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On governance for re-engineering city infrastructure

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Given the challenge of re-engineering the infrastructure of a city so that it may become a force for good in the environment, what structure of governance might promote/stifle any associated technological and technical innovations? How might the 'quality' of the sought-for governance be gauged and improved? Cultural theory is introduced to address these questions and briefly elaborated. In particular, it is shown how cultural theory can be used to refurbish Dahl's theory of pluralist democracy and provide a simple (and visual) metric of deliberative quality in governance. Matters of re-engineering the water-nutrient infrastructures of the city of Atlanta within the Chattahoochee watershed in the southeastern USA provide the primary setting for eventually applying the resulting conceptual framework. Drawing together a somewhat eclectic mix of past experience and prospective approaches – ranging from practical resolutions of water conflicts in Nepal, lessons learned from previous community engagement in the Atlanta–Chattahoochee system, and two stagings of the sustainability agora of the International Water Association – a cultural theory-inspired programme of work is developed to explore and assemble those elements of governance that should, in practice, enable the re-engineering needed for a city to become a force for good in its environment.

1. Introduction

Of all the strands of urban infrastructure, that for water touches our lives most intimately. The 'human dimension' ought, therefore, to be highly prominent in the design and operation of water infrastructure. It is also the case that the most local of intensely personal decisions, about diet and plumbing arrangements in households and office blocks, can have literally global ramifications for material and energy cycles. Between these two scales, other actors and agencies, such as neighbourhood associations, municipal authorities, private utility businesses and so on, participate in bringing food and water into the city and in their return to the surrounding environment. In a project on cities as forces for good (CFG) in the environment, a core concern is to understand which elements of governance are enabling of strategies for re-engineering the city's water and nutrient infrastructures and which are not. The present authors' interest spans cities and environments in both the global north and global south. They are concerned, furthermore, to explore structures of governance encouraging experimentation with, and adaptation of, those very structures themselves (Gatzweiler, 2006; Ney, 2009; Thompson, 2008).

To be specific, it is known from computational studies that a strategy of infrastructure re-engineering based on the separation of material fluxes through the household (so-called 'wastes–residuals') could help curb the nutrient and water metabolisms of the city of Atlanta in the southeastern USA and enhance the ecosystem services derived from the Chattahoochee watershed in

which that city is located (Beck *et al.*, 2010a; Villarroel Walker, 2010). The strategy, moreover, is robust under climate change (Beck *et al.*, 2010a). The issue, of course, is whether the arrangement of institutions and governance in which the Atlanta–Chattahoochee system is embedded will catalyse or impede the implementation of any such strategy, or co-evolve with it over the generations in a mutually beneficial manner. Above all, this challenge of governance is likely to be distinctive and recalcitrant on at least three accounts: first, because of the current historical lock-in to the technological features of the water-based paradigm of urban residuals infrastructure (as it has evolved over more than 100 years); second, because of the associated social and institutional lock-in and the immense difficulty of changing one's personal habits and preferences, in particular, those regarding diet; and third, because of the long view into the future that is defining for sustainability.

In short, the two foci of this article – what might be a sustainable form of urban nutrient–water infrastructure; and what might be the associated form of governance enabling a transition to that future infrastructure – are in a state of flux. There is the prospect even of radical change on the first of these two accounts. The authors overall purpose, therefore, is to muster the theoretical and empirical bases of an approach, with which it will be possible to begin to map the contours of the challenges of governance in the Atlanta–Chattahoochee (CFG) case study and respond to them. The goal is not to try and change the circumstances as found 'on the ground'. It is not to try and change the social-economic entities participating in governance there, although it is worth noting that the more radical changes implied by the future engineered form of water–nutrient infrastructure may create opportunities for new enterprises to join the debate and share in its outcomes. Rather, learning is sought from governance in action and adaptations of such operations that should, in general, lead incrementally to a higher quality of performance in that governance.

To this end, the article begins by summarising why exactly the stated two foci are matters in a state of strategic flux: largely in prospect for sustainable infrastructure (Beck *et al.*, 2010a); much in retrospect for governance (Ney, 2009). Observing briefly upon an archetypal case of actual conflict and supposed water scarcity at the urban periphery of a major city in India (Specter, 2006), the authors then set out the basic elements of their understanding of the workings of communities and their institutions in shaping policies and technological systems for stewarding the man–environment relationship (Holling, 1986; Thompson, 2002). The present authors will be quite bold in proposing cultural theory (CT) as their conceptual and normative framework (Thompson *et al.*, 1990). Such boldness should evoke constructive debate over this particular choice of approaching the human dimensions of engineering and engineered systems. This exposition of CT culminates in a brief expression of what amounts to quality in governance, that is a refurbishment of Robert Dahl's pluralist democracy (Dahl, 1989; Ney, 2009). Within this conceptual framework, the authors discriminate between the enabling and disabling elements of governance for achieving CFG. There is also a *prima facie* case for supposing that governance at the scale of the city is uniquely well suited to promoting and nurturing the sought-after learning and adaptation (Gatzweiler, 2006).

Subsequently, CT is demonstrated at work in practice in managing water resources in the Kathmandu Valley of Nepal (see also NCVST, 2009). The paper then proceeds to illustrate how this conceptual framework of refurbished pluralist democracy can be put to work, reviewing first an earlier engagement (circa 2000) with community water and environment issues in the Atlanta–Chattahoochee system. The present authors' experience in designing and hosting two sustainability agora at the 2006 (Beijing) and 2008 (Vienna) World Water Congresses of the International Water Association (IWA) is also reviewed. In closing, it is indicated how the collective insights from these past experiences may be brought to bear on the Atlanta–Chattahoochee case study of CFG. This includes further experimentation on discriminating the good (enabling) from the bad (disabling) elements of governance through the use of agent-based models (ABM).

2. Strategic change

A very great deal has been written and discussed on governance in the water sector (Ashton *et al*, 2006; Barreira, 2003; EC, 2000; 2001; Franks and Cleaver, 2009; GWP, 2000; 2002; Mostert, 2006; Pahl-Wostl *et al.*, 2007a; 2007b; 2008; Pahl-Wostl and Toonen, 2009; WWAP, 2006). In particular, the current authors are well enough aware of the widespread view that, if the global water crisis were a matter of technology and engineering, it would have been resolved decades ago. The Global Water Partnership (GWP, 2000; 2002) and the UN's World Water Assessment Program (WWAP, 2006) recognise the current water crisis is a crisis of water governance. More often than not, moreover, the 'water crisis' is perceived as a scarcity of water. Yet things do not necessarily have to be construed as such, or goods distributed accordingly (Thompson, 2010).

