



Risk management for drinking water safety in low and middle income countries - cultural influences on water safety plan (WSP) implementation in urban water utilities



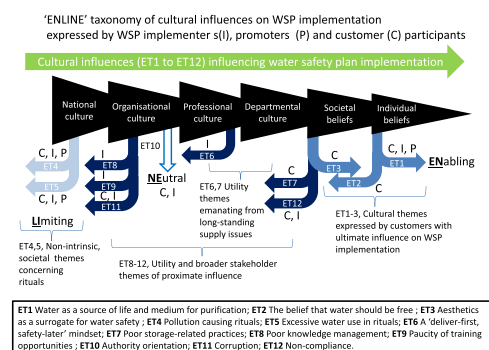
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HIGHLIGHTS

- Few researchers have considered cultural influences on WSP implementation.
- A thematic analysis of three WSP pilots in India, Uganda and Jamaica elicited the views of WSP implementers, promoters and customers.
- Twelve cultural themes emerged that enable, limit or are neutral to WSP implementation.
- Some parallels exist with WSP implementation in higher income countries.
- A structured approach to cultural attentiveness during water safety planning is likely to secure greater traction for these initiatives.

GRAPHICAL ABSTRACT



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ABSTRACT

We investigated cultural influences on the implementation of water safety plans (WSPs) using case studies from WSP pilots in India, Uganda and Jamaica. A comprehensive thematic analysis of semi-structured interviews ($n = 150$ utility customers, $n = 32$ WSP 'implementers' and $n = 9$ WSP 'promoters'), field observations and related documents revealed 12 cultural themes, offered as 'enabling', 'limiting', or 'neutral', that influence WSP implementation in urban water utilities to varying extents. Aspects such as a 'deliver first, safety later' mind set; supply system knowledge management and storage practices; and non-compliance are deemed influential. Emergent themes of cultural influence (ET1 to ET12) are discussed by reference to the risk management, development studies and institutional culture literatures; by reference to their positive, negative or neutral influence on WSP implementation. The results have implications for the utility endorsement of WSPs, for the impact of organisational cultures on WSP implementation; for the scale-up of pilot studies; and they support repeated calls from practitioner communities for cultural attentiveness during WSP design. Findings on organisational cultures mirror those from utilities in higher income nations implementing WSPs – leadership, advocacy among promoters and customers (not just implementers) and purposeful knowledge management are critical to WSP success.

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1. Introduction

The World Health Organisation (WHO) and the International Water Association (IWA) promote a preventative risk management approach

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to providing safe drinking water through ‘water safety plans’ (WSPs). WSPs encompass all stages of water supply, their objectives to preventively minimize the contamination of source waters; reduce or remove contamination through treatment processes; and prevent contamination during storage, distribution, and the handling of drinking water (Davison et al., 2005). WSP implementation (Fig. 1) tests the organisational cultures of utilities that adopt them (Devas and Grant, 2003; Summerill et al., 2011). A continuous improvement cycle of preventative risk management across the water supply chain, maintained by targeted interventions at so-called ‘critical control points’, WSPs require leadership commitment and a revised approach to water safety; cross-department teams sharing system knowledge; and long-term commitment to keeping the water safety agenda alive among utilities and their stakeholders. To assist WSP implementation, WHO and IWA have capacity-building programmes in place to transfer knowledge between utilities in lower, middle and higher income countries, and vice versa.

WSP implementation (Fig. 1) is not a technocratic process operating in isolation of its cultural context; rather, cultural features infuse WSPs throughout. The impact of culture (learned, dynamic patterns of social behaviour, based on underlying values and beliefs and used by people as a guide to interactions among themselves and the world around them) on perceptions and behaviours is established (Leung et al., 2005). Society is a melee of cultures – national, organisational, professional, departmental (within organisations), societal – operating alongside individual beliefs (graphical abstract). The influence culture has on managerial activity is widely discussed (Hofstede, 1980, 2001; van Oudenhoven, 2001; House et al., 2004). For example, Helmreich and Meritt (2001) and Reader et al. (2015) link the safety cultures of organisations with national cultures, and Zomorrodian (1986) argues for cultural attentiveness as a core competency for project managers. A lack of cultural sensitivity is also cited as among the factors why development projects sometimes fail (Rondinelli, 1976; Pant et al., 1996; Schech and Haggis, 2000; GTZ, 2007).

The water and risk literatures are replete with references, studies and findings to reinforce these views. Culture and risk are the focus of the 2014 World Disasters Report (IFRC, 2014), which airs the complex issues around belief systems, cultures and risk perceptions central to human agency during disaster situations. More broadly, UNESCO’s former Director General, during the 2002 World Water Day celebration, expressed: “Water is probably the only natural resource to touch all aspects of human civilization - from agricultural and industrial development

to the cultural and religious values embedded in society” (Matsuura, 2002). The works of Douglas (1992), Schelwald-Van Der Kley and Reijerkerk (2009), Webster (2006), Figueroa and Kincaid (2010), Salzman (2012), Breach (2011), IFRC (2014) and Hutchings et al. (2015, 2016) all offer valuable insights. Correspondingly, WHO recommends implementing its Guidelines on Drinking Water Quality (GDWQ; WHO 2004; 2011) in the context of local or national environmental, social, economic and cultural conditions. Similarly, the Bonn Charter (IWA, 2004; Breach, 2011), a sectoral commitment to improved drinking water governance, recommended accounting for the cultural and socioeconomic situations of different countries. This said, describing the cultural influences on WSP implementation within utilities has been hampered by a scarcity of well-evidenced research, though several reports stress its importance (e.g. Godfrey and Howard, 2004; Davison et al., 2005; 2006; Bartram et al., 2009; Figueroa and Kincaid, 2010; WHO, 2011; WHO, 2014).

Other tenets of successful WSP implementation, for utilities and community water systems, are known. For utilities and their infrastructures, the assembly of water supply system knowledge (often for the first time during the WSP); purposeful training with incentives for skilled operational staff; and visible leadership from the top of the utility (Hrudey and Hrudey, 2005; Hrudey et al., 2006; Summerill et al., 2010; 2011) are important. Meaningful relations between utility customers (Byleveld et al., 2008), WSP implementers and promoters, such as environmental health departments, are vital (Jalba et al., 2014) alongside the need for a receptive institutional culture that adopts a WSP.

In practice, most utility-based WSPs are ‘scaled up’ from pilot projects, like those we examine post hoc, below. By way of context, there is a useful literature on scaling up development projects (Uvin, 1995; Uvin et al., 2000), a practice described by scholars as ‘elusive’ (Picciotto, 2003), ‘confusing’ (Hartman and Linn, 2008) and ‘lacking consensus’ (Simmons et al., 2007). This said, ambitions for scale-up express an intent for an increment in provision, whether in geographic coverage (extension to new locations); service breadth (extending number of people being served in current categories and localities); in the depth of service (additional services to current clients); the reach of customer type (extending to new categories of customer); or in scope (extending current methods to new challenges). To get traction, processes being scaled up should be (Simmons et al., 2007): (a) credible, based on sound evidence or espoused by respected persons or institutions; (b) observable, so potential users can see the results; (c) relevant, for persistent or sharply-felt problems; (d) have a relative

