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The impact of regulation, ownership and business culture on managing corporate risk within the water industry

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ABSTRACT

Although the specifics of water utility ownership, regulation and management culture have been explored in terms of their impact on economic and customer value, there has been little meaningful engagement with their influence on the risk environment and risk management. Using a literature review as the primary source of information, this paper maps the existing knowledge base onto two critical questions: what are the particular features of regulation, ownership and management culture which influence the risk dynamic, and what are the implications of these relationships in the context of ambitions for resilient organizations? In addressing these queries, the paper considers the mindful choices and adjustments a utility must make to its risk management strategy to manage strategic tensions between efficiency, risk and resilience. The conclusions note a gap in understanding of the drivers required for a paradigm shift within the water sector from a re-active to a pro-active risk management

culture. A proposed model of the tensions between reactive risk management and pro-active, adaptive risk management provides a compelling case for measured risk management approaches which are informed by an appreciation of regulation, ownership and business culture. Such approaches will support water authorities in meeting corporate aspirations to become “high reliability” services while retaining the capacity to out-perform financial and service level targets.

Keywords: culture, governance, legitimacy, ownership, regulation, risk.

INTRODUCTION

Organizations responsible for the planning and delivery of utility services such as energy, transport and water are exposed to a wide array of ownership arrangements and regulatory frameworks, and exhibit diverse organizational cultures. The impact of these influences on the effectiveness and efficiency of service delivery in the water sector has been a topic of concern for both researchers and practitioners over at least two decades (Richardson *et al*., 1992; McGuinness & Thomas, 1997; Bakker, 2003a). However, studies seeking to better understand how ownership, regulation and business culture influence the operation of utilities have primarily focused on the economic and customer value oriented performance of the organizations under review. This is understandable given the broader public debate on the wisdom and benefits of privatized water services. However, somewhat surprisingly and of direct relevance to this contribution, few have considered the impact of regulation, ownership and business culture on water utilities’ approaches to managing commercial, operational and systemic risk. This is surprising given that risk plays a hugely influential role in decision making (Haines, 2011) and in the strategic, tactical and operational management of water utilities especially (MacGillivray *et al*., 2006; Pollard *et al*., 2007; 2009). Given that utility

performance (against whatever metrics) is a function of how decision takers deliver results within the confines of what is deemed acceptable, it is unusual that more attention has not been paid to exploring the associated 'risk dynamic' (taken to mean the interplay between (i) the risks associated with utility actions and (ii) the management strategies and interventions for coping with these risks).

The literature base presented in Table 1 constitutes a representative sample of papers that address the topics above and will be drawn upon later in the paper to illustrate significant features of our thesis. A preoccupation with efficiency and performance agendas is clear from the noted study findings, with remarkably little attention paid to other possible impacts of regulatory and ownership change. This is in stark contrast to other literatures, for example those concerned with the evolution of polycentric governance arrangements (Ostrom, 2010) and the influence of regulation on risk perception and management (Haines, 2011), which have recognized and articulated a rich landscape of influences on risk environments and management response preferences. Our own contributions in this area have been on benchmarking risk management capability within the international water utility sector (MacGillivray *et al*., 2006; 2007a, b; 2008) and exploring the operational antecedents of good risk governance in the sector (Hrudey *et al.*, 2006; Pollard *et al*., 2007; 2009; Summerill *et al.*, 2010a, b). Whilst, to date, we have focused on the provision of safe drinking water and good risk governance, the interface with regulatory and investment models has yet to be explored in depth. Here, then, we discuss these factors afresh in the new light of organizational structures and the financing of utility investments.

An understanding of the nature and impact of risk within the water sector can only be attained with reference to the societal role which water services play. Although it is not the intention of this contribution to itemise or delineate all relevant risks, an overview of the central concerns that drive risk appreciation and management within the sector is warranted as a

preamble to our analysis. The principal operational driver for any water and wastewater service provider is the delivery of fresh clean drinking water and the removal of wastewater in a safe and responsible manner. The Bonn Charter (2004) is the central statement of ambition here and constitutes a sectoral commitment, setting the framework for the basic operational and institutional arrangements necessary for the provision of water and waste water services, from source to tap. State and contractual performance measures provide operationally relevant targets but the Bonn Charter offers a (globally legitimate) consensus position on the principles of water service delivery. The primary objective of the Charter is to enable provision of "good safe drinking water that has the trust of consumers". To achieve this, the service provider must aspire to provide water that is safe to drink, aesthetically pleasing, and in sufficient volume at a cost that is considered good value for money. The Charter links this ambition to a consideration of risk, stating that 'management control systems should be implemented to assess risks at all points throughout water supply systems and to manage such risks' (Bonn Charter, 2004: 9). A risk based approach to quality service delivery is evident in the World Health Organization's (WHO) Drinking Water Quality Guidelines (2002) which documents the requirements for the provision of safe drinking water based on a preventative risk management philosophy. The WHO guidelines recommend the development and implementation of water safety plans (WSPs) and a detailed methodology for their development (WHO, 2002).

