



Towards understanding governance for sustainable urban water management

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ABSTRACT

Shifting from traditional, large, centralised infrastructure to alternative, distributed technologies is widely accepted as essential for enabling sustainable water management. Despite technical advances in sustainable urban water management over recent decades, the shift from traditional to more sustainable approaches remains slow. Current research on socio-institutional barriers suggests this poor implementation relates to a limited understanding of the different forms of governance needed to support alternative approaches, rather than the potential ineffectiveness of the technologies and practices. While some governance scholars express preferences for ideal hierarchical, market or network governance approaches, others suggest a hybrid of these approaches may be more appropriate for achieving sustainability. Currently, there is limited commentary about the potential characteristics of sustainable urban water governance. To extend the current scholarship, this paper systematically draws on the tacit knowledge of expert sustainability practitioners to identify potential governance characteristics of sustainable urban water management. In comparison with current urban water scholarship, which is supportive of a network governance approach at a conceptual level, the results strongly suggest that sustainability practitioners see the need for hybrid governance arrangements at a practical and operational level. These hybrid arrangements tended to comprise network and hierarchical approaches with market governance instruments. These insights from practitioners to help identify future research needs, focused on examining interaction among governance approaches at a variety of scales and locations.

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1. Introduction

Sustainable urban water management (SUWM) is an alternative to the traditional way in which urban water systems are managed. It is now an accepted approach in water resources management, incorporating terms such as integrated water management and total water cycle management, and is considered highly desirable and a much needed trajectory for urban water management (see for e.g. Ashley et al., 2007; Harremoës, 2002; Niemczynowicz, 1999; Pahl-Wostl, 2007; Wong, 2006). While traditional schemes comprise large, centralised infrastructure, SUWM is characterised by integrated infrastructure and biophysical systems, which consider social, economic, environmental and political contexts, provision of water for ecological and human uses, and a long term perspective (Brown and Keath, 2008; Mitchell, 2006; Mostert, 2006; Serageldin, 1995; Vlachos and Braga, 2001).

Furthermore, SUWM is proposed as a strategy to overcome and/or cope with the challenges facing our urban water systems, which include addressing the implications of population growth, climate change and environmental impacts of traditional urban water management practices. In 2009, urban residents comprised fifty percent of the world's population (UNPF, 2009) and as the population grows, demand for urban water services also increases. Climate change forecasts indicate extreme events (such as droughts, high intensity rainfall and heat waves) are likely to increase and freshwater systems will be adversely affected (IPCC, 2008). Over-allocated water systems are vulnerable to decreasing water availability and increasing rainfall variability, reducing water security of both urban and non-urban areas (IPCC, 2008). Additionally, environmental impacts from traditional urban water management are observed within and outside of most cities, resulting from damming rivers for water supply and discharging pollution into downstream waterways (Niemczynowicz, 1999). Addressing aging urban water infrastructure is also a challenge confronting numerous countries (Vlachos and Braga, 2001).

Many tools and new technologies are facilitating implementation of improved practices at the project scale, such as stormwater treatment systems, models and assessment methods (see for e.g. Chocat et al., 2001; Harremoës, 2002; Mitchell, 2006), yet

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widespread SUWM remains unrealised. Scholars have identified numerous systemic and interrelated socio-institutional barriers impeding SUWM implementation (Farrelly and Brown, 2011; Harremoës, 2002; Mitchell, 2006). Barriers include, among others, institutional fragmentation, poor political leadership, unproductive intergovernmental relations, limited long-term strategic planning, and inadequate community participation (see for e.g. Brown, 2005; Brown and Farrelly, 2009; Hatton MacDonald and Dyack, 2004; Niemczynowicz, 1999; Vlachos and Braga, 2001).

Based on these systemic and inter-related barriers (Brown and Farrelly, 2009), it can be surmised that there is a lack of insight into governance approaches required to support SUWM practices. Urban water governance, discussed further in Section 2, has generally shifted from the historical, hierarchical governance approach towards a market governance approach over the last century (Bakker, 2002), yet the fundamental functioning of urban water systems has remained essentially unchanged and unchallenged, with some efficiency improvements observed. Governance arrangements for addressing the systemic and interrelated challenges facing urban water management are not readily apparent beyond the explication of regime attributes and approaches which are suggestive of network governance (see for e.g. Brown et al., 2009; Pahl-Wostl, 2007, 2008; van de Meene and Brown, 2009). Therefore, there is a need for further scholarly guidance on what governance for SUWM might entail.

This paper empirically examines the governance needs of SUWM, using the Australian water sector and the significant challenges it faces as a rich source of insight. Derived from extensive qualitative research drawing on the accounts of expert urban water sustainability practitioners, the paper tests the current governance approaches considered suitable for sustainable natural resource management. The paper extends current scholarship by revealing attributes of a hybrid governance approach for SUWM, challenging the traditional separation of ideal hierarchical, market and network governance approaches. The following section discusses current governance scholarship in relation to the urban water sector. The exploratory research design and methods are then described, including the analytical framework for exploring governance attributes. The likely SUWM governance attributes identified from practitioners are described in Section 4 and their implications for current understandings of urban water governance discussed in Section 5. Finally key questions and challenges arising from this research are identified.

