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On the Ethics of Maintaining Waste Infrastructures

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12 Negotiating Visions of Waste

On the Ethics of Maintaining Waste Infrastructures

Joost Alleblas and Benjamin Hofbauer

12.1 Introduction: Waste, Ethics and Maintenance

The ethics of waste has become an important academic and societal topic (e.g., Thompson 1979; Strasser 2000; Hawkins and Muecke 2002, 2010; Hird 2022). The growing literature on this subject shows the many ways in which waste has evolved as a normative category to control and form peoples, bodies and identities. Literature also shows how waste has become a global problem in which responsibility and accountability are difficult to assign. However, the relationship between the ethics of waste and the maintenance of waste infrastructures in urban contexts is still underdeveloped, despite the ongoing urbanisation of the global population and the ever-increasing amounts of improperly managed municipal waste. Accordingly, this chapter seeks to highlight how cultural understandings of waste have become embedded in waste infrastructures, becoming instructive for their design, and explore what role maintenance plays in the continued embedding of these understandings. Furthermore, a collective reimagination of waste is crucial, especially in High-Income Countries [HIC] (UN-Habitat 2010). Support for the behavioural and lifestyle changes deemed necessary to deal with the current environmental crises is only possible through a collective confrontation with waste in these urban contexts. An analysis of the socio-technical systems of waste and the ways in which these systems are maintained allows us to better grasp how emergent, new interpretations of what constitutes waste and how to best deal with it are hampered by the design of these systems and by a static conception of their maintenance and repair.

Previous chapters in this volume have discussed how the imagination, design and construction of systems and artefacts are intricately related to their maintenance and repair and how maintenance can actually be conceptualised as an extension of the design process (see also Young 2021a, 2021b; Edwards 2003). However, regarding the combination of maintenance and waste, this idea seems counterintuitive. Maintenance and waste

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are temporally related, but do not necessarily overlap: on the one hand, maintenance seeks to uphold the functioning of a system or artefact, potentially reimagining it in the process.[1] Waste, on the other hand, represents the end of a system or an artefact's life cycle. What is wasted is no longer of use or its usefulness has been neglected (Hawkins and Muecke 2002). Waste, therefore, often marks an end of what has been maintained, the end of value. Furthermore, though dirt and waste are distinct concepts, improperly managed waste can lead to the creation of dirt. Dirt has been amply discussed in the maintenance and repair literature (e.g., Dant & Bowles 2003; Harmer, Cooper, Fisher, Salvia & Barr 2019; Lejeune 2019). Here, dirt stands in an antagonistic relation to the maintenance and repair of artefacts, such as cars, vacuum cleaners and cameras, bridges and server parks, but also urban infrastructures.

Thus, three perspectives on waste and maintenance emerge: 1) waste as the discarded, disvalued object or material (solid, liquid or gaseous, hazardous or not); 2) waste as that which, if improperly managed, endangers the functioning of machines and instruments, processes and systems, leading to more maintenance and repair and more hazards; 3) maintenance and repair of artefacts as a counterforce in consumer societies, keeping things from turning into waste. The effective management of waste then is a critical service in a society. Waste management infrastructures appear as critical for the maintenance of urban areas and urban living conditions (Nagle 2013; Steele & Legacy 2017). Indeed, urban areas are the sites of the most dense expressions of infrastructure and urban dwellers almost completely depend on these networks (Graham 2010).

However, urban infrastructures are not always perceived as critical. The invisibility of infrastructure, together with urban habits and routines regarding waste, obfuscates the flow of waste through a city and conceals the relevance for urban dwellers of unhindered waste streams. This waste flow takes place in sewers and pipes, grinders and incinerators, opaque bags thrown in underground collectors and garbage trucks, processes modern urban dwellers tend not to notice – except when driving behind a truck in a small street or when waste stops flowing (Nagle 2013). Here, maintenance creates one of the moments through which municipal waste infrastructure becomes (temporally) visible. Breakdown and crisis, as instances of failed maintenance, also create moments in which infrastructure reappears. However, this appearance doesn't necessarily lead to insights concerning previously hidden features and embedded meanings (Young 2021b).

In this chapter, we investigate the maintenance of socio-technical systems that handle waste, especially but not exclusively in advanced urban settings. These systems include sewage systems, drains and canals all the way to recyclable and biodegradable waste, landfills replete with miscellaneous and electronic waste, waste-to-energy incinerators, the shipping

and transportation of waste, nuclear waste and less obvious instances of waste, such as greenhouse gases. The focus of our investigation is on the ethical implications of maintaining socio-technical systems that handle municipal solid waste, to discuss how these systems have become problematic from a moral perspective and to explain why updating these systems to comply with new societal goals and visions is difficult, especially in HIC. We do this on the basis of the subsequent two-step process of analysis and normative argument.

The first step of the analysis consists of laying out the methodological framework for assessing existing infrastructure, based on Henke and Sim's reflexive repair of infrastructure (2020) as well as Mark Thomas Young's dynamic conception of maintenance (2021a, 2021b). From this basis, we explore how waste itself is being viewed and how that view is representative of current socio-political structures, assumptions, values and norms. This gives a descriptive outlook of what waste is and can be, and how it manifests itself in today's industrialised societies. Here we draw on anthropological, sociological and philosophical scholarship that has sought to understand the phenomenon of waste through different theoretical lenses (e.g., Thompson 1979; Hawkins 2010; Douglas 2002; Nagle 2013; Scanlan 2005). We then introduce the normative claim of how waste maintenance should be viewed. Here we seek to evaluate our interaction with waste, arguing how the engagement with and view of waste should and could change. Specifically, we claim that the maintenance of municipal waste infrastructures should be reimagined as an active and dynamic process, rather than caring for a stable, rigid artefact.

