CHALLENGING THE "APARTHEIDS" OF KNOWLEDGE

in Higher Education through Social Innovation

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Chapter 12

Reflections on experiences working alongside informal traders at Warwick Junction in Durban: a human factors and ergonomics perspective

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1. Human factors and ergonomics: an overview

Human factors and ergonomics (HFE), as defined by the International Ergonomics Association (IEA, 2020), refers to the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human wellbeing and overall system performance. Articulated differently, HFE focuses on understanding the system in which humans interact

with their environment, with this focus being applicable to work (Dul, Bruder, Buckle, Carayon, Falzon, Marras, Wilson & Van der Doelen, 2012), sport (Balague, Torrents, Hristovski, Davids & Araújo., 2013) or everyday life. Understanding these systems and how they either enhance or detract from the human's ability to remain safe and productive provides HFE specialists with insights into how to better design for humans, with humans (i.e. a human-centred approach is adopted).

By way of introduction to HFE, John Wilson, in his 2014 paper titled *Fundamentals of systems ergonomics/human factors* provides a framework to characterise the approach that HFE should take in order to successfully reach its dual outcomes of maintaining human wellbeing and safety and maximising performance and productivity. The first of these fundamental notions is that HFE must take a systems approach (Dul *et al.*, 2012; Wilson, 2014). This highlights the importance of identifying and understanding what components of the system a human interacts with, which can best be illustrated through the Work Systems model (Smith and Carayon-Sainfort, 1989; Carayon, Hundt, Karsh, Gurses, Alvarado, Smith & Brennan, 2006). This model (**Figure 1**) highlights five overriding components of a system (Smith and Carayon-Sainfort, 1989; Carayon *et al.*, 2006). This model is useful in that it provides a schematic map through which a system can be understood either at a micro level, where the focus is largely on the human-task interaction, at a meso level, where the interaction between teams of people and their working environment is the focus, or at a macro level, where the overall organisational design and how it is affected by the external environment becomes relevant in trying to optimise or balance system performance and human safety. Recently, Thatcher, Waterson, Todd and Moray (2018), preceded by Moray (1995), argue that HFE even has a role to play in resolving a plethora of global issues relating to food, water, energy, violence and terrorism, pollution and waste, and health and medicine.

The second notion refers to the importance of understanding the interactions between these different components of the system (Wilson, 2014) and to appreciate how these interactions (or a lack thereof) influence the different components and the overall outputs and safety of the humans within. The third notion emphasises the importance of understanding the context in which the system exists and interactions occur (Wilson, 2014). Too often, interventions or changes to an existing system are made without an understanding of the current and past ways in which and why 'people do things', which give some insights into the contextual factors that need to be harnessed to effect more meaningful change. This places an emphasis on shifting research away from the laboratory and into *in situ*, otherwise the interactions do not reflect the context within which they occur.

Figure 1: The work systems model (adapted from Smith and Carayon-Sainfort, 1989; Carayon et al., 2006)

Holism, the importance of understanding the system stakeholders, inputs and outputs, is the fourth notion that Wilson emphasises. Understanding the human and their interaction with the system holistically, and acknowledging the impact that it has on different human responses (physical, cognitive, social and emotional) is an important precursor to taking a participatory approach to either intervening or redesigning a system. The fifth concept is that of emergence (Wilson, 2014). This refers to the importance of constantly observing the emergent properties, behaviours or outcomes of a system and a human's interactions with it, which can, in most instances, highlight areas that present challenges to work or the use of a product or how to do work differently or better.

Lastly, Wilson argues strongly for the important role that embedding plays in understanding and modifying a system from within (Wilson, 2014). By embedding, HFE specialists are able to fulfil the requirements of the above-mentioned notions – to understand the system components and their interactions holistically, how the context shapes these interactions and the emergent properties or behaviours. While this requires time, effort and interaction with multiple levels of stakeholders, it is a critical component of an ergonomist's work, and will likely dictate the level (micro, meso or macro) and quality of the intervention.

2. HFE in the future world of work

Given the focus of the discipline, HFE is uniquely positioned to contribute to understanding and designing work systems following the rapid changes in the future world of work. Ergonomics originated out of the need to design tasks and work environments and systems to meet the needs of the humans (Kuorinka, 2000; Hollnagel, 2001) and was, in its infancy, focused predominantly on physical factors and their impact on the human and, by extension, work performance (Hollnagel, 2001). The need to optimise work systems during and after the Second World War and Industrial Revolution was also instrumental in framing the focus of the discipline. Since the 1980s, the appreciation of how technological development influenced the cognitive and psychological processes of the human resulted in the emergence of cognitive ergonomics, which was primarily focused on optimising human-technology interaction (Hollnagel, 2001). As technology continues to develop, and the way we work continues to be influenced by this, HFE's focus has been centred on work that is considered the 'norm' – where there is a defined employer-employee relationship in the context of formal workplaces, in both high-, middle- and low-income countries. Despite the fact that there have long been calls for HFE to address the multiple challenges faced by workers in low to middle income countries, now often referred to as the Global South and previously referred to as developing countries (Scott, 2009), the focus of these calls has largely revolved around formal work.