2. Governance and sustainable urban water management

Governance describes the management of collective issues, the stakeholders involved and processes used (Kjær, 2004; Pierre and Peters, 2000; Stoker, 1998). Governance studies emphasise interactions among structures and processes, which are important when examining change (Kjær, 2004). The three ideal governance approaches often identified are hierarchical, market and network approaches; these are briefly discussed in reference to urban water management.¹

Hierarchical governance consists of formal arrangements and representative democratic accountability mechanisms (Kjær, 2004). This approach characterised early urban water management and was observed in large, centralised public authorities for wastewater, water supply and drainage services (Vlachos and Braga, 2001), with vertical accountability and little stakeholder participation (Pahl-Wostl, 2007). However, hierarchical governance was criticised by scholars as being inefficient and unresponsive (Newman, 2001) and not conducive to learning and adaptation (Pahl-Wostl, 2007).

Market governance, essentially applying private sector management principles to the public sector (Hood, 1991), was promoted as delivering substantially improved efficiency.

Market governance aims to allocate resources efficiently and empower citizens (Pierre and Peters, 2000). This approach became popular during the 1990s and was observed in urban water management through full cost pricing, introduction of competition and privatisation (Bakker, 2002). Market governance was adopted in different ways, for example water authorities in England and Wales were privatised (Bakker, 2005) and corporatised in Australia (Colebatch, 2006), while in France, the private sector delivered water supply services under contract arrangements with municipalities (Renzetti and Dupont, 2004). While market governance of water has been criticised for both leading to private monopolies (Parker and Sewell, 1988) and restrictive contracts limiting citizen access to previously accessible water resources (Bakker, 2003), recent water reforms demonstrate continued support for market governance (Saleth and Dinar, 2005). However, market governance has also been criticised for causing institutional fragmentation, thereby decreasing state control over policy implementation and increasing influence of other actors through networks (see for e.g. Kjær, 2004).

Network governance is founded on reciprocity and consensus (Kjær, 2004), and acknowledges public, private and civil actor participation is required for effective public policy development and implementation (Klijn and Koppenjan, 2000). Networks can exhibit self-governing tendencies, which can be resistant to external influences, such as government steering, and pose challenges for accountability (Kjær, 2004). Although an empirical example of a network governance approach has not been formally identified in urban water management, scholars implicitly advocate this approach for SUWM (see Brown et al., 2009; Pahl-Wostl, 2007, 2008). Through extensive common pool resource management research, Ostrom (2010) considers trust, cooperation and decentralised management approaches (elements of network governance) to be key considerations of social-ecological systems. van de Meene and Brown (2009) identified SUWM attributes in greater detail through a meta-analysis of 81 empirical studies on different governance aspects, such as organisational change and community engagement, and drew conclusions about more effective water governance that were aligned with the network governance approach.

Although each governance approach has been promoted as a solution to public policy challenges, some scholars (e.g. Hill and Hupe, 2002; Meuleman, 2008; Pierre and Peters, 2000) argue that the three ideal governance approaches will rarely be observed in reality, but rather mixed or hybrid forms will be detected in practice due to the complexity of real world situations. Indeed, environmental governance scholars (e.g. Kooiman and Jentoft, 2009; Lemos and Agrawal, 2006; Pahl-Wostl, 2009) contend that hybrid governance approaches are likely to deliver more sustainable outcomes. Other scholars such as Hayek (1988) and Williamson (1981) identify the complex nature of governance approaches observing the network orientation of some market approaches. However, the challenge to understand governance in practice and develop governance solutions to facilitate SUWM implementation remains.

One approach to understanding urban water governance from a practical perspective is to focus on the city or region scale as this corresponds to the spatial scale of much existing urban water infrastructure (Cech, 2005). Therefore the people and organisations who manage water in this space and the corresponding policies and legislation, in other words, the urban water regime (Pahl-Wostl, 2007), can be used to conceptualise and examine governance approaches. A recent tool to investigate regimes is van der Brugge's (2009) regime conceptualisation, founded in socio-technical studies, comprising four elements: actors, processes,

¹ Additional information is available from references such as Pierre and Peters (2000), Kjær (2004), Rhodes (1997), Hood (1991), and Klijn and Koppenjan (2000).

structures (including physical systems) and influences. These elements are consistently referred to as significant components of governance (Kjær, 2004) and therefore understanding their characteristics may provide insight into the future SUWM governance needs. This conceptualisation of the urban water regime was used as the analytical framework to identify and explore characteristics of governance.

In van der Brugge's (2009) conceptualisation, actors use processes to modify structures, which in turn influence the strategies or actions available to actors. Some regime characteristics have been proposed in the governance literature: actors from different disciplines will possibly work closely together and a proportion will likely be interdisciplinary (Dovers, 2005; Harding et al., 2009); structures would potentially reflect polycentric organisational arrangements which provides resilience to improve the system's response to change (Huitema et al., 2009); and processes will possibly involve greater stakeholder deliberation and participation in decision-making (Harding et al., 2009). Additionally, scholars strongly identify market governance instruments as able to efficiently deliver improved environmental outcomes (Bakker, 2005; Castree, 2008).

However, there remains a lack of detailed knowledge regarding governance characteristics and approaches for supporting improved urban water management practices. To date, scholarship on SUWM governance has largely been theoretical (Brown et al., 2009; Pahl-Wostl, 2007, 2008) and developed through conceptual and ideological arguments, rather than through empirical investigation and theory building. This research is based on the proposition that drawing on the tacit knowledge and practical every day experiences of urban water practitioners specialising in sustainability is likely to yield rich insight into the governance needs and subsequent theory development for advancing SUWM.

