SmART Cities and Waste Innovation

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Abstract

Purpose

Waste is a significant problem, with challenges at every stage including waste prevention, treatment/ management, recycling and reuse, and the health and ecosystem impacts of poorly managed waste. In Europe only 36% of over 2.5 billion tonnes of waste is recycled, with the rest landfilled/burned with disastrous environmental consequences. Clothing has been the fastest growing waste stream in the UK over the past decade. However, recycling and technological solutions alone are not the solution, faced with the reality that so-called 'biodegradable' material does not actually biodegrade in landfill; technical textiles reliant upon micro-plastics pollute the food and water chain; and the export of second-hand clothes destroys developing country textiles production and markets. The contradiction in terms of the notion 'sustainable fashion', also needs to be confronted, as clothes and other textiles have emerged as key waste streams that require cultural as well as technological solutions. The need for both a more creative/arts approach, and a cross-disciplinary and stakeholder engaged process across the production-waste chain has thus been identified and facilitated through this research initiative.

Design/methodology

In response, the AHRC-funded Interdisciplinary Research Network *SmART Cities and Waste Innovation* was established (2016-18), developing a network of artists and designers, as well as social, materials and natural scientists and waste practitioners, to explore how inter-disciplinary practices can enable and envision "smarter" waste generation and reduction. A key aim has been to develop an understanding of how locality, community, identity and culture affect not only the acceptance of specific waste management technologies, but to explore how such 'local knowledge' can feed back into the waste design and innovation process, informed by the necessity for 'cross-talk' between creative artists, scientists, policy-makers and the public. The author is a co-director of the network, and participant observer in the programme of activities and reflections captured in this paper.

Findings

The Network held four workshops, with site installations and demonstration projects in Amsterdam, Maastricht, London and Bangor (Wales), with practising artists, designers, social and STS (Science Technology Society) scientists, and environmental scientists (e.g. bio-mining, nanotechnology, electronic-waste, water, clothes/textiles) and municipal waste authorities in each location, accompanied by group 'making' workshops using waste and 'natural' materials (Ehrman, 2018). This ranged from an artist/textiles designer who transforms paper waste to produce fabulous garments; creative recycling fab labs; make-do-and-mend/repair workshops, to litter-inspired costumes as part of local environmental arts festivals in London and Amsterdam curated by the author with artists and residents. This space for cross talk, and experimental and experiential interventions, enabled those working in one part of the material production and waste scenario to inter-act with others more freely and creatively than within their normal milieu and institutional settings. The involvement of artists enabled both lateral and design thinking, whilst presenting a variety of different waste streams and material types from an artistic, environmental and operational perspective.

This short paper will discuss the work and selected findings arising from the Network, with a focus on clothes/textiles, and lessons from the interdisciplinary approach taken and the role of socially engaged art practice in sustainable design.

Keywords: Waste; Textiles; Fashion, Art and the Environment

Classification: Research paper

Rationale and research context

> there is no such thing as waste: one industry's waste should be another industry's starting material (Leonardo, in Francesca, 2017)

> Nature makes no waste, she recycles everything. Waste is a human invention. Now we need to spend some effort to "de-invent" it (Connett, 2014).

Waste is a 'wicked' problem facing a rapidly urbanising world. In Europe total waste production amounts to over 2.5 billion tonnes, but only a limited share (36%) is recycled, with the rest landfilled or burned. Of the 600m tonnes of products and materials that enter the UK each year, only 115m is recycled - 60% of all waste generated in London is currently exported for treatment or disposal outside of the area. This is contrary to a key objective set out by the UK Government's Waste Strategy 2007, which states that waste should be managed as close as possible to the point of production. Technological and governmental (Foucault – Gordon 1991) solutions to waste reduction and disposal have provided the classic and dominant response, with industry-led smart city and environmental/materials science interventions dominating the institutional and corporate waste landscape. This includes technology-dependant interventions such as sensors in waste bins, (pricing)/charging for variable waste disposal from households and businesses, so-called biodegradable materials production, to a growing market in recycled goods and materials (e.g. clothes) via charity shops and collection points. The consequences of these interventions can be perverse – so-called 'biodegradable' material which does not actually biodegrade in landfill, starved of oxygen/light; exported second hand clothes that swamp African markets and destroy local design and textiles production industries; technical textiles (e.g. 'sports' wear) that produce thousands of microfibers every time they are washed; and reduced collection rates as reliance on a volatile traded market (AMA, 2017) and imposition of pricing on households leads to lower recycling and recovery (and a failure to meet local and national/EU targets).