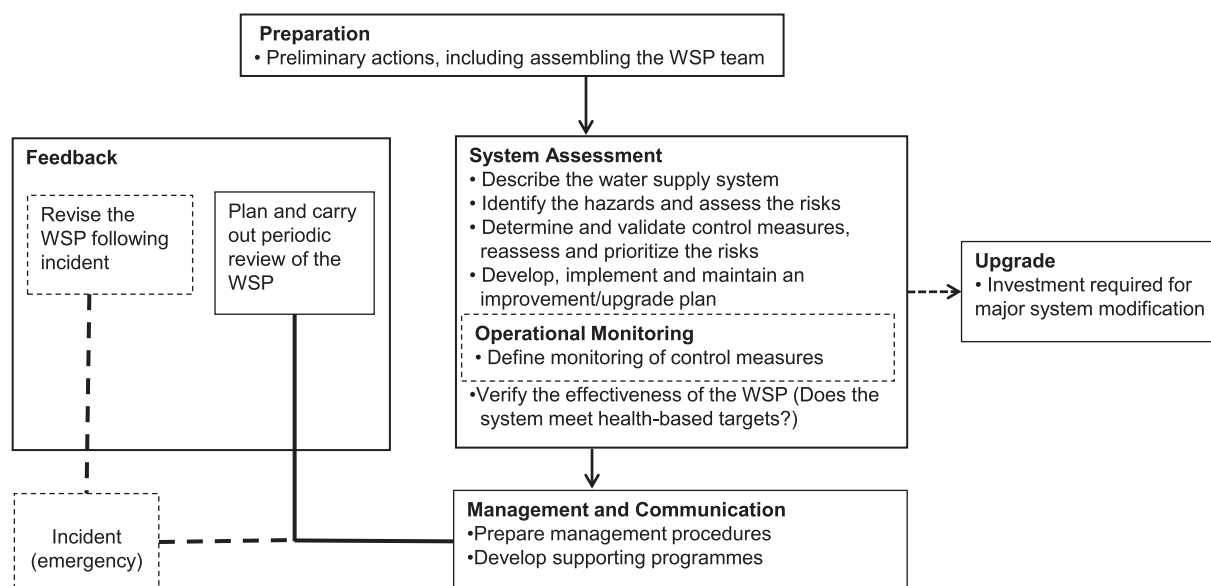


Fig. 1. Implementation process for a WSP (after WHO, 2004).

advantage over existing practices; (e) easy to install and understand; (f) *compatible with the potential users' values, norms and facilities* (our emphases); and (g) testable first, without committing users to complete adoption.

Godfrey and Howard (2004) identified several challenges for scaling up WSPs: (i) limited data availability: many systems in the low and middle income countries are only recently developing the culture of data collection and storage; (ii) unplanned development: limited regulation has resulted in unplanned development making it difficult to locate all supply mains; (iii) sanitation: poor access to urban sanitation means cross contamination of water pipes remains common; (iv) system knowledge: much of the information on piped networks may not be available, as records may have been removed by contractors or colonial powers; and (v) equipment/human resource availability: the selection of appropriate water quality parameters at critical control points, say, should consider the availability of resources.

Given these contributions, we note the critical role played by managing utility system knowledge well. Knowledge management is central to WSPs because a bottom-up understanding of the supply system for operators is essential for preventative control (Luís et al., 2015). Knowledge exchange occurs in water utilities, like in all organisations, between individuals, from individuals to explicit sources, from individuals to groups, between groups, across groups, and from the group to the wider organisation (Alavi and Leidner, 2001; Mounce et al., 2010). These processes are supported by managerial and inter-agency understanding and by technologies that embed knowledge within organisational routines. The WHO/IWA water safety portal is one such tool: <http://www.wsportal.org/>. Organisational cultures are also a challenge for knowledge exchange (O'Dell and Grayson, 1998; Gold et al., 2001; Fahey and Prusak, 1998). DeLong and Fahey (2000) suggest cultures influences it by: (i) shaping assumptions on the type of knowledge to be managed; (ii) identifying links between individual and organisational knowledge, affecting the hoarding and sharing of knowledge; (iii) creating social interactions that determine the appropriate use of knowledge; and (iv) influencing processes through which new knowledge is created, legitimized and distributed. The WSP manual developed by Bartram et al. (2009) helpfully lists typical challenges encountered during the different phases of WSP implementation, many of these linked to how knowledge is best managed.

This research considers the interface between national, local and institutional cultures in low and middle income countries, characterizing the cultural elements that influence WSP implementation in utilities. Research objectives were to (a) identify cultural factors that affect WSP projects in low and middle income country water utilities; (b) evaluate constraints to the transfer of WSP knowledge; and (c) develop a culturally-informed approach to implementation; a facet of practitioner guidance that, whilst repeatedly stressed in numerous commentaries, has received little empirical analysis. We were not concerned with the setting, a priori, of national public health or drinking water standards as such; rather the cultural factors that influenced the implementation of WSPs as preventative risk management strategies.

2. Materials and methods

This study deployed a multiple case study research method, using semi-structured interviews and supplementary sources as the principal data collection method and thematic analysis for data evaluation (Robson, 2001; Neuman, 2003). Three utilities were selected that had taken part in WSP pilots, selection criteria being: (i) WSP experience, the utility having at least one year's experience in WSP implementation; (ii) location, the country selected being from one of the three WSP promotion regions (WHO/IWA) of Latin America and the Caribbean (LAC), Africa, and Asia so to offer sufficient spread; and (iii) utility capacity, the utility having a piped system supplying a population of >200,000 people. From ten candidate countries, three were selected for field studies and seven for desk studies (see Omar, 2013). Field sites where WSPs

had been piloted in Hyderabad, Kampala and Spanish Town were selected.

We stress our intent. The three utilities had each embraced WSPs as a commitment to improving water safety. Our interest was not in a critique of these projects, of the utilities hosting them, or of the individuals involved. All utilities face implementation challenges with WSPs. Nor do we imply criticism of the utilities' governance arrangements. The analysis of interviews is offered purposefully some time from being gathered to recognise the changing environment in which WSPs are implemented as utility experience gathers. Utilities are referred to as Utility H (Hyderabad), K (Kampala) and S (Spanish Town) so not to draw unwelcome attention to perceived organisational performance. In this research, we were solely interested in the cultural factors that appeared to influence WSP implementation and the themes that emerged across the three case studies.

The principal survey instrument was the semi-structured interview. Bernard (2006) suggests survey data is collected at the lowest unit of analysis possible. Keeping our objectives in mind, three units of analysis were chosen: *customers* – of individual utilities with access to piped water systems; *implementers* – water utilities, whether government-owned, semi-private or corporatized, or private; and *promoters* – stakeholder organisations supporting local implementation of WSPs. Preparatory activities informed the interviews. Twelve pilot interviews tested the research questions, with a concise interview schema the result. Next, a case study protocol was developed containing field procedures, a contextual overview, an interview schedule, case study questions (Supplementary Data) and a template for each case study report. Before each field trip, the researcher (YYO) reviewed the site, and evaluated online newspapers from the locale to develop an understanding of the socio-political context (Wengraf, 2001). Together, 150 utility customers, 32 implementers and 9 promoters participated (Table 1). Beyond these numbers, no or minimal new data was being elicited from respondents. A stratified set of interviews across social groups was sought for each unit of analysis: among implementing utilities, from directors, branch managers and junior staff; and among customers, from different social-classes, as inferred from neighbourhoods. Interviews were in English. A voice recorder was used and interviews transcribed verbatim and assigned identifiers H (Hyderabad); K (Kampala); S (Spanish Town); CI (customer interview); II (implementer interview); and PI (promoter interview). The code HCL15 thereby referred to the anonymized Hyderabad customer interview number 15. Of additional value were WSP project and publically available reports, utility and regulatory reports, obtained through consultation with key stakeholders.

Coding (Neuman, 2003) the survey data entailed locating themes in each data set and assigning open codes (Fig. 2), linked to observations and document reviews within the case study. Interview data was analysed manually to establish explanations, connections and differences; grouping emergent themes across the three studies from the qualitative evidence into twelve cultural factors (ET1 to ET12, below) for discussion.

Identifiers from literature definitions of culture provided the primary codes to categorize the data. Phrases, sentences, words and observations from the units of analysis were assembled under each code (A to D; Fig. 3). Common items from the three cases were grouped and meanings synthesised from these categorizations for the context of the study (Fig. 2); data and theory triangulation performed by reference to Robson (2001). The methodology was reviewed and approved by Cranfield University's research ethics committee.

