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Theme :  
materials  
& society

## **Society, materiality, resilience and sustainability: inquiries from the fields of industrial waste management, urban climate science and eco-urbanism**

Fionn MacKillop  
*School of Energy, Geoscience, Infrastructure and Society*  
*Heriot-Watt University*  
*Riccarton, Edinburgh, EH144AS, Scotland*  
[f.mackillop@hw.ac.uk](mailto:f.mackillop@hw.ac.uk)

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### **ABSTRACT**

This paper aims to investigate the links between materiality and society at a conceptual level, using examples from the author's decade of research in several fields relevant to the issue. With current talk of the need for 'sustainability' and 'resilience' reaching fever pitch in industry, politics and other arenas, there is a regrettable tendency to muddle the meaning of these words. Drawing on original research carried out in the UK, China, Germany, and Australia, and using the conceptual approaches of actor-network theory (ANT) and urban political ecology (UPE), the author invites us to re-engage with the materiality of society and how we, as businesses, consumers and thinkers, can advance sustainability and resilience through this re-engagement. We will ask what sustainability and resilience mean, for whom and in what context. We will also look at how we can shift thinking and reinvigorate these words, by contributing to the dialogue between the social sciences and business and industry. Specific examples will be taken from the UK and Chinese steel industries; climate-sensitive urban design in Manchester and Stuttgart; and housing construction and affordability in Scotland and Australia, thus covering a wide range of issues related to urban sustainability and resilience in relation to materiality.

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## Introduction

This paper is a reflection on over a decade of engagement (through both teaching and research) with materials, technologies and systems via the lens of the social sciences and its methods. In this space of time, a number of reflections and (tentative) conclusions have emerged in the author's mind on how to conceptualise and position materiality, society and the current burning issues of 'resilience' and 'sustainability'. Indeed, in the fields where the (contested and complex) notions of 'sustainability' and its latterly more fashionable companion, 'resilience' have taken hold (such as urban planning and design, waste and energy management, production etc.), there is a growing tendency to use these terms in an unfocused, sometimes confusing way that ultimately undermines the goals at the heart of these notions. The Brundtland report (also known as *Our common future*), published under the aegis of the United Nations in 1987, is generally described as a seminal moment in the contemporary history of sustainability, and the laying down of the triple goals of environmental, economic and social sustainability; likewise, resilience, which has grown in use over the last decade or so, is often summed up as the capacity, for a system, city or country (or person or organism), to 'bounce back' to a prior, supposedly steady and enviable state (Davoudi et al 2012). We immediately see that these two concepts, as frequently used, contain a conservative, almost static bias: maintaining things, returning to prior states. I will argue here that, in this dominant use, the concepts propagate a neglect of materiality and its related notions of flow, circulation and metabolism (Swyngedouw 2004), which are key to understanding how environment, economics and society really interact, in a world increasingly understood as unstable and even chaotic. The social sciences need to engage more with the materiality and physicality of the world (and how this informs social, political and environmental conditions), while the physical sciences, the world of business, government and industry, need to open up more to insights from the social sciences and related disciplines. This could allow for a better understanding of how people interact with matter, products and technologies, both in the production process and as consumers and citizens. This greater dialogue can support the development of more effective approaches to implementing sustainability and resilience in homes, cities, and businesses. I will draw upon a decade of international research in the fields of industrial process and waste management (MacKillop 2009), climate-sensitive urban design (MacKillop 2011), eco-urbanism and master-planned communities (MacKillop 2012) and other relevant work, especially in the field of natural resources and technology (MacKillop and Boudreau 2009). There are several theories and conceptual perspectives that allow the social scientist to better engage with materiality and the production/consumption processes at the heart of current issues of sustainability/resilience; I will draw on some of these so as to advance my argument here. The first is actor-network theory (hereafter ANT), developed by French sociologist and philosopher Bruno Latour (See, among many other references: Latour 1993; Latour 2005; Law 1986); the second main strand I will borrow from is urban political ecology (hereafter UPE) (Swyngedouw 2004; Heynen et al. 2005). Both of these approaches are symbolic of a 'material turn' in the social sciences, in that they take materiality seriously. This material turn emerged from the 1960s onwards, with the rise of science and technology studies (STS), interest in urban metabolism and cybernetics, and a general trend towards more focus on the physical environmental conditions of social life, typified by landmark books such as Jacobs' work on the urban environment (Jacobs 2000) or Rachel Carson's *Silent Spring* (Carson 1962), which brought the problem of widespread pollution to the fore. In this respect, the material turn stands in contrast to a longstanding tradition in the social sciences, going back to late 19<sup>th</sup> century work by Emile Durkheim (1982), widely regarded as the 'father' of modern sociology, whereby 'the social' was seen as possessing its own, transcendent 'essence', that placed it somehow 'apart' from the material world. Of course, contemporaries of Durkheim, such as Gabriel Tarde (2012) and Karl Marx (1987) already argued at the time for both a more networked and a more materially-grounded perspec-

tive that didn't just see things and 'stuff' as pawns in humans' games or a mere backdrop to human action. Likewise, other traditions in the social and human sciences, such as anthropology and ethnography, have demonstrated an interest in the material aspects of culture. But ANT and UPE demonstrate a different perspective on the material, one that is considerably more suited to an era when most people are starting to recognize the interrelated nature of humans and their environment (e.g. talk of the 'anthropocene') and the importance of networks, flows and circulation as shaping factors. Indeed, a criticism levelled by Latour and other practitioners of ANT at traditional approaches to materiality in the social sciences is that they acknowledge the existence of the material in a limited way that ultimately only serves to reinforce the preeminence of 'the social' (and humans as social beings) as the determining factor. In *We have never been modern*, one of the founding texts of ANT, Latour (1993) insists on the need for a scrupulous 'symmetry' in discussing the material and the social. Latour applied this symmetry, for instance, in his work on Pasteur's discovery of the mechanisms of infection (Latour 1993b). This marked a strong inflection in the perspective on materiality in the social sciences: it was not enough to say that humans, such as Pasteur, can manipulate nature in order to achieve certain results, such as controlling infection, and that Pasteur just strode in and 'found' what was 'already there' and waiting for humans to manipulate to their benefit. A symmetrical approach requires acknowledging the agency of things (renamed, together with humans and any other entity, 'actants') in these processes, and in so doing, granting full agency to materiality in human endeavours. Thus, in this sense, Pasteur had to coopt and 'recruit' bacteria and infection mechanisms within an 'actor-network', comprising biological phenomena, but also laboratory work and its funding mechanisms, the politics of 1870s France, lobbying of the appropriate authorities etc. An actor-network will only achieve power (meaning the capacity to influence and shape reality) if enough people are convinced of its existence. Demonstrating the 'objective' mechanisms of infection in a laboratory is far from enough in this perspective: facts do not 'speak for themselves', and do not even exist in themselves; rather, they need to be constructed into actor-networks, a combination of materiality, social and discourse that will give them weight in the world. In this sense, God and religion can be as real (or unreal) as gravity. If enough people are convinced of the reality of God, through material artefacts (churches and Bibles), social rituals (mass) and discourse, then this actor-network can be more powerful than 'objective facts' such as gravity, which was undoubtedly the case for centuries. The persistent debates over facts seen as 'objective' by the scientific community today, such as climatic change and vaccines, only serves to reinforce this point: different communities can recruit the material 'facts' of climate and vaccines into specific actor-networks (climate denial, anti-vaccine movement) to serve different social narratives and political goals. In essence, Latour argues that the social shapes the material as much as the material shapes the social, and that separating these two poles is ultimately meaningless because they are so intricately intertwined. This was the overarching narrative of *We have never been modern*: the Modern project in Western society, from the 18<sup>th</sup> century onwards (as exemplified in the French Enlightenment, for instance), sought to 'purify' the world by drawing up two hermetically-sealed poles of 'Nature' and 'Society'. While this was a powerful device for the development of science as a manipulator of 'nature' for the benefit of 'society', the project failed in Latour's view due to the uncontrollable proliferation of 'quasi-objects' or 'hybrids' that could not be put into any of those convenient boxes. Thus, phenomena such as genetically-modified organisms, climate change and related 'natural' disasters have led to a 'crisis' in our carefully-constructed relationship to 'nature' and materiality. ANT and UPE both argue that traditional approaches to society and materiality are powerless to engage with these profound challenges, as they are trapped in an Enlightenment paradigm. Latour also pointed out that anthropology and ethnography were left to advance further in the discussion of materiality due to their status as 'exotic' disciplines that didn't present a threat to the established values of sociology in the Western world, i.e. the predominance of human agency in shaping the world: they were left to pursue an arguably more fecund approach to society and materiality because they were 'out there'

