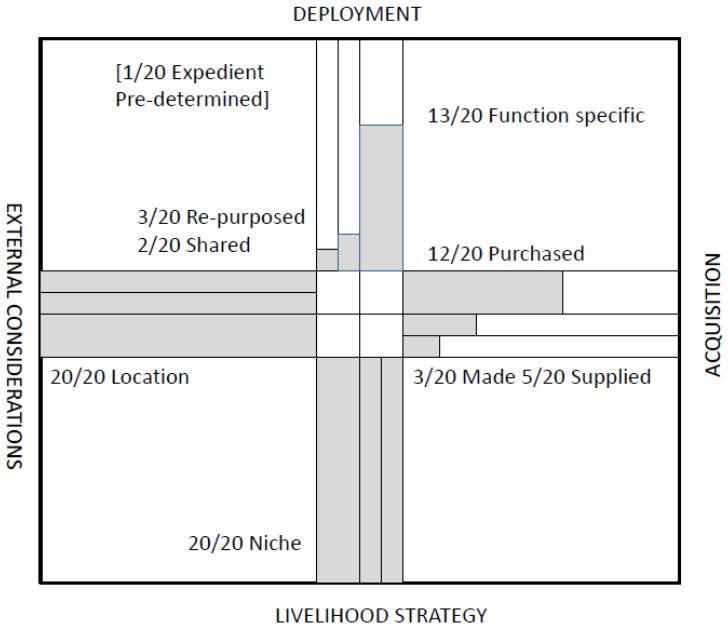
- both sectors are home-based activities where informal workers provide their own workplace and infrastructure.
- the availability of piecework from agents provides a source of work.
- both sectors are members of an effective worker organization that encourages saving and banking, resulting in informal workers' access to loans.
- there is confident investment in purchasing function specific tools.
- a measure of income security from piecework reinforces this confidence. The advantages of their technology choices are reflected in a similar clustering of livelihood strategies.
- there is notable 'mirror' of the sector diagrams despite very different activities and capital investment.

WIEGO
Women in Informal Employment Globalizing and Organizing

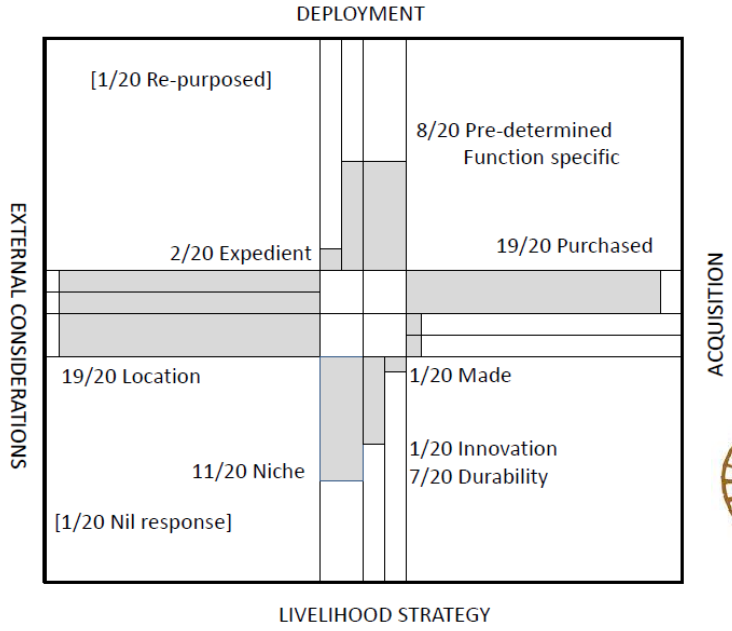
AHMEDABAD SECTOR COMPARISON:

INCENSE STICK ROLLERS AND GARMENT WORKERS

LIMA. MARKET PORTERS



LIMA. MARKET VENDORS

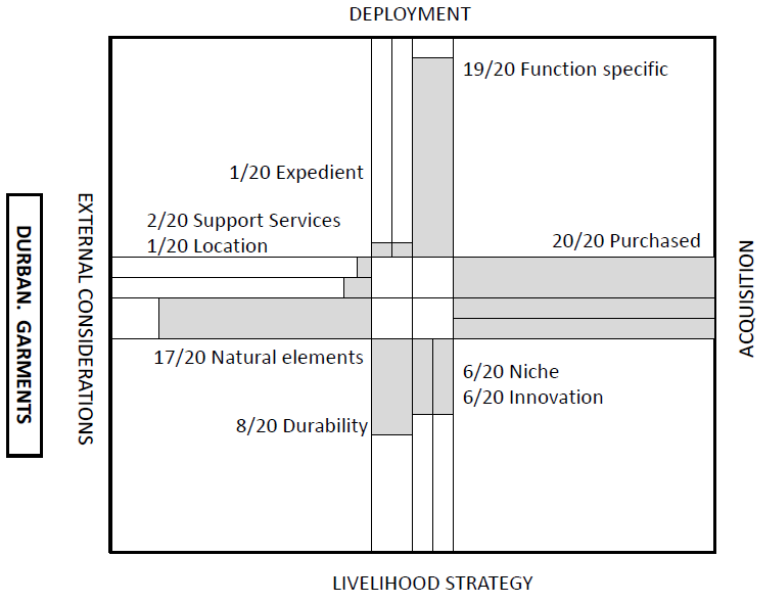


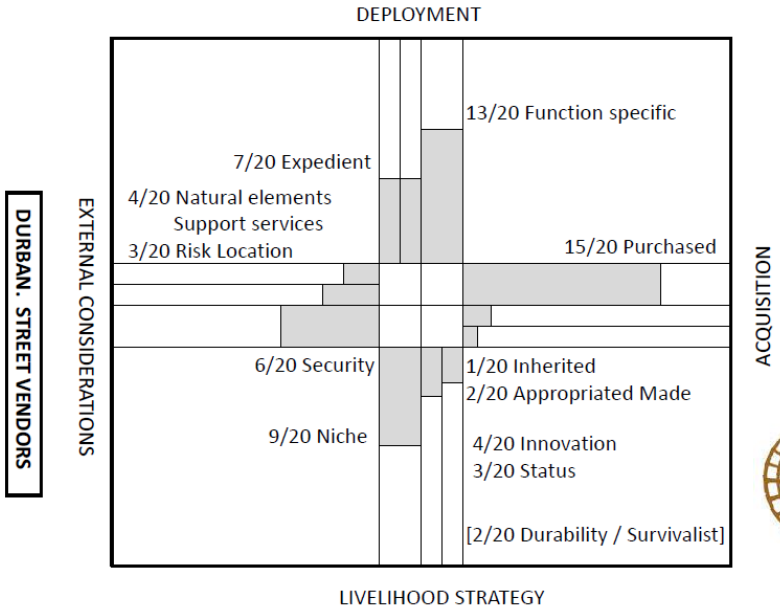
- both sectors work in infrastructure provided by others.
- this infrastructure provides security for informal workers' tools.
- this is clearly reflected in the high specificity of location responsive tools and proportionately high personal investment.
- equally, the working environments dictate incisive technology intended to maximize their livelihoods.
- it is notable that the sector diagrams 'mirror' each other despite completely different activities. The commonality is secure workplace infrastructure and predictable management.