Since we believe the issues discussed here are particularly relevant for urban areas in HIC countries, because of high levels of stratified socio-material organisation, in which infrastructure appears as stable and permanent (Graham & Thrift 2007), we give examples mostly from these countries. We argue that first and foremost, socio-technical systems of municipal waste management in the Western Hemisphere are made to be invisible, and hidden from the public, and their operation is taken for granted, while the continuous effort to keep this system in operation is often neglected. This feature of invisibility has co-evolved with modern understandings of civilian culture and urban progress. Our claim is that the invisibility of waste infrastructure fixes the socio-ethical perception of waste as something to be avoided, something contaminated, thereby fixing its disvalue for society. This modern perception of waste, we claim, is problematic in terms of achieving a more sustainable relationship with waste in light of ecological concerns, health concerns and climate change. The modern perception, facilitated by the current design of municipal waste infrastructures in HIC, hampers the realisation of new visions of waste. A circular economy, for example, should be able to reconceptualise

waste for its potential as a resource and something that has not lost its value. Despite steps taken in this direction, a shift in the collective understanding of waste in advanced urban areas has yet to occur. With 56% of the world's population already living in cities (World Bank Website)[2], the need to change this understanding is urgent. One step towards achieving this reconceptualisation is through the dynamic maintenance and reflexive repair of waste infrastructures (Young 2021a, 2021b; Henke & Sims 2020). In this study, we combine these insights with a focus on the values and meanings embedded in waste infrastructures. Our conclusions amount to a first step that we deem essential for new visions of waste to gain a foothold in advanced urban contexts.

The structure of the chapter outlining this argument is as follows. First, we introduce our methodological background considerations, outlining key concepts of maintenance and infrastructure. Then, we discuss waste as a dynamic and normative concept. In Sections 12.3 and 12.4, we explore how current waste management infrastructures tend to reproduce a specific waste imaginary, linked to a modern, urban ideal of tidiness. In these sections, we look at municipal waste mostly from a HIC perspective. Section 12.5 provides a further theoretical reflection by looking at waste infrastructure through the lens of socio-technical systems. This section highlights how values are embedded, afforded and resisted through the use of such systems. The subsequent Sections 12.6 to 12.9 introduce how value change affects these systems, subsequently presenting budding alternative visions of waste realised through dynamic maintenance and reflexive repair. The concluding section gives recommendations for further research.

12.2 Maintenance and Infrastructure

In recent years, maintenance has emerged as an important topic in the ethics and philosophy of technology, challenging the dominant focus on design and innovation. Maintenance, scholars stress, should be understood as more than simply preserving the function of artefacts (Graham & Thrift 2007; Jackson 2014; Young 2021a, b). Instead, maintenance often involves (re)design and innovation, creativity and adaptivity. Therefore, rather than as static objects in which designers' ideas are realised and carefully guarded, artefacts should be seen as processes of change in which maintenance interferes with, reinforces, guides or blocks these processes (Graham & Thrift 2007; Young 2021a).

Conversely, maintenance can also be understood as a challenge to the ideology of consumer societies, in which innovation, creative destruction, planned obsolescence and excessive growth (and thus lots of waste) are ultimate goals. Instead of a narrative of technological progress, maintenance offers an ideology of care for artefacts and, thus, for the people who

depend on these artefacts (Denis & Pontille 2015). The maintenance of urban infrastructure is no exception. Rather than building new infrastructures that deliver new public goods, most of the time cities are places where existing infrastructure is updated, altered, repaired and maintained, often within tight budgets. This maintenance is an aspect of daily, urban life. However, its relevance is often neglected, even though maintenance carries the burden of keeping intact material and social orders in urban contexts (Graham & Thrift 2007).

Urban infrastructure, that is, the pipes, drains, cables, road networks, etc. plus the agents and institutions running and maintaining them, is often invisible to the everyday user. Despite this common association, the (in)visibility of infrastructure remains a contentious topic (Larkin 2013). Star's (1999) influential study on the ethnographic background of infrastructure has reinforced the idea that infrastructure goes unnoticed, as a seamless web (Hughes 1986), in order to serve its function. Likewise, Edwards (2003) sees infrastructure as the invisible background and the substrate of modernity. At the same time, however, infrastructures do often become noticeable and apparent when we interact with them. This might come in moments of breakdown, which open new perspectives on the technologies we use, and are often instructive of innovation trajectories (Jackson 2014). Furthermore, as Jackson (2014) implies, it is in maintenance and repair that we might encounter relations of value and social order that are often obscured under the 'smooth functioning of complex sociotechnical systems' (p. 231), although this encounter is contested (Young 2021b). But breakdown and maintenance are not the only ways in which infrastructures reappear. As repair scholars Henke and Sims write:

> Infrastructures are never truly invisible, but their salience to us, including their role in shaping power and privilege, shifts in and out of our consciousness based on their operation and to what extent we depend on or are oppressed by them.
>
> (Henke & Sims 2020, 143)

A second aspect of infrastructure that is relevant to our discussion, besides the issue of (in)visibility, is fragility. Nagle's (2013) analysis of urban sanitation workers in New York shows that garbage collection is a fragile assemblage of people, punching clocks, bureaucratic measures, weather forecasts, noses, luck, intuitions, truck maintenance schedules and grunting citizens. In her account, the 'smooth functioning' of this system is far from obvious. Rather, it seems to be in a constant mode of crisis, always about to come to a halt and disintegrate. It can only appear smooth from the outside. Indeed, maintaining a technological artefact or a socio-technical

system can be understood as the continuous abatement of letting that object or system go to waste, despite seemingly solid and robust infrastructures. In the case of urban sanitation and many other urban structures, what needs to be maintained, furthermore, are not only machines but also work relations and routines, a company culture and a precarious relationship with other urban dwellers. What is maintained, then, is a socio-material world (Sormani, Bovet & Strebel 2019). Furthermore, this maintenance is not always successful. Rather, the system breaks down repeatedly, making waste suddenly a public concern (Nagle 2013). As a consequence, the politicisation of waste in urban contexts is often made possible by unsuccessful and neglected maintenance and repair of waste management systems. The fragility of the system is precisely what enables its politicisation.

Maintaining socio-technical systems means ensuring their continuity, alongside the inherent values and agents that underpin that system.[3] Evidently, infrastructure manifests human values and norms (Edwards et al. 2009). Furthermore, infrastructures, given both their centrality and invisibility, continuously reproduce certain values and norms, certain ways of social being, cooperation and existence. Their repair in the form of maintenance often leads to those values and norms being reified through adaptation and slight, which in turn makes the infrastructure ever more resilient to change. In a similar vein, Henke and Sims problematise the fact that repair as maintenance reproduces and embeds current '… material and discursive investments and assumptions embedded in those infrastructures …' (2020, 121). Repair as maintenance could, in this sense, lead to the further entrenchment of the status quo.

