
Chapter 6: Frontiers of Practice: Engine of Conceptual Change

In what has been essentially a *concepts* paper, how now should we best gauge the prospects for progress in the harsh, untidy world of *practice*? How should we bring down to earth all those exalted concepts and principles, such that they may be informed and *re-shaped* by practice?⁷¹ How especially can such be achieved when the whole — of becoming less unsustainable about IUWM within IWRM — is arguably one of the most comprehensively multi-disciplinary matters of our times?

There is a danger here of being sucked into the vortex of attempting to write a manual of practice for the “whole of life”. One can sense the same exasperation, if not exhaustion, in what Ashley *et al* (2008) say in their award-winning paper on sustainability in the water sector:

Problems when devising sustainability criteria include the fact that they must encompass all aspects of human and natural systems if they are to truly relate to sustainability, and that they have disparate and incommensurate units of measurements.

The end is nigh, however. Just one more cycle in the argument of this *Concepts Paper* is to be executed.

We present our findings from a cursory search for evidence of who — which entities in the water sector — are in the vanguard, pushing at the forward-most, practical, operational boundaries of the ever-expanding purview of the (now) fifteen threads, (T0) through (T14). This, then, will be a brief narrative of the cryptic entries for the *TBL_{frontier}* of practice in Table 3; and that should be the point of departure for re-shaping any next edition of a *Concepts Paper* such as this.

⁷¹ Those who write from an academic background are usually persuaded by those who work in practice that theory and concept will be brought down when they meet the “real world”. In a similar spirit, the feasibility of doing something about sustainability is often justified on the basis of this *not* requiring any uplifting “rocket science”. Decisively to the contrary, sustainability should be a rocket science! For how otherwise are we to attract the very brightest and the very best to this field?

Meeting our charge will (again) hardly be any less daunting than what Ashley *et al* (2008) must have feared lay before them.

(T0) *Our Topmost Line*

We are mesmerized by the quest for change. “*Immunity to Change: How to Overcome It ...*” begins the title of the Kegan-Lahey book. In trumpeting the prize of attaining their self-transforming mind (which leads to learn), the self-authoring mind — which may have drawn you or me along in our having learned to lead — has become over-shadowed (and the socialized mind perhaps even more so). What Kegan-Lahey seek for the individual, hence unlocking the potential in “... *Your Organization*”, is shared with the Society for Organizational Learning (SoL). “Leading and Learning for Sustainability” was the purpose of its November 2010 Workshop (www.solonline.org; accessed 13 November, 2010); “*The Necessary Revolution*” was the title of the book that was to support the Workshop (Senge *et al*, 2008).

The Australian Research Institute in Education for Sustainability (ARIES) at Macquarie University has published a case study on “Learning and Change for Sustainability at Yarra Valley Water” (Crittenden *et al*, 2010). The quest for change, in the view of the company’s Executive Team, was to be delivered through “Organisational learning”. Today, Yarra Valley Water has a Learning and Development Manager; Robert Wilson’s skills encompass organizational learning, about which he writes professionally (<http://search.informit.com.au>; accessed 13 November, 2010).

(T1) *Personal Aspirations*

Few enterprises these days would declare themselves disinterested in the health of their employees, or their hygiene, security of employment, well-being, educational growth needs, and so on. The Sulabh Sanitation and Social Reform Movement of New Delhi, India (www.sulabhinternational.org), gives an extraordinary meaning to Maslow’s notions of human motivation. Its achievements, and those of its founder, social entrepreneur and 2009 Stockholm Water

<i>(T0) ORGANIZATIONAL LEARNING</i>	Yarra Valley Water has a Learning and Development Manager; the company seeks change through organizational learning
<i>(T1) Personal Aspirations</i>	Sulabh Sanitation & Social Reform Movement (New Delhi, India) elevates women scavengers through the Nai Disha Rehabilitation Initiative to promenading the catwalk at UN Headquarters
<i>(T2) Citizen Participation</i>	San Francisco Public Utilities Commission (SFPUC) holds itself accountable in respect of (a) engagement of stakeholders from conceptual stage of major planning programs and (b) feedback on this stakeholder input
<i>(T3) Social Bonds</i>	Severn Trent plc recognizes a number of community segments; Veolia frames multiple styles of management according to different ways or organizing; mutually benefitting synergy amongst Clean Water Services, Ostara, and the Clean Water Institute is the result of organizational adaptation and evolution
<i>(T4) Quality in Governance</i>	Nepal Water Conservation Foundation is pursuing a clumsy institutional structure for managing the Kathmandu-Bagmati system
<i>(T5) Ethics and Equity</i>	Sydney Water uses “inter-generational equity” as a matter of routine in assessing its projects; Cheryl Davis (employee of SFPUC) comprehensively addresses ethical dilemmas of water recycling
<i>(T6) Valuation</i>	Over 300 installations of its Water Health Centers signal the success of Water Health International’s business model for bringing affordable, safe drinking water to small, scattered communities
<i>(T7) Environment Within the Language of Business</i>	
<i>(T8) Supply-Value Chains</i>	Some 50 cities committed to the UN Global Compact (with its protocols for protecting human rights); CH2MHill, Halcrow, GDF-SUEZ, and Athens (Greece) Water & Sewerage Company are signatories of the Global Compact’s CEO Water Mandate

Table 3

Empirical evidence of who — which entities in the water sector — are in the vanguard, pushing at the forward-most, practical, operational boundaries of the ever-expanding purview of the Triple Bottom Line (TBL) accounting (*TBL_{frontier}*).

