Capacity attributes of future urban water management regimes: projections from Australian sustainability practitioners

S. J. van de Meene, R. R. Brown and M. A. Farrelly

ABSTRACT

Transitioning to more sustainable urban water management is widely accepted as an essential societal objective. While there has been significant progress in developing technical solutions to the challenges faced, numerous barriers remain at the regime level, indicating that further investigation into the regime is required. This paper reports on a social research project aimed at identifying capacity attributes of a more sustainable urban water management regime. Attributes were identified for the administrative and regulatory framework, inter- and intra-organisational and individual regime spheres. Over 125 urban water practitioners specialising in sustainability in Sydney and Melbourne were interviewed to identify the attributes of a more sustainable regime. The attributes reveal that a sustainable urban water management regime emphasises learning, diverse policy tools and institutional arrangements, together with interaction among stakeholders and professional disciplines. The interaction is characterised by respect, trust and mutual understanding. The sustainable regime attributes are compared to the traditional regime and reveal that while progress has been made towards a sustainable regime, additional improvement is required. Attributes identified across multiple regime spheres indicate potential focus areas for capacity building programs or reform efforts to more effectively enable regime change towards sustainable urban water management.

Key words | institutional capacity assessment, institutional capacity attributes, regime, sustainable urban water management

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INTRODUCTION

The well documented challenges facing urban water management include increased population growth, uncertainty regarding climate change implications and the environmental impacts from our traditional urban water management systems. It is widely acknowledged that addressing these issues and transitioning towards more sustainable urban water management is an essential socio-political objective (e.g. Harremoës 2002; Harding 2006). Significant progress has been made in developing technical solutions to advance urban water practice across Australia and internationally (Mitchell 2006; Wong 2006; Chocat *et al.* 2007). Solutions include new technologies such as biofiltration systems, concepts such as water sensitive urban design and increased use of alternative water sources. Additionally there has been significant financial investment in urban water reform across tiers of government from the supra-national and national, state and local government levels, for example the European Water Framework Directive, the Australian National Water Initiative, the Québec Water Policy (Canada) and local government strategies and policies. However these reforms have not been as successful as anticipated (Harding 2006) and numerous institutional barriers remain (Brown & Farrelly 2009).

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A whole system transition to sustainable urban water management (SUWM) requires co-evolutionary change between the technical and management regime components (Geels 2002). The management regime comprises the individuals and organisations that innovate, develop, produce, market, distribute and use the technologies, together with the cultural meaning attached to these technologies (Geels 2002). These elements are often highly self-stabilising and therefore present significant inertia to change (Holtz *et al.* 2008). Furthermore, the literature on socio-institutional barriers indicate that urban water regimes have typically not yet developed the required capacity characteristics to enable SUWM in every day practice. Proposed attributes of such a future regime (Mitchell 2005; Mostert 2006; Pahl-Wostl 2008) suggest that it is likely to be complex, with multiple organisations sharing responsibility for water, leading to enhanced cross-sectoral interaction, a greater focus on learning, and a willingness to share information. The next step in this area of research needs to focus on identifying more specific capacity attributes of a SUWM regime to guide policy, planning and institutional capacity building. This paper aims to contribute to this knowledge gap through an empirical study of sustainability practitioners' perspectives on what they believe these capacity characteristics should be.

The regime framework of Brown *et al.* (2006) (Figure 1) is one of a number of frameworks available to investigate the regime (others include Geels 2002; Holtz *et al.* 2008). This framework was selected to guide this study because it is actor focused and therefore lends itself more readily to analysing practitioner perspectives and experiential knowledge. As shown in Figure 1, it comprises nested spheres of individuals, intra-organisational, inter-organisational and administrative and regulatory elements. The individual sphere represents the knowledge, skills, and motivation of individuals; the intra-organisational sphere refers to organisational culture, management practices and procedures; the inter-organisational sphere refers to relationships between organisations which include communication, information sharing and formal agreements. Finally, the administrative and regulatory sphere relates to the rules and incentives, from formal legal and policy instruments used through to more facilitative mechanisms (e.g. grants or tax concessions).