This resistance to change is a third aspect important for our analysis, besides invisibility and despite fragility. Resistance is closely related to Henke and Sims' (2020) idea of resilience in infrastructure design: the protection against destabilising feedback loops in infrastructure use. According to Henke and Sims, growing resilience is a consequence of the two ways in which infrastructure is reflexive (2020, 124f). One, infrastructure is causally reflexive, that is, infrastructures are shaping the very environments within which they operate. For instance, the required additional infrastructure to maintain sewer pipes further entrenches the initial infrastructure on a physical and societal level. Two, the infrastructure's causal reflexivity requires the engineers, operators and policymakers involved in the design and operation of the infrastructures to be 'self-aware' (Henke and Sims 2020, 125). Accordingly, anticipating disruption paradoxically enables disruptive behaviour. For example, waste infrastructure that anticipates poor recycling behaviour (e.g., through the introduction of further tracking systems or additional sorting after the collection) and seeks to remedy those disruptions reflexively becomes more resistant to a necessary overhaul or rethinking of its central assumptions on how people view waste.

The disruptions are reflexively fended off, and life can continue business-as-usual without the need to reflect on the values that drive the behaviour and attitudes towards waste, as well as the need for the infrastructure in the first place. The degree to which disruptions succeed in discontinuing urban flows seems to determine, to a large extent, the degree to which citizens are able to engage with the politics, ideology and embedded values of waste and waste infrastructures (Graham 2010). A steady and uninterrupted urban flow eliminates the need for reflection on a socio-political level.

Concluding, urban infrastructures are essential to (modern) society and resistant to change. However, the age of the Anthropocene and environmental reckoning of societies built on ever-increasing consumption has shown the limitations and dangers of these infrastructures. Despite their continued function and delivery of energy, urban sanitation and stability, these systems are also 'broken'. Fossil-fuel-based energy systems, for example, show all of the above characteristics of an incredibly resilient piece of infrastructure that at the same time has become an existential threat to humanity. Similarly, albeit to a much lesser existential degree, current waste infrastructures are struggling to break free from now problematic and unsustainable perceptions of resource depletion – what we refer to as a 'modern' waste imaginary (see Section 12.6). The question then arises whether we can change these current infrastructures, whether we can reimagine waste and waste management to account for meaningful sustainability and social justice – all this without proposing a design from scratch or letting waste management systems break down and disintegrate completely. Maintenance seems to fit this role well. It allows the questioning of socio-technical regimes and socio-material routines and practices in urban environments without necessarily falling for the intrusive dogmas of innovation and design. Maintenance, breakdown and repair of infrastructure, furthermore, are able to engage citizens. They might successfully bring to the fore the inconspicuous culture and politics of waste.

12.3 Reflexive Repair and Dynamic Maintenance

Scholarship on maintenance and repair provides us with at least two possible answers to the question of how to change critical infrastructure, such as municipal waste management systems. In both these answers, the focus is on challenging the existing material and social order through the maintenance of infrastructures that always already reinforce these orders. One, through 'reflexive repair' (Henke & Sims 2020), and two, through a more dynamic and procedural conception of maintenance (Young 2021a, 2021b).

The guiding principle behind 'reflexive repair' is mainly discursive, that is, making the agents maintaining infrastructure projects aware of the

underlying power dynamics as well as the values purported through these projects. Reflexive repair means '… asking questions that bring the sometimes obscure but always present properties of infrastructures to the surface, critically appraising the embedded dynamics of power, discourse, and materiality that are built into these sociotechnical structures' (Henke & Sims 2020, 143). Reflexive repair opens up a space for debate, for interaction among those stakeholders who otherwise would not communicate with one another. Such interactions might lead to the realisation that maintaining a given kind of infrastructure in a specific way through repair is not a value-neutral undertaking. Rather, it is the re-assertion of specific worldviews and specific ideas of urban living and cooperation. A re-assertion of ways of disclosing the city and disclosing urban life. Preceding that re-assertion by a reflexive and discursive engagement could highlight problematic power dynamics and injustices.

Henke and Sims (2020) summarise their views by proposing that reflexive repair will be able to 'repair infrastructural repair itself', providing a critical, political form of repair. Thus, reflexive repair proactively considers the limitations and (unintended) consequences of repair and maintenance, effectively negotiating maintenance amongst stakeholders with different aims and needs. Henke and Sims are aware of the difficulties of putting their approach into practice. For instance, we can question the manner in which a representative group of stakeholders is brought together in a globalised economy with complex supply chains. As an example, vast amounts of discarded 'fast fashion' from the Global North end up in Africa and increase economic inequality (Brooks 2019). Second, the unprotected disassembling of container ships in Bangladesh (Jackson 2014) and informal recycling of e-waste in developing countries (Ádám et al. 2021) show that discarded artefacts have become a global issue with a global supply chain, in which questions of justice are still disregarded. Can reflexive repair consider all these global consequences? And how would a hierarchy of repair preferences be justified? We do not attempt to answer these questions concerning 'waste justice' here, but realising its complexity is important.

The second approach to changing infrastructures is based on Young's reconceptualisation of maintenance as a dynamic procedure, rather than a static continuation of a given socio-technical system. The main thrust of this reconceptualisation of maintenance stems from a fundamental shift in how technology is viewed. Many current approaches in the philosophy of technology still frame technological artefacts as expressions of human (usually engineers' and designers') intentions. For instance, the value-sensitive design approach (Friedman, Kahn & Borning 2002) prioritises intended values in the design process of HCI technologies. The proponents of Constructive Technology Assessment have stressed the importance of

broadening the design, development and implementation processes (Schot & Rip 1997). Verbeek's (2011) mediation approach focuses on the design of human–world relationship through technology. In all these approaches, the focus is on the design stage of artefacts: how an object is brought into the physical world through construction, following an ideal, preconceived form. The artefact is complete and ready to use at its creation, and any deviation from the designed ideal form is remedied through repairs or adjustments. Maintenance here plays an auxiliary role, meant to aid a finished design to cope with reality. This is what Young (2021a) dubs 'technology as form'.