The WSP approach is designed to assess the risks to water supply by: identifying mitigating actions that prevent raw water pollution from occurring; establishing appropriate treatment processes; and documenting risks to the water supply in distribution that prevent secondary contamination, post treatment. These risks might relate to asset condition, financing, technology performance, skills and competencies, or any of a whole host of factors embedded within and without the utility's corporate remit. The principles within the WSP approach are

scalable from small rural supplies to larger networks that serve urban centres. The WSP approach provides an important mechanism that enables water companies to take steps towards pro-active adaptive management, as discussed by Davison & Deere (2005). Other contributions (e.g. Byleved *et al*., 2008) build on this principle and explore the benefits of using safety plans to inform communication strategies when dealing with public health matters. Yet others, (Hrudey, 2001; Pollard *et al*., 2004; Hrudey *et al*., 2006) provide compelling evidence for the value of the risk management approach which lies at the heart of water safety plans, whilst Summerill *et al*. (2010b) have considered aspects of leadership in risk governance within the water utility sector.

Building on our recent work (MacGillivray *et al.*, 2006; 2008) and our proposal that vigilant and mindful organizations (Pollard *et al.*, 2007; 2009) can successfully manage the challenge of cost reduction and risk mitigation, this review considers how ownership models, business culture and regulatory frameworks influence the ability of an organization to manage business risk. As these interrelationships are explored, the paper will consider other important influencing factors such as competition, management culture, leadership and governance that have a role to play in establishing an organization's business strategy in delivering water and waste water services that meet regulatory objectives (quality, environmental and financial). Using a number of literatures as the primary source of information, the existing knowledge base is mapped onto two critical questions: (i) what are the particular features of regulation, ownership and management culture that influence the risk dynamic; and (ii) what are the implications of these relationships in the context of ambitions for resilient organizations? In addressing these queries, the paper considers the mindful choices and adjustments a utility must make to its risk management strategy to ensure that the tensions between efficiency, risk and resilience are effectively managed.

LITERATURE REVIEW METHODOLOGY

The literature review was conducted over a period of approximately six months, utilising the library resources at the authors' host institution. The primary research was conducted using a number of electronic library databases, as listed in Table 2. Output from the database searches was refined from thousands of publications down to 191 studies that focused on the principle topics related to our research themes. The papers selected for more detailed review were assessed based on the degree of certainty of the claims made within the studies and the extent to which the studies were generalised. We adopted a filtering and selection strategy based on the strength of knowledge claims made for the reported studies and their vulnerability to rejection, as specified by Wallace & Wray (2011). Additional refinement and enhancement of the literature base was achieved by identifying emerging themes and links, and by tracing the contributions of leading researchers in the various fields of study (see Table 2) to construct an understand of how their thinking has evolved and informed related research agendas.

REGULATION AND RISK

Although regulatory models for water utilities vary from country to country, they generally focus on the areas of operational performance, environmental protection, drinking water quality and cost effectiveness. As Parker (1998; 1999) notes, it has been necessary to implement financial regulation to prevent monopoly abuse as countries move towards privatized services. Parker highlights the important role of governance and its dependency on a country's regulatory framework. A regulatory model fit for one country does not necessarily fit another country's institutional arrangements. The UK, for example, works to five year regulatory (financial) contracts that set the objectives for each organization, and detail planned levels of infrastructure investment and predicted improvements in customer

service delivery. The contracts document an agreed level of customer charges over the regulatory period. Each company's performance is measured against the base plans submitted to the regulatory authorities.

The specifics of regulatory frameworks are informed by a range of performance attributes such as economic benefit, water quality improvement and environmental protection intended to protect the interests of the consumer. Such arrangements shape how water and wastewater services are delivered within any given governance and ownership model. To illustrate the impact of regulation on the institutional risk environment, four dimensions of the relationship are considered: funding of the asset base; productivity of the organization; retail competition; and legitimacy of regulation.

In order to meet the demands of regulation, a range of funding models has evolved to facilitate access to the capital required for investment. For example, in England, the funding arrangements are based on a fully privatized model with access to capital gained through a combination of shareholders, access to capital markets and customer charges. Interestingly, an alternative model was adopted by Welsh Water between 1989 and 2001, built around mutualization (examined by Thomas, 2000; 2001). Establishing the ownership and financial structure for Welsh Water had to take account of regulatory constraints and political views, as well as constitutional issues. The Welsh Water model raised issues around efficiency improvements, risk mitigation and distribution, and there was a principal challenge on the impact of functional separation of the utility business on customers. As Bakker (2003a; 2003b) discusses, the UK water industry is constantly seeking alternative ways of securing sufficient capital to ensure regulatory objectives are met. For example, Bakker (2003b) points out that in June 2000, the Kelda water group, which owns Yorkshire Water, unveiled plans (which did not come to fruition) to mutualise its water service subsidiary. The objective was to create a non-profit community mutual with consumers owning the assets, but with

operations remaining with the private organization. This would lead to asset-owning customers having a direct input into the running of a local business by making the customers the shareholders. An alternative model can be observed in Scottish Water, which remains a publically-owned utility financed through customer charges and an element of government borrowing.