The authors' context and purpose with respect to CFG and the Atlanta–Chattahoochee case study are deeply different from this mainstream discourse. For they are centrally concerned with governance in respect of the roles of engineering and technological innovation in moving away from unsustainability in urban nutrient–water infrastructure; and their thinking is not primarily driven by any crisis of water scarcity – neither in respect of food production outside of cities nor even in respect of water itself.

2.1 Future infrastructure

In simple terms, the city can be caricatured as an entity receiving its 'daily water' and 'daily bread' (food–nutrients) on its input

side (upside). Because of the water-based paradigm for conveying waste residuals away from our conurbations, thereby securing public health, only one output presently emanates from the city on its downside: conventional (mixed) sewage. This will be called configuration I. It is predominant in cities of the global north; Atlanta is no exception (see for example Beck *et al.*, 2010a). Two basic structural rearrangements of this macroscopic picture are possible: (a) the introduction of some form of source separation – epitomised and explained in the device of the urine-separating toilet (Lienert and Larsen, 2007) – so that there are two separated fluxes of water and nutrients on the downside of the city (configuration II); and (b) the same as II, but with no water-assisted conveyance on the downside of the city, as the logical endpoint of entirely dry sanitation (configuration III). This last would be tantamount to the supreme achievement in urban water savings and in lowering the water metabolism of the city to nigh on zero. Both structural rearrangements are notably confined to the downside of the city, which is conventionally referred to as the city's wastewater infrastructure; and both words in that compound – 'water' and 'waste' – can be said increasingly to be impediments to the way we should be thinking about the less unsustainable city.

For many cities and conurbations in the world (in the global south), their current arrangement may be more or less as configuration III. Furthermore, there may be no reason or incentive in such cities for infrastructure to be adapted over the decades towards I. Conversely, it might be highly desirable for the (downside) infrastructure of cities in the global north to seek to be adapted from I to II and possibly beyond to III. There is some grand irony then in the fact that Paris, for example, went from III in the late 1700s to something akin to II by the beginning of the First World War (1914) and on to I thereafter, with the complete loss of an impressive symbiosis between the city and its surrounding agricultural lands, in terms (crucially) of nutrient recycling and nutrient infrastructure (Barles, 2007a; 2007b). To propose today that the 'clock should be turned back' – specifically for the city of Atlanta (Beck *et al*, 2010a) – has much merit, except for some critical, historical differences, concerning variously:

- the priority of maintaining security of public health, and perhaps deliberately enhancing citizens' sense of 'wellbeing' (not least through engineering interventions), because this may relate in essential ways to their awareness of sustainability and climate change;
- the vastly different array of contemporary technologies and unit processes available today (see, for example, *Source Separation and Decentralisation* by Larsen, Udert and Lienert (currently in preparation); and
- the unimaginably different means – in 2010 *vis à vis* 1910 (or 1860, or …) – of communicating across the science–society divide, using computers, mathematical models, virtual realities and the internet.

The role of engineering and technology is self-evident in the latter pair. The present authors assert it should be just as relevant to the first of these historical differences.

Were an eventual re-engineering of the nutrient–water infrastructure of the city of Atlanta along the lines of configuration II to become socially legitimate, then this could technically have a number of environmentally benign and strategically significant environmental outcomes, in terms of (Beck *et al.*, 2010a): enhancing aquatic ecosystem services – the essence of a CFG; recovering fertilizer and downstream chemicals for rural–urban agriculture; and producing biofuels from algae, for example, at what is presently called the wastewater treatment plant. Yet it is the phrase 'socially legitimate' that is utterly essential in all of this.

2.2 Governance in the contemporary discourse

Governance has come to mean a lot of different things to many people, with a soaring popularity for the term itself. In 'Resolving messy policy problems: handling conflict in environmental, transport, ageing and health policy', Ney (2009) has argued thus:

> Over the past three or four decades, the institutional settings of policy-making have changed as rapidly and profoundly as have our society. In the not too distant past, policy was something produced and owned by government. Working within recognizable institutions, governments steered societies by making and enforcing rules. Today we use the far more amorphous term 'governance' to describe a confusing myriad of criss-crossing activities, institutions and processes that all seem, in some way or other to contribute to similarly opaque things called 'policies'.
> Widening and deepening the remit of policy-making has meant that governance involves more, and a rather different mix of, people than did government.

Policy-making has become more pluralist. As social problems have become more complex and technical, addressing them calls for more variegated forms of specialised expertise, which no longer reside solely in government bureaucracies. Social problems have also become more uncertain (or messy). What types of expertise are most appropriate for the given issue is not only unclear, but is also an object of considerable contention. The associated, issue-directed 'policy networks', or 'policy subsystems', themselves no longer the sole preserve of hierarchical government agencies, have become gateways for participation in the policy process for any actors with any credible claim to have some kind of relevant, specialised expertise. From Ney's perspective (Ney, 2009):

> By widening the scope of policy actors and weakening the hierarchical control of central governments, the differentiated polity creates the potential for intractable policy controversy.

To some extent the changes Ney (2009) records suggest affairs have at least moved off the bottom-most rungs of Arnstein's

(1969) 'ladder of citizen participation', with policy subsystems currently only partly government 'manipulated' (see also Mostert, 2006). A distinctive part of the mainstream discourse over governance in matters of water is pressing for progress upwards towards the topmost rung of Arnstein's ladder, where some form of egalitarian 'citizen control' is to be realised.

2.3 Nutrients versus water; novelty in governance

Water issues readily grab the headlines and therefore the public's attention. With popular titles such as those of Pearce's (2006) book When the Rivers Run Dry and Specter's (2006) *New Yorker* article, 'The last drop', we all immediately know what confronts us: in essence, the massive water footprint of food production (in rural areas). On this bald account of the global situation, what happens in cities seems peripheral. Yet even there, supply of the city's daily water and the removal of our metabolic residuals through a wastewater system keeps attention locked onto water issues, water engineering, water technologies, water institutions and water governance – a thoroughly, but not wholly unreasonably, 'water-centric' perspective. When it comes down to it, moreover, individuals have few, if any, real choices over water. Either they get it, or they do not.

In sharp contrast, the essential thrust of doing something about sustainability in the present context of the (admittedly) self-defined CFG is all about re-engineering of the city's (downside) wastewater infrastructure: not in pursuit solely of its water, but also of its nutrient content (and other non-water resources). In this much simplified caricature of the city, personal choices over diet may be crucial and they are certainly several. Not only do these choices have an immediate bearing in the locale of the city; they also have a substantial impact around the globe through the tele-connections of those market signals regarding dietary preferences. They have significant consequences for food production, hence the water 'burned up' in producing that food, not to mention the carbon-energy footprint of manufacturing the associated massive amounts of agriculturally applied fertilizers. In order to try to arrest the public's attention in this, it would probably be necessary to pen an article or a book entitled 'When the soils (do not) starve'.