The total volume of waste generated globally is expected to increase by nearly 50% over the next decade, however there are major variations in landfill disposal - from Copenhagen (2%), Paris (11%) to New York (64%). The collection and disposal of controlled waste in the UK is estimated to be worth £8.9 billion. This market has grown recently through the implementation of EU Directives which are aimed at reducing the volumes of landfilled waste and increasing the levels of material recovery through recycling, composting and energy-from-waste. This is predicated on the hierarchy of waste (Fig.1) that seeks to reduce material production and disposal through design and smarter textiles, longevity of use/ownership (e.g. clothes), recycling/repurposing, and only then, more sustainable disposal methods to avoid landfill and burning.
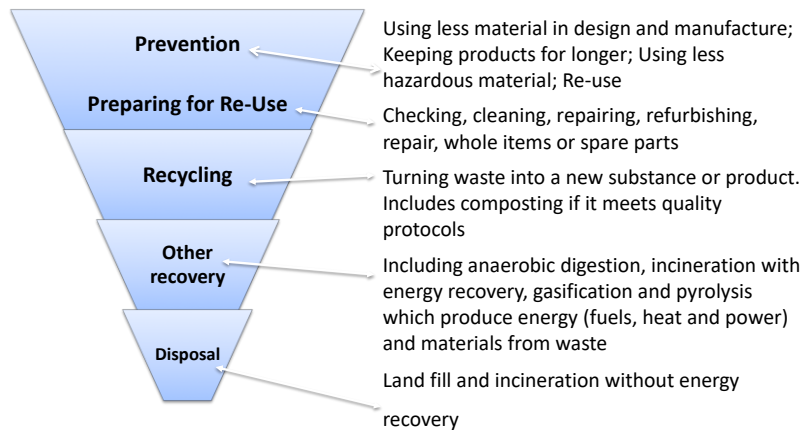
Waste Hie

Prevention	Using less material in design and manufacture; Keeping products for longer; Using less hazardous material; Re-use
Preparing for Re-Use	Checking, cleaning, repairing, refurbishing, repair, whole items or spare parts
Recycling	Turning waste into a new substance or product. Includes composting if it meets quality protocols
Other recovery	Including anaerobic digestion, incineration with energy recovery, gasification and pyrolysis which produce energy (fuels, heat and power) and materials from waste
Disposal	Land fill and incineration without energy recovery

Fig 1. Hierarchy of Waste (DEFRA, 2011)

As 'Prevention is Better than Cure' (DEFRA, 2013) stated: *we need to make better and more efficient use of the increasingly valuable resources available to us… a world where substantially less waste is created across the economy, delivering real financial, environmental and social benefits. We need to develop further the concept of a circular economy, where one person's waste becomes another's valuable resource…Making the changes needed may **require innovation and creative thinking**...* This policy report also stressed the importance of community / public / stakeholder-led approaches to waste. Creative practice and engagement across waste 'silos' have thus informed our approach and the Research Network's formation and activity programme, as discussed below.

A strategy of zero waste looks to sustainable *natural cycles*, where all discarded materials are resources for others to use. This means designing products and processes to reduce the volume and toxicity of waste, conserve and recover all resources, and not burn or bury them. Waste as understood, and explored in our network, is a "slippery" concept with multiple meanings: waste as resource, [*circular economy*], waste as "boundary object", and the challenges of scales of waste treatment and "tipping points" where a valued/useful object, thing, state, becomes understood as "waste".