Thus, maintenance, under this framing, is conservative of an initial design and function. In this understanding, artefacts are discarded when this initial design and function can no longer be restored. These artefacts are beyond repair – the change that time and use have created have pushed them over the brink of 'preservation' (Young 2021a, 360). With the intent to move the focus from the designers to the maintainers, Young proposes maintenance as the primary drive and functioning of technology. Rather than highlighting the design and innovation phase of an artefact, more emphasis should be placed on the continuous process of maintenance through repair, readjustment and upkeep. Technology should be seen as 'a process sustained by constant human activities of maintenance and repair', that is, 'technology as a process' (Young 2021a, 102).

Hence, we should think of the process of making, using and maintaining a technology as a process of growth, guided throughout different, fluctuating phases of interaction with the artefact. The following quote exemplifies this idea:

> Technologies are understood as fluid entities which constantly respond to the changing environments in which they exist, and which therefore require guidance through time in order to appear for us as stable entities.
>
> (Young 2021b; 364)

This fluidity and room for growth, coupled with reflexive repair is in focus when we argue that waste management systems can be reimagined to represent different visions of waste. In other words, we claim that a dynamic and reflexive conception of technology as a process gives theoretical room to re-conceptualise waste infrastructure/management systems and open up these systems for the negotiation of new, sustainable visions of waste. In the coming sections, we also show that this reconceptualisation encounters considerable sociomaterial resistance. However, we first need to establish what we mean by 'waste'.

12.4 A Dynamic Concept of Waste

Having established the concepts that we need to address and problematise municipal waste management, we now turn to waste itself. For the focus of this chapter, we chose municipal solid waste as a distinct category of waste, aside from fluid and gaseous municipal waste. Municipal solid waste has several characteristics that we will explore in relation to municipal waste management and waste infrastructures. Additionally, we show different perspectives on waste and then highlight how different valuations of waste have emerged over time. Finally, we show how the modern imaginary of waste hampers the materialisation of new visions of waste, as, for instance, proposed in the European Union.

Based on philosophical, anthropological and sociological scholarships, we identify four main characteristics of waste. Waste is 1) a socially determined product, 2) a normative category, consisting of ethical and aesthetic components, 3) an environmental agent and 4) inevitable. These four aspects give respective explanations of waste's ontological standing and ethical significance (1 & 2), its practical implications (3) and why waste merits debate in the first place (4).

First, waste is a socially determined product. Importantly, waste is not a predetermined, ontological category, something that can be objectively distinguished. Rather, waste is the product of a relational process of categorisation (Hawkins 2010; Douglas 2002). Structurally, we can argue that waste, like dirt, always is 'matter out of place' (Douglas 2002). However, that doesn't determine what counts as matter out of place in a certain (cultural) context. Thus, what is considered waste is culturally dependent (e.g., Edgerton 2007). The category of waste is itself a social product, something that has to be agreed upon and negotiated to be 'waste'. This means that waste itself is a dynamic concept that changes based on historical context, societal norms and values and the possibilities present in societies to reinterpret what constitutes waste. However, this dynamism of waste is curtailed by fixed processes, institutions and infrastructures for waste. Thus, while waste is nominally dynamic, real processes and structures fix its meaning through reproduction and static engagement.

This nominally dynamic character of waste becomes especially poignant when considering the ethical and aesthetic relevance of waste. Waste is an ethical and aesthetic category. From an aesthetic perspective, waste is something that is unpleasant, even disgusting and unclean. We want to avoid contact with waste. The idea of waste evokes sentiments of disgust, uncleanliness, potential danger through contamination, etc. These aesthetic judgments also have moral implications. Especially, if these judgments are mobilised to produce emotional reactions and relationships with waste, they fall clearly into the category of the ethical (Roeser & Todd 2014).

In those cases, these reactions have real-world effects that bear upon other people, close-by or far-off, affecting their lives and livelihoods.

Waste surrounds us, while always being something undesirable. Designating something as waste entails that it no longer has use, has lost its initial purpose or is spent. On the ethical significance of waste, we follow Hawkins when she writes that '[w]aste is now a field of activity structured by legislated and normative moralities, by disciplinary codes that order conduct in the interest of wider objectives: from reduction of landfill to global ecological survival' (2010, 22). The way we engage with, categorise and maintain waste has important moral implications, since waste is a normative category: it tells us how to interact with a given artefact or phenomenon. We focus on this criterion of waste in the following sections.

Thus, the ethical and normative characters of waste highlight the third and fourth practical and moral criteria of waste tied to its maintenance. From this third perspective, waste is relevant as an environmental phenomenon. The production and effective management of waste is seen as crucial in dealing with environmental degradation. Spilled and improperly processed waste can emerge as pollution and environmental hazard. This aspect of waste is further compounded by environmentalists' and climatologists' realisations that one of the biggest threats to humanity yet – the continuous emissions of CO_2 through combustion – is the ultimate kind of waste through its double invisibility. Not only is it invisible in the physical sense, as it cannot be perceived by the human eye and is odourless, that is, our senses cannot make sense of it. It is also invisible in its direct impact.

Finally, waste seems inevitable. There will always be matter out of place, as waste and dirt establish material and social orders and borders. The very human condition seems trapped in the necessity to produce waste and to create excess. The inevitability of waste production is particularly glaring in industrialised consumption-based societies, where waste rears its head undeniably through packaging, sewage and broken gadgets – societies in which, as Nagle (2013) puts it, 'San[itation] workers are key players in maintaining the most basic rhythms of capitalism' (46). This connects to Schumpeter's (2008 [1950]) more general idea of 'creative destruction', the destruction of old forms of wealth to create new ones, that is, the constant upheaval of economic structures in capitalist societies. The production of waste becomes necessary for economic progress.

12.5 Modern Waste Management: An Institutional Perspective

So far, we have argued that the dynamic nature of waste is most properly complemented by a dynamic concept of maintenance that allows

infrastructure to be aligned with new visions of waste. However, as we have indicated, infrastructures provide resistance to change as well. The coming sections pay attention to some of the forms of resistance that urban infrastructures exhibit.

Given the sheer production and amount of waste, modern municipal waste management systems *need* to be invisible. In this aspect, they differ from other systems operating in our urban backgrounds. Insensibility is deliberately designed into municipal waste management systems (Hawkins 2007). Rather than retreat into the background of modern urban life, municipal waste management infrastructure always already has retreated. Recent garbage crises that affluent societies have faced mostly concerned the re-emergence of the sensibility of waste and the re-emergence of the question of how to best deal with this sensibility. More philosophical and ethical questions about waste often escape the political agenda. That is, infrastructural innovation is directed towards technological efficiency and efficacy regarding a set of predetermined goals taken as exogenous 'givens': health, tidiness and, therefore, insensibility. The existing rationale for waste management was, and to a large extent still is, 'expand and upgrade', based upon design principles committed to universal, reliable and affordable service (Moss & Marvin 2001, p. 5/6). Figure 12.1 shows a schematic overview of the four phases of solid waste management in urban areas in HIC, phases that are (in)formed by infrastructures, technologies, habits and institutions.