The implications for governance in respect of attaining CFG, as opposed to governance for addressing a (global) water crisis, may be substantial. At the very least, this 'non-water-centric' perspective would make the associated policy network more extensive, if not more complicated. For example, today the business opportunities are recognised of recovering resources (nutrients, energy) from the biological residuals of animals reared intensively on an industrial scale, in what are referred to as confined animal feeding operations (CAFOs). Inspired thus for the moment – not dulled by the unflattering (perhaps unpalatable) companion view of cities as confined human feeding operations (CHFOs) – it may be asked what would spark the interest of the sustainability-minded CAFO entrepreneur (from outside the water sector) in any such business opportunities for fertilizer and energy recovery from the CHFOs of cities? Through what forms of social, sectoral and institutional lock-in would that entrepreneur have to break, in order to gain access to the market, even to create one? Is his/her voice, in fact, gaining access to the debate? It has happened before, on just such an industrial scale, with turn-of-the-century (18–19th) inventors in Paris filing patents for fertiliser preparations; and entrepreneurs identifying 'cow dung, and horse manure even more', as 'the object of a lucrative trade, with rising prices' (Barles, 2007b).

Such new players on the scene of governance for CFG might seem like invasive species in an ecological system. Insofar as the structure of an ecosystem must adjust to the introduction of novel species – through a kind of elastic bouncing around and eventually plastic rearrangement of the interactions among the species (Matthews *et al.*, 2002; Strayer *et al.*, 1999) – so too should the structure of governance be expected to change. With appropriate reflexive learning it may be hoped that the ensuing self-adaptation might be guided by the notion of deliberative quality in governance, which is introduced below.

However, while the authors may argue so strongly in favour of projecting into the governance debate the role of re-engineering the largely unrecognised urban nutrient infrastructure, this implies no diminution in concern for the form and function of the city's water infrastructure, or energy infrastructure, and so on. In fact, elsewhere a systems-wide ('holistic') approach to re-engineering city infrastructure is advocated (Beck *et al.*, 2010b; Villarroel Walker, 2010).

3. Theories of social organisation and governance

Specter (2006) wrote his article ('The last drop') in the *New Yorker* magazine after he had visited India. A sketch of the circumstances he found there follows. He was reporting on access to groundwater for the irrigation of crops in rural areas.

Rice and wheat crops, he is informed by Sunita Narian – Stockholm Water Laureate (2005) and director of the non-governmental Centre for Science and Environment in New Delhi – are the 'two that use the most water', yet they are those 'promoted most heavily by the Indian government' through price guarantees. As a result 'farmers have little incentive to grow anything else or to use less water', writes Specter. Coming across the many water trucks of private water vendors circulating around the metropolis of Chennai, another of his interviewees explains:

'Indian farmers are good capitalists, and, when a good capitalist has a product that everybody wants, he sells it.'

'Everything is for sale in the gray area between urban India and farmlands', observes Specter; and these days, he tells us,

'water earns more than rice'. There is no sharing in the access to water below the ground, merely a process of 'competitive deepening' (Specter, 2006).

Nepali water scientists and engineers know this only too well, hence the cartoon of Figure 1 drawn from CT (Dixit, 2002; Dixit and Gyawali, 1997), to whose explanation the authors now turn, for this is central to the present paper. In one way or another CT has shaped the experience that the authors propose to bring to bear on the Atlanta–Chattahoochee case study of CFG in Section 4 below.

3.1 Cultural theory

CT (also called the theory of plural rationalities) has been set out many times (e.g. Douglas and Wildavsky, 1982; Schwarz and Thompson, 1990; Thompson, 2008; Thompson *et al.*, 1990; Verweij and Thompson, 2006). Here it will be introduced as succinctly as possible, because it is only necessary to underpin the fundamental sociocultural nature of the four cartoon farmers (Figure 1), suggest how it is that the complex dynamics of their interactions can lead things in sometimes destructive and sometimes constructive directions, and then express its role in refurbishing Dahl's pluralist democracy.

The farmers of Figure 1 are arguing from different premises, which CT maps in terms of a fourfold typology of forms of social solidarity (Figure 2). Two of the forms of solidarity – individualism and hierarchy – have long been familiar to social scientists. The theory's novelty lies in its addition of the other two solidarities and in the making explicit of the different sets of premises – the different myths (or social constructions, or models) of nature (physical and human) – that sustain and justify these four fundamental arrangements for the promotion of social transactions. The term 'social solidarity' (originally from the sociologist Emile Durkheim) is now defined as the different ways in which we bind ourselves to one another and, in so doing, determine our relationship with nature. The argument is that it is the social solidarities – the contending ways of relating, perceiving, acting and justifying – that are the appropriate units of social analysis, not the individual (as is the case in neoclassical economics, behavioural economics, evolutionary psychology and so on).

Hierarchies – of the upper right panel of Figure 2 (and the similarly positioned farmer of Figure 1) – institute status differences (asymmetrical transactions, as in Boston, USA, where, it is said, 'Lowells speak only to Cabots and Cabots

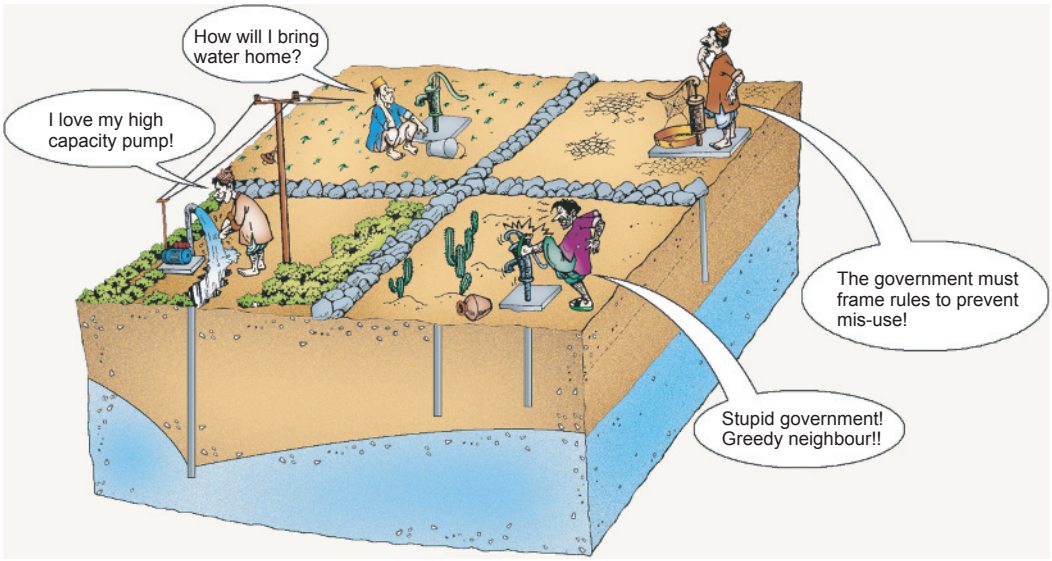

Figure 1. Cartoon of 'competitive deepening' with respect to accessing groundwater for irrigation in Nepal. Upper right quadrant: hierarchist farmer proclaiming 'The government must frame rules to prevent mis-use!'. Lower right quadrant: frustrated egalitarian farmer complaining 'Stupid government! Greedy neighbour!!'. Lower left quadrant: contented, out-competing individualist farmer declaring 'I love my high capacity pump!'. Upper left quadrant: disengaged fatalistic farmer asking 'How will I bring water home?'. Reprinted with permission from Dixit (2002) and, previously, Dixit and Gyawali (1997)