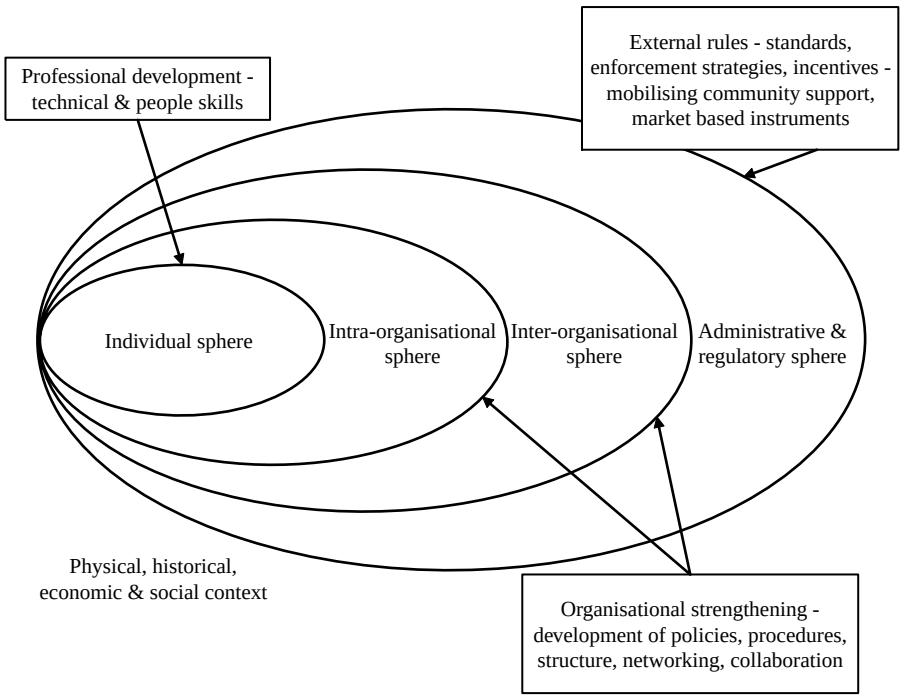

Figure 1 | Regime framework and capacity building initiatives for sustainable urban water management. source: (Brown *et al.* 2006: 5-2).

The traditional urban water management (TUWM) regime can be described as founded on the social values of public health protection, safeguarding against flood risk and supply vulnerability (Chocat *et al.* 2007), with an administrative and regulatory framework that is hierarchical and centralised (see Table 1). The TUWM regime is protected by strategies and solutions which have been long established (Niemczynowicz 1999), comprising organisations that are typically focused on optimising single urban water management streams in isolation of one another (Raadschelders 2005), with little community involvement or inter-organisational interaction (Niemczynowicz 1999). At the individual level, engineers, as the system builders and managers, are the dominant profession and this technocratic culture frames how risk is understood and addressed with regards to the design, construction and management of infrastructure systems (Harremoës 2002).

This paper aims to improve the knowledge and understanding of SUWM regime characteristics. It extends and reinterprets the results of a previous paper by the authors (van de Meene *et al.* 2009) which reported on a single case study. This study draws on the tacit knowledge of leading sustainability practitioners in the Australian urban water sector (across the metropolitan regions of Sydney and Melbourne) to assist our understanding of the attributes of sustainable urban water regimes and provide the focus needed for future reform and institutional capacity building efforts.

Table 1 | Attributes of the traditional urban water regime

Regime sphere	Attributes
Administrative & regulatory	Hierarchical, centralised
	Compliance focused
	Application of technologically optimal solutions across locations
	Minimal stakeholder involvement
Inter-organisational	Minimal inter-organisational interaction
Intra-organisational	Individual organisations focused on efficiency and optimisation of the specific urban water service
	Separate sections focused on parts of urban water services
	Stability valued
Individual	Engineers are the main profession

Niemczynowicz (1999); Harremoës (2002); Raadschelders (2005).

METHODS

The qualitative case study method was employed because it is suitable for investigating phenomena, such as regime capacity attributes, which are closely related to the broader physical, social, economic and historical context (Yin 2003). Metropolitan Sydney and Melbourne were selected as case locations because they are large Australian cities, facing global challenges that are comparable to other large developed urban areas, additionally the cases share similar urban water governance characteristics. These cities face poor waterway health due to traditional urban water management practices (e.g. Brizga *et al.* 1996; Courtenay *et al.* 2005), changed water supply and urban flooding regimes due to climate change (Hennessy *et al.* 2007) and aging infrastructure (Palaniappan *et al.* 2007), to identify just a few such challenges. Additionally, both cities are stressed by rapid population growth, with populations expected to increase by approximately 60% over the next 50 years (ABS 2008). The urban water governance arrangements of the cities are similar, although not identical; the key difference is the organisational accountability for stormwater and waterway health. In Sydney, stormwater management is the responsibility of local government, while the catchment management authorities and state government provide some advice and funding; the formal responsibility for waterway health is unclear. In Melbourne, there is a strong intergovernmental responsibility for stormwater and waterway health between local government and Melbourne Water (an agent of the state government).

Over 125 urban water professionals identified as 'sustainability leaders' from different stakeholder groups were subject to semi-structured interviews (59 from Sydney, 68 from Melbourne). The interviews focused on revealing detailed experiential knowledge about the current regime and what the practitioners perceived to be capacity attributes of a SUWM regime necessary to realise their technology and/or policy goals in practice. The semi-structured interviews enabled participants to talk in detail

about each regime sphere and identify capacity variables that were integral across more than one sphere as shown in Figure 1, 10–15 years into the future. This timeframe was determined to be appropriate through pilot interviews. Context information, of the biophysical, institutional, historical, economic and social settings in relation to urban water management in these cities, was collected and analysed from publicly available sources.