One way to understand the neglect of philosophical and ethical questions concerning waste is provided by the literature on socio-technical regimes. In this institutional perspective, the focus on efficiency, expansion and upgrading is seen as part of the socio-technical regime of urban solid waste management in HIC, constituting its paradigmatic centre. This regime is the result of the co-evolution of infrastructure and institutions.

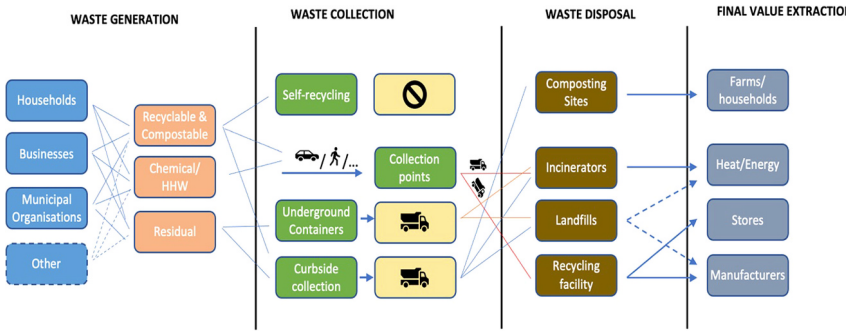

Figure 12.1 Schematised Municipal Waste Infrastructure.

It has its own 'logic' and 'grammar' (Fuenfschilling & Truffer 2014). Problems and their solutions come about as salient through this logic, which forms 'coherent arrangements of beliefs, norms, values and practices' (ibid. p. 773).

We have seen, furthermore, that waste management systems (Figure 12.1) come into the public eye when they break down or when their continued use and operation leads to morally problematic situations, such as disease, pollution, the involvement of organised crime and increased global inequality. In a socio-technical regime, these problems are often interpreted and dealt with in preconfigured ways, along already-established innovation pathways. The robustness of this institutional logic, its endurance, is determined by both internal and external events, such as the arrival of new actors and niche technologies, changes in the distribution of power and the social impact of crises and disasters (Geels 2010).

The institutional perspective adopted in the socio-technical regime's literature explains how institutions and technologies co-evolve in socio-technical systems, such as municipal waste management systems. From this perspective, the extent to which a complete reimagination and system transition is deemed necessary depends at least in part on the success of other (and earlier) attempts of the regime to cope with problematic situations caused or endured by the system. These attempts might have left the material design of the municipal waste management system largely intact. We can think here of failed attempts at the improvement of the institutional context (new rules, guidelines, laws, etc.) or failed efforts at educating city dwellers about good and bad waste habits (stickers on garbage bins, codes on packaging materials, waste separation folders, school trips to landfills, etc.). In these cases, new objectives and goals in waste management are pursued at the supply side of waste, changing the waste behaviour of citizens through education and regulation. In the case these new goals amount to substantial revisions of the ultimate objectives of waste management, we refer to these new objectives as 'values'. The pursuit of new values is often associated with socio-technical transitions, in which new practices, rules and technologies emerge (Geels 2004).

We depict the changes in these practices, rules and technologies in Figure 12.2. In this visualised trinity of (re-)education, institutional (re)design and material (re)design, the latter option, the material (re)design of parts of the socio-technical system of waste management, is often the most time-consuming and costly. We are dealing in these infrastructural systems with a materialisation of norms and values associated with waste, that have 'locked in' certain waste practices. The underground sewage pipes, the closed-off garbage trucks or covered trash cans, all represent physical manifestations of a certain understanding of waste that leaves its mark on waste practices. At the same time, physical infrastructures embedding

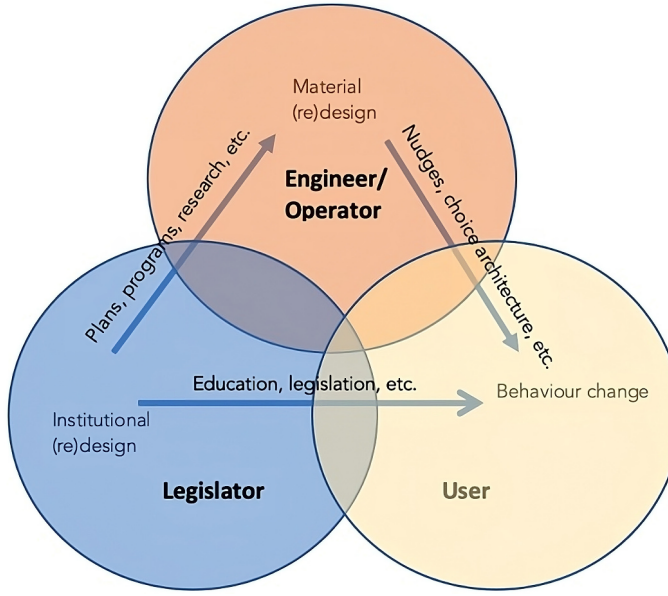

Figure 12.2 Visions of changing (waste) practices in socio-technical systems.

entrenched norms are very difficult to change, which is why acting on them is often the last option to be considered.

This leads to a paradoxical situation: *citizens are instructed to change their behaviour and practices while existing infrastructure keeps reinforcing that behaviour and those practices*. Institutionally, therefore, citizens, are motivated to change, while materially they are motivated to keep on doing what they did. A purely institutional perspective on change is therefore not enough. If cities want to successfully implement new waste visions, all three aspects of Figure 12.2 need to be put into operation. Institutional change, citizen education and motivation and material change need to go hand-in-hand. This means the inclusion of diverse stakeholder groups, such as citizens and maintainers, and the development of new ideas concerning the interaction of these groups. In our view, maintenance offers an underestimated opportunity for effectively bringing to the fore the material aspects of socio-technical transitions that are inspired by new visions of urban waste.