WIEGO
Women in Informal Employment
Globalizing and Organizing

LIMA SECTOR COMPARISON:

MARKET PORTERS AND MARKET VENDORS





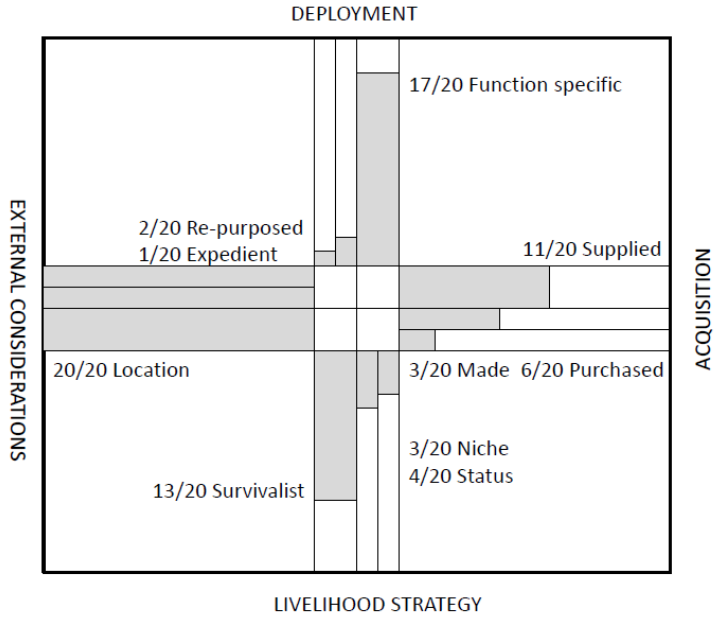
- garment workers occupy space on a rail station concourse and street vendors have a measure of workplace security through the local government permitting system.
- their access to work spaces in the public domain, although tenuous, is nevertheless more secure than their colleagues in the other 2 sectors.
- they attract relatively good custom but have to work hard to secure business / sales.
- street vendors work in the open with relatively little protective infrastructure.
- with the exception of the latter, both diagrams reflect similar technology traits namely, high investment; function specific and as a result of high competition, the need to utilize opportunity defining tools

WIEGO
Women in Informal Employment
Globalizing and Organizing

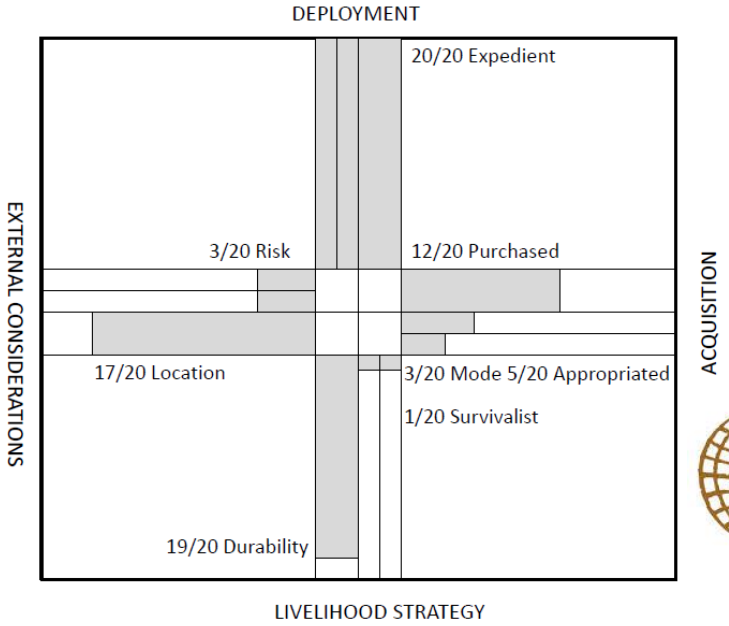
DURBAN SECTOR COMPARISON:

GARMENTS AND STREET VENDORS

AHMEDABAD. CONSTRUCTION WORKERS



AHMEDABAD. WASTE PICKERS



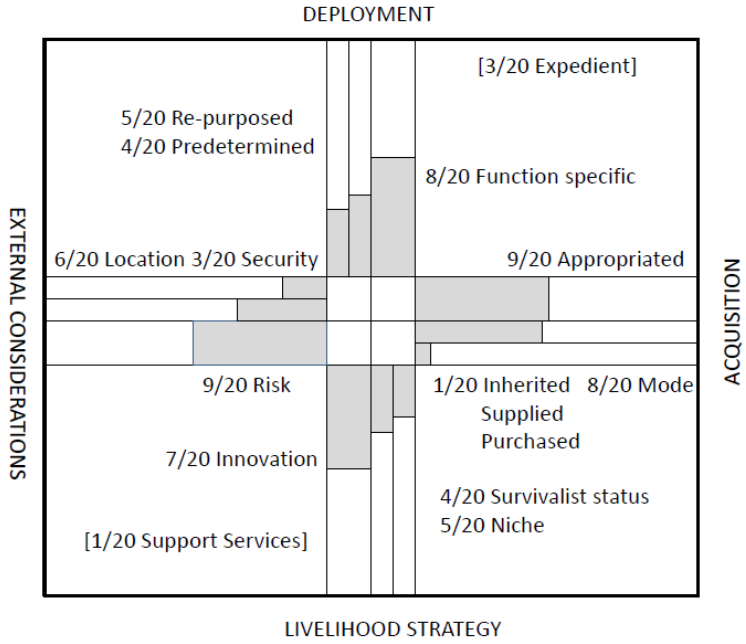
- two distinct work place environments namely, confined and off-street compared to overly public.
- both are representative of very low income workers with the marginal exception of the artisans [in construction]
- both sectors are members of an effective worker organization.
- despite the differences in the work place environments and that most labours' tools are supplied, both diagrams reflect responsive fit-for-purpose characteristics.
- the waste picker diagram is notable for its incisive clarity with positive extremes on all 4 scales demonstrating a clarity of purpose and dignity despite menial work and tools.

WIEGO
Women in Informal Employment Globalizing and Organizing

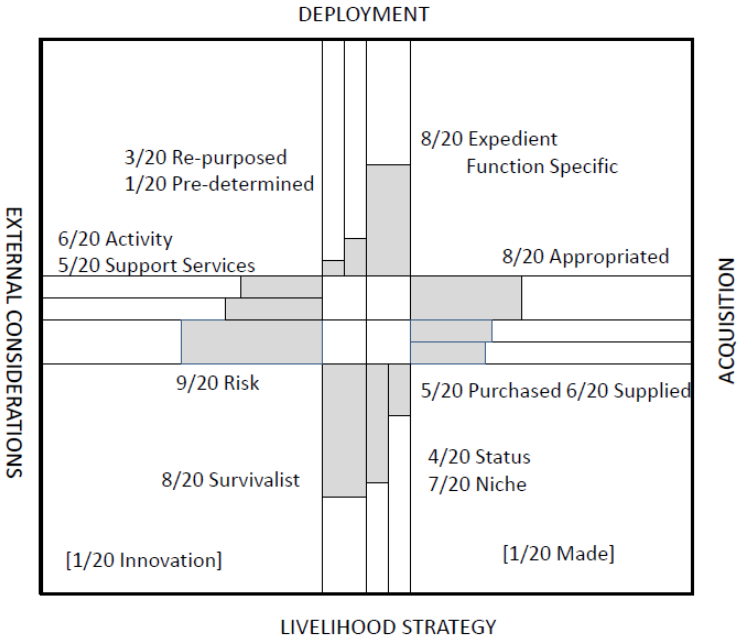
AHMEDABAD SECTOR COMPARISON:

CONSTRUCTION WORKERS AND WASTE PICKERS

DURBAN. TRANSPORT



DURBAN. RECYCLERS



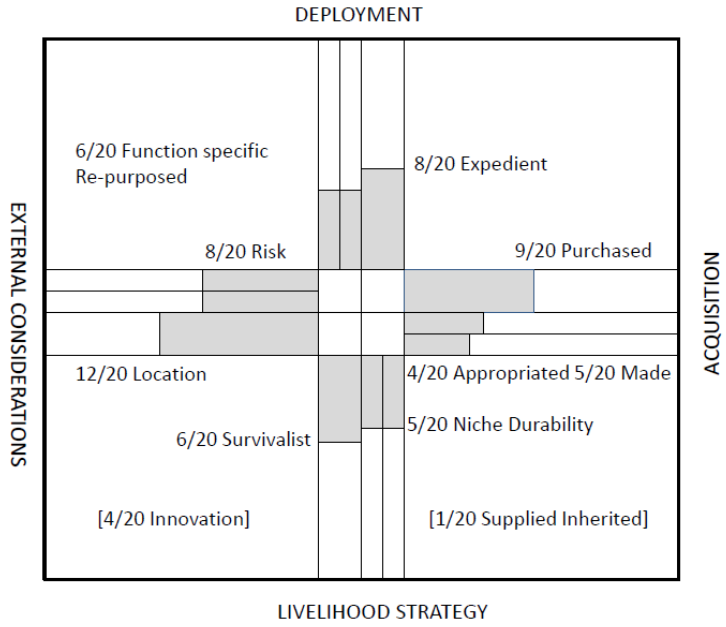
- these two sectors of informal workers represent the most harassed, ironically within a city that is reasonably supportive of informal work in public space.
- the informal non-motorized transport operators provide an invaluable, 'green' service but without acknowledgement or acceptance by the local government.
- equally, recyclers are continually victimized and regularly characterized as criminals.
- obtaining or retaining appropriate tools is extremely challenging .
- both diagrams, and in contrast with the Ahmedabad examples, are distinctly contracted and through their technology reflect the timidity they have been forced to adopt.
- the dominant characteristics on the 4 scales are equally informative; appropriated; risk; survivalist.

WIEGO
Women in Informal Employment
Globalizing and Organizing

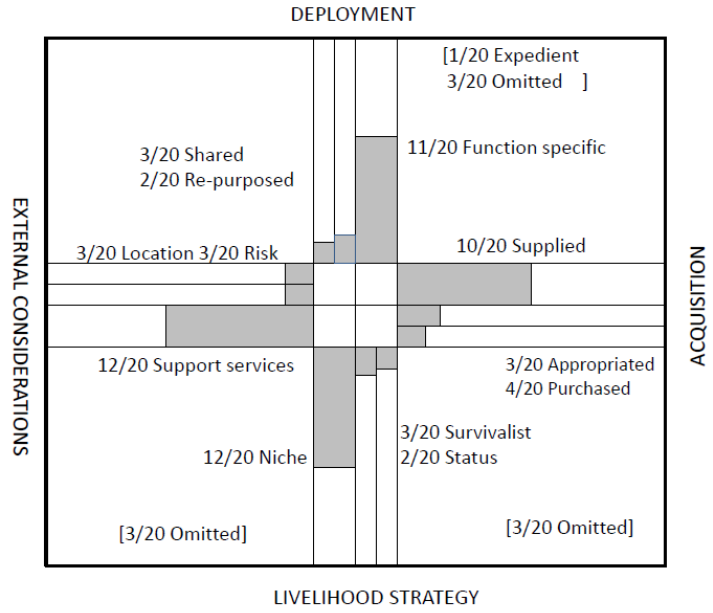
DURBAN SECTOR COMPARISON:

TRANSPORT AND RECYLERS

LIMA. STREET VENDORS



LIMA. WASTE PICKERS



- these two sectors utilize public space to earn a livelihood in comparison with their colleagues who work in market environments with protective infrastructure.
- despite a measure of acceptance and support they are nevertheless vulnerable or dependent to others.
- their circumstances are comparable to the recyclers and transport operators in Durban.
- not surprisingly, the diagrams of both Durban and Lima for two vulnerable sectors are ‘mirror’ images.
- across all the scales are tentative measures and a constrained clustering at the center.
- it is clear that workplace security is a definitive pathway to the use of or investment in enabling technology.

WIEGO
Women in Informal Employment
Globalizing and Organizing

LIMA SECTOR COMPARISON:

STREET VENDORS AND WASTE PICKERS

APPENDIX III:
KEY INFORMANT INTERVIEW WITH RICHARD DOBSON

Technology and the Future of Work Project

Key Informant Interview with Richard Dobson, Project Leader at Asiye eTafuleni, Durban

December 1, 2015

Marc Kalina

[The project background was explained and the interview subject was asked to reflect on what is changing in citywide technological systems.]

MK: From your perspective, what technologies have you seen that have disrupted the work of urban informal workers?

RD: I'm going to skirt around the question a little bit as we kick off. I think there was quite a bit of discussion around the question of disruption, and what constituted that etc. etc. That's the first kind of broad box. The second, I guess the research project as we read it, the intent, and the intent that seemed to emanate from New York was that it was going to be a whole series of apps and other high-flying stuff, as opposed to the real basics. I think the big discovery for me, and that's literally at the level of the doing the photo documentation and starting to look at it, was to see the difficulties and the struggle for people to retain ownership of their technologies. So the categories that we're covering, particularly those that were informal workers, but the transport workers etc., maybe the machine garments are a bit more stable. But I mean, those people are working in public spaces, that don't necessarily have protection, etc. So the amount of confiscation there was of their tools and technology was huge. So at that level, there was really… big learning.

MK: What technologies are you specifically referring to? What do these workers have access to?

RD: So, in the transport… amongst the transporters there is a lot of self-made equipment. So the technologies would be adaptions. There would have been the salvaging and scavenging of the key pieces, particularly the things like the wheels, and then a lot of inventions like the things you use in the chassis, etc. Also, purpose-designed in the sense that they were designed to fulfill specific needs and functions. So, if you've got to transport and store traders' goods that are a particular size, shape, and weight, etc., you would come up with an idea for doing it. If you've got to transport water, you've got to come up with a clever way of how to do it, so self-made, salvaged. And then at the other end, the people working with sewing machines are very global and connected. Look at the brand names on those sewing machines -- all emanating from China, India. So the pictures of the women using the sewing machines -- if you took them out of their background context which gave you clues, and just lined up all the machines you could have

been taking pictures of machines in Ahmedabad as you were in Durban. An interesting reference from the kind of colonial day kind of machines to what they are now.

MK: How has access to these machines affected their businesses or livelihoods?

RD: I think that is also interesting. We started talking yesterday, before the power cut. Really, the garment industry here is a consequence of the collapse of the garment industry. So a lot of those machines are coming onto the market as a result of that failure. So, formal businesses are getting rid of their equipment. The second level is that the formal businesses that are still in business are in a highly competitive market that demands the latest technologies much more regularly than perhaps in the past. So it is in a sense the trickle down of now feeling new technologies as a push… as I'm reading it from the demands of the garment industry which is now talking about very fancy over-locking systems, etc., etc. So, there are a lot of interesting anecdotes about how people access these machines—there are almost like spotters in these formal businesses who are getting a sense that their boss is going to change all the machines and there could be an opportunity for you to get a new machine.

MK: So, although this has been bad for the formal garment industry it has increased access for the informal workers to upgrade their equipment?