AHRC Smart Cities and Waste Innovation Research Network

To address this challenge, an initiative which has been funded for two years by the Arts & Humanities Research Council (AHRC), has sought to develop the capacity and potential of an emergent network of European artists, arts & humanities academics, social and natural scientists and practitioners, all of whom had a common interest in exploring how inter-disciplinary practices can enable and envision "smarter" cities in relation to waste generation and management. Participants pragmatically also recognised that current technological and municipal waste systems were neither sustainable nor successfully meeting waste reduction/disposal targets.

To deal with waste effectively we need to understand more about its multi-faceted aspects; the people and organizations who generate it, and the places - cities, specifically – where it is generated. We need a cross-disciplinary approach to facilitate 'innovation and creative thinking' in order to investigate how arts, humanities and the sciences, can inform cutting edge innovation, raise awareness and enable better design and uptake of sustainable waste management initiatives. The Network therefore sought to develop understanding of how the specificities of locality, community, identity and culture affect not only the acceptance of specific waste management technologies, but indeed the very sorts of wastes which are produced, and to explore how such 'local knowledge' (Geertz 1983) can feed back into the waste governance innovation process. We were therefore informed by the need for 'citizen science' (Irwin, 2001), and the necessity for 'cross-talk' (Bucchi 2004) between scientists, innovators, policy-makers and the public, enabling citizens to be part of waste innovation and service delivery (Fig.2).
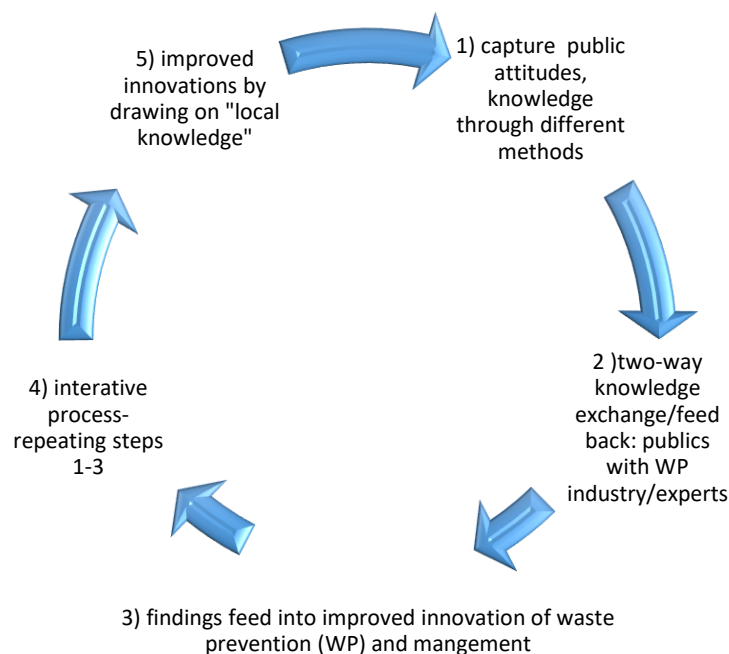
Figure 2. Techno/scientific innovation needs to have input from end users

Aims and Objectives

The aim of the Network has thus been to develop a forum for knowledge exchange and debate across art & humanities and science disciplines and subject areas with a common focus on waste treatment, management and innovation, in response to the question: *how can creative arts-based approaches inform waste management innovation techniques and processes;* and secondly, *how does place (local context, identity, culture, governance) make a difference to waste generation, waste innovation delivery and uptake*? Each workshop brought together the core team (www.smartcitiesandwaste.com), plus invited guest speakers and local participants/stakeholders, including local/city waste management authorities in each location. Each workshop was preceded by publication of a project briefing edited by the workshop team/leader as preparation for the forthcoming workshop theme/agenda. Following each workshop, an e-Newsletter was published online summarising the event, promoting future events and Network activities

(www.smartcitiesandwaste.com/doku.php?id=start). These Network activities combined to generate novel interaction across arts-science boundaries, and lead to greater understanding and insights into creative approaches and design thinking for effective waste innovation. The workshops thus sought to:

- Develop interdisciplinary knowledge exchange focusing on facilitating innovation on waste management
- Develop links and share knowledge between academics/researchers and practitioners/stakeholders
- Reflect the specificities of place and local networks/opportunities/challenges within European context
- Be *iterative*, building from workshop to workshop, facilitated through ongoing interactivity (above), moving from: "talking to each other across disciplines"; [why, how] can arts-led approaches inform technical/science/practice-based innovation; what are the barriers? **-** to case studies of 'good practice'; and by the final workshop, articulating how a more targeted approach to how particular arts-based approaches can inform the waste innovation process in relation to particular processes/innovation models/contexts.