3. Results and discussion

The raw interview data for Hyderabad (Utility H), Kampala (Utility K) and Spanish Town (Utility S) is extensive, with summaries presented in the supplementary data. We were first interested in institutional experiences of WSP implementation and the traction

Table 1
Participant demographic for Hyderabad, Kampala and Spanish Town.

Customer demographic	Hyderabad (n = 50)	Kampala (n = 50)	Spanish Town (n = 50)
Male (%)	68	60	40
Female (%)	32	40	60
<20 years (%)	2	2	Nil
20–29 years (%)	42	34	32
30–39 years (%)	30	32	26
40–49 years (%)	18	26	22
50–59 years (%)	6	6	20
70–79 years (%)	2	nil	Nil
Hindu (%)	56	2	Nil
Muslim (%)	38	12	6
Christian (%)	2	80	86
Sikh (%)	4	Nil	Nil
Rastafarian (%)	Nil	Nil	8
Indigenous (%)	Nil	6	Nil
Primary education (%)	28	42	42
Secondary education (%)	30	26	36
College education (%)	30	26	22
University education (%)	12	6	Nil
Implementer demographic	Hyderabad (n = 15)	Kampala (n = 10)	Spanish Town (n = 7)
Male (%)	100	90	14
Female (%)	Nil	10	86
30–39 years (%)	20	40	43
40–49 years (%)	33	30	29
50–59 years (%)	47	30	29
Hindu (%)	93	Nil	Nil
Muslim (%)	7	Nil	Nil
Christian (%)	Nil	100	100
College education (%)	13	10	29
University education (%)	87	90	71
Promoter demographic	Hyderabad (n = 5)	Kampala (n = 1)	Spanish Town (n = 3)
Male (%)	80	Nil	33
Female (%)	20	100	67
30–39 years (%)	20	Nil	33
40–49 years (%)	33	Nil	67
50–59 years (%)	47	100	Nil
Hindu (%)	80	Nil	Nil
Muslim (%)	Nil	Nil	Nil
Christian (%)	20	100	100
University education (%)	100	100	100

utilities secured (or not) implementing WSPs, considering aspects of organisational culture and scale-up. These contextual observations serve as a platform for the discussion of the emerging themes 1–12; cultural influences on WSP implementation observed across the utilities and a means of presenting these for practitioners.

3.1. Endorsing the WSP approach

Acceptance of a WSP pilot is a key commitment to improved water service provision in these countries and utilities, and represents an underlying dedication to public health outcomes, irrespective of the challenges of implementation. Hosting a WSP pilot required prior political and executive support in all three utilities. Hyderabad was chosen as a pilot following consultations between the USEPA, the WHO (2008) and the Government of India. Evidence shows a warm reception for the concept by Utility H's leadership, a (not atypical) lukewarm reception by middle managers, and a lack of awareness by operational staff. The Kampala pilot (Howard et al., 2005) was research driven, reflecting the organisation's healthy learning culture, supported by its leadership. The WSP was warmly received by executive management, implemented by middle management and awareness created at the staff level. Even at branch level, managers were aware of the WSP. Spanish Town was chosen during a Pan-American Health Organisation (PAHO), Centres for Disease Control and Prevention (CDC), and USEPA workshop in the region where it was suggested Jamaica host a pilot. The selection of Spanish Town was influenced by the challenges faced at its water

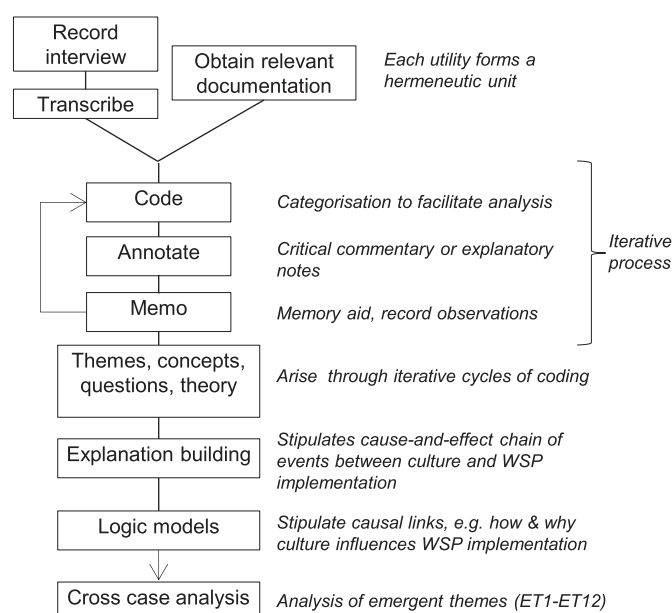


Fig. 2. Approach to coding and development of emergent themes ET1 to ET12 (adapted from Summerill et al., 2010).

treatment plant and the effects of human activities within its large catchment. Although the executive had reservations initially, the pilot was fully adopted. There were initial concerns about 'know-how' and the state of facilities, alongside a widely-held (and not uncommon) view 'we are already doing it'.

3.2. Organisational cultures within case study utilities

The three utilities possessed various similarities and differences between and within their organisational cultures. Johnson's (2002) 'cultural web', which presents the interrelated elements of power structures, organisational structures, control systems, stories and myths, symbols, rituals and routines, was deployed to illustrate the cultures at these three utilities (Fig. 4). Summerill et al. (2010) successfully adapted this construct to the implementation of WSPs in high income utilities. Pollard et al. (2007) has described this approach more generally for water utility risk management.

Several scholars note the role organisational culture plays in the implementations of risk management initiatives (Summerill et al., 2010). Reliant on people frameworks and organisational structures, risk management is an inherently political affair. In this study, all three utilities were publicly owned with hierarchical structures. The management levels were six at Utility H and four each at Utility K and Utility S. The organisational structure in Kampala had more management functions, including the functions of 'institutional development' and 'management services'. As a result of reforms, some powers had been delegated to managers. Devolution in Hyderabad was apparent in the functional levels of 'circle', 'division', 'subdivision' and 'section', with managers at these levels being successively empowered. In Uganda, devolution was reflected in the branch structure, while in Jamaica it was evident in terms of its two divisions and four management areas.

From the interviews, it was evident that power bases at the utilities were invested principally in the Boards that oversaw them, though ultimate power lay with politicians appointing to Boards. In Hyderabad, the Board was appointed by the State, but in Uganda and Jamaica, Boards were appointed by national governments since these utilities operate nationwide. Ultimate power was seen in the control exercised over budgets, tariffs and of politically sensitive decisions such as the eviction of squatters. In Spanish Town, the WSP pilot had to be delayed because of a change in Government. In addition, some felt that there was a

A	B	C	D
Rituals	Pollution causing		
	Excessive water use		
Practices	Storage related	Water handling	
	Knowledge management	Training	Opportunity
			Mode of delivery
	Timing		
	Availability		
	Venue		
	Materials		
	Non-compliance	Poor enforcement	
		Responsibility overlap	
		Unrealistic laws	
		Double standard in enforcement	
Corruption			
Beliefs	Should be free		
	Source of life		
	Medium for purification		
Attitudes	Deliver-first safety-later		
Aesthetic preference	Smell		
	Taste		
	Colour		
Authority orientation			

Fig. 3. Sequential coding structure following primary analysis.

connection between ethnic and political affiliations in some of the Board and top level appointments. Operationally, executive leaders in these utilities had the greatest influence. The powers yielded by Utility K's executive were greater compared to their counterparts at the other two. Departmentally, water quality control teams perceived themselves as having less influence, compared to colleagues in engineering departments. Some felt more emphasis was placed on meeting quantity needs (supply), with water quality not ascribed the deserved level of attention.