RD: Correct… to equip themselves when maybe they might not have been able to equip themselves. Of course, the challenge sitting around that end of the technology, from the example that I gave you about the self-made carts, is that… being an informal worker, and having valuable and vulnerable technology means that your accommodation is critical. So to be in a public space with some of this technology is a real challenge. So the provision of infrastructure that supports your acquisition of this technology becomes another link in the chain. So unless you've got protection from the elements, unless you can lock it up safely, unless you've got somewhere where you can cut and sew and you've got electricity, you are not able to enjoy your access to that new technology.

MK: Do you see that as the major role of the Municipality in supporting these technologies?

RD: They can be defining, yea. So, my belief, just at the vending level, which would exemplify what you have referred to, is that if someone… they will only sell fresh produce and fruit if they do not have protection from the elements, because if it rains it doesn't matter if your bananas get wet. But you will only start selling higher value electrical goods if you've got security, etc., etc. So the provision of infrastructure, I have absolutely no doubt, is a defining pathway for the uptake and use of higher-order technology, however you want to define that.

MK: And how would these impact livelihoods?

RD: It would probably not have a greater impact- it would certainly provide a greater diversity. And I was hesitant in my answer, because if you were to start reading the focus groups you would find that ironically, the same threat of foreign imports which undermines the formal garment industry is also challenging the informal industry. So where, here in Durban, the niche market was the making of pinafores, those pinafores have now been copied by overseas markets and they are now coming back at a fraction of the cost that people can make them here. So, they are drawn into a global challenge just as the formal people were. So, the same strategies are now needing to be applied, as to how can you reduce those import costs. And sadly, from what I've heard coming out of the focus groups, because I didn't attend the focus groups, is one of the ways to reduce your input costs are cheaper fabrics, or alternative fabrics, and the alternate fabrics that they are now accessing are the subject of higher-end exploitative-end technologies, which in fact means that the fabrics have got a lot of pollutants in them, chemical pollutants, which are actually now affecting people's hands, and are laden with dust, and that is now a real health hazard.

MK: Are there any other technologies you have noticed in any other facets of informal work? Like information technology for example?

RD: Yes, the information technology, the assumption is that, the people that are doing the research are in the market and the era where it's smart phone technology and its apps, etc. etc. The reality on the street though is that it is really basic-level, entry-level phones. And I'm not seeing it here, but is really strong and coming out of places like India and Kenya, is a real high level of innovation about how one can exploit low-end cell phone technology to a maximum. So they are actually now starting to write apps and programs for those low-end technologies which would obviously be SMS-based, it would be… please phone me, etc., etc, send your number, whatever. So, there is incredibly high level of innovation around that, and also around banking. Kenya, from what I can see, is almost in an invisible, new economy which is just sitting inside people's phones. None of that am I seeing here on the streets yet. And, I think one of the challenges, and this is a technology one, is that there is a high degree of people not being able to… simply being able to see their phones, they don't have glasses for their eyes, so just being able to see their phones is just a disaster. So there is an assumption, I think, that informal workers are just the downstream repositories for old technologies, people's cast-offs…. That is first off, I think, that is not necessarily true. So, if you look at people who repair electrical appliances for instance, the current meters that those people have would be the same meter that your repairman would use when he comes to fix the electricity in your house. So there is savvy out there that there are some defining instruments that you need, and you will invest in them if you need to. The guys that recharge the batteries for instance… there are a lot of batteries that you use for razors, the barbers, and everything else -- the technology for that is… you could walk into a formal business and see banks of batteries being charged with these high-level, high-technology chargers. Shoe repair is actually very interesting. Because, you almost see old-style cobblers with their tools, they all still hand stitch, etc. Sadly I think that is a dying era, because,

yes there are still people here who would have shoes, but you can see straight-away that most of the shoes are now all molded, and once the shoe has torn away from the sole you can't repair it. So, I think you've got a downstream technology that is going to start putting a whole lot of people out of work, simply because these things can't be repaired. There is an aspect I guess, where the evolution of the aesthetic is one that actually demands a new different technology, so move away from the stitching to have it molded. But then, on the other hand, it is all about designed obsolescence, so that people can sell more shoes. So, a colleague of mine has got a wonderful picture of a guy in India, a street-side cobbler, looking at a branded running shoe, this thing is broken, and you can see… I mean, it's a classic. This guy, probably in his seventies, bearded, and you can see he's just looking at the shoe perplexed… 'what the hell am I going to do with this thing?' So, in South Africa of course, it is slightly different. You do have… through... the 50's and 60's in South Africa with the popularity in the old township movement of the old dress-up aesthetic and all that, where people did invest heavily in stitched brogues, and all those shoes, that there is still a huge market for those skills to repair it. So that is an irony. But a lot of people… we've got a guy we're going to do as a micro-narrative, he salvages scrap metal, and you can see he is very purposefully starting to build up a toolbox of appropriate tools that are going to allow him to add value to his metal salvaging. In other words, if he can separate out an electric motor, he can get money for the steel for the casing, but then he can get the copper and all the other valuable metals inside. So he needs tools, spanners, pliers, etc. And that is where the vulnerability is; I mean, his tools were confiscated the other day by Metro Police because he was considered to be a public nuisance working in the bottom of a public park, and we know that his tools are probably now in the toolbox of the policeman who confiscated them. So, I guess in that environment, you can also start to postulate that there are some very astute decisions being made by people about how to invest in the tools that they need, and yet see it as a business decision… 'do I spend R120 on this pair of pliers or do I spend R70 and these pliers are only going to last 6 months but I'm probably only going to keep them in my possession for 8, so it's probably a good decision.' So, I think I'm really trying to make a business case that I think there are some people out there who are making some very astute decisions, because of their vulnerability, on the technology that they engage with.

MK: So, you believe that the biggest barrier towards the adoption of technology is the ability to maintain or keep it? What technologies do you feel that informal workers need that they don't currently have access to, to either increase their productivity, add new sources of income, etc.?

RD: Immediately as you asked the question my mind locked-in straight away on the transporters. Durban is interesting because it has a local government policy on non-motorized transport.

MK: Now, when you talk about transporters you are referring to the barrow pushers and the like?

RD: Yes, barrow-pushers, people who move goods around. We call them transporters because they are not necessarily market barrow operators; they are a range of people, super market trolleys who move goods to the taxis and things like that. So the city has this policy on non-

motorized transport, which ironically has really played out as being a strategy for recreational cycles and the mayor on his bicycle doing a bit of showmanship. When we engaged with the early consultations we brought recyclers and market barrow people along to the meeting which produced some surprise. We estimate that something like a hundred tons of goods are moved around the city by people who move goods.

MK: How many people do you think that employs?