on the margins, geographically and intellectually. While certain strands of the social and human sciences have claimed to engage with materiality, it seems to always be on society's terms, maintaining the idea of a transcendent social realm that is the ultimate source of power and explanation. Materiality, in this perspective, appears as an enabler or a disruptor of social reality, but is not apprehended on its own terms. Our explanation of the social and the material must be symmetrical and interwoven in order to be effective and address the social, political and environmental 'crisis', such as evidenced in contemporary debates around sustainability and resilience. Thus, for the purposes of this paper, we will envisage materiality as follows, so as to incorporate this principle of radical symmetry. We can envisage the material as what makes the social stable, whilst also leading to its changeability over time and space. Indeed, the material (or, more accurately, the non-human, such as animals and bacteria) is recruited into actor-networks by humans, leading in turn to relatively stable social configurations. These, in turn, can be modified or upended by the creation of new actor-networks, featuring new combinations of material, social and discourse (to follow Latour's typology). This perspective goes beyond seeing the material and the social as two separate realms, on the one hand, and the material as a mere building block (or an obstacle) to human plans, on the other hand. Indeed, material, social and discourse are all 'actants' in these actor-networks, to be analysed symmetrically, and are all granted agency. Thus, if we take the case of the industrial revolution, built around hydrocarbons and new machinery and production technologies (steam engines, factories), we find a vast array of actants, from financiers to captains of industry, as well as masses of employees, salaried employees, and the significant pollution and environmental degradation of burning coal on a massive scale. This strong actor-network was gradually destabilised by increasing social demands for better pay, women's equality, and the health consequences of mass urbanization and poor air quality. New actants, such as rising CO<sub>2</sub> emissions, the welfare state, and the sustainability discourse emerged, each with their level of autonomy and agency, leading to attempts to forge new actor-networks, such as clean production, better housing etc. In each configuration, human actors need to grapple with material realities, leading in turn to new challenges and resultant social and discursive changes. The material and the social are thus intertwined, there is no case for seeing the two as separate realms. Indeed, even changes in legislation and social norms (which could be seen as 'purely social' and independent from the material) will require offices, stationery, buildings, the internet (and its own constellation of material, social and discursive realities) to enact, communicate and enforce. This approach to materiality avoids the pitfall of a commonsensical definition, whilst allowing for the detailed analysis of the actor-networks that constitute the socio-material world, including the current social, technical, economic and political debates around sustainability and resilience.

In what follows, I will proceed in three main steps. I will first discuss the terms of 'sustainability' and 'resilience' as they are being used today, and whether they are at risk of being emptied of their meaning, especially through a lack of engagement with materiality and space/place. I will also argue that these concepts of sustainability and resilience, situated as they are at the junction of material and social, are an ideal locus to foster greater dialogue between materials and social scientists, and can be built upon to improve their contribution. In the second section, I will then explain how ANT and UPE can allow for a better engagement with these parameters, whilst also developing a useful focus on flows and circulation. Lastly, in the third section, I will explore how a better dialogue between the social sciences and business, industry and government can help us to engage more productively with the 'anthropocene' and its consequences.

Section 1: What Are 'sustainability' and 'resilience'? And are they being emptied of their meaning?

The origins of the terms of 'sustainability' and 'resilience' point towards the material and physical basis of these terms, even though their use, in recent years, seems to have drifted. Resilience comes from metallurgy, and refers to a material's capacity to 'bounce back', its 'springiness' (Davoudi et al. 2012). It has therefore come to be used in this sense in fields such as psychology (whether a person can bounce back from trauma) and urban planning, where it refers to a city's capacity to return to the *status quo ante* following a catastrophe, for instance. Thus, Hurricane Katrina in New Orleans was shown to have revealed the city's lack of resilience, with its institutions and infrastructure seemingly falling to pieces, and the city appearing very diminished after the event (Kelman 2003); in contrast, the 9/11 terrorist attacks on New York are said to have demonstrated the city's resilience in its capacity to quickly get 'back to normal' after the events despite the heavy loss of life and damage to infrastructure. Therefore, we see a gradual widening of the meaning of the term, from a rather circumscribed original definition, based in the material world, to a wider meaning, embracing the social, the political and the material.

Sustainability, which achieved growing recognition in the wake of the Brundtland report (1987), comes from the verb to sustain, meaning to maintain, to preserve, to keep things, and has its origins in forestry in 18<sup>th</sup> century Germany, the term being first used by Hans Carl von Carlowitz (German Forestry, n.d.). In this sense, the term is very much about keeping what we have, maintaining the stock and the availability, especially of raw materials like wood, but also minerals and other resources. Thus, the American Progressive movement under president Theodore Roosevelt and his secretary of the Interior Gifford Pinchot can be seen as an early practitioner of 'sustainable' resource management. Indeed, Progressivism called for 'the greatest good for the greatest number', established National Parks and managed the use of resource-rich federal land by corporations to ensure sustained growth and American 'greatness' (Deverell 1994). The term sustainable, though, has seen a considerable widening of its meaning since then. Today's advocates of sustainability would probably not recognize themselves in the figure of big-game-hunting Theodore Roosevelt and his very practically-minded approach to growth and development. Sustainability is commonly used today to signify development that takes into account social, economic and environmental aspects on an equal basis (the 'triple bottom-line'), as opposed to 'traditional' development patterns that give priority to economic aspects. In this sense, it is not really about sustaining as it purports to add a new quality to growth, to 'soften' its hard economic reality as it were. When the word 'development' used to suffice, since it seemed to indicate betterment, it now needs to be prefixed with 'sustainable'; the term promises a 'better', more inclusive form of development. This is indicative of a certain blurring, which can in part be ascribed to a rising use in a variety of contexts over the past few decades.

Both sustainability and resilience have seen a considerable growth in the use of the terms and the range of stakeholders referring to them, as well as a widening of the meaning of the words from their origins. While this is to be applauded to a certain degree, as a sign of a wider embrace of new ways of thinking about growth and development, it also poses the risk of a dilution and even emptying of content of these terms. Is the rising spread of sustainability and resilience (as words if not actual implementation) a threat to their credibility and actual implementation on the ground? While 'sustainability' has been used for longer, it has been obscured in the last decade or so by 'resilience' (itself currently threatened with displacement by the notion of 'smart cities', at least in the field of planning/design). This is partly a function of changing intellectual fashions, of course, but also a result of the dilution of meaning suffered by 'sustainability'. In other terms, the latter has been victim of its success, if by this we mean wide adoption in discourse (if not in actual practice). A rapid overview of business websites and policy pronouncements is enough to see the word 'sustainability' crop up in a multiplicity of contexts, leading to the

growing accusation of 'greenwashing', or simply general fatigue in the face of an over-used term. A Google N-gram search for the frequency of words over time illustrates this rise in use of the term, especially since the 1980s. Another reason 'sustainability' has suffered is the complex politics inherent in its attempt to 'balance' economic, social and environmental aspects. For a start, which of the three should be prioritized? Different sides of the political spectrum, such as businesses and environmental activists, will each choose to prioritise one aspect. To what degree, and how, can the goals be made compatible or even symbiotic? Some will argue that without a solid economic base, there cannot be a sustainable society as there will not be enough jobs; others will claim that if the economic activity in question destroys the environment, then the jobs are illusory. Such debates, entirely legitimate and welcome in a democratic society, sometimes do end up reaching an impasse, which can turn violent, as evidenced, for one example among many, by the bitter standoff over the North Dakota oil pipeline in Standing Rock (Larkey 2017).