Control systems are the internal machinery by which initiatives are driven through organisational structures and reporting levels, including line management chains, financial systems, quality systems and rewards. In Hyderabad and Kampala, a renewed emphasis on customer service had resulted in new systems to address customer complaints

with staff reward linked to these. Performance management contracts in Uganda were effective in improving service; indeed the impact of incentives at Utility K ranged from the delegation of responsibilities, financial bonuses and recognition for meeting goals. Whether embodied in company awards in managers' offices or in international standards (ISO) certificates in the main corporate office, the operational environment reflected a performance culture, not sensed to the same extent in Hyderabad or Spanish Town. Some interviewees felt their city should not be held to the same standards as those from higher income countries: "It is not the same here, like in those developed countries" (K118).

All organisations hold a bank of internal narratives – storylines that influence the uptake of management initiatives. Storylines across the three case studies were similar, indicating how staff cope well despite resource constraints, political pressures and a lack of customer cooperation in efforts to satisfy their customers. A common storyline in Hyderabad and Uganda was of organisational change. In both cases, employees spoke about how their organisations had changed and how employees had become more empowered. Unlike Hyderabad and Jamaica, where there was no one main character, the stories told in Uganda had the managing director centre stage as the main character.

Outside the organisations, stories evolved around service delivery and change. In all cases, customers narrated that the organisations studied had improved service delivery, pointing to improvements in water quality, rationing, connections and the addressing of complaints. However, customers described institutional trust differently. In Hyderabad, the majority of the customers indicated they trusted the water but not especially the utility per se; in Kampala of trusting the utility but not the water; while in Spanish Town of not trusting the water nor the utility. The link between trust and faith might explain why customers in Hyderabad indicated trusting the water given the theistic perceptions of water in their culture. In Kampala, the majority of the customers indicated they regularly boiled their drinking water because of a fear of illness. Utility K, though confident of its water quality, could not bring itself to tell its customers to stop boiling their drinking water, believing many things could happen to the water between their facilities and the

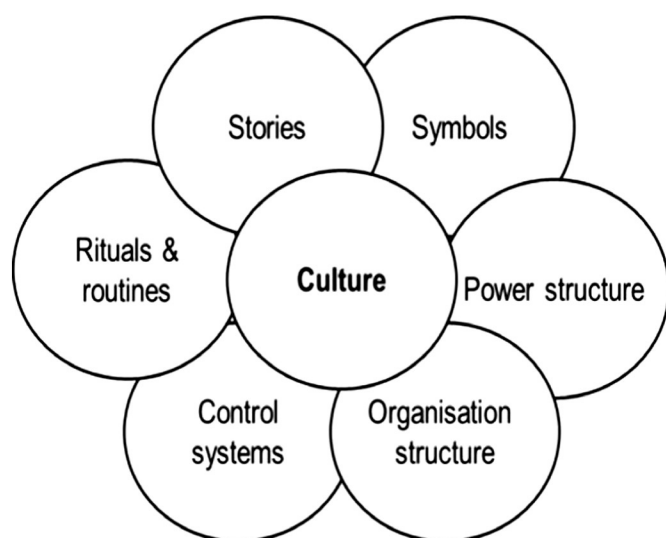


Fig. 4. Johnson's cultural web (after Johnson, 2002).

taps. Nonetheless, Utility K underwent efforts to have the utility trusted: “[Utility K] dealt harshly with staff and managers who violated principles of honesty and trust. The MD was particularly in the spotlight in this regard—both as a cheerleader for the organisation and as a person who set the tone for others. However, the capacity to detect malpractice depended on effective use of both formal and informal monitoring techniques” (Berg and Muhairwe, 2006).

The lack of trust indicated by customers in Spanish Town may be indicative of a more general attitude in Jamaica where it was common in casual conversations to be told “Don’t trust nobody” or hear people say “Me don’t trust nobody”. In all three cases, implementers indicated low levels of trust towards customers, particularly those in low income areas. They attributed this to non-payment of bills or tampering of their pipes by the customers. Finally, trust is an indication of reputation as noted by Bartram et al. (2009) and elements that pose a significant risk to a utility’s reputation should be addressed for WSPs.

Symbols in organisations are important cues to the management culture. The language adopted and the importance given to the fabric of water assets and even offices décor can suggest what gets prioritised, in turn reflecting management priorities. In all three utilities there were strong visual representations of the organisations. In all three, the logo colour of choice was blue and promotional material displayed different assets. The offices were of a high standard compared to other service providers and portrayed institutions committed to water service provision. A lexicon of customer service had been adopted in all three. In Kampala, giving advice to other managers, a branch manager indicated “Packaging your product well in line with customer demand, will ensure that you succeed” (KII).

In all three utilities, managers were formally addressed using local titles indicating respect. Power was symbolised through amenities available to managers such as vehicles, office location, secretaries as support providers, and reserved parking.

The rituals and routines of work practices in all three cases revolved around operational problem solving. Managers indicated that daily activities were shaped by operational necessities. When matters diverged from their intended course, blame targeted at the customers, the government, or other departments appeared common.

Career advancement within the utility is an important signal of what type of expertise and professional subculture is seen to have premium status. The established paths to joining the organisation and advancing in it differed. In Hyderabad, managers mostly had engineering backgrounds and the order was to do your time and work your way up the organisation. In Uganda, managers came from different backgrounds and advancement in the organisation was pegged to performance. The managing director in Uganda, himself with a non-engineering background, made it possible for non-engineers to bid for branch management jobs. In Jamaica, the approach was somewhat between Hyderabad and Uganda with the possibility of joining the organisation from outside, based on experience.

3.3. General comments on cultures and scale-up

The catchment to consumer approach of WSPs presents challenges in choosing the right path for scale up, in terms of handling catchment concerns, utility departments’ capabilities and water demand patterns. As our results indicate, scale up is influenced by political and organisational leadership, vision and values. Where these are used to incentivise individuals (Hartman and Linn, 2008), scale up can succeed. Comprehension of the WSP process and commitment to its values are fundamental. Evidence from the field indicates the work to be done: “WSP is nothing but locating and fixing leaks” (senior utility manager); “We finished the WSP” (treatment plant employee); “I would say that we are implementing it, whether we are doing it the way it is supposed to be done is another issue” (utility manager); “WSP is a challenge because from an engineering point of view they still don’t believe water is both quality and quantity” (quality control manager); “Engineers believe first

deliver then improve” (lab technician). The need for ‘champions’ for effective implementation is widely recognized (Hartman and Linn, 2008; Summerill et al., 2010) to sustain momentum. Leadership is not only required among implementers, but among promoters as important drivers. Given the long-term ambition of WSPs, the mentoring of future leaders is important to avoid a leadership vacuum.

Infrastructure improvements also increase the chances of WSP success. As one manager put it “After all is said and done, having the capacity to supply the needed quantities of water will be a decisive factor in whether WSPs will be successful in developing countries” (senior manager). This can be linked to another manager’s comment “When there is no water, quality becomes a secondary issue” (utility manager). However, it is important to understand that even starting a WSP without the necessary infrastructure improvements, despite its difficulties, is a step forward. Long-term support from promoters is needed to ensure successful scaling up of WSPs (Cooley and Kohl, 2006). In some of the WSP projects there was little evidence of involving stakeholders from the catchment. Catchment communities have to be involved and the challenges of identifying strategic partners, task force membership and the coordination of meetings and the actions they recommend have to be overcome.

For effective scale up, many water utilities in developing countries will have to substantially improve their organisational capacities on knowledge management and training. The following quotes identify the challenges: “People do not have a reading culture and the literature is shelved” (promoter); “There is no in-house training” (utility manager); “In my experience, operational staff are quite good at collecting data – but they think that this is the end of the process and data is not used – it is collected, stored and collects dust!” (promoter).

With these generalised observations as background, we turn to our principal focus – twelve emergent themes (ET1 to ET12), assembled from the cross case study thematic analysis, that reflect the impact cultures have on implementing WSPs. Considered in categories of influence below, and associated with customers, implementers or promoters (or a combination of these, see graphical abstract) these themes, to various extents, offer signposts for WSP implementers and can be assembled in a framework for adoption during WSP implementation. Useful for the discussion, are Fig. 1 for water utilities and the simplified WSP framework, albeit intended for small communities, published by the WHO (2014; Fig. 5).