Two criteria were established to select interviewees: 1) participants should represent leading practitioners in their area of urban water practice (such as wastewater treatment and regional water supply planning), and 2) participants are identified by their colleagues as sustainability leaders within their organisations. To ensure the appropriate people were targeted, a snowballing technique was used where leaders from a range of organisational types were asked to identify their sustainability champions, who were subsequently interviewed. Participants from across both cases represented the full spectrum of key stakeholder organisations including: state government (22%), local government (17%), water management organisations (15%), land development (15%) and consulting organisations (12%), professional associations (6%), non-government organisations (NGOs) (6%), liaison (bridging) organisations (5%) and research organisations (3%). To allow for more open responses, all interviewees were assured that their opinions would remain anonymous, therefore improving the insight and validity of the research.

Data analysis followed the general qualitative coding strategy which involves generating themes, from the raw data and moving to more abstract codes through theoretical analysis (Creswell 2007). Following analysis of the cases separately, substantial similarities were identified and therefore the datasets were combined to identify overall trends and key themes. The results presented here represent the capacity attributes of a SUWM regime that received the highest level of saturation for each of the four regime spheres.

RESULTS AND DISCUSSION

The overall results of the key capacity attributes of a SUWM regime are displayed in Tables 2 to 5, including quotes from interviewees which were typical responses. The capacity attributes represent the spectrum of regime foci from 'establishing vision' (Table 2), to more effective inter-organisational communication (Table 3), through to individuals' personal qualities such as respect for other actors (Table 5).

The interviewees emphasised the co-relationship between the technical and management regimes and discussed the overall regime characteristics with this relationship in mind. The physical SUWM systems were foreseen to comprise infrastructure that integrates the three urban water streams, with the infrastructure managed holistically in a way that best fits the local biophysical, social, economic, political and institutional context (Mitchell 2006). To deliver these SUWM systems and practices, interviewees underscored the need to foster the development of new knowledge and learning processes within the intra-organisational and individual spheres. Interviewees also highlighted the need to foster a culture of creativity to ensure each solution is suitable for its context and offers multiple benefits. Participants discussed developing and implementing complex, integrated SUWM systems which are likely to require multiple disciplines and organisations that do not historically have a collaborative relationship and have also not been understood as mutually dependent. Regime characteristics that were continually emphasised include stakeholder engagement, collaborative inter-organisational relationships, inter-disciplinary organisational operation and diverse knowledge at the individual sphere. In particular interviewees highlighted how professionals needed to understand the whole system to be able to design integrated solutions. For example, how to design wastewater treatment to meet water quality standards for particular reuse applications and other technical requirements of the water supply system.

The operation and interaction of these regime capacity attributes is complex. Brown *et al.*'s (2006) framework identifies the four regime spheres as nested, meaning individuals contribute to organisational capacity which contributes to inter-organisational capacity and so on. The reverse direction of influence also occurs, for example organisational policies are likely to discourage or prohibit individual employees advocating strategies contrary to the organisation's position. Identifying links between regime

Table 2 | Administrative and regulatory sphere capacity attributes for a sustainable urban water management regime

Attribute	Qualitative example
Establish a clear vision A vision provides the long term objective to which all stakeholders contribute, as well as the framework for long term strategic planning	"if we've got some clear long term vision … and policy to back that up then that would be a really positive thing" (state government) "I'd like to think that there was a common vision and outlook across all the different departments and organisations that are involved" (water management organisation)
Develop diverse institutional arrangements that are coordinated and integrated Multiple stakeholders will have responsibility for different parts of urban water which will require coordination	"And joint responsibility and joint evaluation and joint funding and yeah, that extends to the private sector." (state government) "I'd like to see a more integrated approach, I'd like to see a more transparent approach" (state government)
Employ a mix of policy tools Different stakeholders respond best to different tools including incentives, regulation and education	"It needs to be mandated so it flows down into the smaller developments" (state government) "if you do have a sliding scale of developer contributions that are performance based, … that would provide incentives for the whole range of developers to implement their solutions." (developer)
Community contributes to SUWM in a variety of ways Community members will play a range of roles in SUWM from co-design, co-management through to very limited roles. This choice and flexibility is important	"in the future what we'll start to see again is more community based water cycles and people taking a bit more control of their own destiny." (consultant) "Certainly there needs to be increased community engagement on integrated urban water management." (local government) "I think it's more about getting the participation rate as high as possible" (developer)

Table 3 | Inter-organisational sphere capacity attributes for a sustainable urban water management regime