Due to this steady erosion through overuse, on the one hand, and the rise of contradictions or tensions between the three poles of sustainability, on the other hand, the use of 'resilience' has grown, especially in the last decade or so. Resilience is concerned with how places and people 'bounce back' after an event such as a natural or anthropogenic (Coaffee et al. 2009) catastrophe, and how cities, for example, can be designed to bounce back better, and faster, with fewer impacts on people's lives and infrastructure (Davoudi et al. 2012, Raco & Street 2012). In this sense, resilience places a greater focus on notions of risk, uncertainty and related aspects of a complex, unpredictable world. This is a welcome and needed evolution, following in the footsteps of Beck's seminal work on the 'risk society' (Beck 1992), where the author showed how the post-modern (or 'post-normal' in the terminology of Funtowicz & Ravetz 1993) society we live in is characterized by the pervasiveness of risk, on the one hand, and how risks are distributed socially and spatially, on the other hand. In other terms, while modern, industrial society was about the production and distribution of *goods*, post-modern society is about the production and distribution of *risk*: who suffers from pollution? Who (unknowingly and unwillingly) eats genetically-modified, or contaminated, food? Who gets hit the hardest when catastrophe strikes the city? These are real, day to day questions that go to the heart of what it is to live in the contemporary world. Thus, resilience aims to analyse risks and their probability of occurring to inform how cities (for example) are designed: what types of flood defences should be designed, for which areas? How high does the flood barrier need to be? How should we design electricity production and distribution systems to withstand a catastrophic event? Will decentralised electricity production (windmills, solar etc.) help? How can we get public transport up and running quickly after an earthquake or fire? In each case, cost and effectiveness of the measures will need to be balanced with the likelihood of the event occurring (100 year flood? 200 year storm event?) and the potential scale of the impacts. Thus, on the face of it, resilience seems more practically-minded and less political (in the sense of breeding controversy) than sustainability. However, just as with sustainability, resilience is also getting embroiled in a range of issues that threaten its usefulness.

One key problem shared by 'sustainability' and 'resilience' is the lack of focus on who, where and why: just *what* are we making more sustainable/resilient, for *whom*, and *why*? In other terms, there is a great need to focus on *space, place and positionality* when discussing these attributes: to paraphrase George Orwell, could some be 'more sustainable or resilient' than others? Who chooses, and through which socio-political process? A related question is *how* things, people, places etc. are being made more sustainable or resilient: in other words, what is the material (physical and technological) aspect of the question? Just when we thought that we were removing politics from the equation, it creeps back in and demands to be addressed. Indeed, cities and their inhabitants demonstrate strong, and rising, inequalities in terms of their exposure to natural (and anthropogenic) catastrophes for instance. Generally speaking, developing world cities are

more exposed, and have the least capacity to prevent and respond due to limited financial resources as well as insufficient infrastructure. However, the picture in reality is more complex, since the wealthier, more politically powerful residents of these developing world cities generally fare much better than their poorer counterparts: for instance, they may reside in gated communities with their own infrastructural systems (generators and other back-up systems, private security etc.). Conversely, poor residents of developed world cities may be particularly hard-hit by disasters due to decades of increasing poverty and lack of infrastructural investment. This has been illustrated recently in the case of Hurricane Katrina in New Orleans (2005), or Hurricane Sandy in New York (2012), with the shocking example of powerful financial institutions in the CBD, such as Goldman-Sachs, benefiting from more resilient electricity connections than the vast majority of the city. Large numbers of residents in poorer parts of the city, often from ethnic minorities, were disconnected from power and other networks for a significant amount of time, revealing once again a multi-tiered access to networked systems, characteristic of dynamics of 'splintering urbanism' (Graham & Marvin 2001) at work for decades. These dynamics of differential connection to networked systems (water, power, energy, transport, telecoms etc.) are in stark contrast to the (however idealized, since there were always underserved areas and populations, often from poorer and/or immigrant backgrounds) 'modern infrastructural ideal' described by the authors, which went roughly from the late 19<sup>th</sup> century to the 1960s/70s, and whereby national governments rolled out heavily cross-subsidized, universalized networks to the general population based on a socio-democratic ideal of equal access and positive health and wellbeing outcomes for the population. The rise of neoliberal policies from the 1970s/80s, however, has seen the gradual dismantling of this ideal, with an attack on cross-subsidies, mass privatizations and 'unbundling' (where a *service* operator is separated from the *network*, i.e. privatization of railways and separation of track and train management into different, competing companies). This has led to increasingly complex service provision arrangements and rising inequalities in terms of access to, and quality of, service (for example with prepaid electricity meters in the UK for poorer households, where unit costs are significantly higher than for regular customers; or the fact that certain areas are connected to high-speed broadband while others have no coverage etc.). In the developing world, this 'modern infrastructural ideal' never occurred, and instead the development of networked services (and infrastructure more generally) followed a pattern of 'islands' of development in a 'sea' of under-connected or unconnected, often illegal or semi-legal urban development (see Smith et al. for a recent overview of issues in Latin America and Africa).

The rise of gated communities, private streets, pseudo-public spaces, CCTV and many other evolutions towards increasingly fragmented, disconnected urban landscapes, in both the developed and developing worlds, combined with inequalities in access to networks and infrastructure, illustrate the fact that cities and their residents experience highly contrasted socio-material circumstances. Thus, any discussion of sustainability or resilience must start from this perspective of radically unequal material circumstances, instead of adopting the usual 'bird's eye' view which seems to assume that all are equal in the face of natural and anthropogenic catastrophe and other major events affecting cities. Longstanding social and racial inequalities are maintained if not accentuated, whilst income polarization is reaching unprecedented levels (Alichi et al 2016), further undermining social and spatial ties in the city. Sustainability and resilience developed with the notion of community at their heart. However, as they are being rolled out today, these terms refer to *islands* of sustainability/resilience in increasingly fragile and fragmented urban environments. Indeed, gated communities, or parts of cities with robust, powerful networked connections, or cities of the developed world generally, may prove more sustainable and resilient to catastrophe, but they will increasingly find themselves surrounded by people and areas experiencing the opposite, a gradual degradation of their living conditions and capacity to weather extreme events (which are planned to become all too common, such as heat waves in the heretofore mild UK; see Smith et al. 2009 for the case of

Manchester and Lee & Sharples 2008 for the case of Sheffield). This will be worsened by the fact of a rapidly ageing population, and not only in the developed world (China for instance is experiencing rapid population ageing, see BBC 2012), as older people are more vulnerable to catastrophic/extreme events as well as social isolation. It is essential to re-focus on people's and cities' material circumstances, as well as their relative position in the evolving reality of fragmenting urban environments, to avoid the mistake of one-size-fits-all sustainability or resilience. The reality is more that of an increasingly fraying patchwork of temporary fixes. Going back to Beck's work on the risk society mentioned above (Beck 1992), risk implies taking into account space and society in a much more fine-grained way, as not all places and not all people are equally affected by risk. In a sense, there is a socially constructed logic of production and distribution of risk at work: the toxic waste dump is not sited in the upper-income neighbourhoods; flood protection measures are better designed and better maintained in white areas than in black ones; access to parks and recreation areas is easier for those possessing cars etc. As we see, attempts to escape the political dimensions of 'sustainability' give us resilience and its attempts to smooth away the political by calling for a 'back to business' scenario. Yet, the business as usual is eminently political, since it is the result of longstanding and complex social and political processes which produce 'winners' and 'losers'. Furthermore, some would argue that 'bouncing back' is not necessarily a good thing: if the state preceding the disruption was so vulnerable to disruption, why should we wish to go back to that situation? For instance, why 'bounce back' to the pre-2008 crisis banking landscape, since that is what got us into the current situation? Thus, there are calls in the resilience research community for replacing 'bouncing back' with 'bouncing forwards' (Davoudi et al. 2012). In other terms, resilience is also riddled with controversies and becoming increasingly politicized too. Maybe this is why the concept of 'smart cities' is now enjoying increasing attention, notwithstanding many problematic aspects (see Marvin et al. 2016 and Picon 2015 for an overview). 'Smart' urbanism places a heavy emphasis on technology, from monitoring traffic and energy use to 'intelligent' buildings in order to achieve sustainability and resilience. In this sense, it fits into narratives of the 'technological sublime' (Latour 1996), whereby the 'silver bullet' of technology can 'solve' seemingly-intractable social and environmental problems. This neglects the way people interact with technologies in a way that sometimes undermines the latter, on the one hand, as well as simpler, low-tech approaches, on the other hand. Thus, 'smart' buildings often follow the template of glass and steel design relying on air conditioning instead of simpler, more economical and vernacular-inspired solutions derived from passive and low-energy architecture. Furthermore, large corporations such as Google and IBM have heavily invested in this field, raising issues of privacy, transparency, as well as concerns regarding hackable, buggy and incomplete software powering these 'smart cities', such as the famous Masdar City in the United Arab Emirates and many examples in China and other developing nations trying to get a head start in this arena with flagship projects. Smart urbanism appears as yet another way of escaping from the political aspects of sustainability and resilience, and letting the 'neutral' algorithms 'manage' society, as is increasingly being rolled out in other areas, such as social media or ecommerce.