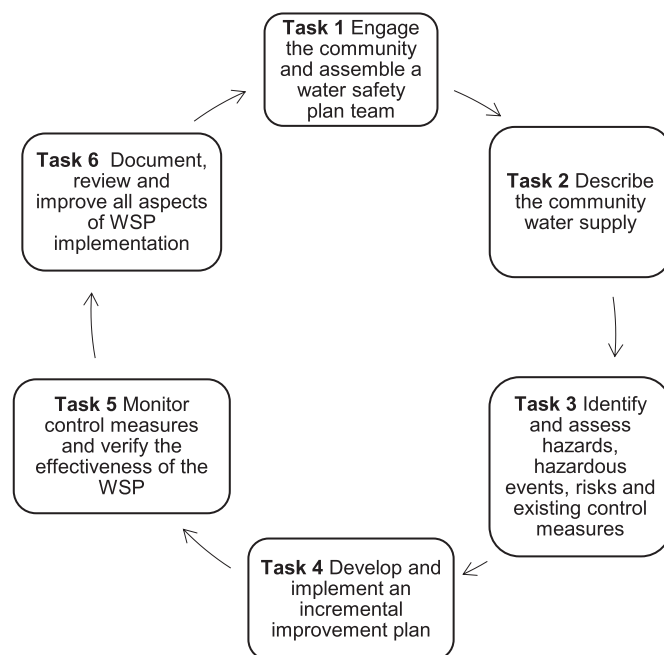


Fig. 5. Simplified WSP framework for smaller communities (redrawn from WHO, 2014).

Water and sanitation practitioners are well versed in the need to consider the cultural aspects of community water supply from catchment to tap (e.g. Cranfield University and John Hopkins Bloomberg School of Public Health, 2009). Less attention has been given to these influences within urban utilities, certainly within the context of WSP implementation, though notably a literature exists on utility governance in low to middle income countries (see Hutchings et al., 2015, 2016). Institutional cultures, however, have been largely ignored. Typical practical activities for WSPs that invoke cultural facets include stakeholder/community engagement (securing legitimacy); water supply system assembly (ensuring comprehensiveness); identifying control points and measures for risk-informed intervention (including outwith the formal supply network and at households); monitoring and review (organisational commitment to change); and continuous improvement (leadership).

3.4. Cross case study themes with 'ultimate' influence

We now turn our attention to cultural influences across the three case studies. Cultural themes categorised as having ultimate influence, identified in this research, were linked to the fundamental beliefs and cultural convictions of study participants that determine perceptions about water, and influence decisions such as bill payments and water consumption, for example. These are principally expressed by utility customers and have a direct influence of the success of WSP implementation.

Water as a source of life and medium for purification (ET1). All participants indicated reverence for water in their belief systems. The findings reflect a widely-held theistic conviction about the capacity of water to purify spiritually, in addition to its daily use in physical cleansing. Some participants indicated water literally washed sins off their bodies. The literature points to a universal reverence for water among most of the world's major faiths (Priscoli et al., 2004; Salzman, 2012) and this belief has strong associations with ET2 below. A significant driver, identification of this theme across the case studies supports the calls made for the inclusion of religious and community leaders during WSP scoping and framing; a positive force for infusing WSPs with ethical intent (Tasks 1 and 2; Fig. 5; see WHO, 2014) which risk-based prevention has at its heart. This said, knowing it might be a challenge to drive a preventative risk management mind set in cultures that are fatalistic may need the design of amended WSP strategies.

The belief that water should be free (ET2). This was expressed by the majority of customers in the three locations; mostly in Hyderabad at 90% compared to Kampala and Spanish Town at 80% and 65% respectively. Variations in the rate of belief between locations may indicate different strengths of religiosity. This in turn impacted on approaches towards access, tariffs and connections; as in the example of a Hyderabad resident who set up a drinking water dispenser for sharing water with others outside his gate. Here, the utility had been pressured by elected officials who considered water to be a social good, to keep tariffs at low or no cost to residents, especially the poor (Davis, 2005). This conviction is so strong that politicians had obstructed the dismantling of illegal connections by organising residents to confront employees enforcing disconnection rules, or had influenced the transfer of employees to undesirable departments as punishment.

At the three utilities, implementers recognized the lack of an ability to pay by some customers. Implementers were also quick to differentiate this from a willingness to pay. They argued the payment of water bills was not accorded the priority it deserved. Thought-provoking examples came from Kampala, where nearly half the outstanding arrears were from government ministries. Here, there were many examples of well-off segments of society being disconnected for non-payment. This impact has to be viewed in the context of whether water is a regarded as a commodity or human right.

One approach to the challenges posed by a belief that water should be free is in explaining to customers that water abstraction, processing

and delivery have associated costs. Linking payments to service delivery is educational and might modify the strength of the impact of such beliefs in a supply context. However, whether customers accept this argument or not depends on the quality of service affecting parameters such as the availability and quality of water. This presents an obvious paradox - achieving such parameters is itself dependent on effective tariff collection.

There were several activities dealing with illegal connections in Hyderabad, Kampala and Spanish Town. These included public awareness campaigns on legislation, amnesty periods for illegal connections and customer audits. The example of the Spanish Town customer who considered the illegal use of electricity as theft was recorded at a time when there was a country-wide campaign by the electricity company to curb illegal use. In Spanish Town, some customers believed that making profits from selling water was inherently wrong. Engaging the public on the financial challenges facing utilities, mindful of the implications of inadvertently promoting a deficit model in communication, might challenge these perceptions. In a related context, Hutchings et al. (2015) discuss success factors in the community management of rural water supplies in lower income countries. These authors call for additional external support in terms of financial support, technical and managerial advice, suggesting it remains challenging for rural communities to 'go it alone' with water supply. For WSPs, whether in urban or rural settings, a key issue is sustaining the quality improvements secured by the WSP from catchment to consumer. WSPs are envisaged as continual improvement plans and, as such, the ongoing monitoring (and funding) of control measures to maintain risk reduction requires resourcing from the tariff base.

Aesthetics as a surrogate for water safety (ET3). Most customers used aesthetic preferences for judging their water as safe to drink. They mentioned its appearance as the first indication of safety, followed by odour and taste. Customers believed safe water should have no colour, smell, nor taste. Others indicated listening to the tap as a strategy for judging water safety. A customer in Spanish Town explained: "When the water is safe, I can tell from the sound of the tap. The days when the tap starts making funny noises I know that day water is not safe". Narrating this to the utility manager led to the revelation that the utility had experienced difficulties with water pressure. Findings on aesthetic preferences raise an important concern for WSP implementation regarding the chlorine residual. Some customers (50% Hyderabad, 90% Kampala, 70% Spanish Town) raised objections to the smell and taste of residual chlorine in the supply and boiled their water. The challenge for utilities is in providing adequate disinfection without compromising the aesthetic acceptability of their product. In extreme cases, there is a risk that consumers may avoid aesthetically unpalatable safe drinking water in favour of seemingly more pleasant but unsafe supplies (WHO, 2004). This theme is enabling to WSP development and implementation, with a clear reference to critical control points where interventions to manage risk are best targeted.

3.5. 'non-intrinsic' cross case study themes

Non-intrinsic themes relate to societal rituals in which culture is not the issue per se, but where water practices related to it may impact WSPs. These factors are peripheral though may influence perceptions of WSPs and their implementation. Noted in the themes below, both water quality and quantity issues are relevant.