<i>(T9) Commercial Sectors</i>	Veolia Environnement offers itself as a sole provider of multiple services, such as management of water, waste, transport, and energy utilities; Veolia Water UK describes itself as a “Multi-utility Services Company” (or MUSCO)
<i>(T10) Space</i>	DHV Group (Consulting Engineers) “blurs the line between sewage treatment and river habitat” (between IUWM and IWRM) in re-engineering Soerendonk Sewage Treatment Plant; The Natural Step provided training for DHV employees
<i>(T11) Life Cycle and Time</i>	The Natural Step works with Yarra Valley Water on concepts and techniques of Life Cycle Analysis (LCA)
<i>(T12) Function</i>	Within IBM’s Smarter Planet and Smarter City portfolio are various Smarter Water Management applications, including the SmartBay project of Galway, Ireland (www.ibm.com/smarterplanet ; accessed 24 January, 2011)
<i>(T13) Gauging Environmental Benignity</i>	DHV Engineering Group’s re-engineering of Soerendonk Sewage Treatment Plant generates rhythmic flow variations to enhance watershed ecosystem services. PUB, Singapore’s National Water Agency, funds research into biomimetic membranes that seek to emulate behavior of micro-organism cell membranes (www.pub.gov.sg/ewi ; accessed 24 November, 2010)
<i>(T14) Cycling of Materials</i>	STplc bemoans the lack of policy joining up considerations of the carbon cycle with those of the water cycle; Resources Centres on Urban Agriculture & Food Security (RUAF) promote Sustainable Urban Nutrient Management coupling aqueous and nutritious human residuals

Table 3 (continued)

Laureate Dr Bindeshwar Pathak, seem to soar above the plane of aspirations many now take for granted.

His Laureate's presentation tells us this (www.siwi.org; accessed 17 November, 2010). The technologies of the Sulabh "twin-pit, pour-flush, compost toilet" and "public toilet complexes with biogas plants" were designed with the express intention of ending the "sub-human practice" of women scavengers obliged to clean bucket toilets and carry away their contents. Whatever the hegemony of better governance over any engineering interventions for enabling IUWM within IWRM, these were technological solutions (decisions u_{now}) designed to eliminate a social problem. The women scavengers were lifted out of their almost unspeakable drudgery, taken through the Nai Disha Rehabilitation Initiative, and crowned (metaphorically and festively) by the President of India. Together with the celebrities of New York fashion models, they promenaded along the catwalk at UN Headquarters, in front of a backdrop of "Mission Sanitation". Their social status has been marvelously transformed and — one would like to presume — their personal aspirations too.

Pathak's innovation of the public toilet complex is "equipped with the provision of drinking water, telephones, laundry, health centres, lockers, cyber cafe, first-aid box, etc". One can only but conjecture whether individuals in such a "Happy Home" — his sobriquet, and the outcome of his tangible Acting Locally — were brought to a yearning for appreciation of the bigger picture (a Thinking Globally), hence to dispute the good (or ill) of sustainability and the relevance (or otherwise) of climate change, just as suggested by the iconic sketch of Figure B2.1 of Box 2.

(T2) Citizen Participation

Before the San Francisco Public Utilities Commission (SFPUC) consolidated expression of its 2008 "Sustainability Plan and Program" (SFPUC, 2008), gathered around the Triple Bottom Line, it had published an interim "Sustainability Plan" (SFPUC, 2006).⁷² Community Issue CY6 therein shows empirical evidence of how affairs might be brought to climb the rungs of Arnstein's ladder of citizen participation.

⁷² With its broad, *unconsolidated* kaleidoscope of assessment dimensions, SFPUC (2008) can be read as the qualitative counterpoint to the quantitative, all-encompassing, distillate of a single, scalar index (TBL_{∞}) derived in Krajnc and Glavič (2005).

Along this axis of CY6 — measuring the "extent and effectiveness of community consultation" — Indicator 2 was directed at "Timeliness", i.e., the "% of projects or major planning efforts where community input is sought ... at *early* or conceptual stages" [emphasis added] (SFPUC, 2006). Indicator 4 had to do with "Effectiveness": the "% of projects or major planning efforts where community input is received and *feedback* provided by SFPUC on how input has been taken into consideration" [emphasis added].

Adaptive Community Learning (Beck *et al*, 2002) starts by asking the community "What are your greatest hopes and worst fears for the future of your environment?", hence the sculpting of the green ovals in the "Futures" block of Figure 15(b) (and those in the upper right corner of the earlier Figure 2). This mirrors CY6 Indicator 2 of SFPUC (2006). Should SFPUC judge that it is doing well by its CY6 Indicator 4, however, that would be to have gone in practice beyond any of the theory of Adaptive Community Learning. One cycle from "Society" to "Society" would have been traversed in Figure 15(b). And perhaps from this one cycle alone, all — SFPUC and its entire community of stakeholders — would have exited from Figure 2 at its lower left corner with a socially more legitimate u_{now} . Steps up Arnstein's ladder would have been taken.

In their case study of the Yarra Valley Water (YVW) company, Crittenden *et al* (2010) begin by observing that:

Since 2003 YVW have developed and integrated a number of sustainability tools and approaches, including The Natural Step [www.naturalstep.org], Life Cycle Analysis and stakeholder consultation, to support more effective decision-making at all levels of the organisation.

What the "systems thinking" of The Natural Step (TNS) Framework offered the company was crucial, but then once grasped, frustrating (Crittenden *et al*, 2010):

MD Tony Kelly, expressed this as:

Where we struggled with TNS is that it really didn't help us work out what we had to do on Monday. They gave us the beacon on the hill which was the thing to aim for [the green ovals of aspirations at the upper right corner of Figure 2], which was great and the principles are very sound I think, but after 18 months an

unanswered question for us was “What are we going to do tomorrow?” [how do we exit from the lower right corner of Figure 2?].

(T3) Social Bonds

Severn Trent was an early leader amongst comparable water utilities in respect of sustainability performance and assessment. In 2005 it was ranked first in this category for a fifth year in a row according to the Dow Jones Sustainability Index (Severn Trent, 2006). Like its peer water businesses, Severn Trent well appreciates the significance of “community”, segmented for them into the groupings of suppliers, customers, employees, government regulator, socially responsible investment asset managers, and so on.