Finally, upholding a modern vision of municipal waste ('Burning, Burying, Be rid of it') through the static maintenance of waste infrastructures is costly. Most of these costs might be borne by future generations, the environment or subaltern social groups. Some of these costs might be invisible (air pollution and CO_2 emissions of waste transport) or might not

be experienced collectively (the shipping of waste into other regions/countries). Hence, local invisibility is often associated with affluent parts of the city or affluent parts of the world, while waste becomes more visible in marginalised localities. Affluence, in this sense, determines the period during which municipal waste is visible and still affirmed and a confrontation and negotiation can take place.

This is a development long in the making. As a number of scholars have pointed out, the modern imaginary of urban living and waste focused around conceptions of tidiness that emerged throughout the nineteenth century in cities in Northern America and Europe (Chakrabarty 1992; Melosi 2004; Hawkins 2010; 2007). These conceptions have solidified in infrastructural design choices for modern urban waste management systems and continue to inform contemporary choices.

12.6 Modern Imaginary of Waste

The modern imaginary of urban living and waste emerging in the nineteenth century is the 'tidy city' (Chakrabarty 1992; Hawkins 2010; 2007). In this tidy city, the management of waste (and health) has become a public concern. This means that urban sanitation is no longer an individual responsibility, as it was prior to the nineteenth century, but a communal responsibility and a service that the city provides (Melosi 2004). Furthermore, responsible waste practices become an important aspect of civic life and citizen culture. The administrative treatment of waste and public health becomes a sign of urban progress. As the Dutch environmental ministry's homepage puts it: 'It is the role of governments to prevent the waste of raw materials and energy and to ensure that human health and the environment are not harmed by waste'(Ministerie van Infrastructuur en Waterstaat 2022). Modern waste management is a public concern.

A wide range of scholars of waste have shown how this nineteenth-century imaginary of waste is both persistent and resistant in the western hemisphere. It has set societies on socio-technical pathways of waste management systems that have led to both technological and institutional lock-in. The force of this imaginary of tidiness is dependent upon several of its features. First, its geopolitical power. As Newell (2015) and Chakrabarty (1992) argue, the assumed connection between cleanliness and civilisation has justified colonisation and subjugation of the 'dirty native' in the nineteenth and early twentieth centuries. Filth today is still associated with lower social classes (Berg 2015; Forty 1986), and with 'othering'.[4]

Second, overconsumption, and therefore waste, started to be taken as a fact of civilian life. Nineteenth-century affluent citizens began showing their wealth by buying things they wanted, but didn't need and could discard at will (Benjamin 1999).[5] Third, the medical sciences of virology and

bacteriology emerged at the end of the century, as modern public health science established relations between (human) dirt, disease and death that are still prevalent today (Melosi 2004). Finally, the emergence of municipal sanitation had both ethical and aesthetic consequences. The 'tidy city' still is an attractive epithet. It attracts tourists, yuppies and supports increasing levels of gentrification (Hawkins 2007). Clean, tidy and orderly urban districts preserve the otherness of waste – as something that is both aesthetically and morally disavowed.

On this basis, we introduce the modern waste imaginary. In this imaginary, waste is something to be discarded; something that is both aesthetically unpleasant, morally bad and unwanted. It is out of place and should be put away, either geographically or excised and obliterated as a whole. Even apparently more reflective approaches, such as the Zero Waste plans of cities like San Francisco and Singapore uphold this image: 'Zero Waste' here does not refer to a completely circular (urban) economy or 100% biodegradable consumer goods. Rather, these Zero Waste plans rely heavily on waste-to-energy incinerators. These incinerators reduce waste mass up to 90% (Setoodeh Jahromy et al. 2019). Since the leftover material can be used for road construction and leftover metals can be separated and recycled, these Zero Waste plans almost realise Zero Waste.

However, as we detail in the latter sections of this chapter, these plans fall short of realising a new vision of waste on the supply side of waste, for example, with urban dwellers. In the next section, we introduce how socio-technical systems can entrench or hinder the expression and materialisation of new values. This provides theoretical tools to explore how current waste infrastructures either reproduce the modern waste imaginary or do not go far enough where they seek to go beyond it, given the inherently static underlying assumptions of current waste management systems.

12.7 Value Change

A growing amount of recent scholarship recognises that socio-technical systems, since they're bound to exist for multiple generations, will see some level of value change. In short, although these systems might have been designed while keeping certain social, ethical and public values in mind, the relative importance of these values, their conceptualisation or the (design) norms associated with their realisation, might change (van de Poel 2021; van de Poel & Taebi 2022; van de Poel & Kudina 2022). We can even imagine completely new values emerging in society that start to weigh down on the operation of certain systems, such as energy or waste systems (Taebi et al. 2020).

The literature on value change argues that morally problematic situations, whether caused by these socio-technical systems or not, create an

urgent call to reassess the design of those systems, with this value change in mind. These might be values new to the context (e.g., new to the context of waste management systems, such as ecological sustainability) or completely new values as abstract goals (e.g., intergenerational justice). That is, the redesign of parts of the system of waste management, deemed necessary because of the problematic situations the current design has caused, is often guided by new requirements that stem from new values. As is evident from our discussion so far, the realisation of these new values cannot be achieved through institutional change only. Despite a recognition that municipal solid waste management needs to transition to more sustainable, just and ecological practices, urban waste management infrastructures continue to express an imaginary of tidiness that trumps the expression of these new values. Both education and institutional (re)design (Figure 12.2) have been unable to realise major shifts in collective beliefs and practices concerning waste in European urban areas. To date, the focus has been primarily on how to deal with waste, and visions are built around answers to this question. Yet, another question often goes unmentioned: to what extent should we change what we consider waste in the first place?

For instance, in Europe, the Smart City concept developed in the early 2000s, hardly pays attention to the reimagination of municipal solid waste, despite a focus on issues such as urban pollution, sustainability and sanitation. Smart waste collection does receive attention in urban contexts (e.g., Ali et al. 2020), but seems to focus more on Internet-of-Things solutions in which garbage cans communicate with garbage trucks (e.g., Bhor et al. 2015) and sensors determine the level of air pollution. The focus here is on efficiency and reliability, rather than new values emerging in relation to waste management.