Abbott & Cohen (2009) highlight the influence of regulatory priorities on the productivity of water utilities (for example, the volume of drinking water produced and wastewater treated) and overall efficiency within the sector. They suggest that post-1995, changes to the price cap in the UK helped improve productivity over and above what might have been expected with privatization *per se*. Similarly, Rodriguez (2004) and Francois *et al.* (2008) discuss the financial challenges that utilities face in acquiring sufficient funding to ensure water quality, customer service and environmental objectives are met. Both studies highlight a tension between the general economic interest, public service provision, internal markets, competition and state intervention.

These contributions on financing and productivity illustrate the constraints that a limited, periodic regulatory cycle impose on utility efforts to deliver regulatory obligations. Evidence suggests (MacGillivray *et al.*, 2007a; 2007b) that when faced with an aging infrastructure and limited funds, utilities will prioritize short term interventions before long term mitigation measures (Hrudey *et al*., 2006). Such strategies instill a reactive approach to risk management, as resources (human as well as financial and technological) become focused on immediate priorities. In contrast, a mindful approach to risk management (Pollard *et al*., 2008) under such circumstances would be characterised by contingency planning and, with little incentive for operators to value more pro-active strategies, even contingency planning will reflect restricted temporal and risk threat horizons.

The third dimension of regulation worthy of consideration in the context of corporate risk management is the role that competition plays. Privatization theory (Boycko & Shleifer, 1996) suggests public services can be improved through the introduction of competition. Cubbin & Stern (2004) discuss the role of competition within the utility sectors and observe that in some areas (gas, electricity and telecoms), the positive effects of competition took some time to show and evolved along with regulation. However, for utilities like water, where there is a public service obligation and significant networked infrastructure to deliver services, it is more difficult to establish true competition given the natural monopoly that exists. Stern (2010) examined lessons from the introduction of competition within energy markets and applied the knowledge base to the English and Welsh water sector. Stern points out that the recent Cave review (Cave, 2009) raised the issue of competition. He points to the liberalization of the telecoms and energy markets as relevant, and postulates that wholesale distribution of water could be opened up to competition in England and Wales, drawing on existing models in other utility sectors. This would require appropriate codes of practice, abstraction controls and consideration of the wider environmental costs to society. By contrast, Scotland has already opened up competition in water services. Sawkins & Reid (2007) looked at concerns that cross-subsidy existed in water services in Scotland and examined the approach taken to cross subsidization by the Scottish Executive; they point to the Water Services (Scotland) Act 2005 and the formation of the Water Industry Commission (WIC) that has been tasked with developing an approach to competition in the Scottish water market. The Scottish Executive published a number of statements and reports (Scottish Executive, 2004a; 2004b; 2005a; 2005b) as part of the consultation, concluding that the introduction of retail competition was desirable. Sawkins & Reid (2007) established a mechanism for the flow of cross-subsidy but also highlighted that more work was required to

implement their framework. Competition in the retail markets in Scotland is now established with a number of licensed providers operating.

There is little unambiguous evidence to support conclusions about the effectiveness of competition in public utility services. Water is essential for life and difficult to value. At present, it is typically only the costs of transporting and treating water that the customer pays for. Opening up water service provision to competition might create incentives to improve performance and efficiency but may also lead to additional operational risks (MacGillivray *et al.*, 2006). For example, manpower reductions without the introduction of suitable alternative monitoring systems or controls could increase operational risks. Risk management strategies will need to be adjusted to compensate for any variations in service provision or new entrants to the market. Contracts between delivery partners will need to expose systemic risks and be clear on the owners of such risk (Ruester & Zschille, 2010).

The dynamics exposed by the above discussion are illustrated in Figure 1. Regulation sets the ambitions and minimum performance standards that utilities must aspire to, with respect to efficiency, service, quality and environmental sustainability. Regulation also shapes the strategic operating environment for a utility and influences the relationship between utility, customers, markets and (increasingly) the natural environment. It also circumscribes a risk agenda in terms of both the character of dominant risks and a utility's ability to respond to those risks (Macgillivray *et al.*, 2006). As alluded to by Parker (1998), the priorities which an organization places on competing regulatory objectives within a regulatory contract period will have a direct impact on the company risk profile.

OWNERSHIP AND RISK

Water utilities must also demonstrate value for money. Ownership and efficiency have been widely debated internationally (Wallsten & Kosec, 2008; Martínez-Espiñeira *et al*., 2009;

Bayliss, 2003; García-Rubio *et al*., 2010; McKay, 2003), and improvements to productivity and efficiency were a central consideration in policy decisions made by the UK government that led to privatization of the water companies in 1989. Emerging evidence suggests that successful privatization and efficient delivery of service is contingent on a wide range of additional factors (Ruester & Zschille, 2010; Saal *et al*., 2007). For example, a management culture that drives for efficiency within the limitations of a regulatory pricing review period and constrained funding availability tends to be characterised by a reactive management approach.