In Veolia’s 2008 “Annual and Sustainability Report”, the company talks of a “partnership model that fosters sustainable development” (Veolia, 2008).⁷³ It goes on to draw a two-dimensional plot, delineated by axes of competition (all-none) and public-private, upon which it then locates four styles of management model: “public management”; “municipal companies”; “public-private partnerships” (Veolia’s preferred style), and “privatization”. The sketch smacks of Figure 3, at the core of the way social bonds are to be construed and counted in assessing sustainability. Veolia might here be said to be taking empirically observed styles of management, as they have evolved naturally in practice, and plotting them on a conceptual 2-D grid, thus to understand and succinctly define them — for its community of stakeholders, in its turn, better than to comprehend them. The public-private axis of Veolia’s 2-D grid, however, provides no scope for plotting the emergence into practice of so-called Public-Social-Private Alliances (PSPs). There is no conceptual place for the “Social” segment thereof. Had this third way of organizing and acting been acknowledged, the

resulting 3-fold categorization should have yielded up other, additional styles of management.⁷⁴

These entities of organized individuals are not static. They may evolve into, give birth to, and merge or partner in changing ways with other entities. In 1970, ten cities and sixteen sanitary districts in Oregon, USA, formed what was then called the Unified Sewerage Agency; the Agency was subsequently renamed Clean Water Services (CWS) in 2001 (wikipedia, Clean Water Services; accessed 26 November, 2010; www.cleanwaterservices.org). CWS is a public-sector utility for handling stormwater and wastewater. In 2007, reconstruction began at Clean Water Services’s Durham wastewater treatment facility. A nutrient recovery facility, invented and marketed by Ostara Nutrient Recovery Technologies (www.ostara.com; see also Britton *et al*, 2007), was being introduced. Ostara, as a private-sector business, was established in 2005; it sells the Crystal Green® slow-release fertilizer that is thereby recovered from its technologies. Clean Water Services has since developed the related WASSTRIP process, which is to be partnered both technically and commercially with the Ostara reactor — a public-private partnership in some sense, therefore. The Clean Water Institute™ (CWI) (www.cleanwaterinstitute.org) came into being in late 2009, when it was incorporated. It is a not-for-profit organization, with a vision that “looks 50 years down the road”(www.cleanwaterinstitute.org; accessed 24 November, 2010). Its purpose *inter alia* is to generate and hold the intellectual property that benefits from the Institute’s access to the everyday practice of its public-sector counterpart (Clean Water Services).

From this interaction between theory (CWI) and practice (CWS), as it were, flow the financial incomes from their partnership with the private-sector entity (Ostara). And these incomes in turn support the existence of the not-for-profit Clean Water Institute™, notably in employing those who invent the intellectual property, provide the education, and so on (and on). To some, this cluster of CWS-Ostara-CWI would doubtless evoke the label of a virtuous circle amongst the “triumvirate” of public, private, and not-for-profit

⁷³ Phrasing is significant. Here, the very merger of the two (Annual Report; Sustainability Report) was strategically important for Veolia that year. Previously, 2006 marked the year when Severn Trent replaced its “Stewardship” report, which it had published annually since 1999, with the first of its “Corporate Responsibility Reports”.

⁷⁴ These PSPs were cited in a session on social entrepreneurship in “Accelerating Innovation in the Water Sector”, a Workshop held at the (September) 2010 IWA World Water Congress (Montreal, Canada). They were cited, moreover, in association with the work of Dr Bindeshwar Pathak (above).

partners. It seems an exemplary case study in how a way of organizing — and a structure of governance — can enable innovation in the re-engineering of city infrastructure. This Clean Water cluster has created for itself a way of partnering (a synergy) mutually benefitting each of the three separate entities within the cluster.

In these three illustrations of the *TBL_{frontier}* for the current thread of (T3), i.e., Severn Trent, Veolia, and the Clean Water cluster, we find a variety of ways of organizing. One, notably that of Veolia, hints at the typology of Cultural Theory (so prominent in the *TBL_{future}*), but is surely not congruent with it. Another (Severn Trent) points to a quite different mapping and segmentation of groups within society.

The boundaries being drawn (by Severn Trent) around the social groups of asset managers, suppliers, customers, employees, etc, differentiate them according to the nature of their *functional* relationship with the given company, in particular, their financial relationship. The company is aware of how then it must attend to the different dimensions of well-being respective of each. From these follow considerations of the desired codes of ethics and equity that the business may choose to apply to each such relationship (as (T5)), in particular, in respect of suppliers along the supply-value chain (witness the Global Reporting Initiative and Global Compact of (T8) below). These are not, therefore, lines drawn across and within Society to mark out how groups of individuals bind themselves to one another in solidarities according to their differing world-views, including those on the Man-Environment relationship. You or I may belong to any one of these groups. But we do not necessarily choose to be a “supplier” on the basis of this group of like entities being egalitarian in outlook, say, because you or I may be likewise egalitarian in stance on the relevant issues at stake. We might, of course, choose to be a company’s supplier for such reasons, just as we might choose (or decline) to join the ranks of that company’s customers (or employees) according to a resonance between “our” and the “company’s” attitudes towards the Man-Environment relationship (in Figure 3).

In practice, there is a multitude of ways of associating, and of entering into relationships with other entities — so much so, that we have been obliged to use the rather abstract phrase of “entity” in order to embrace them all. Groups will have *their* own say in any debate over *their*

respective hopes, fears, and aspirations for the future. They do not present themselves at the table of debate as the *I* (individualist), *H* (hierarchical), or *E* (egalitarian) voice we now know so well; they do not see themselves as necessarily entering into a debate in the first place. They do not have an *I* or an *H* or an *E* emblazoned on their foreheads, as they rise to have their say.

(T4) Quality in Governance

The city of Kathmandu, Nepal, is situated on the Bagmati River. 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 (2011) estimated to be close to 3 million. As a result,

You don’t have to be a trained ecologist to know that the river is polluted.

says a study of the Nepal Water Conservation Foundation (NWCF, 2009). The Bagmati river itself flows through the three districts of Kathmandu, Lalitpur, and Bhaktapur. There, the unique Bagmati civilization has flourished; and to this civilization, the rivers and tributaries of the Bagmati watershed are sacred. The same NWCF (2009) report goes on to state:

[W]ater quality near the shrines of Pashupati, Sankhamul and Teku, places where people offer prayers and carry out rituals like funerals and bathing, has degraded.