Pollution causing rituals (ET4). The immersion of idols into water bodies is an example of a pollution-causing ritual in Hyderabad. Here, one of the largest Ganesh festivities in the world is held. The procession consists of people, lorries, trawlers and trucks carrying Ganesh in his various forms and sizes to the Hussain Sagar Lake. Several cranes offload and immerse gigantic idols, and studies on water quality in the lake indicate high mercury concentrations attributed to the artificial paints on immersed idols (Suneela et al., 2008; Rao et al., 2004). This practice is common among believers of Hinduism (Vyas et al., 2006; Dixit and

Tewari, 2007; Pradhan and Latkar, 2008). The pollution of water sources by idol immersion is an escalation of family-level rituals to a community scale. Both Ganesh and the Durga Puja idols were traditionally sculptured in clay and decorated with natural colours, such as turmeric. These days, idols are made of plaster of Paris and the paints contain compounds of lead, mercury and cadmium (Pradhan and Latkar, 2008). India's Central Pollution Control Board recommends the use of natural materials, as stated in the religious scripts, for the decoration of idols and synthetic liners to support idols upon immersion and ease their removal.

One might imagine this could become a water quality issue. Public education backed by deterrence is one strategy. The approach taken by park rangers in New York provides one example. Reported in The New York Times (2011), the growth of the Hindu population in Queens has been matched by growth in ritual debris comprising of food, clothes, statues and cremation ashes, in Jamaica Bay. Park officials have been active in encouraging community members to pray at the water's edge but leave no offerings for the gods. Although many Hindus have complied, others unaware of the rules and some refusing to obey necessitated the levy of \$75 fines. As a result, more devotees are taking their offerings home after rituals. Community leaders and activists have successfully rallied members of their congregations in a campaign to educate and clean up the area.

Excessive water use in rituals (ET5). *Wudhu* is a ritual in which there is often excessive water use (Omar, 2013). Muslims perform *wudhu* at least five times a day, before the five daily prayers. This finding was noted during a visit (YYO) to a Hyderabad mosque where one of the caretakers was asking individuals to reduce the flow of water on the taps. In an interview with the elder: *"The prophet, peace be upon him, used to use around half a litre of water for Wudhu. Nowadays we have taps in the masjid and it is not like before in the olden days where people used water from a pond or a container. Instead of using half a litre, people open the taps all the way and use a lot of water. Some of them would be talking to their friends while the tap is running, this is not good. People come to the masjid for five prayers, now five times a day wasting all that water is not good. Wasting water is not allowed in Islam. This also makes the water bills very high"* (HIC30).

Individuals could be wasting twenty litres of water per day during *wudhu* and this could be significant in water stressed areas. The excessive use of water may limit WSP efforts because attempts to meet demands shift the focus on quantity issues at the risk of relegating quality aspects.

3.6. 'emanating' cross case study themes

Emanating themes emerge from the context of water supply by utilities and are deep seated, long-standing challenges for utilities in low and middle income countries with a significant limiting influence on WSP implementation where left unaddressed (graphical abstract). Two themes are of note; one a feature of professional sub-cultures, the other an issue for utility customers, both with the potential to limit the effectiveness of WSP implementation.

A 'deliver-first, safety-later' mindset (ET6). This was brought to light by different water quality control members in the three utilities. They suggested water engineers were mostly concerned with the quantity of water delivered, in preference perhaps to its quality. Examples to support this include the laying of water mains in close proximity to, or crossing sewer lines:

"The location of pipes in some places has not been well thought of, there are sewer lines crossing, I think more concern should be taken on where pipes are being laid" (HII7). *"WSP is a challenge because still from an engineering point of view they still don't believe water is both quality and quantity. That is why you will find an engineer laying pipes passing through a drainage system which is collecting waste water and you will find sometimes again a pipe close to an onsite septic tank, so if you were to consider what you are transporting should be of good quality then the idea of*

locating this pipe should have come into your mind. When your focus is solely on whether the water is reaching the customer then any path through which you lay your pipes is ok, and that is the challenge we have at the moment" (KII9). *"The safety issue would be better achieved if the engineers had the same concerns, it would make a difference"* (SII2).

Driving this attitude is a pressure on engineers to meet quantity needs:

"There is consideration, but sometimes there is pressure to meet the supply needs and the quickest or easiest route is taken" (HII15).

Grappling with this challenge, one utility staff member commented:

"When there is no water, quality becomes a secondary issue now, and that is a challenge which we have in developing worlds, how to keep the quality of something when what you are providing is not enough, so you end up going to quantity. We should change the way we think about of water, we should look at water in terms of quality and quantity. And if you look at water as quality and quantity, you find the system has to be monitored, the system is all interconnected. But if you look at water as quantity only then you find the engineering aspect over powers the quality" (KII3).

WSPs are an important vehicle for addressing this. The assembly of system maps reveals cross-overs between water and wastewater infrastructure and WSP teams, themselves assembled from across the utility, can force a discussion of these tensions that reflect different departmental and professional sub-cultures with respect to service provision.

Poor storage-related practices (ET7). All customers in Hyderabad, Kampala, and Spanish Town indicated having a storage tank or container because of intermittent water supply. Storage points are a formal part of the water supply system, albeit post-delivery, but nevertheless represent a control point for managing disease outbreaks. In these studies, the forms of storage varied from 5 L 'jerry cans' to large rooftop tanks. Several observations were made of individuals dipping hand held cups into storage containers. The most telling was during the Ganesh festival in Hyderabad. Both the utility and local government had set up 'water camps' to provide the public with clean drinking water. In both camps, water was dispensed from 100 L drums. Utility H staff dipped their hands into drums and scooped out water using plastic cups which they passed to celebrants. In the other water camp, staff used hand held jars to scoop the water, but poured the water into a dozen or so cups which everybody drank from. Some celebrants used cups to wash their faces and rinse their mouths. These and other observations raise a concern that the safe handling of stored water is not understood.

At the household level in Hyderabad, 65% had a designated utensil for fetching the water. However, on several occasions YYO observed individuals dipping hand held cups into the storage containers. In Kampala observations of the water fetchers' hands coming into contact with the stored water were made in 25% of the households. The Hyderabad WSP found *"Contamination of stored water samples significantly higher than source sample, indicating intra-household contamination"* and *"low awareness regarding hand washing"* (George et al., 2007). Similar findings were made in Kampala and Spanish Town. A promoter pointed out that *"Many times pollution takes place due to mishandling of water at the household level"* (HPI03).

Figueroa and Kincaid (2010) explore the social, cultural and behavioural correlates of household water and storage in some depth, a complex field of study with close connections to themes ET1, ET2 and ET3 above. There is a clear role for WSPs to play in influencing storage practices. Educating customers about contamination risks during storage and use should be important considerations to a consumer-centred approach. Practices such as covering storage containers or not and dipping hands into the containers to fetch water using tumblers need to be addressed to make WSP efforts successful.

3.7. Cross case study themes with 'proximate' influence

Themes of proximate influence are not linked specifically to a water-related belief but are facets of organisational cultures that may

nevertheless limit WSP implementation, as encountered in the three case studies.

Poor knowledge management (ET8). The generation of reliable data and its conversion into useful, accessible information play a key role in the success of WSPs through construction of supply system maps and the identification of control points for risk-based interventions (Figs. 1 and 5). Findings indicate gaps in the knowledge management practices of the host utilities. The first was evident at the beginning of the WSP process in all cases and this was the lack of, or outdated network maps and a lack of, or outdated utility data to support initial phase tasks. In all cases there were indications of a lack, or low levels, of data assessment and validation. For instance, during the Hyderabad WSP, it was found the rate of acute gastroenteritis was several times higher than reported by the public health surveillance system. This discrepancy was attributed to the fact that “93% of cases treated by private providers were not covered by surveillance system” (George et al., 2007). Clearly, professionals in these organisations need to be sharing and discussing the same real time data on risk indicators, an issue shared by utilities across the globe.