Thus, we see that sustainability and resilience, as concepts, are rife with controversies and impasses, at least as currently employed. The emerging concept of 'smart urbanism' appears as another flawed way of avoiding the inherently political core of the debate. Indeed, how we decide to run our cities, businesses and governments cannot be left to algorithms, on the one hand, and to piecemeal approaches to planning and design, on the other hand. To summarise the key problems with the notions of sustainability and resilience as currently employed, we can mention the following:

-a *conservative bias*: maintaining (sustainability) a certain societal state, or returning (resilience) to it, which implies that this state is desirable despite the evidence of shortcom-

ings;

-a *human-centric perspective*: 'preserving' the environment, for instance, in order to primarily enhance human life;

-a *techno-centric bias*: the idea that technology, and technological advancement, will ultimately allow us to 'solve' relationships between humans and their environment;

-as a corollary to the above, a *capitalist-centric perspective*: market-based solutions, including technology and financial mechanisms, will allow for the advancement of sustainability and resilience.

These concepts do contain interesting promises however. Indeed, they mark a positive desire to move away from a totally human-centric vision of development, on the one hand, with the acknowledgment of the existence of other species and their importance (albeit, too often, in relation to our own wellbeing or survival). On the other hand, they introduce a necessary reflection on inequalities, not only between humans and non-humans, but also between different social, ethnic and gender groups, in contrast to top-down approaches to development, centred around (usually white and male) managers or engineers. Furthermore, they open the door to taking into account the materiality of social life, on the one hand, and the imbrication of the human and non-human in world affairs, on the other hand. It is no longer tenable, with a straight face (although this still occurs frequently) to see humans as bravely building their world as they see fit, with a stubborn faith in technology's capacity to save the day and ensure endless growth and wellbeing for all. Thus, it can be said that the deployment of the concepts (if not the realities) of sustainability and resilience have opened the gates to new ways of envisioning humans, science and 'the environment', and that they can form the building blocks of real change. Indeed, as Latour reminds us, controversies and disagreements are a key starting point of conceptual and empirical progress, and the mark of successful actor-networks, albeit 'unstabilised' ones: new alliances need to be made to 'solidify' these concepts and give them real power in effecting change.

Therefore, we may ask how a more appropriate and effective way of envisioning contemporary life, with its complex opportunities and challenges, be devised? One that would avoid falling into the one-size-fits-all trap, as well as debates that end in impasses? This is what we now turn to with the examination of promising theoretical approaches that allow to more productively engage with the materiality of human life, whilst exploring socio-political conditions in a more nuanced way.

## Section 2: Using ANT and UPE as approaches to re-engage with materiality

The last two decades or so have seen the development of approaches in the social sciences that allow for a better engagement with the material conditions of human life, on the one hand, and for a potentially more fruitful dialogue with the worlds of industry, business and government, on the other hand. These approaches are many, but I will focus here on actor-network theory (ANT) and urban political ecology (UPE), and draw on illustrative examples from my research in three areas: waste management in the steel industry; urban climate science and urban design; and eco-urbanism in the developed and developing world. These approaches engage with materiality and technology, as well as industrial processes and governance. They also strive to situate people and places within their context, and point out the significant inequalities in how our world operates today.

ANT and UPE have emerged over the last 2 decades as responses to a perceived lack of engagement with materiality on the part of the social sciences, or, rather, as we have

discussed above, a limited account of materiality. Indeed, as mentioned in the introduction, modern social sciences emerged as a scientific practice in the late C19, with seminal work by Durkheim (1982) and Max Weber (2012, 2013) in France and Germany respectively. This groundbreaking work on the part of these ‘founding fathers’ aimed at modelling the social sciences on the hard sciences in terms of methods and objects. While their approaches and methods were very different, these authors shared a vision of the social as somewhat disembodied from material and spatial conditions. Thus, in Durkheim’s work there is clearly a realm of ‘the social’, which is to be considered as a ‘thing in itself’, a force which somehow ‘structures’ human activity. Max Weber developed a thorough typology of ‘rationality’ as it shapes and constrains human activity, without materially situating this ‘rationality’. In none of these approaches does the materiality of existence feature as more than a backdrop, or only in the sense of something that has been absolutely molded and shaped by humans and for humans. These approaches, it must be emphasised, were a great step forwards in their historical context, especially in terms of explaining the massive social, political and psychological changes accompanying industrialization. The latter saw the rapid fraying of traditional societies and their modes of regulation, with sometimes tragic consequences, as analysed in Durkheim’s classical work on suicide, for instance (Durkheim 2002). The latter piece of work also illustrates the complexity of approaches often simplified as being about a disembodied and transcendent social reality structuring action, sometimes to the point where humans seem to possess little or no agency. In the case of suicide, Durkheim’s work borrowed from psychology and religious studies, which went some way towards nuancing the role of social structures as all-encompassing. However, it was clearly his goal to establish the social as a defining force (akin, in a way, to gravity or other physical forces), which could be scientifically isolated and described beyond individual variations.

Thus, with the rise of postmodern society, and the shift from structure to agency (from the collective to the individual), these approaches can seem somewhat unsatisfactory in explaining rapid change and new ways of life in society, from the collapse of patriarchy to new relationships to the environment and work, where overarching patterns seem hard to discern with the certainty of the ‘founding fathers’ of sociology. Indeed, classical approaches are now what we could call circular or bootstrapped: ‘the social’, a transcendent force, defines and structures social life, which in turn becomes ‘the social’ that will structure future activity, on the one hand, and people’s relationship to things and the material world on the other hand, etc. The work of a third ‘found father’, Karl Marx, was very different, with its strong focus on material conditions and the physical realities of life; furthermore, a forgotten founding figure, and one who was hugely influential for Bruno Latour, can be seen in the work of Gabriel Tarde and his focus on networks and the widening of the capacity for action (agency) beyond humans. We will come back to these figures later, as they opened the ways for approaches that are more suited to the perspective we wish to develop here.

Clearly, there is space here for approaches that give the material world and materiality considerably more agency than has been the case. Thus, actor-network theory (ANT), developed by French sociologist and philosopher Bruno Latour (see Latour 2005 for an overview) is based on a radical acknowledgement of the agency of non-humans (things, matter, other living beings, but also ideas and concepts). In his analysis of *Laboratory Life* (Latour & Woolgar 1986) or in *The Pasteurization of France* (Latour 1993b) Latour shows the process of creating scientific ‘facts’, which in his view is a co-creation by humans and non-humans to ‘make things speak’ in reproducible and convincing ways, until these findings are in turn challenged. Thus, scientists need to assemble ‘actor-networks’ of, for instance, bacteria, concepts, microscopes and graphs to create the fact of ‘infection’ or ‘anthrax’. Where Max Weber would speak of the different forms of rationality at work in different periods of history (feudal or modern bureaucratic society for instance), acting as a structuring force, Latour asks: what is rationality’s office number? Where is the building located? What documents and procedures does ‘rationality’ use to effect

changes? Does the invention of the telegraph and the internet change how rationality presents itself and acts in the world? In other terms, what is the actor-network that we call 'rationality', comprising of which material, social and discursive parameters? How does one actor-network come to dominate, in one specific place and time? And why does it become superseded by another one? The stronger the elements recruited in this actor-network, the more cogent the 'fact'. Conversely, an actor-network may be too weak to win the day, as in the case described in *Aramis, Or the love of technology* (Latour 1996) of the self-driving cars (PRT) proposed by Matra in France. Although the engineers allied themselves with strong technology, they were unable to include politicians in their actor-network, explaining how an apparently 'superior' technology may be abandoned in favour of seemingly 'inferior' solutions (or a how a seemingly 'great' technology may be undermined by human actions). With his work, Latour has widened the scope of social scientific analysis, removing people from the centre-stage and emphasizing interconnections and networks. Part of this was drawn from Tarde's work, which Latour has cited as a key influence in his approach.