It provides photographic material indicating the restrained under-statement here of the word “degraded”.

In November, 2008, the Foundation hosted a stakeholder meeting. Representatives from the watershed’s five municipalities were present, as were members of civil society, graduate students, media persons, water resource experts, environmentalists, community leaders, and non-governmental organizations (NGOs) — all as segments of society arising entirely naturally in practice. Now they were indeed entering into a debate.

The report maps their “plural perceptions” onto an unlabeled 2-D grid immensely suggestive of Figure 3. This plotting assigns the groups of media persons and graduate students to a quadrant with a very strong hint of the individualist (*I*) about it; elsewhere, as another

illustration, the collective perceptions of four other groups of stakeholders are lumped together as though those suggestive of an egalitarian (*E*) solidarity.

If the Foundation were to recognize where on Figure 17 might reside the deliberative quality of the governance it might hope to bring to bear on the Kathmandu-Bagmati system, things could be on the brink of some forward, if clumsy, momentum (for a while). A policy prescription (u_{now}) — once more an exit from Figure 2 at its lower left corner (the one routine step tomorrow) — could then be accorded a degree of {social legitimacy} for its having emerged from something at least better than closed hegemony (Box 4). Multiple actor-voices were granted access to the stakeholder meeting, although we cannot tell whether each responded to any or all of the others.⁷⁵

From an account provided subsequently by Gyawali (2010), here interpolated on the basis of the empirical 2-D mapping of NWCF(2009) (and reported in passing in Beck *et al* (2011b)), the outcomes would appear to have been these:

- (G1) the water experts, environmentalists, NGOs, and civil society — collectively the *E* solidarity — got much of what they wanted;
- (G2) the municipalities and ministries (jointly the *H* solidarity), did not get a great deal, but neither did they have to cede what they really would have wished for — they could still hold fast to an incremental nearing of their (ultimate) hope for a major inter-basin water transfer;
- (G3) the media persons and graduate students (*I* solidarity) essentially got nothing of what they wanted, although they may putatively have gathered up some crumbs of comfort from around the table of the debate — on this account, they ought to be the most disgruntled group and, therefore, most likely to force changes upon the debate in a while (Δt); and

- (G4) the apparently fatalist-like (*F*) community leaders and general public were left, as the theory would tell us, stuck in their “apathetic doldrums” (the rubric of their quarter in the 2-D grid of NWCF (2009)), with neither audible approval from them of the u_{now} , nor complaints of which anyone else would take heed.

This is conjecture. Yet it is nevertheless the closest approximation of $TBL_{frontier}$ (Table 3) to TBL_{future} (Table 2) in the playing out of this particular thread (T4).

(T5) *Ethics and Equity*

The cell for our entry on this line item of the TBL_{now} in Table 1 is vacant. In contrast, its counterpart in Table 3 is brim full of entries. Some candidates for entry have even been deferred instead to thread (T8) below (on supply-value chains). Water utilities and businesses consider they owe a good deal in practice to those with whom they have a relationship. In return, they can expect — and do expect — certain things in the conduct of their suppliers (under (T8)). Conversely, these considerations of the ethics and equity in looking outwards beyond the “factory fence-line” have their uncommon reflections when turned inwards, onto the conduct of we engineers and water professionals (within a utility).

To begin, technology is today such that water can be so comprehensively purified as to become devoid of its taste and smell, in ways sufficient to affect the aesthetics of consuming wholesome and healthful potable water and the ethics of its being supplied. Indeed, so successful can the technology be that there are businesses with an interest in producing and marketing minerals for re-introduction into the thus purified water, to re-balance its taste, its wholesomeness, and its healthfulness, with an express view to preserving equity in supplying water to customers and consumers.⁷⁶ No member of a community should be discriminated against on the basis of the (varying) taste of drinking water (or its wholesomeness and healthfulness), not least when provided by one utility obliged yet to access a variety of

⁷⁵ Coincidentally, it appears that the portfolio of prospective technologies in this Kathmandu-Bagmati system (the red rectangles in Figure 2) might even have been inspired by much of what has been expressed here of CFG, in particular, through the case study of the Atlanta-Chattahoochee system in Chapters 3.3 and 3.4 (Beck *et al*, 2011a; NWCF, 2009).

⁷⁶ This was conveyed to me as a personal communication (at the September 2010 IWA World Water Congress in Montreal, Canada), which — by request — is being kept anonymous.

raw water sources and applying a variety of purification procedures to those heterogeneous sources.

Elsewhere, Sydney Water has for some time had an “Ecologically Sustainable Development (ESD) Policy”, duly aligned with various Australian federal and state government policies (www.sydneywater.com.au; accessed 19 November, 2010). “Inter-generational and intra-generational equity” is one of the Policy’s four Principles. It is applied as a matter of routine, for example, to evaluation of the sustainability of the Hoxton Park recycled water scheme (Sydney Water, 2007). There, 16,000 dwellings were to be served with recycled water for toilet flushing, outdoor use, and washing machines.

Writing of her first-hand, in-service experiences of the “Ethical Dilemmas in Water Recycling”, Cheryl Davis (an employee of SFPUC) observes (Davis, 2008):

As professionals in the water industry, we often perceive ourselves as upright people seeking to serve the common good, producing high-quality water to support commerce and protect public health. Although not generally a flamboyant or self-dramatizing group, sometimes those of us who support increased use of recycled water may even detect a quiet heroism in our battle against public ignorance, government inefficiency (or even corruption), and/or corporate greed. We may be more inclined to congratulate than doubt ourselves when rallying behind a cause which seems to offer so many benefits for both humanity and the environment. Recycling advocates, whose competence and motivations are often questioned by others, can end up feeling defensive or even self-righteous; this does not contribute to a spirit of open inquiry about possible ethical dilemmas.