3. Research approach

An inductive research design (Blaikie, 2000), grounded in qualitative data from expert Australian urban water sustainability practitioners was used to identify potential SUWM governance attributes. A variety of methods can be used with grounded studies (Glaser, 1978), and the case study approach was selected because of the need to understand the influence of context on the responses (Blaikie, 2000). Urban water sustainability practitioners were targeted as they have tacit and experiential knowledge of water governance in practice and insights into what governance attributes are likely to be important and more or less effective for enabling sustainable management and technical alternatives. While SUWM is not mainstream practice, there are a number of sub-regime, alternative SUWM practices such as localised wastewater recycling and stormwater quality management that have begun to mainstream over the past 5–10 years. This background provides sustainability practitioners with an important comparative context to reflect upon. This tacit knowledge is often difficult to access but may be valuable for improving scholarly insight (Lienert et al., 2006) and moving the current focus beyond the more abstract governance approach debates. Data analysis occurred in two stages: (1) coding interview transcripts (see for e.g. Kitchin and Tate, 2000), and (2) analysing the interview outcomes with reference to the scholarship on ideal governance approaches. The ideal governance approaches were used as a heuristic tool (Meuleman, 2008) for analysing sustainability practitioner perspectives on what would be the governance ingredients for enabling the effective practice of SUWM.

Practitioners based in the cases of Sydney and Melbourne were selected because they face significant challenges to enable SUWM which are similar to other large urban areas, such as population growth, environmental impacts from traditional urban water approaches and uncertainty due to climate change. Additionally,

the urban water governance arrangements in both cities have followed international trends, evolving from hierarchical and centralised management structures to market governance structures (Bakker, 2002; Brown and Clarke, 2007; Colebatch, 2006; Jane and Dollery, 2006). These features improve the potential for the results of this research to be applied in other contexts.

Interview participants were identified through both formal and informal approaches and nominated through at least two independent sources. The formal involved approaching managing directors, chief executive officers and senior managers from public, private and community stakeholder organisations across the urban water sector (refer Table 1). These executives referred the researchers to potential interviewees within their organisations ('snowball method'). The informal approach involved identifying interviewees through industry and academic (e.g. conference proceedings) publications and levels of participation in professional networks and associations. In total, 127 interviewees were selected. To minimise the chance of disciplinary and/or practice area bias to a particular governance approach (i.e. there may be a preference for hierarchical approaches with regulators), the interviewees were drawn from across all key stakeholder groups within the water management regime (Table 1) representing a mix of disciplinary backgrounds. However, as reflective of the traditional nature of water management, there were net more engineers than any other discipline represented in the total pool of interviewees.

To help structure the interview questions, the institutional capacity assessment framework (Brown et al., 2006) was used and proved easy for interviewees to understand by focusing on the individual, intra-organisational, inter-organisational and the administrative and regulatory governance factors. Reflecting on their experiences of what seems to be more and less effective, interviewees described their perceptions of future governance ingredients for mainstreaming SUWM. Data collection and analysis for Sydney was undertaken prior to Melbourne and when concluded, the data was coded and analysed iteratively until all categories were saturated, suggesting additional data collection would not provide significantly greater insight (Strauss and Corbin, 1998); the two coded datasets were then combined because of numerous similarities between the cities' data.

The coding process involved two phases, and the first comprised a detailed and inductive analysis of all the interview data using van der Brugge's (2009) regime conceptualisation as a guide. The lead author conducted the initial coding, with the co-authors independently and iteratively peer-reviewing the emerging codes. As further layers of the coding were developed and refined, the three authors reflected both independently and together on the coherence and quality of the coding. The process of developing the codes involved actively seeking alternative sets of codes and coding patterns (i.e. splitting and splicing as described by Kitchin and Tate, 2000) to ensure that the resulting codes were both distinct and comprehensive, and the most robust in terms of

Table 1
Number of interviewees and stakeholder group.

Stakeholder group	Number of interviewees
State government – policy	16
State government – regulator	11
Local government	21
Water management organisations	20
Land development organisations	18
Consulting organisations	15
Non-government organisations	8
Professional associations	7
Liaison (bridging) organisations	7
Research institutions	4
Total	127

Table 2
Integrated regime and governance analytical framework.

Regime element	Governance approach		
	Hierarchical	Market	Network
Actors	Little autonomy, follow predefined orders Dependent relationships Rational Considered as 'subjects' Subordinate actors motivated by fear of punishment Superordinate actors motivated by career advancement, bureaucratic stability Common motivation is to minimise risk	Exercise self choice Independent relationships Rational Considered as 'customers' or 'consumers' Subordinate actors motivated by material benefit Superordinate actors motivated by profit Common motivation is to maximise advantage	Depend on others; trust others, empathetic Interdependent relationships Considered as 'partners' Subordinate actors motivated by belonging to a group Superordinate actors motivated by the esteem of followers Common motivation is to satisfy identity
Processes	Clearly defined and applied across locations Decisions based on authoritative, formal adjudication Accountability exercised through political system	Emphasis on private sector management practices – efficiency, competition Decisions based on consumer preference Accountability exercised through consumer choice	Context dependent Emphasis on cooperation and negotiation Decisions based on general consent, unanimous agreement Accountability and transparency difficult to identify
Structures	Strong vertically, formalised, static Low flexibility Establishes clear actor roles and responsibilities	Provide guidance to actors Establish explicit standards for performance High flexibility Establishes principal with local actors	Strong horizontally, informal Moderate flexibility Context dependent
Influences	Centralised power Power exercised through coercion, administrative and legal expertise, procedural correctness Collective goods are produced and distributed	Centralised power with autonomous actors Resource allocation linked to performance Power exercised through entrepreneurship Private goods are produced and distributed	Distributed power and resources Power exercised through respect and trust Solidaristic goods are produced and distributed