RD: Market barrows, the guys who literally push the market barrows are at least a cohort of 800, they could easily be 1000. Now all those people don't have… an enabling environment to really do that job. If you're pushing a market barrow, you can't push them on the sidewalks because you can't get up onto the sidewalks. The sidewalks themselves are either potholed or they're full of pedestrians. The technology that you have to use in this climate, the ideal technology, is a solid cast steel wheel because it doesn't get spongy in the heat. But those wheels are very susceptible to shattering in impact damage. So potholes are probably…. need a long lecture on the tragedy of someone breaking the steel wheel on their market barrow and the effect that that has on some proportionally as someone who has lost their steel belt radial in their fancy motorcar… and the financial cost is probably greater to the person with the market barrow. So if those guys had access to better technology, then their work would certainly be a lot easier, more dignified, and it would be kind of celebrated within the green economy. But, it means, and the barrier there is the enabling environment. They need barrow-ways; they need the right environment in which to operate. They need protection from motorists. We've got stories of taxi conductors hanging out the windows with sjamboks and wiping guys because they were in the way. So, they are particularly vulnerable and were you to give them better technology… I guess there is a chicken and the egg situation, if they had better technology would they be better respected? We think they would, because from our cardboard recyclers we know that where cardboard recyclers had their informal trolleys confiscated, we know that ones that had our trolleys that were branded, and branded as part of the city project have been left. So there is an aspect where appropriate technology is going to dignify you work and therefore give you greater security. However, that technology is going to be of zero use if you're still getting sjamboked by a taxi operator, or you can't actually get it. I mean, I saw a guy today, he was parked behind me when I was coming into work -- the taxi that was running, he had enough space to go with his barrow, and the next minute the taxi pulled in front of him and just stopped, the taxi wasn't going to move. This guy tried to see how he could get around. He couldn't get around the other way because there were other cars, and the taxi guy was just completely… And it was a heavy load, the guy was staggering to push backward just trying to figure out how he could get around. So barrow-ways, that's a city system. So if you're going to have people who are going to do this work then systemically you need a full range of stuff. So the irony is that we have the policy, but we don't have it actually playing out. And we've got the guys who agree to do a pilot barrow-way from here, but it's never been implemented, yet anyway, we're still on it.

MK: Any other technologies that you can think of? What other technologies might be valuable to informal workers that they don't currently have access to?

RD: One is tempted to say that more pervasive use of electricity would be useful. However, we know that we have unstable supply, and also it's expensive. The obvious people that would want to use it are people that cook; however they are very unlikely to cook with that technology because it would be expensive to have hotplates going all day -- it would be more expensive than using gas or something like that. But, there are people sell music, people who do sewing, who definitely struggle to get electricity. I think possibly the other interventions that could work would perhaps be... and this sounds kind of ironic, but we're working on projects at the moment where an incisive invention is very high-tech, but it's in the hand of people that can manage it. I'll de-code what I'm saying just now -- the intervention is very high tech that could have a huge kind of knock-on effect. The project that we're looking at, at the moment, is to work with cardboard recyclers. For every ton of cardboard you recycle you save between 17-20/25 trees. So, the project is to get that amount of cardboard recognized, translated into the equivalent of trees, and get that equivalent value of trees valued from a carbon exchange point of view and to sell the potential of that carbon exchange and get income to plant trees. But of course the program would never work unless you can verify the tonnage received. So the program is in fact to insert a smart card into the process, which would be a smart card that could effectively be an ID card for recyclers who are within the program and on the back of the card would be the smart technology. So every time they weigh in their cardboard it would be swiped by the middle agent which is where the technology would be located. So the impact on the recycler would be minimal -- it would be just be as if they are carrying an ID card. But, it would be the thing that would verify the sale. In the same way that things like the dispensing of water to people who work on the street -- at the moment it's done manually and is all quite complicated, but there is high technology which is very simple at its front face, complicated on its back face, for dispensing water through coin operated systems, through mobile phones, all those sorts of things. So, you could make services more readily available through exploiting technologies, but it is the city who would be the user of the technology but the informal worker would be the beneficiary.

MK: Has there been any interest on the behalf of informal workers, or a willingness to adapt or adopt new technologies like this?

RD: I think it's never been presented to them. So, my challenge is starting to see some of the systems that are coming out of Nairobi around water dispensing, in particularly spontaneous settlements, where there is a very high level of innovation. Years ago we used it on the overnight shelter that was built in Mansfield Road, we used it for a public bath house where you… coin operated shower. So you put in R5 and you get a shower for three minutes, and it's really very simple technology. You just put a coin in. So, I think really the city hasn't really started to explore how it can be the provider of these services.

MK: Are there any technologies that you can think of that urban informal workers have adapted to meet their own needs? Anything that has developed in unforeseen ways?

RD: I think definitely within the craft industry, there would be some technologies there. In other words, it has been a traditional, hand based activity, but now people are moving to getting larger volume orders for particular things and they are starting to be inventive about how they can either increase their productivity or decrease their input costs. So, now it is very common to see beadwork that is no longer glass beadwork but is actually plastic beads, so they are obviously cheaper to make, easier to work with because the beads are bigger, all that sort of stuff. We will be doing a micro-narrative with a person who makes grass mats and has come up with their own very clever little jig that is wood and a whole series of nails, and that's where the strings are held, and how they can virtually do a weaving process with this jig. So, I think probably, no it's not probably, I'm certain that within some of the traditional practices -- either craft, or the production of food -- people have made adaptions of current technologies that would actually suit their purposes. One of my curiosities is why a whole lot of tools, particularly things like axes and hammers have all been -- not all but it's very common to see them having their wooden handles removed and they have actually got metal handles. And that's curious as to why they've done it. With the bovine head cooks who use axes, to have a metal handle would I guess make sense as you can come with a theory that to have a wooden handle would not be hygienic- I would doubt it because a proper hickory handle is probably more impervious than a steel handle would be. But there are some adaptions, yes. I think where… probably the adaptions probably come in are where you're working in environments that don't give you all the equipment that you need. So I'm thinking now of the carpenter who makes these boxes and pallet tables. He doesn't have a workbench so that he can hold the wood, so he generally tends to use hand tools as opposed to electric ones. And not using the electric ones is not just because he can't easily get electricity, but it's a difficulty holding those things when you're trying to work with them. So I think the working environments probably produce some form of adaption simply because you can't actually use it in the context in which it was intended. That is really your lower end stuff.

MK: Can you think of any emerging technologies that might speed along or hinder these adaptations?

RD: I think the barrier has got to be that people are working in public space. And because you are working in public space there is kind of a glass ceiling over what would be appropriate to be used in that public space, what's appropriate in terms of where you would store it, how you're going to manhandle it and move it around. A classic one for instance is a lot of people that cook; they generally have gas equipment that they use. So… sooner or later the size of the gas cylinder that you use… the determining factor is how you are going to transport that back to the storage. So shorter ones get used up very quickly, probably three days -- the bigger ones may take a whole week. And then the supplier will really only come and service the big ones, you can't really get someone who is going to top up the small ones. So there is a whole range of intersects

around where you are accessing… where your technology is accessed from, who is going to maintain and service your technology, considering that you really don't have a formal address and you're not interfacing with formal structures that would commonly service that. A good example would be the people doing sewing machines. Those sewing machines, some of them, need quite heavy servicing technologies. A lot of them run off… they've got a bath of oil underneath, that oil needs to be changed. So, what all that does is it starts to develop a sub-industry of people who are going to look after and maintain those things. I think the thing is pretty much governed by the fact that people are working in public spaces, and that's probably the seed of it.

MK: Have you noticed if this influx of higher-end garment technology has affected this sub-industry that you're talking about? Do they have different maintenance requirements? Do they require different skills?

RD: I think that you might get that… one of the candidates we put on the list is a person who does that. Definitely, and I'm sure it's the same here, but you've got more definite stories coming out of the Indian example where the women themselves now are adept with an oil can, whatever it is to take out a broken needle that is caught at the bottom of the machine and anything else.

MK: In your opinion, how have technological advancements affected the ways in which informal workers, first, organize, and then also access emerging opportunities.