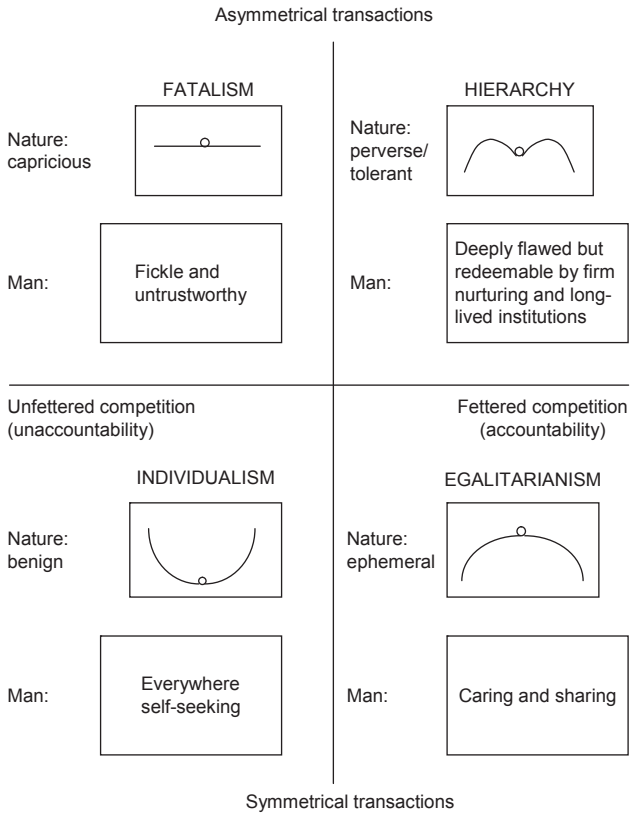

Figure 2. Cultural theory: the four forms of social solidarity and their associated premises (or myths of nature)

speak only to God'). By requiring forms of behaviour appropriate to those of differing rank and station (accountability), hierarchies set all sorts of limits on competition. Markets, the transactional arrangements that accompany individualism (lower left panels of Figures 1 and 2), do the diametrical opposite. They institute equality of opportunity (symmetrical transactions) and promote competition, that is no accountability (in the sense of 'If I don't do it, someone else will'). The other two permutations, of symmetrical transactions with accountability (labelled 'egalitarianism' in the scheme of CT) and asymmetrical transactions without accountability (labelled 'fatalism') tend to be ignored by social science in general and by policy science in particular.

In Figure 1, therefore, the market individualist who can afford the deeper boring will do so for as long as s/he can make money (lower left quadrant in Figure 1). The hierarchist village headman (upper right quadrant) thinks groundwater law is the answer. The angry egalitarian activist in the lower right quadrant of Figure 1 is mostly against both the individualist and the hierarchist, while the poor fatalist has no alternative but to cope with whatever else is 'dished out' (upper left quadrant). Figure 1 may only be a cartoon, for the purposes of easy exposition. The situation on the ground, however, in Gujarat, Tamilnadu and Rajasthan in India, as well as in the Kathmandu Valley of Nepal, is literally a matter of life and death (Dixit, 2002; Dixit and Gyawali, 1997).

For upholders of the individualist solidarity, nature is benign and forgiving, able to recover from any exploitation, hence the iconic myth of nature: a ball that, no matter how profoundly disturbed, always returns to stability (lower left panel, Figure 2). Man is inherently self-seeking and atomistic. Trial and error in self-organising, ego-focused networks (markets) is the way to go, with Adam Smith's invisible hand ensuring that people only do well when others also benefit. Individualist actors, in consequence, trust others until they give them reason not to and then retaliate in kind (the winning 'tit for tat' strategy in the iterated prisoner's dilemma game; Rapoport, 1985). They see it as only fair that those who put most in get most out, as in the joint stock company. Managing institutions that work 'with the grain of the market', free of environmentally harmful subsidies, for instance, are what are needed. This is the voice in the debate that calls for deregulation, for the freedom to innovate and take risks, and for the internalisation of environmental costs so as to 'get the prices right'.

Nature, for those who bind themselves into the egalitarian solidarity, is almost the exact opposite (hence the ball on the upturned basin; lower right panel of Figure 2): it is fragile, intricately interconnected and ephemeral; and man is essentially caring and sharing, until corrupted by the coercive and inegalitarian institutions of markets and hierarchies. We must all tread lightly on the earth. It is not enough that people start off equal, for they must end up equal as well – equality of result. Trust and levelling go hand in hand, while institutions that distribute unequally are distrusted. Voluntary simplicity is the only solution to our environmental problems, with the 'precautionary principle' being strictly enforced on those who are tempted not to share the simple life. This is the voice in the debate that defines the opposite of development as hospitality, that scorns the idea of 'trickle down' and seeks instead to target 'the poorest of the poor', that argues for zero growth, and that calls urgently for major shifts in our behaviour so as to bring our profligate consumption down within the limits that have been set by mother nature.

The world, in the hierarchicist solidarity, is controllable. Nature is stable until pushed beyond discoverable limits, hence the two humps in the upper right panel of Figure 2. Man is malleable: deeply flawed but redeemable by firm, long-lasting and trustworthy institutions. Fair distribution is by rank and station or, in the modern context, by need, with the level of need being determined by an expert and dispassionate authority. Environmental management requires certified experts, to determine the precise locations of nature's limits

and statutory regulation, to ensure that all economic activity is then kept within those limits. This is the voice that talks of 'global stewardship' and readily invokes the fallacy of composition: that what is rational for the parts – belt-tightening during a recession, say – may be disastrous for the whole. It insists that global problems, such as climate change, demand global solutions.