Work as we know it, the conventional 9 to 5, five days a week with weekends off, is changing rapidly and is, by and large, very different in the contemporary view of work. Recently, the International Labour Organisation has set up a commission to investigate, understand and potentially prepare for the changes in how work is being done around the world – this group, the Commission on Future of Work, has identified a number of key aspects that provide a glimpse into what the future of how we work will look like.

3. New ways of working: the gig economy, digital work and the platform economy

One consideration is found in the International Labour Organisation (ILO) reports that state that, since 2000, there has been a marked growth in the provision of services online, referred to as the platform economy or digital work, which can take the forms of crowd work or work on demand via applications that form part of the gig economy (ILO, 2018). For instance, there has been an increase in the growth of disruptive technologies and ways of doing work. Businesses such as Uber, AirBnB, TaskRabbit and other service-related industries and shared

economies have upset their conventional equivalents (metered taxis, hotels and calling an electrician or plumber or other tradesperson for support). Facilitated through improved connectivity and technology, these industries provide round the clock service and accessibility to consumers, but at a cost to those who provide them. Again, the fact that these industries offer individuals the chance to work when they want means that work hours as we would know them can differ significantly both in terms of when they happen and for how long. In the ILO publication on working time and future of work, it is evident that there is concern around how technology and the new forms of work are blurring the lines between work and home life (Eurofound and the International Labour Office (2017)). The growth in these industries has been driven by the need to be able to self-regulate working time and effort, but their effect on individuals is yet to be determined, particularly around how workers in these jobs can get access to basic protections, such as insurance, leave, health and social benefits and collective bargaining, given that there is no employer–employee relationship. It is also interesting to note that these new types of work also transcend the income bracket countries fall into.

4. A different perspective on the world of work: the informal economy

For many years development economists assumed that as development progressed, low-income traditional economies, including petty trade, small-scale production and casual jobs, would be absorbed into the modern formal economy (Lewis, 1954). It became clear in the 1970s, however, that this model was not matched by empirical reality, even in countries where economic growth was occurring (ILO, 1972). The model came under further scrutiny during the 1980s and 1990s, when developed economies began to see the rise of 'non-standard' employment (an umbrella-term to cover a range of work arrangements including part-time, temporary and agency work, often with low pay, few protections and little chance of upward mobility), and economic crises in Latin America and Asia led to the growth of the informal economy.

A number of theories developed to explain the emergence, continuation and growth of the informal economy. Chen (2012) argues that the informal economy is in fact too complex and heterogenous to be encapsulated by single causal theories. While some informal workers choose to operate informally, many are forced into informal employment during economic downturns, so that it is necessity as well as choice that drives the informal economy. While the informalisation of employment relations is a characteristic of the global economy, it also has to

be recognised that in many developing countries the majority of the workforce has never been formally employed. Important as well is that the informal economy is not separate from the formal economy, as the dualists would have it, but is in fact linked into it in complex ways (Chen, 2006; Meagher, 2013). This suggests that more heterodox models are needed which can better capture this complexity (Chen 2012).

4.1 *Defining and profiling the informal economy*

Despite informal employment having long dominated the labour markets of many developing countries up until recently, the informal economy was ignored by economists and policy makers. This started to change in the 1970s when the term 'informal sector' was first coined by the economic anthropologist, Keith Hart (1973), in his study of low-income activities among unskilled migrants from Northern Ghana to Accra, and later adopted by the ILO's 1972 employment mission to Kenya (Chen, 2012). 'Informal economy' is widely accepted to refer to the diversified set of economic activities, enterprises, jobs and workers that are not regulated or protected by the state (Chen, 2012).

While this definition has largely remained unchallenged, the definitional debates around the term informal employment were more complicated. In 2002 the ILO, the International Expert Group of Informal Sector Statistics (called the Delhi Group) and the global network Women in Informal Employment: Globalizing and Organizing (WIEGO) worked together to broaden the concept. In 2003, the 17th ICLS adopted a definition of informal employment which refers to all employment arrangements in which individuals do not get access to social protection through their work, whether the work is for informal enterprises, formal enterprises or households (Vanek, Chen, Carré, Heintz, & Hussmans, 2014). In summary, the three key concepts are:

- The informal sector: production and employment in unregistered enterprises.
- Informal employment: any employment outside of labour protections, whether in formal or informal firms or households.
- The informal economy: all economic activities, enterprises, jobs and workers that are not regulated or protected by the state and the output from them.