Paucity of training opportunities (ET9). Training and development plays a key role in WSPs because of the change in philosophy they adopt and the renewed focus on preventative risk management over compliance monitoring alone. Training has its various connotations that are not always viewed positively. In Hyderabad, being sent for training was viewed as a punishment, whereas in Kampala, training was considered an opportunity. For WSPs to be successful, training and knowledge transfer must be at the core of the process. One promoter called for a revised mindset towards training as a continuous process, remarking that in India, as far as utilities were concerned, training could be mistakenly perceived as a punishment post: “There are administrative reasons why somebody should not be put into some field and they will be transferred to the training centre but that man may not be interested in training” (HPI05).

Some implementers and promoters in Hyderabad indicated the desire for a locally developed WSP guideline: “International organisations bring the advantage of getting a body of expertise to tap from, but they fail to appreciate local conditions; they should understand the local conditions and the social-cultural aspiration of the people” (HII4). These aspirations include the desire to be ‘independent’. When it comes to the transfer of WSP knowledge, differentiating between oral societies and those with a culture of reading and writing make a substantive difference to how messages are received. A manager in Kampala indicated the staff he worked with would prefer to be called into a meeting and be given a presentation on new ideas, rather than provided with written material: “People do not have a reading culture and the literature is shelved” (HII10).

Learning on the job is key for knowledge exchange. The frequent transfer of employees between functions, whilst offering career development, can sometimes interfere with the smooth transfer of knowledge between them. In the Indian system, personnel were transferred every three years. As pointed out by one promoter, this could have a devastating impact if all the employees trained on certain skills were transferred at the same time and replaced with others without identical skills.

Authority orientation (ET10). We have previously commented (Summerill et al., 2010) on leadership for WSPs. Authority orientation refers to the propensity to relate to others according to their rank in the social order, and the levels/classes of power available to, and discharged by, authority figures. At customer and implementer levels, there were high levels of authority orientation noted throughout the interviews and observations. Broadly, most customers indicated authority figures in households level were the main “bread winner” or eldest parental figure. In Hyderabad (90%) and Kampala (80%) orders given by these figures were not directly questioned, even in cases where there were legitimate reasons to do so. In Spanish Town these numbers, although still high (60%), were significantly lower. At the community

level interviewees mentioned clan or tribal leaders, political leaders, religious leaders and government officials as authority figures. Again, there was some indication they could not be directly challenged more so in Hyderabad and Kampala (80% and 70% respectively) than in Spanish Town (50%). In Hyderabad one customer explained they went to community meetings to listen and would not raise any challenge during the meeting. Confronting an authority figure, it was explained in all three cases, would require a concerted effort involving several individuals.

More critically for utilities, how operational staff respond to line management instructions impacts on the roll-out of WSPs because these are cross-departmental initiatives. Authority orientation may be linked to the (Hofstede, 2001) power distance dimension defined as “the extent to which the less powerful members of institutions and organisations within a country expect and accept that power is distributed unequally”. At the utility level, authority orientation played out in similar ways. For example, during visits to Utility H offices it was common to see (YYO) junior staff saluting their managers. While junior staff in Utility H would often salute their managers, all Utility K offices had the managing director's portrait hanging from the wall. In Kampala, all interviews and most conversations did not pass without reference to the managing director portrayed as a ‘father figure’. In Kampala, managers considered support from senior leadership to be vital: “At the branches we are just like soldiers at the forefront vanguard, the managers at the head office are generals behind the scene and without their facilitation we cannot perform” (KII3).

The disparity between the three cases, showing Hyderabad and Kampala being more authority oriented than Spanish Town, might be explained through the indices of the respective countries on the power distance dimension (Omar, 2013), as reflected by the informal attitude towards managers in Spanish Town compared to the salutes in Hyderabad and the analogy of military generals in Kampala. High scores in this dimension suggest communication is directive in style and that feedback, which is (mis)perceived as negative, is not offered up the management ladder.

Corruption (ET11). Though challenging to discuss and open to contentious debate, most customers and implementers perceived corruption to be a widespread problem in their countries. The promoters also considered corruption to be an issue of concern whilst pointing to its pervasiveness in many countries of the globe. Proportions of customers considering corruption to be widespread in their countries were 90% in Hyderabad and 92% and 94% in Kampala and Spanish Town respectively. The language used by customers to describe corruption was frequently laden with emotion and symbolism: “When you have these big diseases which infect people like AIDS and cancer, you die a slow and painful death, corruption is destroying us like that” (KCI49). The numbers of implementers considering corruption to be widespread in their countries were similarly high (Hyderabad 80%, Kampala 92%, and Spanish Town 84%). The views expressed are comparable to the corruption perception index (CPI) in these countries. Transparency International publishes a perceived level of public sector corruption ranging from 0 (highly corrupt) to 100 (clean) and the 2011 scores for these countries were: India 3.1, Uganda 2.4, and Jamaica 3.3 (Transparency International, 2011). Customers considering that corruption negatively affected their water provision were 70% in Hyderabad, 65% in Kampala and 90% in Spanish Town. When implementers were asked about corruption at their organisations many portrayed tension or anxiety. However, most (80% Hyderabad, 100% Kampala, 90% Spanish Town) acknowledged it as a problem being actively managed.

Our findings show a difference in participant opinions on ideas for combating corruption. Suggestions by customers mostly voiced the need for punishing those who demanded bribes. The solutions offered by promoters and implementers were much broader and included aspects such as the role of leadership, the need for checks and balances, the need for involving the wider society through public education, and the strengthening of other arms of government such as the police and

the judiciary. Creating a culture of accountability, integrity and transparency at the utility level can shape the attitudes, beliefs and behaviours of the utility staff. Organisational culture can influence ethical behaviour by assimilating diverse attitudes into a more universal standard of behaviour (Watson, 2003). While fighting corruption in the water sector has to be viewed within the wider context of the problem, the sector can and often does, provide leadership to other sectors. A manager from Uganda's utility pointed out: "*Corruption is in every sector, but we are fighting it*" (KII6, 2009). The utility has demonstrated that by actively fighting corruption the effects can be felt within no time. The utility made its employees understand that "*strategic oversight means keeping your eyes on but your hands off*" (Berg and Muhairwe, 2006). Utility K's ability to struggle against corruption meant more visible progress and more goodwill from stakeholders further enhancing its capacity to supply safe drinking water.

Non-compliance (ET12). All customers in the three locations were aware of the existence of water regulations. They described government laws or the water utilities' own regulations. Nearly all customers made references to bill payment and the prohibition of illegal connections. The findings also point to intra-utility, public and private non-compliance in all three cases. Here non-compliance refers to defiance of existing rules and regulations of which there is awareness. Intra-utility noncompliance can be seen in failure on the utility's staff to adhere to laid down guidelines, procedures and regulations. For example, documents linked to the Hyderabad WSP identified several cases of non-compliance with the utility's guidelines such as non-uniform dispersion of chlorine, inconsistent alum dosing, non-representative lab sample programme, and inadequate chlorine residual monitoring. Examples from Uganda included inaccurate dosing of chemicals and irregular replacement of worn out parts. Similar examples of intra-utility non-compliance can also be seen in the Spanish Town case.

Public non-compliance refers to failure on government officials' part to comply with and implement rules that directly or indirectly impact on the provision of water and sewerage services. Private non-compliance refers to commercial and domestic non-compliance. Both relate to non-tariff payment and pollution. All customers, with the exception of one in Spanish Town, indicated their connections were legal. However, a substantial number in all three locations indicated they knew of "someone" with an illegal connection (Hyderabad 30%, Kampala 41%, and Spanish Town 47%). Reasons given to explain illegal connections included affordability, personal beliefs, and perception of high rates. A final note on compliance is that the development of any risk management capability is dependent on each organisation's cultural and regulatory context (Dalglish and Cooper, 2005). What does the rule of law and non-compliance mean for WSPs, therefore? In order for WSPs to be effective in low and middle income countries, there has to be a means for holding responsible parties accountable for their actions from catchment to consumer, albeit within a portfolio of regulatory approaches, a facet of WSP implementation not widely researched to date.