RD: I would think the first thing that comes to mind is that there's no doubt that particular sort of technologies start to develop a sector of informal workers, which in themselves slowly start to aggregate out into a larger group of people doing the same thing. And therefore there would be common interest and they would organize around that. So, definitely the cohort of garment workers are a result of people who use sewing machines, similar sewing machines that have similar challenges of getting electricity, they have similar challenges of needing to get them serviced, maintained and stored. The market barrow operators would be another good example. So there is… kind of the rallying point is the same market barrow. The market barrow does similar work, the similar work produces similar clients, similar clients… you know, etc. etc. So I guess that would probably be my answer, is that definitely the technologies as in the past start to form guilds of people that are doing similar things; shoe repair people, people who cook all use similar gas ranges, yea.

MK: Has information technology had any influence on this type of organization here in Durban? Or their ability to access new opportunities? Or are we not to that point here yet?

RD: It's really hard to say. One's tempted to say it hasn't. But the… there's a kind of a subtle proliferation of access to technology. Little cyber cafes are coming up and some people have got data on their phone and they're able to make those connections. I tend to think though that where the big differences are coming would be where groups of workers are supported with access to that technology from somewhere else. So one example that comes to mind would be this one agricultural group where they've developed an app which allows people to get into an alert as to when would be an appropriate time to bring your product to market. I've got a whole field of cabbages, when they're about to be ready I send in information that I'm ready for harvesting, and then this app finds gaps in the supply of cabbages and you actually get an alert as to bring yours tomorrow. So the advantage there of course is that you get a better price- you don't bring your cabbages in the same day you brought your cabbages, and there is a better price. But I'm tending to think that's an attribute that's actually brought in from the outside. Definitely money, banking on phones… that's definitely a defining thing. Even if people aren't actually paying for transactions here they're actually able to send money as a result of transactions. The herb market uses technology hugely. You can order products from Cape Town and have them delivered to you through the taxi network. So definitely just sheer communication. I've done research out in Underberg, definitely the people who sell there have their suppliers all based in Pietermaritzburg and places like that and they have goods delivered to them as a result of them using communications.

MK: What barriers have you noticed for workers being able to access these types of technologies?

RD: Definitely the cost. Cost of the network… the network costs definitely. There are going to be generational barriers just in terms of accessing… understanding the technology. But then it's a very communal environment, so if you can't read a screen on your phone or understand what's going on there is someone that you turn to help you. I think it is also a market that doesn't or can't afford the latest technology. So it tends to be a beneficiary market of other people's cast off technologies. So I think we are probably now starting to enter… I mean we are probably now into the third generation of smart phones, so those first entry-level, first generation, are probably now coming onto the streets. The data… data is still quite expensive, and until we can get an environment… I see Cell C is starting to do it, where you can carry over 'so-called' unused data from month to month, until that starts to happen it's just a huge investment. How can you actually predict how much data you are going to use in a month unless you are a pervasive consumer of the data.

MK: What about other technologies you talked about where barriers exist, like electricity for example? Do you have any ideas about how these might be made more accessible to informal workers?

RD: I think that one… is just for me… so simple. It is really about the city having a heart for making these services available. Because once you've made the decision then you start inventing

ways in which you can actually distribute it. So, yes there are impediments to distributing electricity in public spaces -- it's really the value of the infrastructure that you're laying out there and the alternate value that's seen in it. So to steal the wires to sell them is probably more valuable than… or seen to be more valuable than the person who is consuming the electricity. But those can be solved. You'll never start to actually take on the design challenges of making that available unless you have a heart to try and actually bring it to market. So I think that there is no top-down decision at this point in time to actually really see that as being a benefit.

MK: Of the technologies mentioned so far, can you think of any potential negative or disruptive repercussions?

RD: Yea, a classic is the irony of electricity. So you can actually see that electricity can be a huge asset to many, but I would believe that inappropriate provision of electricity can have serious consequences. So, the city only just manages to manage and maintain health standards for people who are cooking on the street. The failsafe in the cooking that's happening at the moment is that it is really production on demand, and it is production within a market where there are very narrow and tight markups. So you don't overcook, and you almost know to the day, to the month, to the hour, like Kentucky Fried Chicken, how much you're going to have to prepare. So you can't afford to waste food, and you also can't store it because you've got no refrigeration to actually store it too much. The moment you provide electricity, and inappropriate electricity, people are going to be able to start using electricity. So there can be daytime benefits of the refrigeration in the sense that you can keep cool drinks cool, etc. etc. But cool drinks can also become alcohol that is being stored and sold on the streets. Now, I'm not obsessive about the availability of alcohol, but there are sensitivities about alcohol in public transport nodes and places like that. Where commuters are… use alcohol inappropriately and might then get on public transports, and we've seen horrific accidents when people are drunk on public transport. So, all of a sudden your urban management is going to have to increase enormously because you have things like refrigeration and people storing food overnight, and the food security which now starts to arise through people escaping a life of cooked food when they shouldn't. So there are aspects that can increase the challenges for city management.

MK: Are there any technologies that you can think of that make workers more vulnerable, perhaps to crime, to predation from Municipal authorities?

RD: Definitely coming out of the Nairobi experiences, which I'm sure is actually the same here but I've never heard it expressed as clearly, are people's vulnerability to high value assets like smart phones and things like that. I mean, the most ridiculous thing that's pervaded this country at the moment is, are these crazy notions to give all the children in Limpopo, or somewhere up north, iPads to go to school with, turning them into target #1 for criminals, and on their way they get beaten and the phone and their phones… their iPads taken from them. So yes, you hear stories coming out of Nairobi where people are into very low-entry, near disposable phones. And that is interesting for me because that has now reinforced the market for people to get really

fancy and think about the low… the capacity. And often it's the unutilized capacity… the really low entry-level device. You know, I think we jumped straight to Android and smart phones without really perhaps exploiting the full potential of texting and things like that. Yes, young people have in a sense… whole new text languages and things like that, but how do you start to deal with a whole lot of characters for this, that and the next thing. A whole different language that is utilizing technology which wasn't really designed to be, other than what are the main languages of the world, and now you're suddenly using an indigenous language to try to use something. But people have actually got around it. So I think there is huge scope to be investing in the so-called 'low-end' technologies.

MK: These last questions focus on the specific sectors. We have touched on most of them already, but I'll just go through each one and see if there is anything you'd like to add. The first one is energy, which we've discussed quite a bit. But, specifically, how do you think we can empower informal workers to be more engaged in the emerging alternative energy economy?

RD: I think within the South African context with the energy crisis, there is a wonderful irony in that informality in a sense… informal workers are generally… make quite a low demand on services -- energy and electricity. So if you're going to start to be inventive about how you can reconfigure your consumption of some of these things they are probably a market that is more susceptible to, in a positive sense, working creatively with an alternative consumption of electricity. People that have previously had it are already equipped with all those energy-consuming things. So, for instance let me give you a clear example. What does everyone do with the energy crisis? Everyone either buys generators, inverters, solar panels; the assumption is you've got to keep going what you've got, not I will now not even think about buying a fridge, I will now think about some clever solar thing and so on. So in other words, you think about equipping yourself in the low-tech or alternate-tech mode. Now that I think is an un-exploited asset, or un-exploited opportunity with informality. It's really a… It's a low demand sector simply because it's been deprived of being able to get to the sector. But how could that now be a sector that can more easily move into a low energy demand environment without actually feeling deprived. In fact, that would actually feel empowered if they got a solar cooker instead of having to switch on to electricity. However, sadly within South Africa some of these things are seen as status symbols, so for you to cook off a solar cooker where you could actually have a nice Defy plug-in stove is suddenly just seen as you… alternative technology. And of course there are cultural barriers against things like solar cookers. If there is a cultural caution about mirrors, and how mirrors attract lightening and all those kind of things, why on earth do you want to be the person in the village to put a solar dish up that is like this size, and be the person that is going to attract the nearest lightning strike in the middle of your village. So, I think it is an unexploited market that has potentially the right mental status to actually assimilate some of these alternative technologies. So, a very clear example here on the streets is the battery technology. So, the big battery technology… the street barbers are a very clear case where these guys have actually exploited that opportunity… it's a type of equipment that's low demand, it doesn't actually draw

a hell of a lot of current, but it actually has a huge benefit. And you… not only a huge benefit in terms of a better haircut, better service… they are able to market themselves better compared to the traditional Zulu barber who used hand clippers and a razor and pulled out every second hair on your head, and gave you a bit of a torture treatment.