The AHRC interdisciplinary Research Network scheme (and the AHRC Highlight theme of 'Design') therefore provided a timely opportunity to facilitate creative thinking and innovation through genuinely interdisciplinary knowledge exchange. Moving beyond established social science-led approaches to citizen engagement, we have sought to explore a creative arts-informed, place-based approach to improving public participation in urban amenity design specifically in relation to waste (Tietz 1968, Higgs 2006). We were also informed by the UK National Ecosystem Assessment (NEA, 2014), modelled on the UN's Millennium Development Goals (2000 – MEA, 2005) which highlighted knowledge gaps relating to ecosystem services (2011) recognising the approach to the stewardship of natural resources which advocates place-based, participatory and '*creative approaches influenced by research in the arts and humanities* [which can] *not only provide new forms of evidence for decision-makers, but can help engage communities and engender stewardship of local natural resources* (2014). The Network sought to explore the extent to which this approach also has potential in the context of waste management innovation, and how far creative methods such as socially engaged arts practice (Kester, 2015), Design for Social Innovation and Sustainability (DESIS) and participatory planning and action research (PAR), might support this.

Novelty of the Network lies not only in the diversity of the core team and interdisciplinary mix, and our extensive networks, both within and outside of our particular disciplines/practices, but the location of waste scenarios/regimes, situated in the four European cities/regions we chose as the sites of our workshop/creative events. The England/Wales - Amsterdam/Randstad, Maastricht/Euregion (including Belgium and Germany) nexus, benefits from Dutch experience/expertise, with the Netherlands recycling 64% of its waste, most of the remainder is incinerated to generate electricity and heat (only a small percentage ends up in landfill). Their approach is known as 'Lansink's Ladder' - avoiding creating waste as much as possible, by recovering the valuable raw materials, generating energy and only then disposing what is left over in an environmentally-friendly way.

The creative spaces generated by the exchanges encompassed both traditional scientific presentations around specific waste streams /types – from construction waste, ship/docks waste, water/pollution (e.g.

plastics), electronic (E-waste), and textiles – to the technological 'solutions' such as bio-materials, bio-mining, water treatment and re-use/recycling initiatives at municipal level in each location. In order to facilitate this collaboration, a series of seminars, workshops, maker-sessions and pop-ups were organised in the major cities of Amsterdam and London, with sites specific workshops also held in Maastricht and Bangor Wales, representing smaller and 'peripheral' cities with post-industrial landscapes and waste legacies (e.g. mining, textiles, ceramics). This Anglo-Dutch collaboration also sought to draw and on the differing historic and governance regimes and the more successful Dutch experience in waste treatment, as well as collaboration between artists and academics in each country.

Here, organisational cultures were revealing and surprising, with waste authorities - the unsung heroes of the waste process – using innovative public awareness campaigns and educational programmes (e.g. with children) and Eco-Park experiences. Artists working with recycled or reclaimed materials or themes also presented alongside scientists and waste experts, accompanied by exhibitions of their work, installed prior to the workshop. This included installations using waste materials, litter etc. and events engaging the public at sites in each city. Informed by Hakim Bey's concept of the TAZ- Temporary Autonomous Zone, we trialled arts-led methods for public engagement with arts-led pop ups held in each of the four workshop cities which fed back into the workshops. These pop-ups informed the network in a multiplicity of ways; methodologically (approaching the topic of waste and eliciting public views in lateral, creative ways) - and conceptually, e.g. "what we mean by waste", with the multiple meanings of waste and associated values, explored in the workshops and through these artist 'pop ups'.