Fatalist actors (or perhaps they should be termed non-actors) find neither rhyme nor reason in nature and know that man is fickle and untrustworthy. Fairness, in consequence, is not to be found in this life and there is no possibility of effecting change for the better. 'Defect first', the winning strategy in the one-off prisoner's dilemma, makes sense here, given the unreliability of communication and the permanent absence of prior acts of good faith. With no way of ever getting 'in sync with nature' – push the ball this way or that and the feedback is everywhere the same (upper left panel in Figure 2) – or of building trust with others, the fatalist's world, unlike those of the other three solidarities, is one in which learning is impossible. 'Why bother?' therefore, is the rational management response. Fatalist actors do not really have a voice. If they had, they would not be fatalistic! Nevertheless, as time and money that are spent on something about which nothing can be done is time and money wasted, there is some wisdom here that should not be ignored.

These solidarities, in varying strengths and patterns of pairwise alliance, are clearly discernible almost anywhere one cares to look, for example: in international fora where delegates struggle to do something about climate change (Thompson *et al.*, 1998; Verweij, 2006); in the various ways households set about making ends meet (Dake and Thompson, 1999); in the different diagnoses of the pensions crisis in countries with ageing populations (Ney, 2009); and in the different panaceas that are variously championed and rejected by theorists of public administration (Hood, 1998).

Significantly for this article, they are also present in the different ways municipalities go about the business of transport planning (Hendriks, 1994) and international regimes cope with trans-boundary risks, such as water pollution (Verweij, 2000); in the conflicts over access to water in Nepal (Figure 1) and in the wider debates over water engineering in South Asia (Gyawali, 2003; Thompson and Gyawali, 2007); and – closer still to the present needs in respect of Atlanta and CFG – in assessing the prospects for introducing resource-recovering ecological sanitation systems in peri-urban Accra, Ghana (Kwame, 2007).

Significantly too, given the present focus on matters of re-engineering and technological innovation, the archetypal hierarchist actor favours high-tech virtuosity and large-scale engineering projects, whereas the egalitarian would celebrate 'small is beautiful', as well as small being frugal, empowering and environmentally benign. The latter ignores any economies of scale, in contrast to the former, who overlooks any diseconomies of scale, such that big is always best. At a scale somewhere in between, where the minimum of the curve of net economic production lies, the individualist will plump for (economically) appropriate technologies – as 'cheap and cheerful' as possible. The individualist's challenge, however, is that the minimum is inherently both uncertain and shifting, hence the need for careful judgement and risk-taking. The fatalist instead simply has better things to worry about, such as 'getting by from day to day', so that economic productivity is diversified, but not in any systematic or strategically reasoned way – 'very cheap, but not so cheerful'.

3.2 Gauging quality in governance

In all these examples it is found that each solidarity, in creating a context that is shaped by its distinctive premises, generates a storyline that inevitably contradicts those that are generated by the other solidarities (Douglas *et al.*, 2003; Ney, 2009; Thompson *et al.*, 1998). Yet, as each distils certain elements of experience and wisdom that are missed by the others, and as each provides a clear expression of the way in which a significant portion of the populace feels we should live with one another and with nature, it is important that some sort of account be taken of all of them in the policy process (including the fatalists). That, in essence, is the case for clumsiness (Verweij and Thompson, 2006): the state of affairs in which each of the three active voices – individualism, egalitarianism and hierarchy – is (a) able to make itself heard and (b) is then responsive to the others.

Clumsiness may look a little less strange if it is pointed out that these two dimensions – accessibility and responsiveness (two of the axes in Figure 3) – are at the very heart of Dahl's theory of pluralist democracy (Dahl, 1989). This democratic insight suggests that if an organisation, such as an international agency, for instance, or a firm, is carrying out a scenario planning exercise, it will need to ensure that all three storylines are fully developed into scenarios that are then engaged with one another, noisily and argumentatively – anything but elegantly, hence 'clumsily'. The climate-change scenarios of the Intergovernmental Panel on Climate Change (IPCC), for instance, have all been shown to be elaborations of the hierarchical storyline, hence the increasingly disruptive behaviour of those who have found themselves denied both access and responsiveness – and whom the IPCC's chairman calls 'voodoo scientists' (see, for example, Pielke, 2010). On the other hand, Shell, which is famous for its pioneering of scenario planning, has consistently missed out the egalitarian storyline.

Dahl's classic theory provides an over-simplified and dualistic scheme: closed hegemony, when there is neither access nor responsiveness, and pluralist democracy, when both obtain. Refurbished by way of the typology of CT, however, it is possible

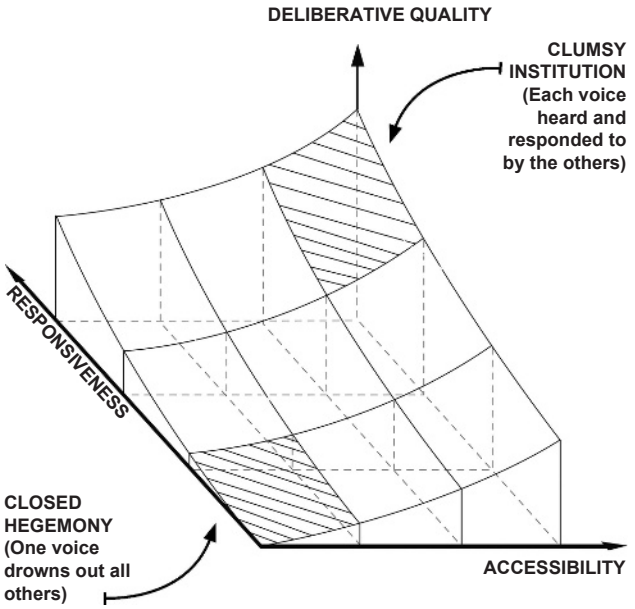

Figure 3. The classic theory of pluralist democracy refurbished

to map an extensive 'excluded middle' (Ney, 2009). Therefore, each graduation along the two axes of accessibility and responsiveness in Figure 3 marks the addition of another voice to the debate, be this hierarchist, individualist, or egalitarian, in any order. The distinction of CT in this, of course, is its three such voices, as opposed to just the two generally acknowledged. Plotted on Figure 3, closed hegemony grants access and responsiveness to just a single voice, while the exemplary clumsy institution is the refurbished form of Dahl's original pluralist democracy. The former has a vanishingly small deliberative quality – the third axis of Figure 3 – while the clumsy institution has scope for attaining the highest of such quality.

Most policy subsystems fall somewhere between the two. Shell, it can now be seen, achieves a fair measure of deliberative quality, perhaps halfway up the surface of quality (Elkington and Trisoglio, 1996). The IPCC, however, could be judged to be relatively impoverished in its closer approximation to the conduct of a closed hegemony. In this last (worst) place the one agent granted access will choose to frame the problem such that it may be solved by that agent's favoured style of problem-solving and governance. Under this lowliest quality of governance, just as the International Water Association's Sanitation 21 document complains (IWA, 2006),

> opportunities for exploring the whole range of potential solutions may be lost and the agenda may be "hijacked" by one particular interest group…
> …perhaps an engineer with highly technical knowledge, or perhaps someone from a development agency with a strong social agenda or a strong home-industry export agenda, or again it may be the environment agency or a donor with a strong commitment to environmental protection.