Source: Adapted from: Elzen and Wiczcerek (2005), Hood (1991), Meuleman (2008), Pierre and Peters (2000), Powell (1990), and Streek and Schmitter (1985).

representing the breadth and depth of the interview results. As outlined by Strauss and Corbin (1998: 136) the authors sought 'saturation' points for finalising the codes, where there were no new insights or properties in the interview data remaining. At the conclusion of this phase, a set of regime features for each component of van der Brugge's (2009) regime conceptualisation were developed.

The second phase of the coding process involved assessing the range of qualities or scope of each of the regime features as detailed in the interview transcripts. This assessment was conducted in relation to the attributes advocated in the governance scholarship for each of the three idealised governance approaches as summarised in Table 2. Table 2 identifies the attributes for each governance approach in relation to the regime conceptualisation proposed by van der Brugge (2009) and has been populated through assessing the attributes as presented in the existing scholarship (see Elzen and Wiczcerek, 2005; Hood, 1991; Meuleman, 2008; Pierre and Peters, 2000; Powell, 1990; Streek and Schmitter, 1985). As the analysis progressed, a series of presentations of interim findings were made to both fellow academics for critique and reflection, as well to a small series of industry validation seminar events. These seminars involved sharing the findings and eliciting practitioner feedback, including discussing the results and seeking practitioner critique. These discussions were used to refine the coding, the synthesis of the final results and further reflection on potential implications of the practical operation of the resulting governance approach.

The coded governance features and the corresponding number of respondents were tabulated and evaluated against the governance approaches. As the interviewees could emphasise multiple attributes of the ideal governance approaches at any time during the interview, responses therefore could be allocated to one or

more governance approaches across the regime elements of Table 2. The number of interviewees who described regime characteristics in each of the three governance approaches was calculated as a percentage (refer Tables 3–6).

An NVivo 8 (QSR International) database comprising the raw data, regime features, governance approach, representative quotes and notes made during analysis provided a chain of evidence connecting the codes with raw data (Yin, 2003). Finally, the governance approach assessment results were contrasted with scholarly SUWM governance projections and the overarching findings considered in relation to relevant environmental and urban water governance literature.

4. Results

As a whole, the SUWM governance features identified from expert urban water sustainability practitioners do not precisely match with any of the ideal governance approaches; instead, discussion of the governance approaches varies across the regime. The SUWM governance features are now discussed using the four regime elements of the analytical framework (Table 2): actors, processes, structures and influences. Under each of the four elements, the regime features and characteristics are described and discussed using literature and then summarised in tables. The tables compare how the characteristics of the regime features were described by interviewees with sample quotes to represent the hierarchical, market and network governance approaches.

4.1. Actors

Overall, a substantial emphasis on the network governance approach emerged from the analysis across the actor regime

Table 3
Actor features and characteristics of a sustainable urban water regime and governance approaches.

Regime feature	Overview	Hierarchical governance		Market governance		Network governance	
		% ^a	Description & key words	% ^a	Description & key words	% ^a	Description & key words
Problem frame	Holistic approach, understanding links between water cycle elements, broader sustainability considerations & regime actors	13	System viewed as separate components which can be controlled, looking to authority for direction. “systems management process”, “track progress”	11	Economic approaches are used to analyse the system and decide how to deliver services. “efficiency”, “ecological economics”, “commercial”	76	System viewed holistically, including examining impacts beyond the water cycle. “conscious of sustainability”, “sense of connection”, “system thinkers”
Purpose	Value sustainability, contributing to society though SUWM	12	Motivated by a clear objective which is then followed precisely. “sound decision making”, “long term vision”	21	Efficient delivery of water services to customers. “outcome focused”, “commercially aware”	67	Taking responsibility, working together to achieve outcomes. “openness”, “work collaboratively”, “prepared to take risks”
Knowledge & skills	Diverse knowledge & skills, inter-disciplinary operation	13	Knowledge & skills to ensure control, e.g. through use of technology. “better abilities to measure change”, “security and risk management”	16	Knowledge & skills to provide economic valuation. “costing the environment”, “key externalities”, “market oriented people”	71	Knowledge & skills to understand links between physical & social systems. “ability to work across disciplines”, “diversity”
Approach towards relationships	Willing to engage with others, open minded, respectful of different perspectives	14	Directive and formal approach to relationships. “push it as much as you can”, “impartial advice”, “formal relationships”	18	Focus on responding to customers' needs. “customer focused”, “authorisation to be flexible”	68	Focus on genuine engagement & connection with others. “involved upfront”, “trusting”, “respectful”

^a Number of interviewees identifying SUWM attributes which correspond with this governance approach expressed as a percentage.

Table 4
Process features and characteristics of a sustainable urban water regime and ideal governance approaches.