Informal employment is not uniform and incorporates a wide variety of statuses in employment, the two most significant being self-employment and waged employment. Each of these incorporates their own sub-categories as follows:

Informal self-employment	Informal wage employment
Employers in informal enterprises Own account workers in informal enterprises (self-employed workers who do not employ others) Contributing family workers (in informal and formal enterprises) Members of informal producers' cooperatives	Employees of informal enterprises Casual or day labourers Paid domestic workers Contract workers (someone who performs work under conditions of dependency, but not within a formal employment relationship) Unregistered or undeclared workers Industrial outworkers

In developed countries, the use of the terms 'non-standard' or 'atypical' work are preferred over using the term 'informal employment' to refer to employment arrangements that would fit into the definitions provided above. The term 'non-standard work' includes: own account self-employed workers, temporary (or fixed term) workers and some part-time workers (Vanek *et al.*, 2014). It also encompasses the gig economy.

In 2018, a revision of status in employment in the informal economy was on the agenda of the 20th ICLS (Carré, Negrete & Vanek, 2017). The 19th ICLS noted in 2013 that there was a strong consensus on the need to revise the International Classification of Status in Employment (ICSE-93) (Carré *et al.*, 2017). One of the suggested revisions that was accepted in 2018 is the incorporation of the concept of 'dependent contractor'. This category of informal employment is aimed at more accurately capturing workers who do not fit easily into either the self-employed or wage worker categories (Carré *et al.*, 2017). Although the definition has not yet been fixed, the working definition is as follows:

- Employed persons with no employees (currently classified as own account) whose access to the market depends on resources provided by an entity that directly benefits from the work performed by the contractor.
- These persons are dependent on another economic unit for access to raw materials, capital items or clients. Their work may be organised or supervised by another economic unit as a client or as an entity that mediates access to clients.
- They are paid for the end product (usually on a piece rate basis).

Recent statistics, released by the ILO show that over two billion of the world's population work informally, which accounts for just over 60% of people employed globally (ILO, 2018). In sub-Saharan Africa, 85.8% of workers work in the informal economy. Due to its particular economic history, South Africa has a much smaller informal economy, with 33% of workers employed informally, a lower percentage

of self-employed informal workers and a higher percentage of informally employed wage workers (Budlender, 2011). Nevertheless self-employment in the informal sector – the part of the informal economy in which the workers in Warwick Junction are located – plays a significant role in reducing poverty rates in the country (Cichello & Rogan, 2017).

WARWICK JUNCTION IN DURBAN, SOUTH AFRICA

Warwick Junction is one of the largest transport nodes in the city of Durban, KwaZulu-Natal, South Africa. On average, nearly 500 000 commuters move through the station each day to and from their place of work. An emergent characteristic of this number of people being in one place was the development of a large-scale informal sector, which houses as many as 8 000 street traders, the majority of whom are women. The junction has several markets that trade in a variety of goods, including a fresh produce section, a bovine head market, a general food court, the early morning market (chicken traders), the traditional medicine market, the music bridge, a mixed strip section that sells a variety of goods and perishables (ranging from cigarettes and snacks to hand lotions), and finally, the Brook Street market that has bead makers, garment makers and clay traders (Dobson, Skinner & Nicholson, 2009). The trade of certain items vary, depending on the time of day and the needs of potential customers – traders are responsive to customer needs (Dobson *et al.*, 2009). The majority of people working in and around Warwick Junction are self-employed own account workers who operate in public spaces and along the road sides.

Initially, in the 1990s, traders were allowed to sell at the junction but were not provided with any amenities and trading facilities (Dobson *et al.*, 2009). Historically, African women were not permitted to live in the cities, and, as a result, they did not acquire accommodation in the cities and most commuted between their rural home and the city to do street trading (Dobson *et al.*, 2009; Siqwana-Ndulo, 2013). The banning of traders from the streets at night made it difficult to find overnight accommodation as it was often expensive; this resulted in several traders sleeping in the market with their trading stock (Dobson *et al.*, 2009; Siqwana-Ndulo, 2013).

In the present day, there are still several workers who sleep at Warwick Junction, mainly the porters and lime stone traders. The porters or barrow operators offer their services of transporting goods around the market for traders and customers and their working hours are from 04:00 until after 21:00 (Dobson *et al.*, 2009). The morning routine includes delivering traders' goods to the trading site from the storage facility before the traders arrive (Dobson *et al.*, 2009). Often

times the porters will sleep in groups around their heavily packed trolleys to avoid paying for overnight storage (Dobson *et al.*, 2009).