These autonomous sites included canal boats, community gardens, parks, artists studios and university campuses, as well as urban and rural trails. The OWEE (Open Walked Event-based Experimentations) approach developed by the Research Group on Collaborative Spaces (https://collaborativespacesstudy.wordpress.com/owee/owee-method/) was also adopted to directly engage in the waste chain and spaces of collaboration (workspaces, labs, waste facilities, recycling centres, artists studios). Following the more formal presentations and discussions and displays, maker-workshops were held, led by artists/designers involving all participants working both in groups and individually. Hands-on group work directly engaged with a variety of waste materials which were re-purposed both creatively and using templates (e.g. brown paper into beautiful headgear, loose textiles and jewellery into interiors and artworks, etc.). Workshop artists also led sessions with all participants (re)-constructing furniture from dis-used cardboard (sourced from a local bike store and University IT department), based on templates supplied by the artist. Surprisingly robust, these could be painted or left in their raw state and used as functional furniture.

Clothes and textiles waste

Clothing has been the fastest growing waste stream in the UK over the past decade – the value of clothes in the average UK household is estimated at £4,000, 30% of which haven't been worn for at least a year - as an indication of the value, 750 clothes banks (Fig.3) were stolen from car parks last year in the UK, to be 'rebranded' and sold to (un)suspecting charities.

Fig. 3 Overflowing charity clothes recycling for international aid (Traid) - municipal swimming pool car park, north London (© Graeme Evans)

Britons were expected to send 235m items of clothing to landfill in 2017, with a study commissioned by the supermarket Sainsbury's finding that three-quarters of consumers throw away rather than recycle or donate unwanted garments (Guardian, 6 Apr 2017). The practice of burying waste in landfill has been a late-nineteenth phenomenon, up and until then human waste archaeology had remained largely unchanged – domestic and sacred items (e.g. glass, ceramics). Early landfill sites were located on the coast, in soft, sandy soil. Only industrial manufacturing which started to rely on non-degradable and synthetic materials, notably from the 1930s, plastics and other oil-derived products, required landfill sites closer to growing, urban populations. With the advent of synthetic materials used for clothing and other product and packaging, a new waste stream was created that defied both re-cycling and re-use. Archaeological digs at landfills in Birmingham that were first filled with rubbish in the 1950s/60s, then covered and 'greened' over to mask their waste treasure, revealed clothes that were made with synthetics, e.g. nylon. Adult and childrens clothes were completely in tact, with no degradation after over 50 years. Disposing of or exporting unwanted clothes is not therefore the answer or sustainable solution.

Our workshops in Amsterdam and Maastricht, also focused on construction and mining waste and the re-use of waste materials in building and furniture. Artists and designers working with recycled waste in situ were able to convert rubble and textiles into furniture and construction materials, utilising on-site processing machinery. An example is the Solid Series 'Cloudy Grey' an alternative to hardwood beams and benches - the material is 50% recycled plastic (LDPE) and 50% recycled textiles fibres and remnants, producing a 'cloudy' grey marbled appearance alternative to wood and steel.