The ownership arrangements of utility services vary widely at an international level (Table 3) but can be categorised into state ownership (or public ownership), private ownership, or a form of corporatised public–private partnership. Each variant has important consequences for the particular forms of risk experienced by a water service provider (Pollard *et al*., 2007) and the risk management tools available to them (Macgillivray *et al*., 2006). Responsibility and accountability for managing risk is the most obvious implication of utility ownership, with either society or shareholders sharing the burden. However, both public and private ownership models allocate risk and responsibility across a variety of individuals, institutions, corporate bodies, communities and even generations. Consideration of the ownership models in Table 3 invites discussion about how risk is distributed across the social, commercial and governance landscape. Indeed it could be argued that this would greatly aid an understanding of the challenges and advance the development of more integrated approaches to risk management.

Interdependencies between regulation and ownership influence corporate risk management. Parker (1999), discussing the regulation of privatized public utilities in the UK, highlights the move from state-owned utilities to private ownership with governance through state regulation. He reported that the privatization model developed in the UK in the 1980s is now

being used or adapted for use in other countries, introducing the private ownership of what were traditionally state-run organizations. He argues that privatization in the UK has provided benefits for consumers and investors with respect to reduced charges, quality improvements and return on investment. He explains that successful privatization is reliant on the legitimacy of regulation, effective relationships between the regulator and regulated body, and an appropriate institutional context. Highlighting examples in Asia, Latin America and Africa, Parker (1999) cites evidence of political instability that impact on the legitimacy of regulation, and therefore on the perceived independence of the institutions and individuals. Risk management practises within a specific jurisdiction will be influenced by local legal and institutional arrangements and have a direct impact on the reliability of service to consumers. For example, with a publically-owned utility such as those in Norway, Scotland or the Netherlands, the majority of the infrastructure and financial risk sits with the governing authority (see Table 3). As the ownership arrangements move towards the private sector, so the risk is shifted to a greater or lesser degree away from the governing institution. Table 3 also highlights a contract management approach adopted in Germany and France, where the service providers and contractors hold the balance of operational risk. However, a weakness of this arrangement is that financial benefits to the controlling institution do not always deliver attractive or even sufficient returns on investment (Ruester & Zschille, 2010).

The dynamic between regulation, ownership and risk management is re-enforced by Ruester & Zschille (2010) in their examination of the German water sector. Germany provides a useful case study because water services are provided by 765 individual suppliers, operated by the state through a range of business models that include municipal, private and public–private partnerships on a regional basis. For public–private partnerships, there is a further subset of ownership models that Ruester & Zschille define as public sector ownership with support from private contracts for various elements of business operation. The diverging

objectives of public and private operators can generate very different approaches to managing risk. Although for the private operator, profit is a significant concern, public authorities may prefer to outsource more difficult operations where environmental factors, age of assets or poor raw water quality (and therefore higher treatment costs) are considerations; this passes on higher cost to the operator and keeps the authorities direct overheads relatively low. Price caps on customer charges and constraints on access to capital for infrastructure investment leads to tension between new design and build infrastructure projects and capital maintenance requirements. This tension within the capital programme needs to be factored into mindful risk management choices.

Other studies (Bhattacharyya *et al*., 1995; Shaoul, 1997; Bosworth & Stoneman, 1998; Renzetti & Dupont, 2003; Chenoweth, 2004; Dore *et al*., 2004; García-Sánchez, 2006; Bel & Warner, 2008) conclude that although private companies *should* be more efficient, evidence suggests this may not necessarily be the case. Renzetti & Dupont (2004) discuss factors that influence the performance of water utilities, highlighting that ownership is of particular interest. They point out that econometric modelling predicts that private ownership incentivises a reduction in costs to help achieve maximum benefit for shareholders and customers in the form of reduced charges. However, there is little empirical evidence to confirm this. Renzetti & Dupont argue that changes in ownership need to be accompanied by the introduction of competition if the move to privatization is to demonstrate greater benefit to the customer and shareholder. Parker (1999) supports this by highlighting that, where natural monopolies exist (such as water and waste water service provision), service providers (public or private) will only be motivated to improve performance when either legitimate regulation and/or competition is in place to create the necessary incentives. Renzetti & Dupont (2010) provide evidence that concurs with Ruester & Zschille (2010) that the specifics of size of operation, cost of treatment, geography, customer base and water

resources (quality and quantity) all have an impact on the ability of a water service provider to achieve its performance targets. An additional factor influencing performance is variability in pricing policy and accounting practices that do not take into account the full cost of service provision. This is in agreement with Saal, Parker and others (Saal & Parker, 2000, Saal & Parker, 2001, Saal & Reid, 2004, Saal *et al.*, 2007) who observe that when privatization of the water sector was introduced in the UK in 1989, the price cap regulations were relatively unchallenging and resulted in a lower than expected rate of efficiency improvement. It was not until 1995, when the price cap rules were reviewed, that efficiency improvements increased. However, the efficiency gains within the water industry in the UK were not as significant as those secured from earlier privatizations (e.g. gas, telecoms, electricity) due to the water companies' regional monopoly position (lack of competition) and the relatively low initial price cap. Saal and Parker concluded that improvements in efficiency post 1995 were due to the changes in regulation rather than privatization *per se*.