A unique characteristic of Warwick Junction is the presence and active involvement of Asiye e'Tafuleni (AeT). AeT is a non-profit organisation (NPO) that was set up in 2009 to provide urban design solutions to informal workers in Durban, and specifically in Warwick Junction where it is based. The NPO was founded by two ex-municipal employees who had both worked on the regeneration of the Warwick Precinct during the late 1990s. The two have unique skills in architecture, urban design, participatory processes and social facilitation. These skills, combined with over 20 years of sustained relationship building with the Warwick community, have allowed them to establish a unique South African 'laboratory' for developing and testing participatory human-centred urban design solutions to support urban informal livelihoods. It is this human-centred and participatory approach to their work that attracted researchers in the field of HFE.

4.2 *Why should HFE take an interest in the informal economy?*

Of interest to HFE specialists, is how the characteristics of the informal economy work (the environment, the tools, tasks and activities and the organisational, social, political and economic structures and processes) affect the individuals that operate within that system. Workers in the informal economy usually use adapted technologies for the purposes of their work, which are usually small in scale but at times can be incredibly labour intensive (Alfers, Bali, Bird, Castellanos, Chen, Dobson, Hughes, Roever & Rogan, 2016). The actual individuals working in these public spaces are more often than not from a lower socio-economic status, with little formal education, which therefore drives the need to generate income through informal activities as the access to formal employment is limited. There is also a large proportion of women in the informal economy, which results from a complex interaction of social, cultural and patriarchal norms dictating that women work in low-income jobs. There is also very little in the way of support for mothers who have to work but have no-one to assist them with their children.

Informal traders are often affected by inclement weather, which can damage or destroy their goods. Furthermore, exposure to heat, cold, rain and other artificial pollutants such as dust, smoke and chemicals can affect work in this context as well as the overall health of those exposed to these elements (Ametepeh, 2011). The nature of the work can be physically taxing, which, when performed in hot environments, presents additional challenges to the successful execution of the physical tasks (Lund, Alfers & Santana, 2016). Furthermore, the actual physical

urban space they operate in is seldom designed with informal workers in mind, resulting in significant mismatches between the physical environment and the work. There are also many examples of how, in order to work, informal workers use a variety of adapted tools and technologies (Chen, 2016). An example of this from Warwick Junction specifically is the trolley used by the water porter, which is fashioned out of bread crates and other sourced materials. The use of industrially made shopping trolleys attracts negative attention from police who usually confiscate them, hence the innovation to fashion a self-made, functional yet rather unattractive trolley. From a social perspective, informal traders more often than not have very little social or legal protection in their work spaces, characterised by a high prevalence of abuse from city officials, police and members of the public who perceive these activities as nuisances that take up space and are unattractive. More broadly, non-inclusive city planning, design and policy-making add to the burden of trying to generate an income.

Another challenge that has emerged from previous research concerning time-use in the informal economy is the concept of time poverty. This concept refers to how competing claims on an individual's time limit the choices they make about time allocation. They usually need to make some compromise, resulting in either increased work intensity or the neglect of other important activities such as those that are economically productive or leisure- or recreation-focused or those dedicated to sleep and rest (Kes & Swaminathan, 2006; Gammage, 2010). In particular, women are restricted to activities related to or performed in the domestic sphere (this can include care work) and/or activities that warrant extended hours of work and reduced hours of rest and recovery (Gammage, 2010).

In an attempt to begin to understand the context and the systems within which the informal economy operates, specifically in the context of Warwick Junction, the Department of Human Kinetics and Ergonomics has started research into how certain aspects of working in the informal economy present challenges to the traders. These challenges will be outlined below in the form of two case studies.

4.3 Understanding work as done: examples of the application of HFE principles in the informal economy

CASE STUDY 1: Time-use survey at Warwick Junction

Following an introduction to the informal economy at Warwick Junction, we were interested in understanding the effects of one particular aspect of workers in this context: how they used their time (Hirway, 2009). Time-use surveys offer an excellent, non-invasive and easy means of gaining insight into how work is

done, the time allotted to it and the value associated with the work performed. Through time-use surveys, one is able to understand the nature of the workforce and determine the wellbeing and socio-economic status of individuals, all of which can be used to support and recognise activities that are not always formally recognised, such as informal work or care work. From an HFE perspective, understanding time-use affords important insight into how work and working time is arranged and how other activities that require time (commuting, domestic and personal activities, eating and sleeping) are arranged around work. Anecdotally, informal workers are thought to work excessively long days (over 12 hours) and have limited time for personal, domestic- and sleep- related activities, which ultimately impact their ability to rest and recharge and be productive at work. As such, we sought to determine the time-use behaviours of a small cohort of traders at Warwick Junction with the help of Asiye e'Tafuleni (AeT).