Urban political ecology (UPE) is another approach that has sought to better engage with the materiality of human life, by emphasizing the links between socio-political dynamics in the city and natural/environmental conditions. Instead of seeing rivers, copper mines and hills as mere backdrops to the drama of human life, UPE shows how these are part and parcel of struggles for power, domination and the thirst for urban growth. In cities as varied as Guayaquil (Swyngedouw 2004), New Orleans (Kelman 2003), New York (Gandy 2003), Athens (Kaika 1999), and many others in different epochs and places, authors from the field of UPE have shown how the control of natural resources and flows (water, energy, waste etc.) is intimately tied to socio-political power and domination more generally. For instance, in the fascinating case of Los Angeles (Mulholland 2002; Kahrl 1983; MacKillop and Boudreau 2008), it is clear that a white, Anglo-Saxon 'oligarchy' (MacKillop 2004) intent on 'whitewashing' (Deverell 2005) the city of its Spanish and Latin-American roots to establish a 'new Italy' of white, mid-western settlers on the Pacific, achieved control of the city and its surrounding areas' water resources by means both legal and not (as described in fictional form in Polanski's *Chinatown* movie). At the beginning of the C20, this 'oligarchy', around the figurehead of 'colonel' Harrison G. Otis, engaged in massive real-estate speculation in the San Fernando Valley, North of the city, and procured the vast quantities of water required to develop this land into lucrative real-estate. Opponents of their plans were publicly pilloried in the newspaper controlled by Otis, the *Los Angeles Times*. The Owens Valley, hundreds of miles North of the city, was one of the biggest victims of the city's 'water grab': land was secretly purchased in the area by LA operatives, in order to secure the water rights attached to it. Then an aqueduct was built to transfer this water to Los Angeles, ensuring the 'city of angels' would grow into the giant, sprawling metropolis envisioned by its leaders and sold to its population. As a result, the Owens Valley slowly died both figuratively (with dwindling water came rising unemployment) and literally, with the drying up of rivers and lakes, with the emblematic Mono Lake turning into a dust bowl. With control of water and land resources, the oligarchy allied around Otis, leaning on the technocracy of William Mulholland's Department of Water and Power, achieved control over political and cultural life in Los Angeles for decades, with far-reaching consequences in terms of racism, police brutality, attitude to unions and other elements that became notorious characteristics of the cities until very recently.

ANT and UPE both reject the distinction, inherited from the Enlightenment, of a rigid separation between 'nature' and 'society'; Latour, in an appropriately-named essay (Latour 1993), describes how this enterprise of 'purification', aimed at separating human from non-human, is an artificial and cumbersome construct that had slowly been eroding until such 'hybrids' as nuclear energy, genetically-modified food and a host of bio-mechanical implants made this dichotomy untenable. Indeed, where to position climatic change and its impacts, for instance, on the nature-society continuum inherited from Enlightenment

thought? It is neither a fully 'natural' process nor a clearly 'social' one, but a complex mix of both, with feedback loops and threshold effects that we do not fully understand—and that are bitterly contested. We are then led to conclude, with famous urbanist and journalist Jane Jacobs (2000), that:

*Human beings are, of course, a part of nature, as much so as grizzly bears or bees of whales or sorghum cane. The cities of human beings are as natural, being a product of one form of nature, as the colonies of prairie dogs or the beds of oysters.*

Likewise, urban political ecology shows the intricate intermingling of 'natural' and 'social' (or human and non-human) in the shaping of cities, their people, economies and environment. It is impossible to say where 'nature' ends and 'society' starts. We are in a world of 'hybrids', combining material, culture, language, technologies, ideologies, hopes and desires etc.

Another key point to these approaches is the focus on flows, circulation and metabolism. This last term, borrowed from the physical and natural sciences by Karl Marx (1987) in the mid-C19, refers to the exchanges (the original German term is '*Stoffwechsel*') of matter occurring constantly around us, embodied by flows of materials, people and energy. ANT and UPE both make space for the reality of flows and dynamic systems, relevant to a world of uncertainty and change. Cities are obvious places to observe these processes, at multiple scales, as flows of cars, money, waste and greenhouse gases, to take just a few examples, constantly occur. Thinking in terms of flows and exchanges, of circulation, is essential in a world marked by complexity, instability and chaos.

I have applied these approaches in my research on several topics, and I propose to show, in what follows, the benefits of using ANT/UPE perspectives to more fruitfully engage with materiality in research in the social sciences. Through this overview of my research, I will illustrate how ANT and UPE offer us more effective ways of envisaging sustainability and resilience in a wide range of key areas, touching on industry, urban design and governance. For each of the following areas of research, I will emphasize the benefits of using ANT/UPE as a framework, in contrast to other approaches, in terms of bringing to the fore different ways of envisaging materiality.

My research on waste management in the steel industry (MacKillop 2009 and 2012) was an opportunity to use ANT to understand the emergence of 'waste', both as a physical reality and a socio-material construct. Steel production itself can be construed as an actor-network, as it is the result of forging alliances between materials (iron ore, coking coal etc.), rules and regulations (environmental and health & safety laws governing steel plants), the international market for steel products, and the various technologies, traditions and practices present on a steel plant. If any of these is missing, then production cannot occur in a profitable and efficient way. My research analyzed how 'waste' emerged, on-plant and beyond, including contractors' operations. What was categorized as 'waste' varied based on material realities (e.g. certain oily wastes were particularly hard to deal with), fluctuations in the market (with iron ore prices high, efforts to recover value from heretofore 'waste' products were emphasized), as well as local practices and attitudes (e.g. approaches to plastic waste on plants). Beyond these details, the core idea here is that 'waste' is far from being an immutable category. It varies in space and time, even within the same company (the business I studied had plants in several different countries and used different production processes, e.g. blast furnaces and electric-arc furnaces). One interviewee told me that, given a few decades or even centuries, piles of buried 'waste' from steelmaking would be dug up to recover the iron ore and other materials, when permitted by technology and/or market conditions. Today's 'waste' may be a valuable commodity in a different time and place, as also evidenced today with the vast flows of e-waste from developed countries to the global South, for example. What is, then,

a 'sustainable' approach to waste in a given place and time, and under specific market and regulatory conditions, can become an environmental crisis in other contexts, and vice-versa. Thus, on one of the steel plants I researched, a material that had heretofore not been classified as a waste in the law, suddenly became one with a change of regulation, leading to a crisis for the steel company, as they were uncertain what to do with a material which up to now had been stored on-site as an inert, harmless material. The company also struggled to reprocess certain wastes due to insufficient recycling capacity in Europe, combined with the ban on exporting any waste to third countries. Thus the company's waste policy was constantly challenged due to a shift in a variety of areas; the same material was flowing into the waste category and back again. The use of ANT as a conceptual framework offered many benefits in approaching this field of industrial waste management. In contrast to social constructionist views, whereby waste would be somehow purely socially determined, on the one hand, and in contrast to technologically-centred views, whereby waste is simply a matter of using the right technology in the right place, on the other hand, ANT allowed me to trace the complex actor-network of waste. The latter comprises of social, material and discursive elements, as it is a function of material realities, certainly, but also of labour practices on the plant as well as constantly shifting laws, regulations and economic circumstances that tie local practices to global markets and technological developments. Thus, what is 'waste' at one point can become 'value' (and vice-versa) when parameters of the actor-network shift, with the potential to surprise human actors and destabilize established ways of doing things. We thus move beyond a dichotomous and simplistic view towards something more dynamic. By shifting the focus, recommendations on how to improve waste management in this and other industries can also evolve, from an insistence on technology, or the fatalism of 'deferring to market conditions', towards a reflection on work practices and attitudes on the plant, from management to the shop floor. Likewise, different national cultures around waste and production come into play. Thus, the contributions of ethnographic research to sustainable industrial processes (and of the social sciences more generally) become apparent.