Furthermore, the EU directive of 2015 established a hierarchy of goals in relation to waste management: prevention, reuse, recycling, recovery of energy and disposal. However, many member states have difficulties in achieving these goals and often focus on waste-to-energy processes instead of higher order goals (EU 2018). The failure to achieve a more radical transformation of municipal waste practices can be understood to stem in part from limitations in the political directives themselves. For example, one of the research foci of the Horizon 2020 programme was the circular economy [CE] and urban metabolism, which developed valuable insights into the challenges of CE in urban contexts, mostly from a governance perspective (e.g., Obersteg et al. 2019; Remøy et al. 2019). At the same time, however, the programme failed to address the affordance and resistance of waste management systems or the potential for a collective reimagining of waste and related practices.

Hence, waste is often assumed as a given fact of urban life. Contemporary debates concerning the ethics of waste highlight problematic attitudes to

waste, delivering a moral appeal to change these attitudes (Hawkins 2010). Yet, the extent to which the current treatment of and attitude towards waste are seen as problematic is as much the result of the history of waste (see Section 12.6), as of the persuasive power that circulating new perspectives on waste are able to exercise. This persuasive power itself, we argue, depends both on the possibilities to render visible the problematics of the current operation of municipal waste management systems and on the historical meanings of waste still designed into these systems, in the form of embedded values. We call these two aspects *infrastructural affordance* and *infrastructural resistance*.

A collective reimagination of waste, deemed necessary for collective support of changes in socio-technical systems of waste management and the burdens these changes might impose on citizens, requires a collective confrontation with municipal waste in which new values can be brought forward as essential for the accumulation, collection and disposal of solid waste in urban contexts. For such a confrontation to take place, it will be essential to explore new ways of experiencing waste. However, despite a range of art projects involving waste, the conditions for such positive 'waste experiences' are still largely absent in affluent societies. One of the reasons for this may be found in the physical aspects of waste infrastructures, where the resistance presented in the infrastructurally embedded historical meanings of waste weakens the persuasive power of new visions.

Reconceptualising the maintenance of municipal solid waste management systems as reflexive repair and a dynamic process can play two roles here. First, it can undermine the resistance to value change designed into these systems by rendering them visible during the act of maintenance and allowing for new forms of political engagement with them, thus bringing to the surface the problems associated with their operation. Second, maintenance can be seen as a process of redesign of urban infrastructure instead of replacement/repair and short-term fixes, making maintenance an important strategy for bringing political and ethical questions to the fore and thus creating *infrastructural affordance*. However, the redesign of critical urban infrastructures is often avoided because of costs and risks to urban flows of utilities. While we do not claim to have a solution to this problem, we argue that the creation of public acceptance for new visions of waste can only be achieved through the 'visibilization' of waste infrastructures, a process of creating *infrastructural affordance* in which maintenance can play a crucial role.

12.8 Some Politics of Waste Infrastructures in the EU

As noted above, the affordance and resistance of contemporary municipal solid waste management systems determine the extent to which new meanings of waste can establish themselves in urban contexts. In a very basic

sense, this would encompass the transition from a waste and dirt-rejecting system to a waste and dirt-affirming system of beliefs and practices (Douglas 2002) in the city, supported by a waste-affirming vision. Anthropologically, dirt affirmation refers to societies in which some forms of pollution and corruption are 'enshrined in sacred places and times' (Douglas 2002), whereas in dirt-rejecting societies dirt loses all identity and cannot acquire new functions before it is completely disintegrated and undifferentiated, when it has stopped being dirt.[6] Importantly, waste serves as a proxy for dirt in the modern waste imaginary. Most advanced urban areas are dirt rejecting in a non-religious sense, as places where 'order, efficiency, and perfection' (Scanlan 2013, p. 2) leave no room for the reintroduction of garbage as an object or even commodity before it has completely disintegrated in landfills or incinerators. Before it has stopped being garbage, that is. Nonetheless, we argue, that some level of dirt affirmation must occur to effectively negotiate waste and open up a critical space for a collective reimagination of what constitutes waste.

However, existing waste infrastructures are both robust and durable and infrastructure tends to become more resilient over time (Henke & Sims 2020, 121). Late twentieth-century problems with landfills and levels of toxicity and contamination of water tables have led many European countries to focus on waste-to-energy incinerators (McCauley 2009). The current ubiquity of incinerators is a consequence of the mixed nature of most solid municipal wastes, stalled efforts at sorting out different types of wastes, protests against shipping waste abroad and failed attempts at large-scale recyclable plastics. Nevertheless, many of these countries have also seen (local) forms of resistance against these incinerators that, in some cases, have led to further innovations (e.g., reduction of fly ash and better filters). The EU directive 2018/851 recognises that many member states have not yet developed the necessary waste management infrastructures to achieve a circular economy. It does not, however, provide reasons for this failure to adapt. Overall, the directive 2018/851 pays little attention to raising public awareness (and visibility) of waste. Action point (30) states:

> The promotion of sustainability in production and consumption can contribute significantly to waste prevention. Member States should take steps to make consumers aware of that contribution and encourage them to participate more actively in order to improve resource efficiency. As part of measures to reduce waste generation, Member States should include continuous communication and education initiatives to raise awareness on the issues surrounding waste prevention and littering and may include the use of deposit-refund schemes and the setting of quantitative targets, and provide, as appropriate, adequate economic incentives to producers.
>
> (EU 2018)

The EU directive 2018/851 focuses on education and institutional design to raise awareness (see Figure 12.2) about the negative effects of waste. Awareness, we have argued, is something that is hampered by the design of modern waste management systems and characterised by the processes of 'invisibilization' of municipal waste. Efforts at prevention, reusage and recycling (EU directive 2015) are all hindered by these processes.

Problems of citizen education and the collective reimagination of waste come together in the design of waste infrastructures in affluent countries. To gain collective support for the proposed and much-needed changes in the way these countries deal with waste, waste perceptions in advanced urban contexts must first be laid bare as both historically contingent and antiquated. This means that anthropological, sociological, psychological and urban geographical insights concerning waste and its management must be combined to address local, economic, environmental and social issues. Here we believe that both the dynamic reconceptualisation of maintenance as well as the reflexive repair approach can be of use.