Ten traders (5 males and 5 females) – including one traditional hat maker, one storage operator, one bovine head cook (this refers to a cows head, which is a Zulu delicacy), one mealie cook and vendor (mealies are also referred to as maize or corn, the cooked mealies are conveyed in and sold from supermarket trolleys), two cardboard and plastic recyclers (who use trolleys to collect and convey recyclables to central areas where they are purchased by middle-agents), one water transporter (who transports up to 400 litres of water nearly 5 km every day), one bead maker and seller and two barrow operators (who use self-made carts to transport informal traders goods from the storage facilities to their trading posts and back again every day) – were recruited from Warwick Junction.

We sought to determine their time-use by means of an activity clock – a 24-hour clock presented on a piece of cardboard, which allowed each trader to divide their day up according to the time they allocated to various activities. All traders were asked to indicate the amount of time they dedicated to the following activities on both normal and busy days: work and work-related activities, commuting, household and child care activities, personal activities (grooming, bathing, using the toilet, eating) and sleep.

What emerged was that all informal traders who were interviewed work between 53 and 87 hours per week and, on average, 12 hours per day for six and sometimes seven days per week (Davy, Rasetsoke, Todd, Quazi, Ndlovu, Dobson & Alferts, 2018). More detailed analysis of the data revealed that work duration differed between busy and normal times of the year or month, with traders working nearly 13.5 hours per day during busy periods and 10.7 hours during regular or normal periods. The most extreme example in this case was a 15.5 hour work shift, reported by a bovine head cook. These work periods were also, in some

cases, preceded and followed by extended commutes home, with the worst example being 4.5 hour commute. This left traders with 6.1 hours and 7.1 hours for sleep during busy and normal periods respectively, which, according to literature in the area, can be insufficient for some adults.

A comparison between male and female traders revealed that female traders generally have longer work hours, a higher domestic load, less personal time and less time for sleep. This supports previous findings that have consistently demonstrated that female traders experience time poverty, where the competing claims (to work and fulfil the traditional responsibilities associated with the household) limit or require them to compromise on other areas (such as personal time and sleep) (Gammage, 2010; Kes & Swaminathan, 2006). Irrespective of gender, the study highlighted how, in addition to the plethora of social, economic and physical work-related challenges, informal traders likely work extended shifts, which, when combined with extended commutes and other house-related activities, limits the opportunity for adequate sleep and recovery. This may in turn affect the long-term health and work ability of these traders, which the study highlighted as a cause for concern. At the same time, this small study revealed examples of the everyday resilience of informal traders who, in spite of the systemic challenges they face, continue to work in a very routine and organised way.

CASE STUDY 2: An activity analysis of trolleys used by cardboard collectors at Warwick Junction

As part of ongoing collaboration with AeT, the Department of Human Kinetics and Ergonomics participated in research aimed at exploring whether trolleys, designed by AeT (in collaboration with informal workers), were fit for purpose when used by cardboard collectors at Warwick Junction. AeT has been working with informal recyclers (also known as waste pickers) since 2011 through a collaboration with the eThekweni Municipality. During this time they began the process of designing trolleys which would ease the load on the waste picker's bodies, with the intention of increasing collector productivity while also ensuring that the trolleys were robust enough to be used in a challenging urban environment. In 2017 AeT received a commission from the municipality to develop the trolleys beyond the prototype phase. It was at this point that the collaboration with the Human Kinetics and Ergonomics (HKE) Department was set up.

Four informal recyclers who specialise in the collection of cardboard participated in the study, which comprised an observational task and activity analysis of these traders during their use of the trolleys to collect cardboard. Task analysis

refers to the observation and recording of the different components of the work, such as pushing and pulling the trolley, cutting, flattening and stacking the cardboard and selling it to the 'middleman' at the local recycling depot. The activity analysis takes this one step further by exploring the way in which the tasks are performed. For example, in order to flatten the cardboard, traders use sharp pieces of glass as opposed to a more appropriate tool such as a paper knife. The reason for this choice stems from the fact that legislation, specifically the law of Nuisances and Behaviour in a Public Places, prohibits informal traders from carrying knives or sharp objects that could be used as a weapon. Without directly observing and engaging with traders while they work, it would not be possible to understand this emergent behaviour, which is a product of the way the system is designed and organised. Additionally, the waste pickers were asked to give their feedback on the appropriateness (positive and negative aspects) of the trolleys for the job they performed.