The Dutch Textiles Chain (Fig.4), was discussed, addressing the reduction in textiles waste through a series of measures across the production-use-lifecycle.
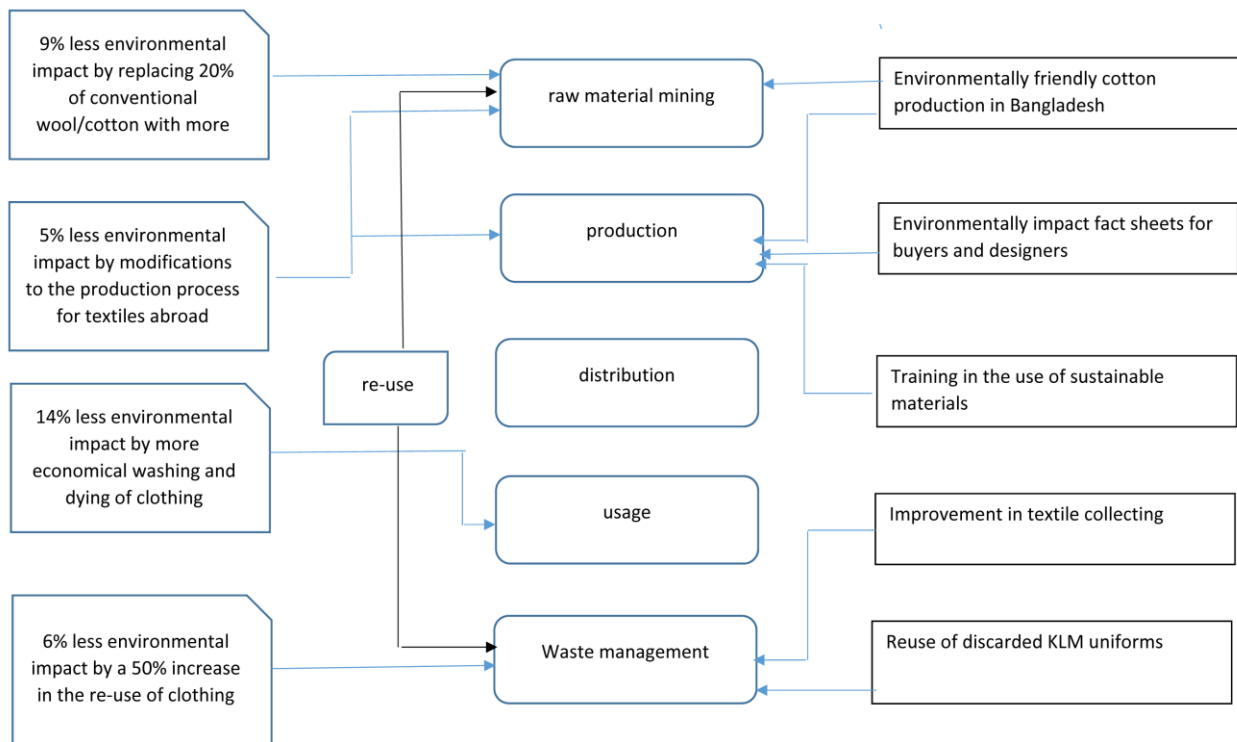
Fig. 4 Textile Chain, Ministry of Infrastructure & Environment, The Netherlands

Targets were modest, but when applied across the production-usage-waste chain, changes implemented accumulated significant environmental benefits over time, as well as capacity building amongst designers, producers and other actors, including waste management authorities.

Critical appraisal of make do and repair movements was also presented by researchers situating this re-emergent practice as a political/ecological activist phenomenon (Graziano & Trogal, 2017). Repair here encompassed bicycles, electronics, furniture, household improvements, environment (gardens, guerilla growing) as well as clothes and other textiles, taking place not only at home, but at collective and social places such as repair cafes, community tool libraries and online fora. The re-emergence of repair and mending amongst a generation who had largely lost the skills commonly held by their parents/grandparents is also being stimulated by austerity, greater environmental awareness and a maker movement that is facilitating knowledge and skills exchange.

From brown paper to luxury garment

Textiles designer and artist, Kuniko Maeda, presented her design and making process and exhibited her work in London at both the workshop and group exhibition at the Ply Gallery, north London. Taking the ubiquitous brown paper bag as her starting point, treated with persimmon juice to alter its properties, then laser cut producing no wastage, she observes that:

> we seemingly have a feeling of positivity and security to paper recycling without considering actual material value which sometimes causes more consumption. Paper can be more valuable depending on how we communicate with it. In this project, I used paper carry bags as my main resource. While we

can find various types of quality and size of paper bags, we barely notice the value and beauty of paper. We take it for granted the paper bag is cheap, disposable and nothing more than that. Some paper has really good quality but they are normally used for carrying items a few times and end up going into bins. If it has lower quality, such as thin brown paper bags, they are immediately thrown away after use. Therefore, I started to question how to regenerate the value of paper waste and I was motivated to convert disposable and low quality paper into long-lasting and high quality artworks. I applied the use of natural painting (using persimmon juice) on paper through the examination of Japanese traditional craft technique for potential approaches to long lasting paper and upgrading the quality of the material. Furthermore, I added a new value on wasted paper by combining traditional craft technique and the new technology of laser cutting.'