MK: Have you noticed that South Africa's energy challenges, particularly load shedding, have affected these workers in any way?

RD: Well, I always think that it's actually been an asset to them, because when the lights go out in the shopping mall, everyone closes down, everyone gets panicked, everyone gets checked out of the shops or whatever, these guys are able to continue on trading. I see that they are better hedged to deal with….

MK: Next is transport, which we've discussed a bit already, particularly low-energy transport. To what degree do you think urban informal workers are positioned to challenge transport planning within these city systems to meet their needs?

RD: Well, their voices aren't heard in it at all. The irony is that … they at this point in time are the key beneficiaries of a transport system that has maximum friction within it. A mini-bus taxi can take you anywhere you want- it's pervasive. It stops, starts, waits for passengers, takes passengers short distances, long distances -- all the dynamics locked up inside taxi transport works to the benefit of the informal workers. To position themselves near the system to sell to… to sell goods to them, be those goods coming, going to a township, going to a rural area, it is just absolutely interlocked. That is not where transport technology is going. Transport technology is going to mass-transport systems, it is going to a frictionless system. And so transport planners don't want a whole lot of people… that system, getting in the way and slowing it all up. They also, in my estimation don't seem to see… even if you are going to allow some friction on it, the connection at the nodes that are on that mass transport system as being opportunities for economic development and for the location of small scale economic exchanges. So, I, so their voices are definitely not… well they're not in the thinking, and definitely their voices aren't being heard, or the people actually aren't understanding the dynamics. So that in Durban is going to have a huge, huge impact -- bringing the BRT into the city is going to be massive. We've managed to do some design work in a KwaMashu node where we were hopeful that we might be able to get a market constructed at one of the BRT stations, and that….

MK: In a way in which passengers would be required to go through it?

RD: Yea, and it was… First of all it was quite organic in the sense that there was quite a large scale economic presence there to start with. But you're never going to make these transport nodes safe in a southern African context unless you populate them with people. You can't have them as these frictionless, kind of pristine, kind of beautiful architectural… things. I mean, it would be a bloody mugger's paradise. I just tell the guy, I mean the imagery… 'Just change the

image, put it into a night-time view, so now it's just a slight glass, crystal thing sitting on the side of the highway, highway 95, 93, at 9 o'clock at night. Every good that gets off, and you now have got to walk home from this thing. Imagine how many paces you're going to take outside the glass box.' It's crazy. So, I don't think there is a realization just what that impact is going to be. We are also hearing, because of our experience here, but I'm seeing it when I go to Latin America, to Lima and places like that, and I'm hearing it when I talk to people from Ahmedabad. That the system is also not geared for informal workers to use. So whereas you would use the public transport to get your handful of goods and your baskets, and packages to your trading spot, you now can't get on this fast moving thing because either they don't allow you to bring all of your kit onto the transport, or even if they let you bring your kit on it's actually not designed to do -- so they all have fancy doors that let you through once, like the turnstiles in some of these transport systems, all your goods get caught in it. And then lastly, it actually doesn't supply the network that you really need. So you… so for people now to find their agents who they are doing work for, if they are doing piecework or something like that… it just doesn't serve the neighborhood districts kind of intensive… so I think transport and particularly public transport and people's voices in it is just something that South African planners have just not wrapped their heads around. They are wined and dined in Latin America, they see the Curitiba system, and they go to other Brazil examples, etc., etc. But they don't realize the context that those things come from. And those systems have fine-grained connections to them. So what they are experiencing are just the race ways that do the final connection. So I think, and you can see it, Rio, all these ones are now starting to take real strain in the sense that they are displacing a huge amount of informal workers. Yea, so it's bringing in a new urbanism which is really very insensitive. South Africa of course the irony is that it was the neglect of the Apartheid era and the complete disregard for how people would get into city centers from outlying and deliberately placed black ghettos… they left that industry for the mini bus taxis to fill as a transport system, and now the mini bus taxi has filled that gap and formed itself as an absolute bastion of immovability. They've now created something that they're not going to be able to remove easily. So, even the taxi industry now is also in itself in some respects becoming a negative force. It's starting a bit to determine who will trade where, in what spaces, and at which ranks. So, yea, public transport bad. And if you take a gendered view it gets even more complicated if you are a woman informal worker, sometimes the number of routes and trips you must do simply to get your children into daycare, you get down to a route that will get you to work and back again and to supplies… it is just so constantly scary.

MK: We've already briefly discussed waste and new technologies emerging there. Do you see any way that informal workers in waste sector… How can they be better positioned to take advantage of these emerging technologies?

RD: The intervention from a technology point of view for informal workers who are the primary gatherers of the recyclables, certainly in the South African context if you don't separate at source yet. So there are some… and Durban inner city is notable for it. There are huge amounts of

cardboards and plastics that are easily diverted from the system. The technology intervention is very simple, it's just proper cards and work gear. So, the investment is minimal, but the impact would be huge. Much, much more from the point of view from dignifying the activity that they're engaged in. It will be both visual and practical, physical, in terms of its impact. So it's very minimal that you'd have to do. But the net gain would be huge. The downstream technologies, in terms of how you start to deal with that, that can be managed by itself because that starts to become a commercial enterprise which starts to have its economies of scale, etc., etc. We have not seen a lot of threat… threats of incineration here yet. Elsewhere in the world that's a big problem… of incineration for energy, to create… drive turbines. And so, it's really the tradeoff, the higher water of the waste. What isn't exploited here which would be a definite thing we'd feed in is alternative energies that can be derived from waste -- particularly organic waste. And that's... starting to look at bio-gas and those sort of things. Very high, highly intensive in the sense of its management, so it's not that you put all of the muck in one end and you've got glorious power. But, the work… the job creation that is in that proper managed system, I think ends up being beneficial all the way through. So you get the energy, you get the potential compost at the end of it, and it's all kind of labor intensive. So if you've got a source that generates it easily, e.g. a market, you've got nearby activity, a nearby source for the sale of things like the compost that would come out of it as a bi-product, and you've got a market to sell the energy… cooking. Then there could be an intersect of appropriate technology.

MK: Do you see this as something that is accessible to informal workers? Or is it something that must derive from government?