Another area where the lack of focus on context can lead to sustainability and resilience problems is in the related, but sadly under-communicating, fields of urban climate science and urban design (Hebbert and MacKillop 2013; MacKillop 2012). Urban climate science (UCS) has a long history, dating back to Vitruvius in the West and even older Chinese concepts of feng-shue. UCS advances some simple precepts, such as judicious orientation of buildings to light and airflows, and construction that is adapted to local climatic realities and the ways people use buildings in context. Today, the field of passive and low-energy architecture (PLEA) embodies these approaches that allow for more sustainable and resilient houses and offices, by reducing energy consumption and increasing comfort, whilst being aesthetically and culturally pleasing. However, despite a series of international meetings and symposia organized in the 1960s and 1970s under the aegis of the World Meteorological Organization and other bodies, UCS and urban design have not established a successful dialogue. The majority of buildings today are built according to standard Western templates, leading to growing cities of skyscrapers that rely heavily on air-conditioning. These buildings are not energy-efficient and often not in line with local vernacular architecture, also leading to blandness and loss of urban character. These buildings are neither sustainable nor resilient, as they depend on vast amounts of energy for their construction, maintenance and operation. In this sense, they embody the lack of attention to the local context and its material, climatic and cultural realities, whilst still claiming to be 'sustainable' via labels such as LEED or BREEAM, and the use of 'smart' technologies for heating and cooling, for instance. We have another instance of something that is 'sustainable' in isolation and a purely abstract way, regardless of the energy metabolism of such buildings and their impacts on local and global climates and resource use. ANT has been applied to planning practice in several instances (see Rydin 2010 and 2012; Tait and Jenson 2007; Boelens 2010; Tait 2010), especially to discussions of what 'sustainable' and 'resilient' planning practices, and their results, can look like. It appears

that these qualities of the built environment may (or may not) emerge as a result of flows of knowledge between expert groups (such as urban climate scientists and urban designers, as mentioned above) occurring or not; local regulations and their highly variable interpretations of sustainability/resilience (e.g. the 'hybrid' system emerging in China where regulations are a combination of British and US standards combined with local and national political realities, especially circuits of power and patronage—see Caprotti 2014 for an illuminating example in Tianjin eco-city); fluxes in the market for real-estate and their local form (e.g. the rise in demand for gated communities and 'secure' living environments worldwide); or even just fashions (as seen in the rise of the 'smart city' discourse in the last decade). Here too, as with the above example of steel, the use of ANT allowed me to describe and discuss the attempts to forge an actor-network around urban climate science and urban design. The establishment of this actor-network failed, for a variety of reasons, underlining the complexity of mobilizing 'good' knowledge and practices to achieve greater sustainability and resilience in urban design. Indeed, while the principles of urban climate science are well established and go back thousands of years for some of them, and while research in this field is buoyant, most of these principles are ignored in the day to day operations of the construction industry and in urban governance practices. Again, this is not a case of simplistic explanations, grounded in either socio-political or material factors, such as the reticence of the construction industry to change established practices or the limited capacity for innovation in urban governance holding sway. While these undoubtedly played a role, they must be taken into account alongside a reflection on how knowledge flows or not, through conduits such as international summits, reports or international organisations such as the WMO or the UN. Thus, ANT allows us to trace the ramifications of this particular actor-network, encompassing the social, the material and the discursive. This in turn opens the door for suggestions on how to facilitate flows of knowledge, with perhaps a shift away from centralized, top-down approaches (as advocated within the WMO, IFHTP and CIB in the 1960s/70s) towards the distributed, online logic now favoured by organisations such as the International Association for Urban Climate (ICUC 2017), which has encountered a measure of success in facilitating a dialogue between the communities of urban climate science and urban design.

Lastly, another area of research that is relevant to the arguments here is that of eco-urbanism, which also encompasses the growing 'smart cities' dynamic. Eco-urbanism is presented as way of preserving the environment, but what environment is being preserved, and for whom? There is a certain artificiality and mise-en-scene of the 'environment' for those who are rich/powerful enough to pay to live in these eco-cities. There is often a short step from 'eco-city' to 'gated community', especially in the developing world where both are growing fast (e.g. China and India). There is also an element of spectacle/performance on the part of national or regional/local governments wishing to demonstrate their ability to deliver 'eco-urbanism', even if on a small scale or causing other problems (e.g. displacement of poor populations or those without enough social/political power to resist). In this sense, eco-cities have become a new form of international competition between countries eager to be the 'leader' in a given area. Eco-cities and their 'cousins' smart cities, are heavy on technology, which is presented as a 'solution' to a host of urban environmental and social problems, from traffic, to energy use to crime. Urban political ecology has a lot to say about such 'manufactured environments' and how they fit into dynamics of power, domination and resource control (Swyngedouw 2004, Swyngedouw & Kaika 2005, Gandy 2002). Here, the use of UPE allows the researcher to reframe eco and smart urbanism as the material embodiment of social, political, economic and discursive strategies deployed by the powerful to enact surveillance and socio-spatial segregation under the aegis of a discourse on security and environmental preservation. In effect, what occurs with smart and eco urbanism is often a new form of 'bypass' and 'premium network spaces' (Graham and Marvin 2001), whereby certain sections of the population benefit from greater technological and environmental conditions and amenities (smart homes and energy systems, high-quality residential estates etc.). UPE

frames such interventions in the built environment as socio-political and technological changes to the material environment that serve to entrench existing patterns of power and domination. However, the agency of materiality remains present, since developing enclaves of 'preserved nature' in isolation neglects the interconnectedness of water resources or the capacity for air pollution to travel between these arbitrary boundaries. Likewise, protest movements against the surveillance society or the greater segregation of cities, which threaten the stability of the eco and smart city envisaged by the elites, are also taken into account by UPE. Again, as with ANT, the material and the social are taken symmetrically, with due consideration for their agency and mutual shaping.

Fundamental research and reflection on concepts of sustainability and resilience are essential, but for them to reach fruition, there needs to be a greater dialogue between the social sciences (including planning, anthropology, ethnography and sociology) and industry, business and government. The reality is that this dialogue does not occur sufficiently and is not profound enough at this time. It is often all-too-hard for social scientists to be considered by these sectors, although the previously mentioned work by Latour, for example, shows the possibility of fruitful engagement and that social science can be taken seriously. In the following section, I develop some ideas as to how this greater dialogue could take shape, especially taking into account the growing rejection of 'expert' and 'academic' discourse that is characteristic of our times.

### Section 3: How to work towards better dialogue between the social sciences, industry, business, government and citizens

Business, industry, government and citizens in general have a central role to play in advancing 'sustainability' and 'resilience', however debated these terms may be in practice. It is indeed now clear that humanity is transforming its environment faster than before, with increasingly serious consequences, leading to current talks of the 'anthropocene' (Economist 2011). These consequences sometimes take the shape of catastrophic 'natural' events (or rather socio-natural ones, to use the ANT and UPE terminology) that hit cities, with devastating impacts. To this must be added the vulnerability of cities to 'manmade' catastrophe and events, as illustrated by the (still unfolding) Fukushima power plant disaster in 2011, or repeated instances of terror attacks on cities throughout the world. Of course, as the preceding examples show, 'natural' and 'manmade' are increasingly blurred categories, since Fukushima for instance combined tidal waves and other weather events (maybe influenced by anthropogenic climate change), inadequate planning and building standards, and human manipulation of the atom through scientific theory and technologies. In other words, this was clearly an actor-network, comprised of a multitude of complex 'actants'. This actor-network was severed in the catastrophe, producing new actor-networks, such as radiation pollution or the socio-political decision in Germany to abandon nuclear power. This itself will engender other actor-networks etc. in a cascade of interactions, leading to further complexity, an example of how ripples in one area create waves of change.