Following the completion of the study, it emerged that the waste pickers were satisfied with the trolley design. They did, however, make important suggestions for improving the trolley design, based on their experience of using them daily. Furthermore, through the observation of the waste pickers, it emerged that, despite the good design of the trolley, the success of the cardboard collection process is influenced by many other systemic barriers and constraints. Four particular constraints were identified. The first was the weather – the wind, heat and rain can sometimes make pushing/pulling the trolleys physically challenging. Furthermore, if the cardboard gets wet, the collectors receive less money for the load, as payment is based on the mass of the cardboard collected and with it being wet the mass is not an accurate reflection of the actual mass collected. A second systemic constraint was the presence of police, who, in some cases, would confiscate goods from the collectors and sell them for their own profits. A third challenge was the terrain and the physical state of the roads or pavements on which the collectors would have to push the trollies. The undulating terrain, combined with a loaded trolley, would at times be physically taxing, while pushing their trollies in the road was made difficult by the presence of potholes and traffic. During periods of peak traffic, traders would be forced to push their trollies on the pavement, which then meant they were required to navigate through many pedestrians, which also made work slow. In an attempt to avoid the traffic, collectors would also start work early.

The study highlighted that, although the intervention from AeT was successful in that it made the work of the waste collectors easier, the system in which the trolleys were being used still presents barriers to effective, safe and meaningful

work for these waste pickers. This emphasises the importance of considering the broader systemic design of systems in which people work, alongside micro interventions such as the trolley design. It also emphasises the need not only to focus on the work system itself but also look at the broader picture and other stakeholders that influence the system. For example, based on both case studies presented here, it is clear that there is a need to understand and work with local municipalities and law enforcement officials.

5. Reflections on experiences in the informal economy: the importance of building bridges between the grassroots and the ivory tower

The partnership with Asiye e'Tafuleni originated from the request made by the organisation to assist with the testing and refinement of the trolleys described in the above-mentioned case study. Although the research has contributed to an improved understanding of the specific challenges relating to issues of time-use and the systemic challenges that waste pickers face, the collaboration with AeT and those involved in the informal economy has been of immense benefit to those (academics and students) involved in HFE. This section outlines some critical reflections on how these projects have shaped our view of our own discipline of HFE, how it has contextualised the notions put forward by Wilson and how it exemplifies the importance of embedded, engaged and locally responsive teaching, learning and research in preparing students to make a meaningful impact on the ever-changing South African (and global) workplace. This is followed by a set of reflections from AeT on their experiences of working with universities and students to advance the interests of informal workers.

5.1 *Shifting perspectives of HFE in the world of work*

Work, whether formal or informal, requires people to interact with one another and many different components of their immediate system. The interactions observed at Warwick present numerous challenges to those working there (e.g. health, social), but also constitute excellent examples of every day resilience and innovation, which should be understood better in an attempt to improve the working and ultimately living conditions of many working in the Informal Economy

5.1.1 HOW WORK IN THE INFORMAL ECONOMY HAS SHAPED HFE EDUCATION

Prior to the start of our collaboration with AeT and our exposure to informal work at Warwick Junction in particular, the focus of the Department, with respect to

research, teaching and learning, revolved around more formal work, mainly because the discipline had been restricted to this context. With respect to teaching and learning and putting HFE and human-centred design into context, exposure to informality has reshaped and enhanced our ability to provide locally and contextually relevant examples of work and work systems to our students, which not only give students a different perspective of what it means to work, but also affords them a more transformed, nuanced and realistic view of what many South Africans (and Africans) face when working in the informal economy. A vital component of this journey was how the collaboration pushed the university HFE academics and students to go beyond our academic ivory towers and to engage with and recognise the reality of most people trying to make a living within South Africa. It also offered a real and, at times, raw perspective on some of the systemic barriers that some traders face on a daily basis. This was captured by one of the students who conducted his honours research project at Warwick when he wrote: *"... to be honest, it was the most eye-opening experience for me. To actually see, first-hand how difficult it is for IE workers to make a living and who have no education was hard to comprehend coming from someone (myself) who has been educated. I take a lot for granted as do other South Africans who drive past them [informal workers] without batting an eyelid or that they consider them a nuisance to our society."* This statement from a white, privileged male, demonstrates the profound impact that spending time in this context had on the student and his preconceived ideas of those in the informal economy.

Furthermore, with reference to the work systems model (**Figure 1**), spending time in Warwick Junction allowed for us as educators to be able to give a number of examples of different components of a system and how they interact and how these interactions affect the human. Both case studies provide ample material which can be applied in a classroom setting to give context to the theory behind the work systems model. As we strive to provide students with experiences that bring home the realities of work as done rather than work as imagined, these in situ experiences are crucial. These examples are also crucial in opening students' eyes to the realities of work in South Africa and changing students' perceptions from initially seeing informal traders as a nuisance to understanding the vital role they play in the South African economy.