The literature reviewed in this section provides a compelling argument that public and private companies can deliver comparable economic performance, dependant on the right combination of business model choice, legitimate regulation and presence or absence of competition. The selection of studies we have reviewed provide evidence for a mutual influence between regulation and ownership (García-Rubio *et al*., 2010, Martínez-Espiñeira *et al*., 2009, McKay, 2003). Our review suggests that the price cap rules will limit or enable funding and that access to funding drives infrastructure investment choices. The balance between infrastructure replacement and capital maintenance will shape operational risks that ultimately influence the reliability of services to the customer. Figure 2 summarizes our discussions in this area. Efficiency improvements (both of themselves and their rate) are not dependent upon ownership models and are likely to be influenced more by regulatory interventions, leadership and cultural factors. Within our proposed framework, ownership

does have an important influence on risk. As margins are squeezed in a privatized sector, perhaps as a direct result of more insistent regulation, decisions about prioritizing investment and driving efficiency in operational practices will necessarily expose some parts of the business to more risk than would hitherto have been the case. Pollard *et al* (2004) remind us that this tension can only be managed by vigilant and mindful organizations.

BUSINESS CULTURE AND RISK

The dominant business culture and leadership style found within a water utility will shape how the organization chooses to meet or exceed the targets and objectives set by regulation and other stakeholders. The influence of organizational culture on business performance and risk has been of growing interest to researchers and commentators since the 1980s, with Johnson (1992) developing a framework, known as "the culture web", that is widely used to demonstrate the links between culture, strategy and management behaviour (Summerill *et al*., 2010a, 2010b). Drew & Kendrick (2005) define culture as one of their five pillars of corporate governance (along with leadership, alignment, structure and systems) that are needed for integrated risk management. Baumgartner (2009) and Rizak & Hrudey (2007) demonstrate that embedding sustainability and risk management into the culture of an organization can lead to corporate success, though both are challenging concepts to drive home within a business. This is consistent with our view that culture and leadership style influence the risk management strategy of the water utility.

As Stacey (1996) explains, organizations tend to desire known outcomes, but in order to be innovative they may need to occupy territory that has less certainty and agreement, and high degrees of epistemic and stochastic uncertainty. This view is supported by Osborn & Hunt (2007), Tetenbaum (1998) and Tetenbaum & Laurence (2011) who suggest that in today's

operating environment, organizations work within complex adaptive systems that force them into domains of high uncertainty. By contrast, organizations that are exposed to more regulation and governance tend to exhibit a more risk averse cultural base that desires greater certainty around the data used for decision making. We recognize the tensions inherent in operating as part of a complex system by suggesting that appropriate risk management cultures will provide a bridging function between uncertainty and risk. Within this context, water companies need to become more risk mature (MacGillivray *et al*., 2006; MacGillivray & Pollard, 2008) and look to preventative measures. This suggests that water utilities need to adopt a risk management culture that takes into account data, uncertainty (stochastic and epistemic), emerging risk, available finance, in addition to the competency of staff and regulatory objectives. We can classify this as a measured risk management culture.

Useful indicators of such cultures can be found in other sectors. For example, Laeven & Levine (2009) consider the links between governance, regulation and risk-taking within the context of the 2008 changes to the banking system when some private banks were supported by public funding. Their contribution highlights that risk taking, and the incentives linked to risky activities, are related to both the ownership and culture of the business. They suggest that institutions that are controlled by fewer, more powerful, owners will take on more risk compared to banks that have a greater number of owners with lower stakes and cash flow. They conclude that regulation can have either a positive or negative effect on corporate risk, dependent upon the nature of ownership and the working culture of the organization. In a different context (that of executive board monitoring), Brick & Chidambaran (2008) also consider the interplay between regulation and risk-taking. They demonstrate that increased regulation has driven an increase in board monitoring as evidenced by data gathered between 1996 and 2003. They conclude that externally imposed regulations can have an impact beyond the intended specifics of the directives themselves. They provide examples of

regulations that make it more costly for institutions to operate with lower levels of board monitoring, due to the higher probability of lawsuits being successful as a result of poor performance. This is both a relevant and powerful example of regulations influencing behaviour, business culture and decision making.

The influence of business culture on risk management strategy and performance has only partially been explored within the water industry. Summerill *et al.* (2010b) considered water safety plans as a move towards a more preventative risk management approach and found that organization culture plays a substantive role in the choices made by utilities with respect to how water safety planning was implemented. The study identified enabling and blocking cultural features that impacted the development of consistent water safety plans. The utilities in this study were self-motivated to produce the plans. However, time, resource and communication issues occasionally blocked progress. In contrast, enabling features included strong leadership, continuous improvement, community (and therefore customer) focus, proactive engagement, competition, empowerment and competency of the workforce.