Regime feature	Overview	Hierarchical governance		Market governance		Network governance	
		% ^a	Description & key words	% ^a	Description & key words	% ^a	Description & key words
Accountability & transparency	Clear accountability mechanisms & information provision facilitate stakeholder scrutiny & participation	48	Formal processes to ensure accountability & transparency. “see decision making processes occur in front of you”, “independent scrutiny”	21	Transparency & accountability ensured by consumer choice & informed consumers. “customer protection”, “competitive neutrality”	31	Accountability & transparency facilitated by communicating openly & debating issues. “start some of the debate”, “sharing information”
Continual improvement	Experiential learning, evaluation & ongoing innovation	22	One-way education & learning with formal evaluation. “community education”, “evaluation”	22	Change through market innovation & incentives. “innovation fund”, “markets will drive innovation”	56	Learning through experience & questioning current approach. “reflective time”, “show and demonstrate”
Risk management	Addressing risks associated with uncertainty of SUWM solutions	28	Risk is controlled, often underwritten by government. “the risks are very high and you cannot accept failure in those areas”, “certain amount of responsibility”	26	Some risk is shared between private & public organisations where appropriate. “preparedness to take risks”, “consider risk management more openly”	46	Risk is shared & reduced through information & communication. “sharing risk”, “risk communication”
Leadership	Clear & strong leadership to set the direction & engage others to participate	45	Strong, formal leaders, directing others. “leadership from the top”, “clear consistent message”	16	Leadership by innovating or doing things first. “leading the way”, “assertive”	39	Leadership through influencing, encouraging & supporting others. “facilitate”, “influencing and guiding”
Cooperation & collaboration	Working together to achieve common goals	25	Formal partnerships & structured cooperation procedures. “partnerships that are more formalised”	13	Partnerships for specific purposes which involve generating profit. “joint venture”, “partner in service delivery”	62	Partnerships which consider members' needs, founded on trust. “interactive”, “community deliberation”

^a Number of interviewees identifying SUWM attributes which correspond with this governance approach expressed as a percentage.

Table 5
Structures features and characteristics of a sustainable urban water regime and governance approaches.

Regime feature	Overview		Hierarchical governance		Market governance		Network governance	
	Description & key words	% ^a	Description & key words	% ^a	Description & key words	% ^a	Description & key words	% ^a
SUWM culture	Focused on integration with biophysical context & other sectors, underpinned by equity & flexibility principles	27	Focused on control, directed from the top. "greater control", "mandated"	16	Focused on economic efficiency & incorporating externalities into the economic evaluation framework. "consumer paying", "economies of scale"	57	Focused on unique solutions integrated with other sectors & contexts. "not one solution that fits everybody", "fully integrated"	
Infrastructure	Infrastructure is integrated, enabling fit for purpose use, valuing ecosystem health	7	Large scale, centralised infrastructure. "dam infrastructure", "desalination", "water grid"	17	Infrastructure evaluated on economic efficiency, enables water trading. "economic order of merit", "economical on a dollars per kilolitre basis"	76	Decentralised infrastructure tailored for site requirements, enabling fit for purpose use. "site specific", "cascading water cycles"	
Policy instruments	Use a variety of policy instruments	45	Regulation, legislation and minimum standards are used. "legislation is needed", "minimum standards"	39	Full cost pricing policies & incentives are used. "pricing", "rebates", "third party access"	16	Learning & capacity building are used. "building the capacity of everyone", "demonstration project"	
Administrative arrangements	Roles & responsibilities are clear & facilitate effective actor interaction	41	Responsibilities are clear & centralised; primarily public sector management. "clear responsibilities", "take over the whole lot"	31	Responsibilities are focused on service provision & independent regulation; private sector involvement. "more private sector involvement", "independent regulator"	28	Responsibilities facilitate cooperation at the local level; some community management. "working closer together", "local level"	

^a Number of interviewees identifying SUWM attributes which correspond with this governance approach expressed as a percentage.

features (Table 3). Interview responses coalesced around four key features that were seen as critical to activating the practice of SUWM. These inter-related features, discussed below, included actors: having the ability for a holistic problem frame; holding personal sustainability values; participating in a diverse knowledge and skill set environment; and having an open and willing disposition for engaging with others.

SUWM regime actors (Table 3) are likely to have a holistic problem frame which involves understanding links among biophysical and infrastructural system components, connections among technical and social strategies, and the potential implications of SUWM solutions for other sectors. This actor feature reflects the debate surrounding environmental management which calls for integrated rather than reductionist approaches (Functowicz and Ravetz, 1993), where the traditional regime of separate management of water supply, sewerage and drainage services, gives little consideration to potential impacts on other sectors (Pahl-Wostl, 2007).

Participants also proposed that both individuals and organisations would view SUWM as a core societal objective. Contributing to society through SUWM would motivate urban water professionals and encourage them to overcome challenges faced when implementing SUWM practices. Organisational commitment to SUWM, facilitated by organisational leaders, would be demonstrated through public statements of commitment, setting objectives, policies, programs or actions.

Interviewees emphasised actors would likely have diverse knowledge and skills and a positive approach to relationships, both within and between organisations. This perspective highlights the need for actors to understand and appreciate the interconnected physical and socio-institutional elements of a SUWM system. Interviewees underscored the need for technical knowledge and skills, similar to the traditional regime, and also mentioned a range of professional roles including ecologists, landscape architects, planners, economists, community engagement professionals, and policy makers. Importantly, interviewees also highlighted the need for their knowledge to be integrated across disciplinary boundaries, which has also been identified as important in environmental management more broadly (Dovers, 2005; Harding et al., 2009). Considered together, these four attributes (Table 3) show that actors within a SUWM regime are likely to perceive themselves within multiple, varied and mutually dependent relationships.