But in a complex world rife with competing values, only a zealot could avoid noticing that the right path sometimes becomes unclear — not because one wishes to do wrong, but because there are so many competing goods. The technical, legal, political, economic, regulatory and environmental challenges of water recycling are such that there is a tendency to ignore or over-simplify ethical issues. We are tempted to pretend (both to ourselves and the public) that there is a scientific, legal, or economic answer to every question. We are often more comfortable

speaking in technical terms (where we are the experts) than in terms of values, which put us on a more level playing field with the public and other stakeholders. As a result, the values imbedded in our recommendations may not be clearly articulated or openly discussed.

For we engineers and water professionals this is telling — in fact, salutary.⁷⁷ The message is hammered home (Davis, 2008):

Jack Ward Thomas has commented on the aversion of resource professionals to acknowledge their own values in policy discussions with the public. He believes there is no way to avoid emotions in important resource management decisions, and that “avoidance of expressing values — other than to indicate unmitigated reliance [on] dispassionate science” results in “persistent miscommunication between professionals and the public.” He observes that “We speak calmly in science. The public speaks passionately in values.” He believes that when professionals express their own values, they use a language that is more widely understood, resulting in communication that is not only more effective but more ethical: “Personal and professional integrity are more fully aligned when passions are expressed alongside science.”

Our interactions with water, its supply, its infrastructure, and its source in the environment, are personal, wistful, lyrical, spiritual, and intimate matters. They are quite unlike the ways we interact with energy or transport systems, for example. Here, in respect of ethics and equity (T5) — as well as along other threads of the *TBL_{frontier}* falling within Davis’s experience at the “sharp end” of practice (Davis, 2008) — there is hard-won empirical wisdom to be put to work in shaping and re-shaping the conceptual threads of the *TBL_{future}*.

(T6) Valuation

Throughout the ages, people have settled where once there must have been a sustainable source of water to drink. Today, that water may still be available, but of unsafe quality. The intent of the business model of

⁷⁷ I have a sound appreciation of this. And with some irony, as Box 4 (from Chapter 4.2) has already revealed (see also Beck *et al.*, 2011b; Hare *et al.*, 2006).

Water Health International (WHI; www.waterhealth.com) is to (Bhatnagar, 2010):

Bring Affordable Safe Drinking Water to populations through a low cost decentralized model using state of the art operations and technologies.

It takes technology to render water safe for consumption, as we now readily appreciate, be it high, low, appropriate, or whatever fervently promoted style of technology. WHI declares itself to be resolutely pragmatic and “Technology Agnostic”. Its installations, called Water Health Centers (WHCs), are decentralized because settlements themselves are scattered and of all shapes and sizes. Users of WHCs are customers, not aid-recipients; they are not obliged to purchase their water from a WHC; its water might not meet customer preferences for taste; and WHC management can be held to account, since dissatisfied customers will not return. Cost per head of population for installing a WHC is (Bhatnagar, 2010):

very low, a fraction of what was calculated by the World Bank in connection with the Millennium Development Goals.

WHI’s business model bears all the hallmarks of a successful, straightforward valuation V_C of classical economics. It is customer-focused and it happens to be a hi-tech solution: of dual-media and activated carbon filters; and of remote sensing and automation, with smart-card technology — a merger of the styles of SiB and D&C (from Box 1). But it values just what lies in the short arc from water source to tap in IUWM. The business model works. Currently, there are some 325 WHCs across India, the Philippines, and Ghana.

Thinking outwards in wider circles, Environmental Management Pty Ltd of New South Wales, Australia (www.environmentalmanagement.com.au; accessed 21 November, 2010) “provides services in ecological economics and water studies”, specifically in respect of “total watercycle management” for “various urban projects”. In our terms, this would be valuation according to V_X .

(T7) *Environment Within the Language of Business*

A Google search on the combination of words {“biodiversity” “business risk” “water utility”} yields sites celebrating the language of business: www.ecosystemcapital.com and www.ecosystemmarketplace.com (both accessed 20 November, 2010). The former provides feeds to “environmental markets and finance news”. The latter, a charitable organization, has published a Primer on “*Payments for Ecosystem Services: Market Profiles*” (Forest Trends and the Ecosystem Marketplace, 2008): “market description” identifies “Water Quality Trading markets”; the “Market Size” was projected to be “over \$500 million” in 2010; and the “Market Players” comprise “buyers” such as the owners of urban wastewater treatment plants and principally farmers as the “sellers”.

If our interpretation of the Google search is accurate⁷⁸, the forestry sector seems presently to be better attuned to evaluating ecosystem services than the water sector. In February, 2011, the Governor of the State of Georgia was handed a large check for \$37B in recognition of the contributions to the State’s economy of non-timber ecosystem services from private-sector forests, i.e., water filtration, carbon sequestration, and habitat preservation (Moore *et al*, 2011; see also <http://www.youtube.com/watch?v=h80feaYX2mk>). Amongst these various services, those for “water regulation and supply” could be quite the most valuable — possibly in excess of \$8000 per acre, depending on forest characteristics (Moore *et al*, 2011).

(T8) *Supply-Value Chains*

The Global Reporting Initiative (www.globalreporting.org; accessed 23 November, 2010) has sought to bring consistency of routine to assessments, through what it asserts is “the world’s most widely used sustainability reporting framework”. One of its six blocks of sustainability indicators addresses Human Rights (HR), in particular, their protection in the Investment and Procurement Practices of any entity involved in

⁷⁸ It would seem so. Only in April, 2011, did the World Business Council on Sustainable Development publish its *Guide to Corporate Ecosystem Valuation* (WBCSD, 2011). The *Guide* is a “guide” because “[t]he concept of ecosystem valuation is new to many businesses”. Two out of 15 of the so-called “Road Tester” businesses of the *Guide* are in the water sector.

procurement. Performance indicator HR2 gauges this, through the:

Percentage of significant suppliers and contractors that have undergone screening on human rights and actions taken.

Commitment, as opposed to consistency, is sought from the UN Global Compact (UN Global Compact, 2008; www.unglobalcompact.org; accessed 24 November, 2010):

Launched in July 2000, the UN Global Compact is both a policy platform and a practical framework for companies that are committed to sustainability and responsible business practices. As a leadership initiative endorsed by chief executives, it seeks to align business operations and strategies everywhere with ten universally accepted principles in the areas of human rights, labour, environment and anti-corruption.