Using this hybrid method, her artwork/garments can be both rigid and flexible, but surprisingly robust, producing headgear, sculpted clothes and interiors that bely their waste origins (Fig.5).

Fig. 5 Repurposed paper into garments (©Kuniko Maeda, https://www.kuniko-maeda.com)

An emphasis of several participants, including practising artists was on the use of reclaimed or 'found' materials in art works. This has been a long tradition in fine art and public art in particular, but in the waste context, artists used their practice to both raise awareness of the waste challenge and possibilities for its reduction or removal in a circular cradle to cradle sense. A seminal example is the US artist Mierle Ukeles who set up her 'office' in the headquarters of the New York Department of Sanitation, and who took it on herself to shake the hand of every refuse collector (8,500!) in the city, as part her Touch Sanitation Performance, (1979-80). Today (aged 77) she is helping to shape a 'new' park on Staten Island on the site of what was once the largest landfill in the world.

As part of our London site-based waste event, the author curated a 3-day festival in Hackney Wick & Fish Island, a post-industrial site adjacent to the new Olympic Park, a legacy from the London 2012 Summer Olympics. Here the River Lee/canal transects the urban landscape, itself carrying past (e.g. in sediment) and present pollution, including from water processing of materials dumped/leaked upstream. This included textiles as well as early plastics production and heavy metals (dumped cars, fridges etc.) combining to undermine the ecosystem and water quality. During the festival, performers were dressed with recycled/ plastic waste bags, ring-pulls and car hubcaps parading and performing to the public, reflecting the local waste and pollution to be found in and around the river (Fig.6).

Fig. 6 Hackney Wicked Connecting Communities Festival – 'Bride of Hackney Wick' and Dancer   (© Graeme Evans)

A particular practice in this edge zone of east London has been the use of graffiti and street art as both activism and creative expression, as the area undergoes extreme gentrification of its post-industrial landscape (and cf. Waste exhibition, Wyng Masters Award, Stour Space, 2015). Here, commentary on the confusion of refuse bin disposal/recycling and the sartorial preferences of new dwellers (Fig. 7).

Fig. 7 Graffiti, Hackney Wick (© Graeme Evans)

"Obroniwuawu" – from charity shops to African markets

An issue that emerged from our London workshop, which also saw expert presentations on electronic waste and its impact on developing countries, was the recycling of clothes via charity shops and collection points.

According to Yvonne Ntiamoah (Course Leader, Fashion Design, Radford College, Accra), in Ghana alone, it is estimated to generate an income of £25,000 a day just from UK charity shops, and imports of a total of 30,000 metric tons a year. As part of the recycling chain for the West, in return Africa is flooded with cheap accessible clothes, sold in   local markets. "Obroniwuawu" (dead Caucasian's clothes) known as the 'Formidable Force' or "Fose" is the local name given to the second-hand clothing industry, one of the main causes of the collapse of the local textiles industry. The trade runs from the port in Tema through Accra then onto Kumasi (Ghana's largest cities), spreading through all the towns and villages along the route and beyond.

The market women that trade in "Fose" come from generations of trading based on the second-hand market, in contrast to the traditional Ghanaian craft-makers of the prized Kente cloth. The 'charitable' act of donating old clothes to charity shops is regarded as good practice until it is turned into the trade that threatens a whole industry in developing countries. This recycling trade has had a massive impact on industries that have been handed down for generations and has imposed unreasonable restrictions on the fashion/textiles industry in Ghana and other recipient countries. Local producers and designers cannot compete with the prices of the second-hand goods imported into the country and sold in the local markets. If unwanted clothes are sold in charity shops to the local community where the products are originally sold, they would then maintain their recyclable value, but if sent to communities that have very little income and their livelihood is based on making and trading their textiles, designs, crafts to each other, then it clearly becomes damaging.