4.2. Processes

Overall, there was no dominant or overarching governance approach which was discussed or advocated across the five process features which emerged from the interviews, as discussed below and summarised in Table 4. The process features considered by interviewees as critical for effective SUWM included: working in a cooperative and collaborative manner; continually seeking to experiment and learn; supporting clear accountability mechanisms and providing information to stakeholders to facilitate transparency; proactively managing risks associated with SUWM technologies and approaches; and providing clear leadership to engage stakeholders across the urban water management system.

Interviewees considered accountability and transparency, which are principles of 'good governance' (Kjær, 2004; Rhodes, 1997), important for informing stakeholders and enabling them to effectively contribute to SUWM. While critical for all three ideal governance approaches, accountability and transparency are often associated with representative democracy and hierarchical governance (Pierre and Peters, 2000), and therefore they may be more easily observed or explicit within the traditional water management approach, and may pose a challenge for alternative forms of governance proposed for SUWM.

Table 6
Influences features and characteristics of a sustainable urban water regime and governance approaches.

Regime feature	Overview	Hierarchical governance		Market governance		Network governance	
		% ^a	Description & key words	% ^a	Description & key words	% ^a	Description & key words
Authority	Power should be shared & strategic considerations be at the forefront of the political process	40	Power centralised with government & enforced through top-down mechanisms. "determined from the top", "government has got to decide"	16	Power decentralised with consumers but centralised regulation with clear separation between government & implementation. "structural separation", "consumers to choose"	44	Power decentralised & actors integrated by norms, individual responsibility is emphasised. "empowering some of the staff", "because they should"
Resources	A variety of resources are allocated using a range of mechanisms	46	Funding secured through formal & stable mechanisms, human resources brought into organisation. "in house", "security of funding"	24	Funding secured through incentives, human resources through consultants. "create the right incentives", "outsourcing"	30	Human resources developed within the organisation & informal human resources are important (e.g. fit with organisational culture); autonomous financial resources. "about getting the right people", "encouraging people"

^a Number of interviewees identifying SUWM attributes which correspond with this governance approach expressed as a percentage.

The characteristics of the continual improvement and risk management regime features discussed by interviewees reflect some significant differences compared to the traditional urban water management regime, which relies on standard solutions to different locations (Harremoës, 2002; Pahl-Wostl, 2007). However, it has been shown that SUWM solutions will need to consider each location's unique context (Mitchell, 2006; Mostert, 2006). Interviewees associated SUWM solutions with continually innovating new or adapting existing solutions, which brought high uncertainty and high risk. Risk management strategies included sharing risk among stakeholders and undertaking trials to learn and improve confidence. These interviewee considerations correspond with those of Blackmore and Plant (2008) who support dynamic risk management and reducing risk through learning.

In a SUWM regime, cooperative and collaborative relationships, between or within organisations, will likely be facilitated by actors positively engaging with others (refer Section 4.1). Interviewees typically used the terms cooperation and collaboration interchangeably, although collaboration was often considered a closer and longer-term relationship than cooperation. This reflects similar concepts in integrated environmental management (see for e.g. Briassoulis, 2004; Cortner and Moote, 1994; Margerum and Born, 1995). Key characteristics of successful actor relationships were generating shared understanding and objectives, and initiating relationships early to develop trust.

Leadership is considered a key factor in emerging (Heikkila and Gerlak, 2005) and successful collaborative and cooperative natural resource management relationships (Leach and Pelkey, 2001). Interviewees identified leadership at the organisational, inter-organisational and political levels as important for setting the direction and vision of SUWM and encouraging stakeholders to support the vision. Organisations nominated as water sector leaders by participants often used facilitative leadership strategies, including information provision, influencing through a client-consultant relationship or leading by example. These strategies contrast with the traditional urban water regime, where power and therefore leadership is formalised and centralised (Pahl-Wostl, 2007). This discussion about both directive and facilitative leadership within one regime feature highlights the likely complexity of sustainable urban water governance.

4.3. Structures

Similar to the processes regime features, the structures regime features emerging from the interviews (Table 4) were discussed in relation to all three ideal governance approaches. Four features were identified from the interviews as critical for effective SUWM: an industry-wide culture which emphasises flexibility and integration of water with the biophysical context and other related sectors (e.g. land use planning); water infrastructure which is integrated across the water cycle and supports ecosystem health; use of a variety of policy instruments; and administrative arrangements which are clear and foster stakeholder interaction.

Interviewees described a sustainable urban water sector with a culture that is focused on integrating knowledge, and with a policy environment responsive to challenges; these cultural characteristics are similar to the actor features of a holistic problem frame and interdisciplinary knowledge (Table 2). Focusing on integration also reflects integrated environmental management literature (Briassoulis, 2004; Cortner and Moote, 1994; Margerum and Born, 1995), while flexibility or resilience corresponds with adaptive governance principles (Olsson et al., 2006).