The two, the UN Global Compact and the Global Reporting Initiative, are pledged to collaborate more closely (www.globalreporting.org; press release of 28 May, 2010):

In addition to creating a reporting framework that will be implemented universally, the new collaboration is also intended to provide a benchmark for financial analysts and other stakeholders to better analyze and identify risks and opportunities as they relate to environmental, social and governance (ESG) issues.

Cities may commit themselves to the Global Compact. When accessed on 23 November, 2010, just under 50 were listed as having done so. Thus may mayors “call the shots” over those who dig the trenches for laying and re-laying the city’s sewer pipes, not only in respect of the protection of human rights, but also in the city becoming less unsustainable more generally.

Likewise may purchasing power be exercised back along the supply-value chain by those chief executive officers (CEOs) who have committed their companies to the Global Compact’s “CEO Water Mandate”. Amongst some 70 signatories (on 23 November, 2010), CH2MHill (consulting water-related engineers), Halcrow (consulting water-related engineers), GDF-SUEZ (water, energy, transport utility), and the Athens Water and Sewerage Company (of Greece) are the most

obviously focused on the water sector. As signatories to the Global Compact, all are bound to submit an annual Communication on Progress.

In sum, “Responsible Excellence Pays!”, claims Claude Fussler in the title of a 2004 article (Fussler, 2004). For having asked (Fussler, 2004)

How would a fund, solely based on Global Compact signatories, reward its investors compared to a fund of no-signatories?

he finds that:

... this group of 76 [Global Compact Signatories] outperformed the mainstream MCSI by 3.7% over the three-year period between June 2001 and June 2004.

Again, from our (principal) sectoral standpoint of water, Veolia Environnement numbers in the “group of 76”. Fussler (2004), then, has been raising the volume of his voice in our “language of business”. His analysis has been re-affirmed. A more recent review of the approach of Sustainable Asset Management (SAM) to Sustainability Investing, in which accounting for a firm’s intangible assets is integral and key (see also Dyllick and Hockerts, 2002), finds a “positive relationship between sustainability and financial performance, as measured by stock returns” (de Groot and Churet, 2009).

Power and influence over more than money flows back along the supply-value chain. At the Copenhagen Climate Summit of December, 2009, Paul Polman (CEO of Unilever) and Muhtar Kent (CEO of Coca Cola) were prominent in the publicity and discussion given to carbon emissions and consumer goods supply chains. An article from *BusinessWeek* at the time (17 December, 2009) calculated that

... consumer goods companies’ full supply chain represents as much as 5 billion tons of CO₂ emissions globally [which could] mean in excess of over \$100 billion of value ...

Amidst these large, high-profile numbers — tied to the cutting edge of carbon-trading and global climate change — water can get submerged. Thus was “Exploring the Forgotten Water Footprint” the topic of a February, 2010, business meeting (www.greenbiz.com; accessed 24 November, 2010). Speaking there of the (2007) “Global Water Tool” of the World Business

Council for Sustainable Development (WBCSD), Jan Dell of CH2MHill was driven to wonder:

[Because] the world has been so focused on counting carbon emissions, we're concerned that in our race to low carbon energy, have we forgotten about water along the way?

(T9) Commercial Sectors

Municipalities everywhere have multi-sectoral public utilities departments. The San Francisco Public Utilities Commission (SFPUC) is one such, catering for water, waste, and energy. At the leftward (public) boundary of the axis for public-private management models in the 2-D grid of Veolia (2008), lies public management. Moving to the right, this is succeeded in turn by municipal companies, public-private partnerships (PPP), and then privatization at the rightward boundary. With its preferred PPP model (Veolia, 2008):

Veolia Environnement draws on its experience of public-sector management to offer tailor-made solutions to companies in the industrial and tertiary sectors. These markets generated revenue of about €10 billion in 2008. Thanks to our ability to generate synergies between our four divisions [water, waste, energy, transport], we offer a wide range of integrated management solutions. These “multiservice contracts” offer a combination of services provided by several divisions, enabling us to cater for the needs of clients who want to outsource a wide range of tasks to a single service provider. This market is growing by over 10% a year, bolstered mostly by the trend for outsourcing.

From its historical roots in the water sector, it is entirely conceivable how a water-sector enterprise — echoing the “I” for Integrated in IUWM within IWRM — will make a commercial success of a running a multi-sectoral enterprise, quite possibly well beyond the water, energy, food, forestry, and waste-handling sectors of Villarroel Walker’s Multi-sectoral Systems Analysis (MSA; Villarroel Walker, 2010; Villarroel Walker and Beck, 2011a).

The ambition for this thread of the *TBL_{frontier}* (in Table 3) looks well ahead of whatever might have been theorized about (T9) in the corresponding line item for the *TBL_{future}* (in Table 2). Specifically, Veolia Water UK

sees itself today as a “Multi-Utility Service Company (or MUSCO)” (www.veoliawater.co.uk; accessed 16 May, 2010).

(T10) Space

Developed and promulgated by The Natural Step (www.naturalstep.org), The Natural Step Framework, “is a comprehensive model for planning in complex systems.” The Framework (www.naturalstep.org; accessed 7 August, 2010):

... has helped many hundreds of different organisations around the world integrate sustainable development into their strategic planning and create long lasting transformative change.

The following headline for one of its reports (29 June, 2010) is transforming indeed:

DHV engineering blurs the line between sewage treatment and river habitat

Taken at face value, these words embody a vision of the spatial interpretation of IUWM within IWRM. They also intend that, in text and by acronym, the whole might evolve to become not just IUWM-IWRM, but yet IUWWRM. Thus The Natural Step’s news bulletin enquires (www.naturalstep.org; accessed 7 August, 2010)

[C]an a sewage facility actually help to enhance the health of natural systems?

and then responds and records these changes:

These new possibilities are now on display at the sewage treatment plant at Soerendonk today. The facility now includes a 9 hectare, €1.2 million (22 acre, US\$1.4 million) addition that consists of ponds, marshes and canals filled with aquatic vegetation that blends into the existing river ecosystem. The final pond along the riverbank is designed to be inundated during floods, and during dry seasons, a fish ladder provides a way for fish to spawn in the sewage facility’s final pond. In this way, the line between the “treatment plant” and the “natural ecosystem” is intentionally blurred, providing a benefit to both systems.