What both of these approaches to maintenance highlight is the fact that infrastructure is more than a simple network of technologies, and that its upkeep is a value-laden process. This realisation, we believe, is paramount to making room for the re-imagination of waste infrastructure, and the way we experience waste itself. As Henke and Sims put it,

> [I]nfrastructural repair is not just about fixing things but also relationships and negotiation. An approach to reflexive repair that focuses only on technical fixes and eschews conversation misses opportunities to build common discourses and identities around a complex and urgent problem; talk also allows us to listen and learn when we disagree and misunderstand.
>
> (2020, 134)

Thus the remaining two sections of this chapter explore the potential avenues of reconceptualising our modern vision of waste through waste affirmation.

12.9 Waste Affirmation and Municipal Solid Waste Management

It is difficult to imagine what a waste-affirming modern society would look like. Indeed, such a society might be considered 'postmodern' in the sense that it would make previously established boundaries and strict dichotomies between concepts and categories permeable and porous. In this light, Douglas (2002) asks how it is possible that something as destructive as dirt can also have a creative force. Douglas (2002), citing William James (1902),

claims that the most complete systems of thought need to find some way of affirming what has been rejected, whether it is matter out of place (Douglas 2002), objects that have lost their aura (Benjamin 2021) or the abject excrements of the body (Kristeva 1982). A more complete philosophy of the city would account for the presence of secular rituals in which the 'mixing up and composting of polluting things' (Douglas 2002) takes place without recourse to technological perspectives on waste. The practical question is how such rituals or, more generally, practices of waste affirmation can be firmly established in urban environments. Do we need to design crises of waste, or are other venues possible?

As we have shown in the previous sections, cities are not designed for zero waste visions, but rather for zero visibility waste visions. This zero visibility paradigm problematises the efforts to challenge the modern imaginary of tidiness, with its hygienic and aesthetic connotations, and problematises the efforts to remind citizens that waste is an integral aspect of urban living that, at the same time, has negative consequences. Waste infrastructures resist new interpretations and visions of waste. Before becoming waste affirming, we need to become waste admitting. Besides education and institutional (re)design (see Figure 12.2), waste infrastructures should also play a part in this admission. Several authors have explored what dirt affirmation would look like from a material, architectural perspective (e.g., Campkin 2013; Shonfield 2014). In these elaborations, dirt affirmation is related to Foucault's (1984) thoughts on heterotopias, places of otherness that function as mirrors to the city, as counter-sites. In these 'othering' spaces, we could find the celebration of dirt and waste, the denial of purity and tidiness, an inverted city, turned inside out, the 'garbage cities' presented in documentaries such as Waste Land (Walker 2010) or Plastic China (Wang 2016). However, despite the existence of heterotopias (Foucault names places of 'deviation' such as psychiatric hospitals, rest homes, cemeteries and zoological gardens), it is unclear how these sites, except as places of contestation and experimentation, could contribute to changing urban waste practices and beliefs.

The 'broken world' thinking of Jackson (2014) may offer a new paradigm here for thinking about urban problems and solutions. We refer to his oft-quoted idea that we should aim at:

> an appreciation of the real limits and fragility of the worlds we inhabit – natural, social, and technological – and a recognition that many of the stories and orders of modernity (or whatever else we choose to call the past two-hundred-odd years of Euro-centred human history) are in the process of coming apart, perhaps to be replaced by new and better stories and orders, but perhaps not.
>
> (221)

One such story that needs to be dismantled is the myth of urban infrastructures as stable, and permanent. This myth of fixed and stable infrastructure (Graham & Thrift 2007), while cities expand, and urban flows change, obscures the extraordinary everyday effort of keeping the city 'running'. The ongoing process of infrastructure, exempt from a narrative of progress and innovation, needs to be brought into focus. Post-modern cities, in this sense, are 'cities of repair' (Graham & Thrift 2007, 10.) Visibilisation of waste, we have argued, comes in two forms. On the one hand, maintenance can serve to lay bare waste infrastructures by enhancing the visibility of maintenance activities. However, this first form of visibilisation only temporally allows for critical engagement with waste. The second form is more permanent. It focuses on dynamic maintenance as an act of redesigning waste infrastructures to allow for engagement with waste. The resensibilisation of waste does not mean that we return to filthy streets filled with manure and all kinds of litter. It would mean that through this resensibilisation, waste becomes something relatable, positive and affirmative. What is repaired and maintained are positive meanings of waste that have become obfuscated by modern imaginaries of tidiness and unlimited progress. We can think here of maintenance and repair as a continuous laying bare of waste streams in urban contexts comparable to the way the Centre Pompidou in Paris lays bare its inner tubing – its flows of air, energy and waste.

12.10 Conclusion

Waste and maintenance are inadvertently connected. We hope to have shown that this connection can serve as a point of exploration to problematise current western urban societies' relationship and imagination of waste. Perceiving waste as something aesthetically and ethically problematic inhibits the transition to a more environmentally aware vision of consumption patterns. Our current vision of waste rejection is further entrenched into the very infrastructure we rely on to rid ourselves from our waste, which makes the re-imagination of waste all the more difficult. A dynamic conception of maintenance alongside a reflexive approach to infrastructure repair could aid us in reconfiguring our understanding of what waste is and how we ought to treat it. It would create infrastructural affordance for new practices related to new values. However, these approaches alone will not be sufficient. Instead, it will take radical new visions of waste that go beyond the modern understanding on institutional, societal and technological levels in order to re-imagine waste as a necessary reminder and remainder of our consumption, as something that we can gladly claim.

Notes

1 See Steinert (this volume).
2 See https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS [last accessed January 2024]
3 See Steinert (this volume).
4 Indeed, modernity is often associated with these strict categorisations and dualisms, such as the distinctions between mind and body, nature and culture, public and private and agency and structure (e.g., Latour 2012; Douglas 2002; Bauman 2003; Jackson 2014; Giddens 2020).
5 For example, the word 'gadget' started being used late in the nineteenth century as a term for an object one cannot remember the name of, although the exact origins are debated (Merrin 2014).
6 We are aware that dirt and waste are not synonymous. In Douglas' work, the two concepts are not always easy to keep apart. On the one hand, dirt seems to be an interpretation and evaluation of superfluous things, materials, words and bodily aspects, as excessive 'things' that confuse and endanger accepted social classifications. On the other hand, as we have noted in the introduction, waste is always in immediate danger of becoming dirt. Douglas herself gives examples of human matter in food such as hairs in soups. For the sake of our argument, we do not think that a strict conceptual boundary is necessary.

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