RD: I mean… it's… again the irony, definitely the city, because it's interventionist and you can't just build these things without coming into public space, putting them under roadways, parking lots, or things like that. So it's interventionist in the sense that someone has to make the first big move. Generally, the better systems tend to be also… tend to be high capital. But where informal workers are critical, and where some sort of social facilitation, sensitive and appropriate social facilitation which the city is not going to be able to provide, is critical, and that is how the resources are going to be shared by the community. So the examples that I've seen working best are not those that use the end product for individual use, but the end product for communal use. So the ones in India that have worked better in my assessment have been those that for instance provide community lighting. So it produces the gas, the gas is a gas turbine which provides a generator and that makes electricity. So in other words everyone is benefitting. It's not like you and I have contributed to the gas but I'm the one that is cooking. And I get there first and the gas is finished by the time you get there. And there is a communalism that is going to be needed to be factored in to the shared resource -- how you're actually going to use it, if it's produced communally. But I think the importance of bio-gas for us is an important one because of the prejudice that informal workers suffer. Notionally everyone believes they are the generators of all the waste and the muck in the city and they are rendering the city dysfunctional and all those sort of things. So if there are mechanisms and technologies that can actually convert some of the

by-products of some of those activities into a valuable asset, particularly in South Africa that is energy deprived, then all of a sudden you start to get people's perceptions changed because now what is seemingly waste now is actually an asset. So all of the lights go out in the city, but Warwick is still burning with gas lights and everyone is cooking happily. What is going on here? It's a good place to be.

MK: The last question is on ICTs, which we've discussed a fair bit. We've talked about its effect on informal workers, and their ability to organize effectively. But, have you seen an impact of ICTs on informal worker organizations, and their ability to connect with members or organize themselves?

RD: Not here in South Africa, not here in Durban. Not here in South Africa is kind of a blanket statement. And the blanket statement I think is more driven by us having a really fractured, and almost non-presence of any strong membership based organizing. If it's happening it's happening at a very small scale and that scale… smaller scale, means that a lot of traditional methods of communication are still being deployed. Yes, you are seeing people subscribing to use bulk SMSing and that sort of stuff to communicate. You are probably also seeing the tools, smart phones and that sort of thing, being effectively used amongst the organizers, in terms of the primary people, the secretary general, etc., the lone person trying to pull together a whole group of people, and they are interfacing with the higher… the outside kind of organizations. But I think it's not a consequence of these technologies, it's more a consequence of just the very limited amount of organizing. But then back to my previous comment about the cost of it. If you look at it in places like Nairobi, India, it's starting to be a big, strong tool. But it's the very-entry level type thing, text message, the sending out of very basic comms [1:08:46].

APPENDIX IV:
SUMMARY OF LITERATURE REVIEW
BY PRACTICAL ACTION & WIEGO

New Technologies: summary of how new technologies (3D printers, bio-centers, e-commerce) can be/are being used by informal workers.
Apart from the ICTs discussed above, there is some evidence of new technologies which are beginning to be used by informal workers. Two of the three examples of new technologies being used by informal workers are in the waste sector. Mendoza (2014) discusses a start-up in Delhi, India which supports waste pickers by providing them with equipment and training to convert waste plastics to 3D printer filament, leading to significant increases in income. In Kenya, as part of a Practical Action project, informal waste workers and pit latrine emptiers have been using modern processing technology to sell their collected human and organic waste to waste to energy bio-centres in the country. The waste is processed to produce methane gas to be purchased as an energy source for everyday activities such as cooking and heating (White, 2015). Lastly, several groups of informal workers in Bangladesh have been using CellBazaar - an e-commerce system which uses an SMS-based platform to list and search for items and services for sale. The system has enabled small-scale producers, informal workers, and others to list their goods and services and find new markets, customers and employers (Zainudeen et al., 2011).

City-Wide Systems: summary of evidence on how access to these systems enhances enterprises earnings and on how lack of access to these systems undermines livelihood earnings.
There is more evidence on how the lack of access to waste, transport and energy systems undermine livelihood earnings than how access enhances enterprise earnings of informal workers. A 3-city study on home-based workers in Asia demonstrates how livelihoods can be undermined by unreliable or lack of energy access. The study by Chen (2014) found load shedding, or rolling power outages were a barrier to the work of home-based workers in Lahore, reducing their productivity and earnings, and negatively affecting their relationship with contractors. Rising electricity prices were a major problem for home-based workers in Ahmedabad, leading many to switch to manual machines which decreases productivity and can be physically exhausting. Similarly, a study on energy access of market vendors in Patna, India found that vendors were struggling for access to artificial lighting, negatively affecting their ability to serve customers at night and leading to lost revenue (Szakonyi & Urpelainen, 2015). In a similar vein, research also demonstrates how lack of access to transport can undermine livelihoods. A study on home-based workers in Ahmedabad found inadequate and irregular public transport negatively affects livelihoods. Long trips to and from the contractor to obtain materials eat into productive time while high fares result in decreased earnings (Mahadevia & Vyas, 2014). In cases where bus rapid transport (BRT) or other updated transport systems have been implemented, there appear to be mixed impacts for informal workers. While upgrades can lead to reduced travel times and open up access to additional work locations (as in the implementation of the BRT system in 33 Brazilian cities) (Senthilingam, 2013), it can also displace workers (as was the case with several Mumbai vendors who depended on trading with the slow-moving train prior to its upgrade) (Patel and Sharma, 1998). Lastly, as a result of plans for large-scale incinerators – such as the one being planned in Timarpur, Delhi, India – waste pickers face exclusion from waste management due to a ban from their being on the landfill,

leading to a loss of their livelihood (McDermott, 2008). Loss of access to waste – as a result of privatization of waste processes or waste to energy/incineration - were also identified as major threats by waste pickers from Asia, Africa, Latin America and Europe at a global workshop (Vryenhoek, 2012). Conversely, where waste pickers have access to waste systems and additional waste processing technologies, their livelihoods can be significantly improved. This was the case in a large project involving thousands of informal waste workers in Nepal who received access to new technology for processing waste (Shrestha, 2015).

ICTs: summary of evidence on how ICTs can be/are being used by informal workers

The main information and communication technologies (ICT) used by informal workers – per a recent review of literature - include mobile phones, applications, the Internet, and other web-based platforms. Mobile phones are being used by informal workers in different sectors in a variety of ways. A short study by Alfers & Lund (2014) with organizations of informal workers in Latin America, Asia and Africa revealed informal worker organizations and their members are using mobile phones for several purposes: to communicate about meetings, to find out about market prices, to warn of impending evictions, to inform about opening hours and bargains and others. The same study found that waste pickers in Bogota, Colombia are using cell phones to manage the payments they receive from the municipality for the collection and transport services they provide. Other studies – of street vendors in Dar-es-Salaam and of carpentry or cabinet-making micro-entrepreneurs in Villa el Salvador, Peru - found a small percentage of vendors were using phones for mobile banking, calculations and business communications (Mramba, 2014) or for contacting customers (Cáceres et al, 2012). There is also some evidence that mobile phone applications providing financial or payment services are being used workers – such as Mfore by street vendors in Delhi (Heikkila, Pia. 2015) or Sr. Pago by street vendors in Mexico (Laya, 2015). Some workers are also using digital platforms or mapping software for their work: a web-based platform and database is being used by waste pickers in Bangalore to connect with households and scrap dealers in an online marketplace (Carr, 2015) while a digital mapping of the informal matatu transport network in Nairobi has allowed users (largely poor urban workers) to navigate the system more efficiently and for informal transport operators to achieve improved routes and reach hotspot areas (Klopp, 2015). Lastly, in discussing how the internet could be/is used by informal workers, Graham (2014)’s book chapter notes that the internet could be used by small-scale producers to access new markets, improve their ability to compare market prices, thereby ensuring they get a good deal. Huarato (2012) also confirms how the internet is used by micro-enterprises in Peru - to obtain market information and to communicate, with comparatively few purchasing or retailing online.