In terms of certain core concepts in HFE education, such as resilience, the collaboration with AeT and the traders at Warwick Junction provided novel examples that lent new meaning to the terms in the context of work. According to Hollnagel, Nemeth and Dekker (2009), for a system (and the individuals within it) to be resilient, it (they) should be able to predict what may happen, monitor what is

happening, respond effectively (and appropriately) when something happens and learn from past experiences. While resilience can refer to how a system (or an individual) bounces back from acute or catastrophic shocks or challenges, a more nuanced view holds resilience as the ability to cope with and function, despite chronic challenges on a day-to-day basis. In any context, there are daily examples of resilience which provide important insights into how humans cope with, adapt and transform in order to overcome difficulties they face. The term resilience has largely been applied to the context of healthcare and aviation and has not been used in the context of the informal economy. Both the time-use and cardboard collector observation studies highlighted how, in spite of the long daily and weekly work hours, the long commutes and the physically taxing nature of some of the work and other systemic constraints, traders and in particular female traders, continued to work almost every day. The informal traders are also 'designers' in their own right, demonstrating remarkable resilience in adapting technology to suit the environment within which they operate. As such, engaging with technology at the bottom of the pyramid is a vital consideration for HFE researchers and practitioners. There is a need for a focus on high-impact low-cost technology that can easily be introduced into the informal sector to alleviate physical and cognitive strain and improve productivity.

5.1.2 THE RESHAPING OF RESEARCH IN HFE

HFE research, certainly in the context of the Department of Human Kinetics and Ergonomics, has taken a typically rigid scientific approach to studying humans, normally in the context of a laboratory setting where as many as possible extraneous variables have been controlled. In other words, the research has taken a micro view of a component of a system, not a systems approach, which Wilson (2014; p7) argues is a necessity for effective ergonomics intervention development. To this end, Wilson argued that "few if any laboratory studies are properly ergonomics because they cannot account properly for the complexity and multiple factors found in real setting" to embrace and understand complexity of systems and how they work. While laboratory research has its place, it has become evident that, in order to understand the way work is done and the inherent challenges faced by informal workers or any worker in any system for that matter, this research must be carried out in situ. Furthermore, it was refreshing to not be bound by taking hypothesis-driven/deductive-based approaches to research in this context. We entered as participants, as part of the system with the help of those who were already embedded in (AeT) the system. With their help, we approached the effort to learn more about humans in this context through

different, contextually relevant yet culturally and linguistically sensitive methods which were suggested and decided upon alongside AeT and other stakeholders who had the necessary insights. This allowed us to move from hypothesis-testing research to broader problem identification and hypothesis generating research.

In the time-use survey study, for instance, the use of the activity clock was particularly effective for determining the time usage amongst the cohort of informal traders. This was attributable to its rather simple design that allowed for the traders to partition their typical (or busy) day up by drawing on the actual clock, much the same as a pie chart. This simple yet effective tool facilitated the collection of quantitative data (through interactions and conversations with the traders) so as to overcome any language or education barriers. In the second case study, activity analysis was adopted in order to investigate the tasks and activities of the cardboard collectors at Warwick Junction. Activity analysis is a method aimed at learning about an individual's conduct, work strategies, thought processes and interactions with others in a given situation. It requires long observations of different patterns of behaviour (or specific behaviours) within a system and is often accompanied by interviews of the workers in order to understand not only *what* people do but also, and more importantly, *why* they do what they do (Garrigou, Daniellou, Carballeda & Ruaud, 1995). In doing so, it became evident that the traders have developed a number of strategies and innovations to overcome certain constraints they face while working (such as not being able to carry a blade, even though it is necessary for their work, or dousing some of the cardboard in effluent to make it heavier and then placing it in the middle of the stack so as to get paid more). This was captured by a student researcher who wrote: *"Even though they [the traders] may have little education, they are still able to adapt to their surroundings with positive effects [outcomes]. So what I found that emerged from them [the innovation] was mind blowing"*. These are not insights that would be immediately observable without applying this HFE method to this work context. Irrespective of the method applied, it is only through taking an embedded approach, which Wilson (2014) argues as fundamental for successful HFE, that one can truly appreciate the complexity of a system such as Warwick Junction and the people who work in it. Furthermore, the time spent there allowed for the understanding of the interactions that occur, the contextual factors that shape these interactions, the emergent characteristics or behaviours and the impact that all of the above have on the humans in the system in a holistic way.

5.2 Reflections from Asiye e'Tafuleni on working with universities

Since its inception, AeT has sought to collaborate with both academics and students. The organisation regularly hosts student interns from a range of different disciplines, for e.g. from social work through to engineering, and has worked with international universities such as Harvard and MIT, as well as local universities such as the University of KwaZulu-Natal and now Rhodes. For AeT the benefits of these collaborations are multiple.