Conclusion

Our Research Network and activity programme took as its starting point the potential of artists working with /on waste to stimulate, visualise and activate thinking on the complex waste challenge amongst mainstream waste professionals – academics/researchers, designers, municipal waste and facility managers, policy-makers and environmental activists. With no fixed notion of waste or waste types, participants were exposed to the range of waste streams and systems that operate in different places through the lens of material (e.g. bio-based) and environmental science and technology, that was able to be interrogated in a safe, non-judgemental space from different perspectives and points in the production, consumption and disposal chain. This enabled useful comparatives to be made and clear evidence of convergence across waste types and scales. The focus on clothes/textiles outlined here sit therefore alongside these other related waste streams, notably water, electronics, buildings and other products, with lessons and opportunities for more sustainable design, user-engagement/co-design and creative interpretation.

The approach adopted and evidence arising from the workshop and engagement activities may therefore form the basis of a more structured research project on the theme of textiles waste in the context of wider waste streams and communities of interest, with an emphasis on local knowledge and practice, rather than the fashion industry itself (from design, raw materials, manufacturing, to retail), which is more than often disconnected from 'place'. As our project both confirmed and articulated, waste is both extremely *located* (situated, culturally context-specific) and *dis-located* (its economic, ecological/ethical footprint stretches across space/time). Place makes a difference to both how waste gets generated and in what context and scale. Waste, not least clothing, is therefore a cultural product, and local policy towards its disposal, rep-use and recycling, and even terrain and building design, can make a huge difference to how waste is perceived and managed.

Bibliography

AMA Research (2017) *Waste Management Market Report - UK 2017-2021 Analysis*

Baker-Brown, D. (2017) *The Re-Use Atlas*. London, RIBA Publishing

Bucchi, M. (2004) Can genetics help us rethink communication? Public communication of science as a 'double helix', *New Genetics & Society,* 23(3): 269-283

Connett, P. (2013) *The Zero Waste Solution: Un-trashing the Planet. One Community at a Time*. Chelsea Green, White River Junction, USA

Connett, P. (2014) *Zero waste: a concrete step towards sustainability.* www.chelseagreen.com/content/zero-waste-sustainability/#stash.DvLTeGFH.dpuf

DEFRA (2011) *Hierarchy of Waste Guidance.* https://www.gov.uk/government/publications/guidance-on-applying-the-waste-hierarchy

DEFRA (2013) *Prevention is Better than Cure: the role of waste prevention in moving to a more resource efficient economy*, HM Government

Ehrman, E.W. (2018) *Fashioned from Nature*. London, V&A

Francesca, D. (2016) Recycling urban waste as a resource for urban and social transformations. In: *Technologies for Sustainable Urban Design and Bioregionalist Regeneration*. Routledge, pp.64—81

Gordon, C. (1991) Governmental Rationality: An Introduction. in G.Burchell, C.Gordon, and P.Miller (Eds) The Foucault Effect: Studies In Governmentality, University Of Chicago Press

Higgs, G. (2006) Integrating Multi-Criteria Techniques with Geographic Information Systems in Waste Facility Location to Enhance Public Participation, *Waste Management Research,* 24(2): 105-117

Irwin, A. (2001) *Citizen Science.* London, Routledge

Kester, G.H. (2015). *Field Journal Editorial / Spring 2015* http://field-journal.com/issue-1/kester

KTN Designing Out Landfill (2011) A UK Mission to the Netherlands 17.1.11-20.1.11, Technology Strategy Board

Lynch, K. (1990) *Waste Away*, Sierra Book Club, San Francisco

McDonough, W. & Braungart, M. (2002) *Cradle to Cradle. Remaking the Way We Make Things*. New York, North Point Press, pp.193

MEA (Millennium Ecosystem Assessment) (2005) *Ecosystems and Human Well-Being*: *Synthesis*. Island Press, Washington, DC

NEA (2014) *Cultural Ecosystems Follow-Up* Work Package 5. London: DEFRA

Thill, B. (2015) *Waste* [Object Lessons: Hidden lives of ordinary things], Bloomsbury

Tietz, M. (1968) Towards a dynamic theory of urban public facility, *Regional Science Association*, 21: 35-51

Wieman, B. (2014) What is reduce, reuse and recycle? http://homeguides.sfgate.com

Wyng Masters Award (2015) *Waste*. London, Stour Space.