A critical component of business culture is leadership, which often has an impact on the risks that the organization is prepared to take (risk appetite), the culture within the business, the approach to achieving its objectives and the performance characteristics of the institution. Leadership is arguably the single most important influence on the success of any business. McKenna & Martin-Smith (2005) explore the importance of good leadership in making decisions with information and data sets which exhibit low confidence grades. Although human nature tends to favour operating in areas close to certainty where decisions are easier to justify, the majority of business leaders must make strategic decisions based on little evidence or data, which then forces decision making towards a more heuristic domain with a greater degree of epistemic uncertainty. Leaders that take more risks and make decisions based on intuition are perceived by their peers as stronger, entrepreneurial and more creative

(see also Williams & Miller, 2002; Millet, 2006; Randall, 2006; and Singh, 2009). Within the context of the operation of a water company, choices must be made about investment and protection of public health which meet the demands of regulators, consumers and other stakeholders. Mindful and measured choices must be made that balance risk with operational performance.

We have established that many decisions that need to be made within an organization sit within a domain that has low certainty and low potential for consensus, so that leadership and organizational culture influence the choices made. Now consider how decision making balances risk, efficiency and regulatory compliance in an uncertain operating environment. Gigerenzer and fellow researchers (Todd & Gigerenzer, 2003; Hutchinson & Gigerenzer, 2005; Brandstätter *et al*., 2006; Katsikopoulos & Gigerenzer, 2008; Goldstein & Gigerenzer, 2009) offer us insight into the way individuals apply heuristic processes in making decisions with limited data. These works explain how simple heuristic systems have developed that allow fast decision making based on acceptance or rejection of a range of cues within an individual's or group's epistemic limits. This might explain why certain organizations with differing regulatory obligations and ownership structures prioritize objectives and targets in a way that legitimises their business strategy. This is of significant importance within this review as we identify the linkages between regulation and risk strategy.

Figure 3 articulates the impact of organizational culture (and leadership) on a water utility's approach to risk management. This in turn will have an influence over the resilience and financial stability of the organization. Hrudey *et al.* (2006), Pollard *et al.* (2004) and Summerill *et al.* (2010a) all emphasize the importance of culture on the adoption of specific risk management strategies and examine why organizations persist with a reactive approach to water quality failures and water safety planning.

DISCUSSION: MANAGING RISK AND PROMOTING RESILIENCE

Resilience can be defined as the ability to recover quickly from failure, and robustness as the ability to withstand a significant event (Pollard *et al*., 2004). In order to protect public health and maintain services to its customers, a water provider must ensure the networks it operates are resilient to challenge and the processes it operates are robust to, *inter alia,* changes in population, climate change and water scarcity (Blackmore & Plant, 2008; Wang & Blackmore, 2009). Where risk management enables an organization to focus on the ability to prevent failures and maintain a stable system, strategies to enhance resilience seek to develop interventions that support the ability of systems to adapt to change. Hence, risk management regimes that promote resilience will be pro-active rather than reactive, intentionally seeking out and characterizing risk within organizational plans and operations as a precursor to building resilience-enhancing capacities: a mindful risk management approach (Pollard *et al*., 2009). In the context of core utility performance ambitions (such as those enshrined in the Bonn Charter), resilience theory, risk management and reliability engineering need to be considered in concert if performance is not be buffeted and compromised by the vagaries of regulation, ownership and management culture.

Other research supports the need for further work to better understand the challenges a utility faces in making the shift from reactive to pro-active risk management. Hrudey *et al.* (2006), Pollard *et al.* (2004), Wu *et al.* (2009) and Rogers & Louis (2008) provide supporting evidence that regulation, ownership and culture have an influence on how a water utility approaches risk management (systemic or corporate). Mindful organizations that have developed high reliability systems will manage the tension between systematic risk and cost reduction. Paté–Cornell (1996, 2002a, 2002b, 2004) developed a critical framework for assessing uncertainty of risk at six levels which has become the basis for many stochastic and epistemic uncertainty models and systems; we acknowledge the significance of this

contribution and the important role it plays in the development of a systematic approach to risk evaluation but we do not intend to fully discuss the work as it is now well embedded into systems risk management theory.

We can also find evidence of the relationships between governance and risk, which has relevance to the research agenda developed here. Rothstein *et al*. (2006) draw our attention to the emergence of risk (systemic or corporate) as an organizing concept for regulation and governance which has led to many debates, particularly with respect to Ulrich Beck's risk society thesis (1992). Rothstein *et al.* argue that more recent preoccupations with risk are not driven by changing distributions of real, or imagined, ills in society but rather by changing ills in governance. In fact, the paper emphasises that failure has always been a part of governance but more recent pressures on organizations (such as greater coherence, transparency and accountability) have exposed the limits of governance as a result of this greater awareness of institutional risk. Rothstein *et al.* conclude by arguing that risk "colonization" resulting from the dynamics of contemporary governance leads to risk defining the object, method and rationale of governance. We argue that management strategies need to remain agile and under review to take account of new and emerging risks resulting from changes to regulation, ownership and culture within a water utility business. Inflexible governance and risk management systems may result in creating further unintended corporate risk.