(T11) Life Cycle and Time

“In My End is My Beginning” writes Oppenheim (2010), by way of an update on the *practice* of eco-effectiveness (as inspired by McDonough and Braungart (2002)). In the cradle of the life cycle, new ways of engineering city infrastructure with new technologies are nurtured (see www.designlondon.net, for example, for a water sector example — the LooWatt (www.loowatt.com) — cited by Oppenheim).

At the September 2010 (Montreal) IWA World Water Congress, a group of water industry professionals organized a Workshop entitled “Accelerating Innovation in the Water Sector”. Speaking of “One Utility’s Journey”, Jonathan Clement, Director of Strategic Business Development, PWN Technologies, the Netherlands, observed that PWN is a rare entity — others were heard to say “very rare indeed”. Numbers substantiate this observation (Daebel, 2010; here paraphrased):

Venture capitalists normally invest their funds in as many as one out of 100 proposals that pass across their desks; we at Emerald Technology Ventures might invest in at most one out of every 200 water-sector proposals we see.

In the life cycle of companies, the birth-rate of new technology enterprises in the water sector is strikingly low.

Beyond organizational learning (T0) and the obvious influence of The Natural Step Framework (in respect here of (T2) above), the experience of Yarra Valley Water (YVW) has one further contribution to make to the *TBL_{frontier}* specifically in respect of the life cycle (Crittenden *et al*, 2010):

The selection of the pressure sewer system rather than more traditional technologies in the Gembrook project came about as a result of the use of LCA [Life Cycle Analysis] and was associated with significant environmental, social and financial benefits over its life cycle. The Gembrook project provides a tangible example of how cultural change combined with the appropriate sustainability tools can create significantly improved business and sustainability outcomes.

In the old YVW culture, where new ideas were

considered risky and actively discouraged, technical assumptions such as these⁷⁹ would be less likely to be scrutinised. Indeed, behaviour that challenges assumptions and the status quo would typically be actively discouraged.

Entirely deservedly — but technically incorrectly — Crittenden *et al* (2010) record the fact that in 2008 Yarra Valley Water was awarded the:

Sustainability Specialist Group Prize for Research Excellence (runner up) by the International Water Association.

The award was *not* for “Research Excellence”, but for pioneering achievement in *practice*. Its “runner-up” status was shared with a fellow Australian project; and both were runners-up to the success of yet another Australian project.

(T12) Function

We know that civil engineering projects have historically allocated much effort and thought to planning, design, and construction, while abandoning all subsequent stages to a much less fully thought-through fate. The way things can be operated is liberated or constrained by what has gone before in the life-cycle. The bull of the city in the china shop of the restored watershed should be endowed with intelligence and the deftness of metaphorical movement for yet expanding the shop’s operations (Chapter 3.4) — the epitome of “smartness”, then, about the city.

There is considerable contemporary interest in this notion (of smartness). Writing of the “Anatomy of a smart city”, however, Heather Clancy cites nothing of the water sector in what she has culled from the source document from Forrester Research (www.smartplanet.com; article posted by Clancy on 30 November, 2010; accessed 4 December, 2010).⁸⁰ In a 7-page IBM Software Solution Brief of September, 2010, on “Smarter cities and smarter buildings for a smarter

⁷⁹ These were the “historical technical assumptions that bigger is better and a centralised system is easier and cheaper to maintain” (Crittenden *et al*, 2010).

⁸⁰ “Getting Clever About Smart Cities: New Opportunities Require New Business Models”, Belissent, J (with Mines, C, Radcliffe, E, and Darashkevich, Y), Forrester Research (www.forrester.com; article posted 2 November, 2010).

world”, the word “water” appears some 15 times, that of “wastewater” just twice. A bit like the pantomime donkey — careering around the theater stage, animated by one person at the front and another at the back — our bull risks acquiring smartness and deftness only in its fore-quarters, on the upside of the city in respect of its intake of daily water. Yet Figure 1 shows that all the strategic, structural re-arrangements needed for the city to become a force for good in the environment should occur in its downside infrastructure: smartness about its hind-quarters, if anything.

The gulf between this practice here of the *TBL_{frontier}* and its companion projection of the *TBL_{future}* for thread (T12), into some higher realm of possibly effete, conceptual subtlety and complexity (witness the discussion of it in Chapter 5), seems as great as it ever was three decades ago (Beck, 1981).⁸¹

(T13) Gauging Environmental Benignity

Just as The Natural Step (TNS) was brought into Yarra Valley Water to effect change, so was its goal in entering engineering firm DHV (www.dhv.nl). Fifteen employees of DHV participated in a TNS certification course focused on the cradle-to-cradle concepts of McDonough and Braungart (2002). Taking up again the news bulletin on the Soerendonk wastewater treatment plant in the Netherlands, this is how TNS reported their impact on DHV (www.naturalstep.org; accessed 7 August, 2010):

The change has been a deep one, as Hans van Sluis, senior advisor on vitalization of water at DHV notes. “The effect of this change in our way of thinking about sewage treatment has been fundamental. We now look at sewage treatment not as a necessity to reduce pollution and safeguard health but as a chance to enhance ecosystems and the related service provision.”

On its own website (www.dhv.nl), DHV’s briefing note on “Revitalizing effluent for STP Soerendonk” reveals the kernel of something more:

⁸¹ Still we can read the following, as one of the main “*Messages for Financiers*” from the UN’s World Water Development Report 3 (WWAP, 2009b): “There is an imbalance between funding for capital investment — which is more attractive to external financiers — and funding for operation and maintenance (O&M), which tends to be deficient. To fund O&M, tariff revenues need to be enhanced and budgetary transfers provided on a more solid and predictable basis”.

A three-stage ecological filter [daphnia ponds, reed marshes, fish pond] — based on the *water harmonica* principle — removes the last remaining bacteria and pathogens and inoculates the treated effluent with appropriate surface water flora and fauna species.