Integration and flexibility are also evident in SUWM infrastructure, reflecting the co-evolution of the management regime and technical system (Elzen and Wiczorek, 2005). Interviewees described integrated infrastructure as providing fit-for-purpose

water and adapting to local constraints and opportunities, which reflects total water cycle management and integrated water management literature (e.g. Chocat et al., 2007; Harremoës, 2002; Mitchell, 2006). However, these attributes differ from traditional urban water infrastructure which is founded on stationary design principles (Milly et al., 2008) and focuses on control and prediction (Pahl-Wostl, 2007).

Interviewees identified the need to use a range of policy instruments and associated different policy instruments with different stakeholders and outcomes, for example, interview participants related regulation to ensuring low performing actors achieved minimum water management standards, while incentives (i.e. financial) were considered to encourage innovation and more rapid implementation of SUWM practices. Using different policy instruments for different contexts is similar to Schneider and Ingram (1990) who support targeting stakeholder groups with appropriate policy instruments to achieve desired results.

Similar to the policy instruments, interviewees identified a variety of roles, responsibilities and administrative arrangements, ranging from centralised through to decentralised, and public through to private arrangements. Although participants agreed that pursuing SUWM was important, the diverse interviewee opinions about roles and responsibilities and policy tools demonstrate SUWM implementation remains contested and will likely require further discussion and debate. This is typical of the broader sustainability policy implementation debate (Jordan, 2008; Meadowcroft, 2007).

4.4. Influences

Similar to the processes and structures regime components, a mix of governance approaches were discussed in relation to the influences features (Table 6). Two regime features emerged from the interviews: the constitution of power across the regime and how resources are allocated.

Participants identified the authority of individuals (e.g. politicians) and organisations (e.g. regulators, government departments) as important because the distribution of authority affects each actor's ability to take control or have control exerted over them. A range of perspectives was expressed by interviewees including, on the one hand centralisation of power with government, and on the other decentralisation enabling actors greater scope to influence SUWM. Interviewees discussed both centralised and decentralised authority, which again highlights the complexity of sustainable urban water governance similar to the directive and facilitative leadership styles in the processes regime element (Section 4.2).

Interviewees identified a number of different resource types and allocation mechanisms. In particular, securing adequate financial and technical resources was perceived as critical to enabling SUWM, and policy instruments such as government grants, incentives or subsidies, could be used to allocate resources. Strategies for accessing human resources, which were also identified as important, included ensuring the organisation has adequate staff employed, using consultancies or undertaking training or capacity building. Financial, technical and human resources are also often considered important in facilitating effective natural resource management (cf. Ivey et al., 2006; Lurie and Hibbard, 2008).

5. Discussion

5.1. Governance approach

Overall, the research revealed that this governance assessment of the SUWM regime attributes as considered by practitioners

(Tables 3–6) comprises a hybrid governance approach for SUWM. These findings correspond with scholars who contend that a hybrid approach is more realistic (e.g. Hill and Hupe, 2002; Meuleman, 2008) and more likely to deliver sustainable environmental outcomes (Lemos and Agrawal, 2006). Based on the empirical findings, the hybrid approach for SUWM would likely comprise primarily network governance in the actors and processes elements (Tables 3 and 4), while hierarchical governance would provide a counterpoint in the structures (administrative arrangements and policy instruments) and influences elements (Tables 5 and 6). Market governance was predominantly identified in the administrative arrangements and policy instruments of the structures regime element. The findings suggest that the commentary on the ideal governance approaches, including the network and market approaches supported in environmental governance literature (e.g. Bakker, 2002; Pahl-Wostl, 2007), are too unrealistic for practical application. However, the ideal governance approaches are useful as a heuristic, to analyse real-world situations.

While the ideal governance approaches may be expected to operate in tension relative to each other, given their different underpinning principles, practitioners did not perceive this as problematic, but rather explained how the hybrid governance approach would facilitate SUWM. The hierarchical approach would provide certainty across the water sector through the formal administrative framework (Table 5), political leadership and authority (Table 4, Section 4.4) and also by ensuring sanctions could be enacted if required. At the same time, the network approach would provide flexibility for implementation, enabling actors to employ less formal strategies such as collaboration, continual learning and innovation (Table 4) and inter-disciplinary interaction (Table 3) for developing context specific SUWM solutions. The market governance approach was considered to primarily facilitate efficient resource use and achieve SUWM outcomes through incentives and stimulating some industry competition (Table 5).

There are some similarities between the hierarchical governance approach, which characterised traditional urban water management (Pahl-Wostl, 2007), and the hybrid approach for SUWM, particularly in the structures and influences regime elements (Tables 5 and 6). However, as a whole, the hybrid governance approach differs considerably from the traditional approach, with its emphasis on connections between actors, professional disciplines and biophysical and infrastructure systems, and also continual improvement. These differences are reflective of the network governance approach, and correspond with the SUWM regime attributes in the literature (Brown et al., 2009; Pahl-Wostl, 2007, 2008; van de Meene and Brown, 2009). In comparison with the scholarly SUWM regime attributes, which are largely conceptual, it appears the practitioner-informed hybrid governance approach provides greater clarity for applying network governance approaches in practice. The hybrid approach improves our understanding of how to successfully integrate the three ideal governance approaches and offers potential solutions for resolving tensions among the governance approaches.