CONCLUSIONS AND FURTHER WORK

The foregoing critique builds upon previous reviews by Walter *et al* (2009) and Bel & Warner (2008), and expands on these works by considering regulation, ownership and management culture as influences on the risk environment. Our review is summarized in

Figure 4 as a conceptual framework of these interdependencies. The model illustrates how interventions by regulators or businesses, which are intended to achieve improvements for customers, may have unintended consequences. So, for example, limiting customer charges is beneficial to the customer and should drive innovation and value into an organization. However, it may also compromise long term quality improvements, sustainability and increase the risk of failing assets. Our review has identified that parameters such a capital constraints, uncertainty (stochastic and epistemic) and operational tensions will influence the business culture to behaviours that promote reactive risk management. Behaviours that promote reactive risk management are also influenced by the ownership structure and regulation. By contrast, maturity in risk management will promote a planned approach and strategic plan to deploy capital in a way which adds resilience to the utility, and is likely to shift the organisation in the direction of pro-active and adaptive risk management. Again, regulation, ownership and the business culture will influence the utilities approach to risk management. As a conceptual model of the dynamic between risk and a significant slice of a utility's operating environment, Figure 4 is both descriptive and diagnostic, proposing explanations for shifts in risk management approach. The extent to which it also supports critical analysis and prognosis can only be confirmed by subsequent deployment through case study research. It does, however, provide a validated (if admittedly rather mechanistic) model for understanding the interaction of regulation, ownership and business culture on risk management choices.

In the foregoing sections we have illustrated some examples of regulatory mechanisms (price caps, quality standards, introduction of competition) that influence this framework. We have documented a range of ownership models which will be informed by regulation (public ownership, privatization and a range of models in between) and inform the business culture, which influences the balance between reactive and adaptive proactive risk management. We

classify this balance of choice as “measured” risk management. Although our review demonstrates that uncertainty (stochastic and epistemic) incentivises reactive risk management, it also suggests that operating within the time bound limits of a regulatory contract and the availability of capital funding has more of an influence over the balance between reactive risk management (typically under restricted funding conditions) and proactive risk management (where there is adequate access to capital markets).

Water utilities operate within a dynamic business environment and are subject to changes in regulation, objectives and ownership models that will affect the risk profile of the organization. It is clear from our review that utilities must remain vigilant to change and constantly re-evaluate the appropriateness of risk management strategies in order to manage risk (systemic and corporate) and cost reduction challenges. There is a clear need to better understand how to best craft an organization’s risk management strategy under different operating conditions, supporting a measured risk management culture. An improved risk management model will support water authorities in meeting the aspirations of the Bonn Charter and becoming “high reliability” services while still out-performing their financial and service level targets.

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Table 1. Selection of studies that report aspects of water utility ownership, regulation and business performance

Authors	**Study focus**	**Principal findings**
Bhattacharyya *et al.* (1995)	Specification and effect of ownership on the econometric efficiency of water utilities.	Public ownership is more efficient. Privatization enables technological changes but does not appear to change the rate of efficiency improvement.
Saal & Parker (2000)	The impact of privatization and regulation on the water and sewerage industry in England and Wales: a translog cost function model.	Changes to price cap regulations had a greater impact on efficiency than privatization.
Saal & Parker (2001)	Productivity and price performance in the privatized water and sewerage companies of England and Wales.	Profitability improvements were realised within the UK Water industry but there is little evidence to suggest expected productivity gains were achieved.
Renzetti & Dupont (2003)	Ownership and performance of water utilities.	There is little empirical evidence that supports the view that privatization is more efficient that public ownership models.
Renzetti & Dupont (2004)	The performance of municipal water utilities: evidence for the role of ownership.	There is a lack of evidence that private ownership is more efficient than public ownership. Changes in ownership need to be accompanied by the introduction of competition and output markets.
Dore *et al.* (2004)	Privatization of water in the UK and France: what can we learn?	The evidence presented from the UK and France does not support the case that the private sector is more efficient in delivery of water services.
García-Sánchez (2006)	Efficiency measurement in Spanish local government: the case of municipal water services.	There is no evidence to suggest that ownership models affect the efficiency of water utilities.
Saal *et al.* (2007)	Determining the contribution of technical change, efficiency change and scale change to productivity growth in the privatized English and Welsh water and sewerage industry: 1985–2000.	Public ownership is more efficient. Privatization enables technological changes but does not appear to change the rate of efficiency improvement.
Ruester & Zschille (2010)	The impact of governance structure on firm performance: an application to the German water distribution sector.	Public ownership appears more efficient than private models. This appears to be influenced by public institutions bringing private organizations to operate more technically challenging treatment processes.