Upstream of the first of these stages

A flowformcascade is placed between the ‘concrete’ sand filters and the Daphnia ponds of the ‘green’ section [of the STP]. Flowforms ... evoke a rhythmical flow, which mimics a meandering river. ... [A] stimulating effect on the downstream ecosystems development is expected.

The alignment between this element of the *TBL_{frontier}* for (T13) and that of the *TBL_{future}* is remarkable, and quite unexpected. What Soerendonk realizes in practice and in space, encapsulated in the words rhythm, meandering, and *harmonica*, so Chapter 3.4 imagines in concept and in time — spectrum and intermittent supplements — in the culmination of the computations for the R M Clayton facility in the Atlanta-Chattahoochee system. The one seeks to enhance ecosystem services in practice through inoculations of biological species from the treatment plant (Soerendonk; practice; *TBL_{frontier}*); the other imagines doing so through nutrient supplements (Atlanta; theory; *TBL_{future}*).

Here we have the quintessence of mutually re-invigorating progress from the intertwining of concept and practice. It feels uplifting, as any rocket science should be. The City as a Force for Good (CFG) in the environment is not as far-fetched as one might have supposed.

(T14) Cycling of Materials

In 2005 Severn Trent published the results of an assessment conducted by the (UK) Carbon Trust of this water/waste utility’s carbon-cycle footprint (Severn Trent, 2005; available from www.severntrent.co.uk). In a “closing reflection”, we find a significant lack of “joined-up” thinking about the carbon and water (hydrological) cycles (Severn Trent, 2005):

Each sector of UK society needs to bear an appropriate level of responsibility for reducing greenhouse gas emissions. Whilst Severn Trent Water and Biffa are prepared to contribute to

reducing the UK's total emissions, it is clear that current water and waste policy is driving our emissions profile in the wrong direction.

It is not as Jan Dell of CH2MHill has put it — that the strength of the global focus on the carbon cycle has merely blinded us to the urgency of matters of the water “cycle” (including blinding us to the possible synergy of joint water-carbon policy interventions) — but that there is the danger of policy antagonisms. This is not the kind of enabling governance to be sought for re-engineering the multiple infrastructures of the city in a less unsustainable manner.

At a very different scale, Issue 23 (April, 2010) of the *Urban Agriculture Magazine* of the Resources Centres on Urban Agriculture & Food Security (RUAF), bears the title (www.ruaf.org; accessed 22 January, 2011)

The Role of Urban Agriculture in Sustainable Urban Nutrient Management

while that of one of its articles (Drechsel and Erni, 2010) is about

Analysing the Nexus of Sanitation and Agriculture at Municipal Scale

The Issue is replete with supremely practical case studies of the benefits of recycling the aqueous and nutritious residuals of the Confined Human Feeding Operations (CHFOs) that are our cities: from West Africa, to Vietnam, Brazil, Colombia, China, Mexico, and other countries. The article by Dagerskog *et al* (2010) on the city of Ouagadougou, the capital of Burkina Faso, is especially encouraging (as already noted in Chapter 3.1). The title of the Issue, then, is the embodiment of the slogan of eco-effectiveness: “waste = food”. The struggle to write a headline for Integrated Urban *Nutrient* Management (IUNM), within Integrated *Nutrient* Resources Management (INRM), has been taken off our hands. What has been written already implies the seamless coherence of IUWM&IUNM, if not yet its being nested within IWRM&INRM.

Where Practice Pulls Theory Along — and Vice Versa

From the perspective of sustainability, we enquired in Box 2 (Figure B2.1) into the nature of what kind of engineering or policy intervention would cause the individual — that most local of you or I — to

apprehend and debate the why's and wherefore's of the big, global picture. At the close of the thread of human aspirations in the *TBL_{future}* (T1 in Chapter 5), we said this would be a matter of engineers “acting most locally” to engender “thinking globally” amongst a community. It would be a form of technology push, for the individual/household does not appear universally to be clamoring for it.⁸² It was arguably a case of an element of the *TBL_{future}* (Table 2) forging well ahead of its companion in the *TBL_{frontier}* (Table 3).

But then in December, 2010, American Public Media reported from the Cancun (Mexico) Climate Conference on what motivated John Perry Barlow to establish his startup business, Algae Systems (www.algaesystems.com). Reporter Scott Tong summed up the company thus (7 December, 2010):

It aspires to take sewage, combine it with sunlight and make fuel. And, along the way, take carbon dioxide out of the atmosphere.

From this we can infer that the nutrients in the sewage (PeFe) would be needed for algal growth. Then, extrapolating from sewage back through the sewer network, to the source of those nutrients in our households, office blocks and so on, the headline was obvious: “Climate Change Drives Market for Urine-separating Toilets”. Here was the demand pull of innovation: drawn on by the global perspective of climate change. It has the synergy of some joined-up thinking amongst the carbon, nutrient, and water cycles, hence an entry for (T14) of the *TBL_{frontier}* in Table 3 capable of outstripping what was imagined (at the time of writing) for its counterpart in the *TBL_{future}* of Table 2 (and Chapter 5). Doing something about climate change would be enacted at the local scale of the household.

In places, comparing Tables 3 and 2, the *TBL_{frontier}* of practice seems to be in the vanguard, ahead of its counterpart *TBL_{future}*. Elsewhere, true to form, concept (*TBL_{future}*) may be outstripping practice (*TBL_{frontier}*). Perhaps nowhere is this more so the case than in respect of matters at the heart of how we have discussed {economic feasibility} in Chapter 3.2, i.e., in the line items of (T6) (Valuation) and, especially,

⁸² Although where people have experience of the once-unfamiliar urine-separating toilet, for example, surveys show acceptance is high (Lienert and Larsen, 2009).

(T7). Insofar as this *Concepts Paper* has sought to gather hard, empirical evidence of water-sector entities pushing at the boundaries of thinking/practice on sustainability, the grand notions of valuing ecosystem services, biodiversity, and our bequests of these to the next generation are conspicuous by their absence from the *TBL_{frontier}*