The clumsy institution, so the normative argument runs, is where instead we should strive to be. The nine 'provinces' on the surface of Figure 3, therefore, should make it possible to appreciate where a particular, problem-tailored, policy subsystem presently lies, thus to identify the various pathways by which it is possible to move closer to the intended destination (Ney, 2009).

In theory, a higher quality of governance should be better disposed towards enabling the kinds of re-engineering the authors have in mind for the future nutrient–water infrastructures of cities such as Atlanta. Conversely, a keen interest should be retained in which specific elements of re-engineering and technological innovation associated with CFG might accelerate ascent of the surface of deliberative quality in Figure 3.

3.3 Special scale of the city

For all the global recognition of the current water crisis as a crisis of water governance (GWP, 2000; 2002; WWAP, 2006), hardly anyone has pointed specifically to the institutions of urban governance as bearing any promise of a means of resolving the perceived crisis. The work of Gatzweiler (2006) is therefore of special interest. For he has recently proposed 'borrowing from the organization of public economies in *metropolitan* areas' (emphasis added) in order to suggest design principles for polycentric, multilevel governance in a coffee forest conservation project in Ethiopia. This he labels a 'public ecosystem service economy for sustaining biodiversity'. If he can borrow thus from the focus of the discussion herein to explore a form of governance enabling the maintenance, if not expansion, of ecosystem services, this surely has to be of some interest here. The city and its re-engineered infrastructure as a means of deliberately enhancing watershed ecosystem services is at the core of the challenge of CFG and the case study of the Atlanta–Chattahoochee system (Beck *et al.*, 2010a).

Gatzweiler recognises the heterogeneity of citizens' preferences across scales and levels of governance. He intends, therefore, to borrow from the better of the schemes of metropolitan governance for his purposes, and as the present authors too hope, he proceeds to note the way in which governance at the city scale is well disposed towards experimentation and adaptation (Gatzweiler, 2006):

> Other hypothesized benefits of multi-level governance are that it provides more complete information of constituents' preferences, is more adaptive in response to changing preferences, is more open to experimentation and innovation, and that it facilitates credible commitments.

In the present authors' previous work on Atlanta as a case study (Beck *et al*, 2010a) they arrived at their present position through an argument driven by the prospect of CFG in respect of the (environmental benignity) component of Elkington's (1998) triple bottom line. Economist and activist, Paul Romer, however, has for quite some time been thinking of CFG in respect of (social legitimacy) (another line item) and good governance – 'charter cities', in his vocabulary (Romer, 2010). 'How to free people from bad rules?', he asks (Romer, 2010) and proclaims: 'Forget aid – people in the poorest countries need new cities with different rules. And developed countries should be the ones that build them' (Romer, 2010). People, the argument runs, should be encouraged to move to places with better rules (better governance), specifically and importantly at the scale of the city. 'The choice is not whether the developing world will urbanise or not – merely where and under what rules'; and for Romer that 'where' should be some 'piece of uninhabited land'. This would be a rural-to-urban migration deliberately motivated by the desire to escape poor governance, as opposed to that of the rural-to-urban migrants of 19th century Europe, who simply happened to take with them their culturally acquired styles of water governance (Barraqué *et al.*, 2006).

Could a 'charter city' succeed for urban-to-urban migration, however, for impoverished individuals seeking to escape from the corruption and mafia-style water operations observed in modern times by Bakker (2006)? For they, acting alone or within their community, would essentially have to 'decide for themselves', under the 'right' incentives – and surely not as a matter of any 'bad' rule of governance, such as coercion. Much more clear is the fact that Romer's charter cities would require nation-to-nation agreements, and between these two scales – the local–individual and the national – that of the city is pivotal, precisely as it is for Gatzweiler (2006) and, indeed, for CFG.

This, then, is the authors' theoretical exposition of CT, with specific reference to city governance and the re-engineering of CFG. Now the matter of putting the theory to work in practice is considered, in due course in the Atlanta–Chattahoochee context, but benefitting first from some hard, practical lessons learned in the Bagmati watershed of Nepal.

4. Putting cultural theory to work in practice

In the two decades between 1981 and 2001 the population of the Kathmandu Valley more than doubled from 0.76 million people; and given the high in-migration since, of Nepalis fleeing the Maoist insurgency, the population is currently (2010) estimated to be close to 3 million. Although referred to as a valley, the approximately 600 km^2 region known as the upper Bagmati watershed is situated at an elevation of some 1400 m, with surrounding hills rising to 2500 m. The Bagmati river itself flows through the three districts of Kathmandu, Lalitpur and Bhaktapur. There, the unique Bagmati civilisation has flourished; and to this civilisation, the rivers and tributaries of the Bagmati watershed are sacred.

A piped network of water supply for Kathmandu was first introduced in 1891 and substantially expanded across the city from 1951 onwards. The former system of pit latrines, whose contents had previously been emptied and carried manually out of the city to the surrounding fields (as a fertilizer) – by the 'untouchable *Podes*' of the Hindu–Buddhist hierarchy – was decimated by the spread of the flush toilet of the water closet. No foul sewerage was installed, however. Instead, the city's storm drainage was increasingly used to dispose of the flushed water closets' contents; the Bagmati itself has become an open sewer; and, just as for Chennai in India, access to clean potable water for the burgeoning population has been a matter of 'competitive deepening'. For Kathmandu this is occurring mostly in the peri-urban surrounds of the city (exactly as in Figure 1), but also within the core of the city, in association with the construction of modern high-rise buildings with access to deep boring technology.

CT interprets the present situation as follows. The issues of the Kathmandu Valley constitute a 'wicked problem': one that defies its proper definition, let alone being amenable to any single solution, such as the proposed scheme of interbasin water transfer from the Melamchi watershed to the Bagmati. A clumsy, somewhat surprising, incremental, albeit partial escape from the impasse is yet discernible. No (egalitarian) conservationist group can argue for 'no growth' in the face of the highly emotive condition of insufficient water for drinking. The situation is recognised as beyond any promises the (hierarchist) water agencies might care to make in order to maintain control over their framing of the problem for their way of problem-solving. The customarily free-wheeling (individualist) private sector of water-tanker supply (as Specter observed in Chennai) now struggles to sell its services. In the very dry period of the year (May), it is subjugated to the hierarchical system of queuing for access to water with which to fill the tankers.