It is clear that citizens, government, business, industry and science/academia need to collaborate and exchange to advance wellbeing in an urban, anthropogenic century. But how can this be done effectively? And with what possible beneficial outcomes? This is what we now turn to in this last section of this paper, starting with the accelerating rejection of expert discourse and its consequences.

Since the 1960s, in the West, there has been a gradual rejection of the rule of the expert and a call for greater citizen involvement, whether in planning, environmental policy or waste management, just to take of few of the often highly contentious areas where this debate has played out. This challenge to experts was illustrated in a striking way in New York at that time with the controversy surrounding Robert Moses' actions as planning 'czar' in the city (See Caro 2004 for a magisterial discussion). Having accumulated enor-

mous power, Moses proceeded to remodel the city, clearing what he regarded as 'slums' (old, mainly immigrant neighbourhoods experiencing various levels of disrepair) and driving large motorways through the city alongside a generally massive programme of public works designed to usher the city into 'modernity'. However, this often heavy-handed approach led to opposition, which was charismatically embodied by the figure of Jane Jacobs, a journalist by training who wrote what is still one of the most influential books on planning of the last few decades, *The death and life of great American cities* (Jacobs 2000). This opposition thus pitted an 'expert' against a 'laywoman', in an era of rampant sexism (notoriously illustrated by Lewis Mumford's comments in the *New Yorker* on the 'housewife' Jacobs) and high regard for technocrats. Despite these obstacles, Jacobs successfully defended neighbourhoods described as 'slums', showing that they were in fact lively areas with similar or lower crime rates than the large-scale housing estates promoted at the time, in the spirit of Modernism and progress (and which are now, today, in an interesting irony of history, seen as highly problematical and demolished whenever possible). In doing so, Jacobs advanced the notion, now commonplace, that 'eyes on the street' and citizens having a stake in the wellbeing of their neighbourhoods are key to successful cities. She showed that experts do not always know best and that citizen involvement in policy and planning can deliver community benefits. In the decades following this turning point, the rejection of 'top-down' styles of planning would accelerate, together with calls for increasing 'citizen involvement', though not necessarily with a clear definition of the latter and what it was supposed to achieve. This (still unfolding) dynamic of the 'death of the expert' was illustrated strikingly in the past few months with the shocking news of 'Brexit' and the election of Donald Trump as US President, both symptomatic of a 'post-fact' approach in public life and citizen decision-making. But the increasing rejection of the 'expert' and a leaning towards 'alternative facts', as evidenced with the rising popularity of the anti-vaccine movement or the host of conspiracy 'theories' propagated online, concerning 9/11 and other events, has been brewing since the 1980s at least, as discussed by Beck (1992) in his *Risk Society*, where he pointed to the rise in 'hybrids', such as GMOs and radiation pollution as a threat to traditional forms of social and political legitimacy. This reality has only accelerated with the rate of technological progress, instant communication on myriad platforms, and the erosion of traditional authorities such as religion, government and media. In a post-Chernobyl, post-GMO era, marked by the rise of climate change and populist politics, it is hard for the experts to compete, despite having 'science' and 'authority' as bulwarks. The question is not whether general opinions should be rejected and the expert reinstated as the one and only voice, as this seems impossible on the one hand, and not desirable, on the other hand, as evidenced by the serious mistakes (and lies) made by science and government throughout history. But what balance can and should be established between expert science and citizen/community input, in planning, government, decision-making etc., in an increasingly complex and unstable world? This is what I wish to modestly discuss here, in the sense of opening up to questions, again based upon the political philosophies of UPE and ANT (and my own research), rather than providing any kind of 'answer'. It is hoped this will help as well in establishing a discussion between the social sciences and the worlds of business, government and industry, since the latter are such influential shapers of the world we live in, and are often reticent to give up their power to 'ordinary' citizens, or to discuss sincerely with 'non-experts'.

The social sciences have also reflected this trend towards the rejection of authority in the governance of society, especially in science and technology and with regard to environmental issues. On top of the work mentioned previously, fields such as the studies of science and technology (STS) have documented and discussed the rising complexity and disagreements over what is accepted fact and science in a pluralist society, and emphasised the need for pluridisciplinarity and cooperation between 'hard' and 'soft' sciences (see Bauer 1990 for one example among many). Related developments in the social sciences have also laid the ground for new perspectives on science, society and materiality.

Thus, to take but one example, the field of the public understanding of science (PUS) has brought to the fore the role of discourses and beliefs in the making of scientific facts as well as their communication and understandings by an increasingly fragmented audience. Where it was once thought that there was one acceptable model of science to be accepted by an equally homogenous body of 'public opinion', PUS has endeavoured to open these 'black boxes' to emphasise complexity, disagreements and challenges, and move beyond a simplistic 'deficit' model for instance (see Sturgis and Allum 2004 for a helpful overview). ANT and UPE are inheritors of this shift, which they have sought to build upon and expand. While they aim to be scientific and neutral in terms of their approaches and methods, ANT and UPE are part of a progressive vein in the social sciences that seeks to expose mechanisms of social power and domination, so as to help emancipate citizens. Through in-depth case studies, work in these fields aims to go to the 'root causes' of how our world operates in terms of control and distribution of resources, showing how such states have been socio-politically constructed over the long term, and how they may be changed. Thus, Swyngedouw's work on the history of water in Guayaquil (Swyngedouw 2004) or Kelman's work on New Orleans (Kelman 2003), to take but two examples in a vast range of studies, document the socio-political and socio-environmental history of control by certain social groups over resources, and how this has affected people and the environment in sometimes dramatic ways. Matters of quality of life, health, racism, environmental destruction etc. are shown to be tied to social and political processes and not just to have somehow 'happened' because certain groups somehow deserve better conditions than others or are 'superior'. Likewise, ANT develops an 'ontology', meaning a philosophical reflection on what things are, their essence as things, and the way they relate to one another, in this case in the form of 'actor-networks'. ANT takes the radical starting point of 'flattening' ontologies, i.e. giving 'agency' (the power to act) to (non-human) things, which are renamed 'actants'. Living things and humans are also 'actants' (or hybrids, quasi-objects and other terms that have been used by Latour and others as research in ANT has evolved; see Callon in Law 1986, for example), thus putting everyone and everything on the same (philosophical) plane. In this sense, power is not immanent to anyone or anything, but has to be painstakingly *assembled and maintained* through a complex work of negotiation and re-negotiation. This is evident in the work of government in democracies as well as dictatorships: a certain number of interests need to be aligned for a party or person to get to, and remain in, power. Coalitions collapse regularly and even dictators are executed or flee, eventually. It is also evident in the work of building a car or an aeroplane (assembling a wide array of disparate materials in the service of driving or flying), and maintaining said assemblages; and this is without taking into account the bewildering number of 'actants' that need to be assembled, and kept assembled: fuel, service stations, computer programmes, air stewards and their uniforms and unions, air traffic controllers, motorways and the financial mechanism that keep them maintained and funded, etc. In turn, each of these, when analysed, is its own actor-network, built upon complex actants etc. By drawing our focus to the assembled nature of things, ANT aims not (only) to bewilder, but to encourage a sense of humility (humans are not in control as much as they think they are) as well as possibility (things can, and do, change, including in the political realm).