The work of the NPO largely centres on responding to the day-to-day needs of the informal workers in Warwick. *"Too often we're in an isolated bubble with our noses to the sidewalk, dealing on a day-to-day basis with what comes up. Engaging with universities is important because they force us to think outside of ourselves,"* said an AeT staff member. Collaboration between the two can help the more practically-orientated organisation to step back from their work, think critically about what it is trying to achieve and delimit new possibilities and directions. It can also push more theoretically minded academics to think carefully about what their theory might mean in the real world and about how to move from research into action. The approach taken by AeT when collaborating with researchers and students is captured in **Figure 2**.

Figure 2: Collaborative model developed and applied by Asiye e'Tafuleni

For AeT, the introduction to systems thinking and a systems approach that has come through its interactions with HFE have been particularly useful. *"Informal workers struggle because they have to ward off controlling influences that are often uncoordinated. For example, the police fine traders because their goods are extending beyond their demarcated area, but at the same time the City has retrenched the team who paints the demarcation lines, so traders don't actually know where the demarcation line is,"* says AeT. The organisation believes that systems thinking and taking a systems approach could be useful in helping them articulate and advocate for the better integration of urban systems, *"to sew urban activities together in support of informal workers."* In this way, academic inputs can help to define the way in which a problem is approached.

This was similarly the case with the time-use research. *"We realized through this research that some of the waste pickers have these clockwork-like existences,"* said an AeT staff member who participated in the research. *"Work, coffee, listening to a religious programme, more work etc. These are highly ordered lives."* This is something that is often not appreciated about the informal economy. This provides another line of thinking about how to understand and approach advocacy work on integrating urban management systems so that they do not disrupt this very careful order that has been established by informal workers themselves.

The work on the waste picker trolleys has also been useful in helping AeT to think critically about the prototypes they were already producing. *"Once you've got a prototype and you've got funding to produce more, it's important to step back and see if we've got it right. We don't want to be producing something that injures or hurts people. Before production we have to be certain that we've got this as good as we can get it to be using strong scientific principles."* The testing of the trolleys, from an objective ergonomic perspective, has given AeT confidence that the trolleys are of an acceptable standard.

Finally, AeT engages with students in particular as a long-term influencing strategy, the process of which is highlighted in **Figure 2**. The organisation sees it as their responsibility to develop a new cadre of professionals from a variety of disciplines to take up the cause of supporting informal workers. Working with students on research projects, contributing to experiential teaching programmes and working with student interns are all a part of this strategy. *"It may be that HFE graduates don't work with informal workers directly, but maybe they are employed by the rail regulator which does employ HFE graduates. Rail regulators are constantly having to work with informality in a variety of ways. We're training people in all walks of life to consider informality and to think about how to work with it rather than against it."*

6. A way forward

Despite the growing number of people working in the informal economy, this type of work remains precarious, given the prevailing negative perception of those working in this context, accompanied by the non-inclusive city planning and design. These beliefs, attitudes and policies threaten the sustainability of those who work in public spaces. Given the role that HFE is now starting to play in city planning and design, there is scope for HFE, which focuses on the needs of the humans in the system, to be involved in 'shifting perspectives' of important decision makers in municipalities and governments and helping them to recognise and be more inclusive of those operating in the informal economy. In doing so, HFE would rise to being locally responsive and advancing social justice. Given the economic, social and political challenges in South Africa, there is need to think differently and facilitate more opportunities for South Africans within the informal economy to grow their businesses and not to focus on the conventional way that work has always been structured in the attempt facilitate an upward trajectory out of poverty. If we, as those in tertiary institutions, get this right, in collaboration with those who already work in these spaces, we advance the public good purpose of universities and break down the ivory tower perceptions that have, for far too long, prevailed.

Through this experience it became evident that HFE has a lot to offer to those who work alongside and in the informal economy, as captured by one of the student researchers involved in the trolley project: "... *from an HFE perspective, I found it rather exciting because never in my life did I consider that HFE could have a huge part in the informal economy.*" Similarly, and more importantly, those that are alongside and within the informal economy can offer incredible insights to the discipline of HFE and in particular HFE education and research in South Africa. However, these insights could not have been gained without the assistance from stakeholders such as AeT. From an HFE perspective, the collaboration with this group, who are already embedded within the Warwick Junction system, facilitates important access to the traders and their work and, to some extent, their personal lives. In essence, AeT has spent years establishing trust with the traders by assisting them to improve their work. It is through such platforms that other research and advocacy groups can join in and assist in pursuit of improving the lives of many who live and work in the informal economy.

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