Today, while the interbasin transfer of water from the Melamchi watershed creeps forward very slowly (under the procedural fixation saturating the letting of government contracts), a bundle of '10% solutions' is underway – opening up choices over styles of technology to a wider set of options (from rainwater harvesting, to sewage recycling, to aquifer recharge, among many others) – such that the whole will be more than the sum of its parts (NCVST, 2009; NWCF, 2009). The whole, in this sense, should still provide at least some service in the face of any failing parts. There is the prospect of collectively accepted progress, for a while. In the present clumsy solution, some are getting more of what they want, which is less of what the others want: a major egalitarian modification of a hierarchist scheme that can no longer be resisted, with the individualists finding just a few crumbs of

comfort. Dispute and disagreement have not been eliminated. Indeed, in any dynamic polity they will only be ameliorated for a while, until new concerns and new alignments of the solidarities make themselves felt. They will eventually resurface and call for another round of the noisy and healthy debates prized within the clumsy institution, towards the uppermost province of deliberative quality in Figure 3. Importantly, CT does not guarantee the benefits of a clumsy solution. However, if institutional arrangements are as in this uppermost province (in Figure 3), and there exists the possibility of a clumsy solution, then it ought to be discoverable with greater probability than would have been the case had those institutional arrangements remained suavely elegant.

Interbasin transfers of water have often been contemplated for sustaining the growth of Atlanta. Indeed, so acute and fraught has become the issue of the city's access to water that plans exist for the introduction of coastal desalination facilities, a network of pipes hundreds of kilometres in extent, and further supplies of energy capable of elevating the water some 300 m.

4.1 Previous engagement with Atlanta–Chattahoochee issues

Engagement with this *problematique* of the city of Atlanta and its interaction with the Chattahoochee watershed has already been attempted by one of the current authors (M.B.B.). Around the turn of the millennium, the concept of adaptive community learning (ACL) was being developed and its prototypical procedure assembled in a 'participatory study' of shaping policy for community-led stewardship of the long-term (intergenerational) ecological integrity of Lake Lanier (Beck *et al.*, 2002; Osidele and Beck, 2003). Constructed in 1958 through impoundment of the Chattahoochee River, Lanier lies to the north of Atlanta and is the city's principal source of potable water. The way in which impounded water is released from Lanier to flow downstream, and the legal basis for Atlanta's appropriation of the impounded water, lie at the heart of two decades of as yet unresolved 'water wars' among the states of Georgia, Alabama and Florida. It was known then (in 1998/9) that this research on ACL was entering a highly charged political situation.

The experience was salutary. Much was learned, as recounted briefly in Hare *et al.* (2006). What was funded as research intended to puncture the impulse towards litigation, over rules and policies emanating from the US Environmental Protection Agency (EPA), in due course provoked the issue of a formal threat of litigation to the project's principal investigator (M.B.B.). In retrospect, one may conjecture that a small solidarity within the governing committee of a stakeholder association – a solidarity, let us say, holding one of the positions in the CT diagram of Figure 2 – came to fear that the research team's survey instrument would reveal sizeable numbers of the rank and file members of the association with quite other positions on the man–environment relationship of Figure 2. Indeed, there is some statistical evidence of this (Fath and Beck, 2005). Any such lack of a singular solidarity across the entire association, that is the position held by the governing committee, may have been perceived by the committee as undermining its stance (of implacable opposition) towards some of the other actors and agencies in the scene. Looking back, all this appears ordinary and obvious.

4.2 International Water Association sustainability agora

In the much less politically charged setting of technical sessions of the World Water Congresses of the International Water Association (IWA), the association's specialist group on sustainability in the urban water sector has begun experimenting with its own microcosm of the kind of refurbished pluralist democracy of Section 3.2 above, namely the 2006 and 2008 biennial IWA sustainability agora (Beck and Jeffrey, 2007). In the spirit of good-humoured theatre, the agora stages the scene of a market place wherein problem-framers pitch their stalls and vie with each other for the attention and purchasing power of IWA shoppers – as professional engineers – seeking to sell them genuine articles of sustainability problem-solving.

With the benefit of learning from the experience of the prototypical 2006 sustainability agora, the 2008 edition was altogether more carefully plotted and better stage managed, without in any way constraining the eventual flow of the market place 'banter' among its sellers and buyers (of styles of sustainability problem solving). An earlier notion of plural 'champions' of certain postures was adapted into three 'actors', each primed to speak the archetypal 'voice' of a particular (active) CT solidarity: George Crawford of CH2MHill (consulting engineers) as the individualist (I); Margaret Pageler (sometime president, City Council, Seattle, USA) as the hierarchist (H); and Ger Bergkamp, at the time transferring from the International Union for the Conservation of Nature to become director general of the World Water Council, as the egalitarian (E). The remit of the agora – in effect, the challenge of CFG (Beck *et al.*, 2010a) – was specified for the actors beforehand as:

> What kind of technological innovations, and which paths towards alternative future metropolitan water infrastructures, might lower the global nutrient and (virtual) water metabolisms, i.e., uncouple human and economic development from industrial N fixation, for example, while yet securing essential public health for citizens – and all under the prospect of global climate change?

Armed this second time with a greater appreciation of quality in governance along the lines of Figure 3 – of access and responsiveness – and with another of the current authorship (M.T.) present to assist the master of ceremonies (D.G.), the debate was arranged such that each voice was obliged formally

to respond to each pitch of the other two proponents on their respective styles of tackling the challenge. Participants, in other words, the entire audience, could join the debate, to endorse, applaud, or criticise the various goods on offer. After the primary debate among the three protagonists, participants in the agora were exposed to the theory behind it, demonstrated at work in practice according to the foregoing examples from Nepal (including Figure 1).

To summarise these experiences of the two agora, its staging has been proved and the profile of the human dimension within an association of professional engineers has been raised thereby. There is a growing appreciation of how to construct the stalls and identify the stall-holders, but not of the shopping experience. Neither agora was designed to reveal the manner of (mass) 'buying into' what must be, in all situations of policy-making (decision-making, choosing), that singular 'one routine step tomorrow' – setting off on some specific technological path towards realising a CFG on the horizon. It remains to reflect too on whether the device of the agora lies at a lowly position above Dahl's two-dimensional plane of access-responsiveness (Figure 3), thence to understand how to change its format, in order to improve its quality as a microcosm for learning about governance.

The important goal, of course, is to understand how to translate insights from a concocted, simplified, laboratory–theatre microcosm into better designs for structures of governance in the complex, messy 'real world', or, at least, re-designs of the agora as a device for catalysing improvements in the quality of governance in a real-world community. Yet one might well wonder what, if anything, can individuals and communities learn from experience of the good-humoured theatre of an agora, when their 'real world' is something of a gladiatorial arena – highly politically charged and a heart-beat away from litigation.