3.8. Deploying cultural influences within WSP risk management

The roll-out of WSPs takes place in an international climate of commitment to the UN sustainable development goals (No.6 – clean water and sanitation especially) and substantive State commitments and donor support to improve water governance in low and middle income countries. Assembly of the twelve themes illustrates the inherent tensions in these utilities' attempts, through WSPs, to address the public health consequences of rituals, perceptions and cultural beliefs that for communities around the globe will require years of efforts to change (e.g. compliance with command and control regulation versus proactive risk management; or of security of supply versus water quality). Our research interest is in exploring and then referencing such tensions to implementers of WSPs as they plan pilots and scale up from them. In this sense, cultural influences are best explored in the early stages of WSP

development during efforts to engage utility employees, stakeholders and wider communities (Figs. 1 and 5).

From an analysis of ET1 to ET12 above, we propose a taxonomy of cultural influences, 'ENLINE', by reference to the enabling (EN), limiting (LI) or neutral (NE) aspects of our 12 emergent themes and their relative strength of influence for WSP implementation, in the three case studies examined (Fig. 6).

Enabling influences support the WSP philosophy. The belief that water is a source of life and a medium for purification (ET1), and aesthetic preferences (ET3) can be incorporated into catchment protection efforts, anti-pollution education, and conservation activities. The aesthetic acceptability of water is an important aspect in its use. Most of the preferences support the purpose of WSPs and contribute to the risk management process; after all, aesthetic preferences may raise valid concerns regarding water safety. Any variation in the normal appearance, odour or taste of drinking water may be indicative of deficiencies in the treatment process or changes in raw water quality (WHO, 2004; 2011). As advised in the GDWQ, it would be wise for water providers to be attentive to local aesthetic preferences in the assessment of drinking water supplies and the development of regulations and standards.

Limiting influences may negatively impact on WSP implementation. The findings indicate eight factors comprising of beliefs, attitudes and practices. The belief that water should be free (ET2) frequently leads to the non-payment of bills. In addition to affecting utilities' income, this increases illegal connections which further intensify contamination risks. Pollution causing rituals (ET4) can negatively impact the quality of water at source. These practices make water non-potable and can increase treatment costs. Excessive use of water during rituals (ET5) increases water demand and puts pressure on utilities that are struggling to meet supply goals. The 'deliver-first safety-later' mindset (ET6) is revealed through the laying of water mains in proximity to or criss-crossing sewer lines. Although it emanates from an expressed priority to meet water demand, it may present a clear risk to the delivery of safe water. Poor water storage practices (ET7) necessitated by intermittent supply can increase the chances of household contamination (Brick et al., 2004; Banda et al., 2007). Various practices of handling stored water observed in the field point to this. Poor knowledge management (ET8), an integral part in all aspects of WSPs, is hindered by the various gaps in the knowledge management practices of water utilities. Corruption (ET11) not only reduces the income potential of water utilities, but can negatively affect each of the WSP steps as explained above. Widespread lack of compliance (ET12) at different levels diminishes shared accountability, which is essential for WSPs. We argue for the value of this taxonomy – as a prompt to challenge conventional understanding of what can be misrepresented as a technocratic process, thereby bringing some order to the structured consideration of cultural factors during WSP development, scale-up and implementation.

This study has been an attempt to draw out recurrent cultural issues from WSP experiences. Of course, ET1 to ET12 do not map neatly across to WHO's sequential stages of WSP development (Figs. 1 and 5). They both infuse and cut across these stages of implementation, making cultural attentiveness during WSP implementation a complex, expert activity in its own right requiring ethnographic input. With this analysis, we propose active consideration of these factors early on during WSP implementation, which we view far more than a technocratic process, infused with factors from national, regional, organisational, professional cultures and with societal and individual beliefs (Fig. 6). We do not suggest the direction or relative strength of influences are identical for each WSP project, nor should they be seen as universal. Further, it would be naïve to infer an over-simplified characterisation of cultural influences as they are multi-faceted and worthy of in-depth analysis in their own right (e.g. Figueroa and Kincaid, 2010 for household storage). However, it is hoped this analysis will go some way towards an evidence-based analysis of the cultural influences at play. Many have direct parallels to our studies of WSP implementation in higher income

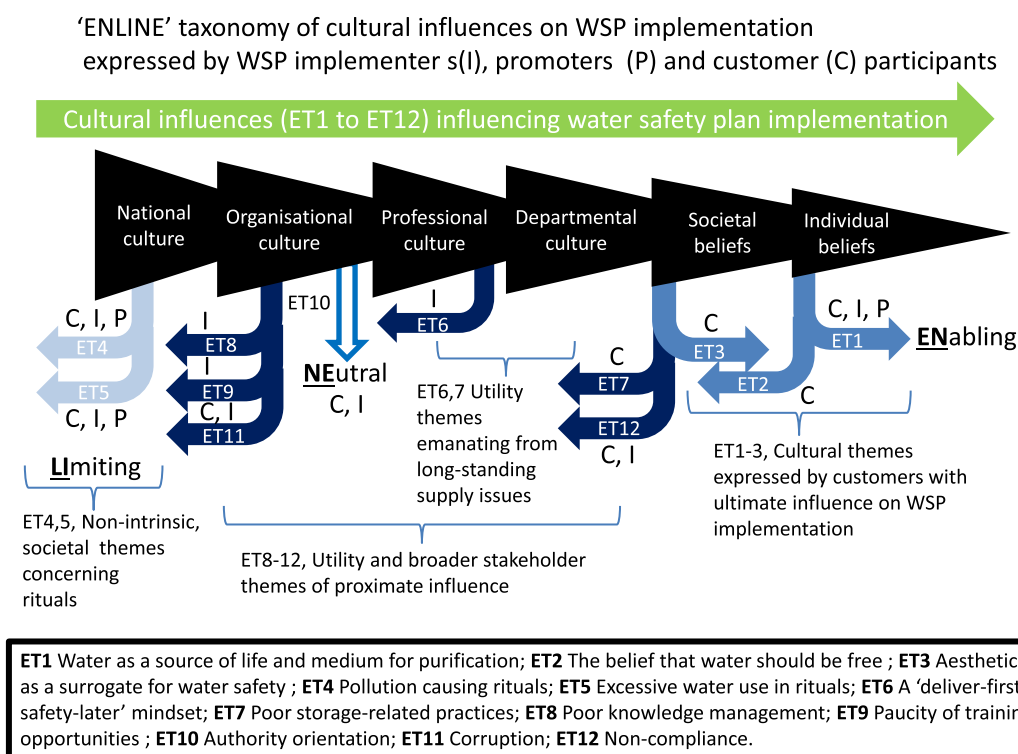


Fig. 6. Taxonomy of cultural influences for the three case studies examined - ENLINE.

countries (Summerill et al., 2010) and so there is important reflective learning for all utilities from this study.

4. Conclusions

WSP implementation, like all risk management efforts, requires receptive cultures to be successful. Whilst often presented to utilities and agencies as a technocratic process, substantive commitment is required to frame and place WSPs in the context of the utility and its broader cultural settings – whether in high, middle or low income countries. Many interrelated factors are at play, as our results indicate. WSP implementers need to give dedicated and structured attention to these factors, identifying and addressing them head on during WSP scale-up.

A single study cannot address the multitude of issues associated with WSP implementation and, since this research was conducted, the three utilities have developed substantially and so the data must be viewed in a somewhat historic context. However, this research offers a comprehensive qualitative analysis of the impact of culture on WSP implementation and important insights for practitioners. Whilst some themes relate closely to governance structures specific to low and middle income countries, many have parallels in higher income countries; for example, the tensions between water supply and water quality; the influence of professional subcultures (engineers and water quality scientists) on risk management initiatives; the essential role of active leadership; and the critical importance of assembling and managing system knowledge during WSP development. The ENLINE taxonomy provides one categorisation of cultural influences on WSP implementation and, we believe, is best deployed as a prompt for application on a case by case basis.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.scitotenv.2016.10.131>.

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