Table 2. Database resources used in the literature review

Database	**Description**	**Subject of interest**	**Keywords used***	**Authors searched***	**No. papers returned**	**No. papers read**
Scopus	A huge database covering all areas of science, technology and medicine. It has several functions that allow searchers to personalize it to their own interests.	Risk, risk management, water utility management, public health, water management, sustainability.	Risk, management, water, utilities, epistemic uncertainty, stochastic uncertainty	Hamilton, Hrudey, MacGillivrayPaté-Cornell, Pollard, Strutt.	1567	38
Environment Complete (EBSCO)	Subject coverage includes agriculture, ecosystem ecology, energy, environmental law, geography, marine and freshwater science, natural resources, pollution and waste management, renewable energy, urban planning.	Water management, water, sustainability, health and the environment.	Risk, management, water, utilities, epistemic uncertainty, stochastic uncertainty	Hamilton, Hrudey, MacGillivrayPaté-Cornell, Pollard, Strutt.	429	12
Science Direct (Elsevier Science Journals)	Full text journal articles in the field of science and technology. Also provides a current awareness service and a powerful scientific internet search engine called *Scirus*.	Water management, water general.	Risk, reliability, water management, utilities, ownership	Hamilton, Hrudey, MacGillivrayPaté-Cornell, Pollard, Strutt.	1387	24
Web of Knowledge	Consisting of Web of Science (WoS), with conference proceedings, and Medline, it covers a very broad range of subjects relating to science, technology, social sciences and medicine. It also contains Journal Citation Reports (JCR). The ability to carry out citation searching is a key feature.	Risk, reliability, water management, sustainability, water, human factors and psychology.	Governance, leadership, heuristics, risk, ownership, privatization, regulation, water, stochastic frontier models.	Bakker, Hamilton, , Hrudey, MacGillivray, Parker , Paté-Cornell, Pollard, , Saal, Sawkins, Stern, Strutt, Reuster, Zschille.	1886	32
ABI Inform Complete (ProQuest)	Full-text access to approximately 2,500 international business periodicals contained within the ABI	Economics, business models, financial management,	Governance, leadership, heuristics, risk, ownership,	Bakker, Cubbin, Gigernzer, Johnston, Ostrom, Parker, Reuster,	532	15

	Inform Global, Trade and Industry, and Dateline databases. Coverage: 1971 – current.	governance.	privatization, regulation, water, stochastic frontier models.	Saal, Stern, Zschille.		
Business Source Complete (EBSCO)	Full-text access to more than 2,800 scholarly business publications including over 900 peer-reviewed journals. Also includes book content, conference proceedings, country, industry and market reports. Coverage: variable (1922 – current).	Economics, business models, financial management, governance, human factors, psychology.	Governance, leadership, heuristics, risk, ownership, privatization, regulation, water, stochastic frontier models, culture, culture web.	Bakker, Cubbin, Gigernzer, Johnston, Ostrom, Parker, Saal, Stern, Reuster, Zschille.	442	53
Factiva	Dow Jones service covering over 10,000 global press sources including over 2,000 newspapers and 4,000 trade publications. Also an excellent source of company information and financials. Coverage: variable (up to 30 years – current).	Economics, business models, financial management, governance, human factors, psychology.	Governance, leadership, Heuristics, risk, ownership, privatization, regulation, water, stochastic frontier models, culture, culture web.	Bakker, Cubbin, Gigernzer, Johnston, Ostrom, Parker, Saal, Stern, Reuster, Zschille.	1005	17

* The authors listed were used as a starting point for further investigation and study, which led to work produced by others that has been used to inform the study. The keywords and authors were aligned to the core disciplines covered in each search engine.

Table 3. Utility ownership models in the water sector (adapted from Ruester & Zschille, 2010)

Ownership model description	**Advantages**	**Limitations**	**Example countries**
Public ownership and operation	Full State control	All financial and operational risk sits with the governing institution	America, Germany, The Netherlands, Norway, Scotland, Singapore, Uganda
Leased assets operated by contractors	Assets remain State owned	Operational and some financial risk sit with the contractors	America, Australia, France, Germany, Panama, Philippines
Cooperation (partnering) model with public institution the majority shareholder	Financial and operational risks are jointly owned	Operational and some financial risk sit with the contractors	America, Argentina, Australia, France, Germany, Panama, Philippines
Contracting out of management activity that includes planning, financing, construction and operation	Financial and operational risks are spread across a range of business	Difficult to co-ordinate and get best value. Some businesses may bid low to win the contract which will lead to budget over spend	America, Argentina, Australia, France, Germany, Panama, Philippines
Concession model that stops short of full privatization	Most of the risk sits with the contractors. There may be sufficient incentive to drive out-performance of the contract. The contract will be better defined and run for longer period, providing stability	The public institutions will still be fully accountable for service failures	America, Australia, France, Germany
Privatization	Service provision, financial and operational risk are the responsibility of the private organization. Efficiency improvements should be achieved	Little state intervention. Private institution must meet service standards and shareholder demands	Chile, England

Figure 1. The influence of regulation on risk and risk management.

Figure 2. The influence of ownership on risk and risk management.

Figure 3. The influence of culture on risk and risk management.

Figure 4. Conceptual framework of interdependencies that inform risk management strategy choice.



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The impact of regulation, ownership and business culture on managing corporate risk within the water industry

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