4.3 Re-engaging with the Atlanta–Chattahoochee situation

In the specific setting of the Atlanta–Chattahoochee system, the present need is to understand which elements of governance spanning that system might be enabling (or disabling) of re-engineering the city's nutrient and water infrastructures such that Atlanta might become a force for good within the Chattahoochee watershed. Enquiry in response to this need should have both practical and computational dimensions to it.

In practice, and in contrast to the Lanier study of a decade ago, two things are salient. First, the anatomy of the governance (and politics) of the Atlanta–Chattahoochee system should be drawn a priori, across the template of CT in Figures 1, 2 and 3. In which institutions are the crucial decisions made; who has access; how do their stances fall across the fourfold typology of CT; in which province of Figure 3, therefore, does this discourse take place, among the parties granted access? Second, representative stakeholders must be engaged in a mutual learning experience from the beginning – as always intended as the very first step in the procedure of ACL. For eventually the question is going to have to be put: what kind of socially legitimate experiment might be conducted with (and within) the key policy-making institutions, in order to inch governance upwards along the surface of Figure 3? There are those for whom facilitating this is their profession, through what is called 'collaborative practice research', for example, and with a grounding in the city of Atlanta (Mathiassen, 2002).

There is also scope for experimentation in the in-silico laboratory world of simulation and computational analysis. It is known that in the studies of Janssen and Carpenter (1999), which were directed at understanding what bestows resilience on coupled natural–human systems, tens of simulated farmers (agents) were let loose to go about their affairs over the years and decades across a simulated rural, agricultural landscape. Their work drew upon the earlier ideas of the 'surprise game' of Thompson and Tayler (1985). The simulated manner in which each farmer would make choices (about fertilizer application) was imbued with rules deriving from the differing perspectives of CT (Thompson *et al.*, 1990). The present authors fully expect agents in the Atlanta–Chattahooche complex to be more varied: households, neighbourhood associations, city, county, regional, state and federal institutions, engineering consultants, private utility operators, conventional equipment suppliers, perhaps even some 'rogue' agents, such as the CHFO entrepreneur redolent of bygone Paris. All these agents would be primed with their own respective aspirations, preferences, rules of choosing and ways of comprehending, each according to their own 'world views', in particular, their perspectives on the man–environment relationship.

In principle, an ABM can be set up for the strategic technological choices facing Atlanta, as and when it aspires to become a CFG. Janssen and Carpenter (1999) were demonstrating the principle for their rural–nutrient situation over a decade ago. Lempert (2002), for his part, has pioneered the use of ABM to assess the adoption and diffusion of alternative technologies in the energy sector, under the prospect of climate change. Yet there is something essentially different about the 'human dimension' of water, relative to that of energy. Except possibly and rarely in its manifestation as fire, energy does not seem to play such a fundamental role as water in our massively variegated global and spiritual cultures. No-one could argue this might not be profoundly significant – not least in the Bagmati civilisation of the Kathmandu Valley.

In the Lanier study, no matter whether survey respondents might actually have been individualist (I), hierarchist (H), or egalitarian (E) in their outlooks, 'bacteria levels' were of the greatest concern to all (Fath and Beck, 2005). Each, however, would have reasoned towards the endpoint of this common

concern from their different, respective premises; and the prescription of each for addressing the concern would be just as different, one from another. Yet first and foremost in people's perceptions of the future of that particular environment, they feared sickness from contact with water-borne faecal coliform bacteria. It is right, therefore, to caution against re-engineering a city's wastewater infrastructure in any manner jeopardising the security of citizens' public health.

Engineers customarily enquire into the nature of this: given the technologies and unit processes of the urban water and wastewater infrastructure, what 'rewiring' of this system might most improve health and wellbeing? This is something of an 'engineering-centric' perception of the world in which citizens conduct their affairs – low on the prominence of the human dimension. Rarely, if ever, is the following complementary 'person-centric' question asked: what can personal health and wellbeing do for (re)engineering of the water and nutrient infrastructures and metabolisms of the city? If we are so convinced of the universal 'good' of our all being less unsustainable, what devices, technologies and styles of water–nutrient infrastructure should be invented and installed, deliberately to create a yearning within the community for a sense of the bigger picture, hence for disputing and debating that universal good itself?

Achieving this through the associated urban policy would be to have taken citizens' wellbeing to an enhanced domain, and one wherein sustainability cannot be casually dismissed as a 'luxury'. Indeed, might a surprising 'social tipping point' be crossed somewhere, with mass buy-in to the ideas of the sustainable lifestyle? Could this be explored using ABM, whose simulated agents might be armed with plural ways of comprehending the environment through which they move, that is plural sets of rules for the belief networks of each of the solidarities? Would such 'mass buy-in', above all, oblige the three active voices in the policy debate to appreciate full well the wisdom of the fatalist solidarity on how to live with one another and nature? Would it be ethical for engineers to contemplate fashioning such policy and shaping technological preferences as interventions intended to push the affairs of the community towards any such tipping point? In fact, would you (we) consider it ethical to witness your (our) aspirations, preferences, rules of choosing, and ways of comprehending laid bare for all to observe on the computer (Beck *et al.*, 2009)?

5. Conclusions

Since the 'great sustainability debate' of the early 1990s and the thought-provoking, seminal paper of Niemczynowicz (1993), pondering how to re-engineer the customary urban water and wastewater infrastructure out of its deep historical lock-in has become increasingly widespread. At the same time, the call for better governance has become ever more present and urgent, if not predominant, and often to the down-playing of what might be the role of engineering therein. Progress in enabling forms of governance is especially needed, but rarely reported, in respect of the possibly radical programmes of infrastructure re-engineering over the long term. Such programmes, however, are particularly important in realising the CFG in its environment (Beck *et al.*, 2010a).

This paper contends that the distinctive, conceptual framework of CT (Thompson *et al.*, 1990), and the way in which it has facilitated a refurbishing of Dahl's classical theory of pluralist democracy (Ney, 2009), offers substantial promise in the understanding and fashioning of forms of governance that will be enabling (not disabling) of CFG. As opposed to the twofold dichotomy of markets and hierarchies, CT is both distinctive and distinctively enriching in its recognition of four social solidarities in the affairs of governance and policy-making. Quite apart from the need for an enabling governance with high deliberative quality and ample social legitimacy, sustainability is very much about how we, as members of the human race, can live with nature and with one another. An approach to governance that recognises and appreciates four (as opposed to just two) styles of such wisdom, would seem to offer the better prospect for achieving progress away from unsustainability, in cities as much as in many other affairs of mankind. The authors assert that the CT-inspired programme of this paper is exactly that – a bold assertion to which equally bold rejoinders are to be welcomed.

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