However, the hybrid governance approach for SUWM, with the limited emphasis on market governance, contrasts with scholarly support for market governance approaches for managing natural resources, including water (see for e.g. Bakker, 2002, 2005; Castree, 2008). An explanation for this may be found in the research context. This research was conducted in the Australian urban water sector which adopted market governance principles during the 1990s. Market governance principles were expressed through the efficiency agenda and largely corporatised institutional arrangements (Colebatch, 2006). Adoption of market governance differed across nations (Bakker, 2002) (see Section 2) which would likely expose practi-

tioners to varied regulation of private companies and understanding how private and public organisations interact. This diverse experience may influence practitioners' familiarity with and therefore discussion of market governance approaches. To ascertain if and how the existing marketised context influences practitioners' SUWM regime attributes, similar research in other locations, with varied governance contexts, is required.

5.2. Towards understanding sustainable urban water governance

This exploratory research has provided insight into potential governance for SUWM. However, due to the emergent status of sustainable urban water governance research, these findings have raised some interesting questions, and identified tensions and challenges to be addressed in future research.

First, the debate within the literature surrounding the most appropriate governance approach for sustainable natural resource management for a given context is often divided between network, market or hybrid approaches, with some tensions identified within the hybrid perspective (Lemos and Agrawal, 2006). The research presented in this paper validates the proposition that a hybrid approach is probable for the realisation of SUWM in practice (Bakker, 2002; Pahl-Wostl, 2007). While the hybrid governance approach for SUWM proposed by Australian water practitioners identifies a mix of governance approaches, additional evidence is required to identify which mix is best for particular contexts. Context specific governance solutions is a key factor that Ostrom (2010) argues needs to be considered for improved natural resource management. For example, investigating practitioner perspectives from locations which differ from the Australian urban water sector would test the proposed hybrid governance approach, possibly validating this research or providing alternative and/or extended perspectives and insight. Additionally, by undertaking these investigations, contextual factors strongly influencing practitioner perspectives could be identified (as outlined in Section 5.1), and thus extend this research to develop a substantive theory for sustainable urban water governance.

Second, combining the three ideal approaches of governance into a hybrid approach can potentially lead to tensions among the governance approaches which may be detrimental to effective SUWM. While the governance approaches were mixed in this research, the issue of combining governance approaches has raised some key questions on how to improve our understanding of the interaction of governance approaches at different scales. Key questions include: what role do tensions among governance approaches play – do they always need to be resolved or are some tensions beneficial, and if so, how are they beneficial? How can different mixes of the three ideal governance approaches be effectively integrated (or the tension managed) at the regime, project scale or macro scale? And how do hybrid governance approaches change over the short, medium and long term?

Finally, a key challenge facing sustainable urban water governance scholars is how to inform and advance SUWM implementation. Using the insights developed in this paper as a starting point, key questions on integrating sustainable urban water governance research and practice have been identified: how can the projected SUWM regime attributes be developed across the regime? How do stakeholders across the water sector influence the development of these SUWM regime attributes? Lastly, what tools are available to evaluate governance capacity for SUWM?

6. Conclusion

The shift from traditional, large, centralised infrastructure to alternative and distributed technologies is widely accepted as essential for enabling more sustainable water management.

Despite significant advances in developing technical solutions to address the challenges facing urban water management, such as stormwater treatment technologies, models and assessment tools, the shift from traditional to more sustainable approaches remains slow. Investigations into SUWM implementation have revealed systemic socio-institutional barriers suggesting limited insight into enabling governance approaches. Governance literature typically identifies three ideal governance approaches: hierarchical, market and network. However, there is scholarly debate about applying these ideal approaches to complex challenges such as environmental governance, and scholars suggest hybrid approaches will more likely be observed and realistic in practice. Current scholarship in urban water governance outlines SUWM attributes which implicitly support a network governance approach for facilitating SUWM. However there remains little detailed knowledge regarding governance approaches and solutions for supporting SUWM practices. Therefore, this paper aimed to extend current scholarship by systematically drawing on tacit and experiential knowledge from expert urban water sustainability practitioners to identify likely attributes of a SUWM regime and examine the attributes for insights into sustainable urban water governance.

The SUWM regime attributes generated from practitioners were analysed using a governance framework, and the main governance findings were then compared with urban water and environmental governance literature. The results reveal hybrid governance arrangements, which comprise network and hierarchical approaches and also include market governance instruments. Practitioners suggested the hierarchical approach would potentially provide certainty for the water sector through a clear administrative framework and leadership, while the network approach would facilitate development and implementation of SUWM solutions tailored to each location. In comparison with the current urban water management scholarship, which is supportive of a network governance approach, it appears that the practitioners' hybrid governance approach provides detailed information about SUWM regime attributes and interaction of ideal governance approaches which may facilitate the practical application of network governance approaches. This research suggests that governance scholarship has underutilised tacit knowledge from practitioners, and as a result has not explored the application of the three ideal governance modes, which are often combined in practice, and that this is possibly desirable.

Based on the emergent status of sustainable urban water governance scholarship, this research was primarily exploratory, leading to the identification of future research questions, debates and critical challenges that need to be addressed. It has revealed that future research should aim to understand how different operational governance contexts influence the effective realisation of SUWM in practice. Further, research exploring the interaction among governance approaches at different spatial and temporal scales will help with understanding more or less productive tensions and synergies among these approaches. Finally a critical challenge facing sustainable urban water governance scholars is how to effectively inform SUWM practice and transform research insights on appropriate, supportive governance approaches into practical guidance to improve SUWM outcomes.

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