So how do we bring together what we have established above? The rejection of the expert and 'top-down' approaches to society, on the one hand, and the emancipatory political philosophies of ANT and UPE, on the other hand? It is clear that going for a fully 'expert-less' future will be impractical, to say the least, as evidenced by past attempts, such as during Mao's 'cultural revolution', which saw all manner of experts being sent to camps to be 'reeducated'. This led not only to atrocious violence against people, but also to the economy and agriculture collapsing and millions dying from famine. Similar processes unfolded in Soviet Russia, especially under Stalin, and today in a country like North Korea. The increasing participation of non-experts through the internet and other forums is generally a positive evolution, since it allows for a plurality of voices to be

heard (if not necessarily taken into account), with interesting contributions such as the online encyclopedia Wikipedia or depression support forums. It is also no longer as socially acceptable as even a few decades ago for matters to be decided by 'old boys' clubs' behind closed doors, although of course this continues to occur. There are forms of uncodified knowledge, diffused through society, which are useful with regards to the challenges of sustainability and resilience. An example of this is the case of urban gardens and urban agriculture in shrinking cities, such as Detroit in the USA, where beneficial agricultural and citizen-led construction activities take place on abandoned parcels of land in a city that has suffered devastation. It can be seen that the internet and increasing global connections allow for bottom-up citizen-led projects that work for a common good, however messily-defined, and carrying the prospect of emancipation and improvement in life conditions where government, industry and businesses have failed to do so over decades. However, the rejection of the expert can lead to excesses such as the 'anti-vaccine' movement, which is based on pure fantasy, and ugly beliefs in conspiracy theories of all ilk, such as those that surround 9/11 in the USA. The internet can be a forum for debate but it also breeds the infamous 'trolls', 'fake news' and other abuses. So what would be a next step, that could combine citizen knowledge, academic research in the social sciences, and business, industry and government? Are there examples of such collaborations, and how could they be scaled? In this final section, I will draw upon some promising examples based on my own experience of research involving these stakeholders.

One example of promising collaboration between a wide range of stakeholders in advancing sustainability and resilience in city planning and design can be found in several research projects I was involved in in Manchester, UK (MacKillop 2012). These projects are the Bruntwood 'eco-cities' initiative and the Green and Blue spaces (GRABS) project. The Bruntwood eco-cities initiative was a partnership between a property company (Bruntwood), and the University of Manchester, to strengthen resilience in the face of a changing climate. It also involved partner cities throughout the globe (Austin, Nagoya, Dhaka and Singapore), and a very large range of local stakeholders, from the municipal government, to businesses and citizens. The project covered risks as varied as flooding, heat and cold, carbon emissions and the state of the economy, in order to devise a range of scenarios for the city at the 2050 horizon. A very strong emphasis was placed on outreach, with modern tools of communication (such as Twitter and Facebook), town-hall style meetings, leafleting etc. used to engage the public as widely as possible. Several of the project's recommendations have been adopted into local policy by the city of Manchester, thus defining a local vision of sustainability and resilience, which takes into account the global realities that shape the city's trajectory. The GRABS project (2012) focused on the potential of green and blue spaces (water bodies) in mitigating of, and adapting to climatic change in the urban environment. The perspective was international as the project was funded by the EU, and led to the development of an open-access assessment tool that allows users to assess potential for climate change adaptation and mitigation in urban development and regeneration, thus contributing to greater sustainability and resilience for the decades ahead. The project involved academics, planners and designers, construction and real-estate companies, as well as citizens from the different countries involved, and has received prizes for its ease of use and contribution to knowledge exchange.

Another project where I witnessed interesting steps towards collaboration between stakeholders was in the development of the Brisbane suburb of Springfield in Queensland, Australia (MacKillop 2013). This master-planned community involved private business (the Sinnathamby real-estate group), local, regional and national government, the University of Southern Queensland and the University of Queensland, and a wide range of local stakeholders, from concerned citizens to environmentalists preoccupied by the potential impacts on the local koala population, for instance. A key goal of the project to develop a large, greenfield suburb was in providing affordable and sustainable housing in a region experiencing high pressure on both counts, and set to experience significant ef-

fects of climatic change in the coming decades. Water supply and resilience to floods and fires were another key aspect. Local populations had strong views on maintaining the environmental quality of the area, but were also strongly motivated by the need for affordable housing and local job availability, as well as effective transport links to Brisbane and other centres of employment nearby. Through a cooperative planning process involving the parties mentioned above, the design of the community was based around energy-efficient housing (use of shading, green roofs, orientation towards the light, solar hot water heating etc.) in order to reduce money spent on cooling, a major component of the budget in the hot and humid climate. The master plan for Springfield emphasizes mixed-use development, with housing, employment and leisure located nearby so as to reduce car-dependency and avoid the emergence of an oil-dependent suburb. Walking trails allow for pedestrian access to address rising obesity levels and lack of exercise. In cooperation with the Queensland Government and Queensland Rail, a light rail link to Brisbane came into operation to improve connectivity and also reduce car use. Significant ecological areas, such as woodlands and wetlands, were preserved as local parks so as to not affect the local habitat of koalas and other threatened species. Furthermore, an emphasis was placed on knowledge and health as local economic drivers, with the 'Education City' and 'Health City' campuses built onsite to provide high-paying jobs that are future-looking. Thus, rather than a traditional commuter suburb depending on the nearby metropolis, Springfield has emerged as a city in itself, offering residents what is needed for a fulfilling life without depending on car travel.

We may briefly reflect here on what made the above projects successful in integrating the perspectives of citizens, academia, business and government, and how these teachings may serve in other potential collaborations for sustainable and resilient urban development. One key aspect is integrating economic, environmental and social concerns from the bottom-up, instead of trying to retrofit elements into the finished design, which is costlier and disruptive to residents. This requires large-scale consultation, using modern tools (social media) but also traditional arenas such as focus groups or town-hall meetings. Furthermore, collaboration between academia, government and business must be sustained, and based on long-term exchange of information and practices, such as through industry-funded research with government facilitation. On the academics' part, willingness to engage with the realities of business (i.e. the necessity to make a profit) can help facilitate the collaboration, by for instance showing the benefit of approaches that satisfy multiple goals at the same time: for instance, more resilient cities with healthy workforces that can easily access transport will result in better outputs at work and less sickness leave. Likewise when engaging with government: solar panels can help reduce the load on the electric system, sustainable drainage systems will reduce the required scale of the drainage system, and nature trails, by increasing the opportunities for exercise, can reduce healthcare costs. Social scientists can provide key insights by conducting consultation exercises with the stakeholders, and connect these to wider knowledge about health and wellbeing in communities or productivity at work. It is another case of getting to know, in detail, the local experience of local populations at a fine-grained scale and not relying solely on general statistics and an idealized image of a 'given citizen'. Differences in culture and history will play a part in how people respond to business and government initiatives, and this is not knowledge that these stakeholders necessarily know or care to know in detail. Sociology, ethnography, the studies of science and technology (such as ANT) and the social sciences of the environment (such as UPE) therefore have a considerable amount to offer, as they can draw on a rich and growing body of work, with evidence from a wide range of places and times, to help enrich local efforts to deliver sustainability and resilience.

## Conclusions

This paper is meant as a personal reflection, based on close to 15 years of research in

the fields of planning, urban history, natural resource management, and the studies of human-technology interaction. It is informed by current debates on sustainability and resilience, and the feeling that these concepts are reaching dead-ends and getting mired in controversy, whilst conversely being emptied of their potential for transformation. There is a risk that our fragmented and polarized world becomes even more so with the spread of weakened interpretations of resilience and sustainability, often driven by short-term commercial or political perspectives. This is particularly the case in the developing world where governments encourage eco-cities and smart cities as way to shine in the international arena, and generally with little consideration for local populations, which may be removed from their lands. These may offer better living conditions for the wealthier and more powerful, on the one hand, or heavily diluted versions of sustainability and resilience, on the other hand. In both cases, little will be done to advance living conditions for the majority in the anthropocene. However, my research has also shown that the potential for effective solutions exists, and that cooperation between citizens, business and government can be achieved. This requires a willingness to engage with the local material realities faced by populations, instead of attempting to define blanket rules for how sustainability and resilience should look like. Research into local conditions, in cooperation with citizens, business and government, needs to determine what the local needs and conditions are, and how to optimally improve them. This will not necessarily take the shape of high-tech 'smart cities' or incremental improvement of standard building types (however impressive their architectural credentials are), although these may form part of a wider strategy to address complex problems. In this sense, this reflection is a modest call for a greater engagement, on the part of the social sciences, with the materiality of existence, which is offered by the perspectives of actor-network theory and urban political ecology, among other approaches. These can be applied to a variety of situations where sustainability and resilience are at stake.

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