Attribute	Qualitative example
Organisations collaborate and cooperate The complexity of SUWM solutions cannot be achieved without recognising the mutual dependence and contribution of multiple stakeholders	"There just needs to be far better coordination, cooperation, and respect." (local government) "one of the reasons I guess for being more collaborative comes from a recognition that you can't do it on your own." (water management organisation) "there are some complexities that come from having to cooperate and collaborate but it actually, I think, provides what is ultimately a good creative tension." (water management organisation)
Organisations committed to effective and transparent communication Collaboration and cooperation requires commitment communication to share information, clarify expectations and develop shared objectives	"all these people have to be talking to each other and understanding each other." (developer) "communication is the key to 90% of these problems" (local government) "the lines of communication would be two way" (NGO)
Partner organisations have adequate resources to engage Collaboration and cooperation involves depending on other organisations. Therefore their resources (cultural, financial, technical, human resources) for participating effectively are a joint responsibility	"you need people who are really committed, who have the right kind of skills and you know, that's got to be reciprocal, there's got to be the right kind of skills at the other end, too." (state government) "ideal clients for us are the ones that have a good idea of what's achievable with a project from a technical point of view." (consultant)
Organisational relationships require mutual trust, shared objectives and understanding These characteristics form the foundation for effective collaboration and cooperation	"it's really about having a common understanding and actually developing that." (state government) "You've got to find the people that understand, understanding of each other's priorities is the other one." (NGO) "it would be trusting, it would be respectful on both parts. I think it would be open and honest" (water management organisation)

Table 4 | Intra-organisational sphere capacity attributes for a sustainable urban water management regime

Attribute	Qualitative example
Organisational leadership works to instil a culture of reflexivity Organisational leadership has significant influence and needs to provide ongoing leadership for reflexive approaches	"there needs to be 100% commitment at the highest levels within organisations to support these principles of water sensitive urban design and other general approaches to water management." (developer)
	"the people need to be open to those ideas but then you really need leadership to drive it through" (water management organisation)
Organisational departments effectively integrate with each other and external stakeholders With the importance of collaborative and cooperative relationships, organisations themselves need to effectively and positively interact with stakeholders	"a council needs to be responsive to its community needs. It needs to be accountable and transparent in its decision making." (local government)
	"the ability to be able to have really good stakeholder engagement is really the key" (water management organisation)
Organisations value and support learning Achieving SUWM will require continuous learning and application of skills and knowledge to develop solutions	"it's critical for us and I think it's critical for pretty much any organisation to have extremely effective data capture and also learning and sharing programs" (developer)
	"obviously in the consulting field you're going to need to be able to be a learning organisation" (consultant)
	"there are always new things to learn" (state government)
Organisations support interdisciplinary operation To develop integrated solutions professions or departments of the organisation will need to work together	"So the most important thing is when you set up a structure you set up the inter-linkages to make sure that the various ivory towers talk to each other." (water management organisation)
	"I think within organisations it's got to be a greater inter-disciplinary working environment." (state government)

capacity attributes beyond the nested relationships of the regime framework is currently tentative, although some links can be intuitively identified. Drawing on this, and the nested regime sphere, it can be proposed that an individual with a systems view will understand the need for and be open to engaging with others across their organisation and also outside of their organisation to implement projects. This will clearly affect the interdisciplinary operation of the organisation and inter-organisational relationships. Additionally, they are more likely to understand the range of policy tools available and target their project to align with the most appropriate policy tool.

Comparison of sustainable, traditional and contemporary regime attributes

Overall the sustainable urban water management regime capacity attributes identified by interviewees (Tables 2 to 5) appear to be significantly different (across all capacity spheres) to the traditional regime (Table 1). In the administrative and regulatory sphere, the SUWM capacity attributes are realised through community involvement and diverse policy tools whereas central control and minimal stakeholder involvement characterise the traditional approach. Similarly, the minimal stakeholder involvement of the TUWM regime in the inter-organisational sphere contrasts substantially with the inter-organisational collaboration and cooperation emphasised for SUWM. Within the intra-organisational sphere organisational learning and reflexivity are SUWM capacity attributes, while the TUWM regimes privilege the use of stable and inert solutions. Finally, in a SUWM regime, the individual sphere includes a large number of disciplinary knowledge bases underpinned by a systems perspective of the technical and management regimes. This increased complexity in the individual sphere directly contrasts to the mono-disciplinary dominance of engineers as the core TUWM profession.

While from today's perspective, the SUWM regime capacity attributes appear far more complex than those of

Table 5 | Individual sphere capacity attributes for a sustainable urban water management regime

Attribute	Qualitative example
Diverse knowledge is valued and broadly held by individuals Professionals need broad knowledge to address the complexity of SUWM solutions	"the next wave of people that come through that industry and start to make their mark will be educators, communicators, marketers … " (developer) "So if you want to be successful you're going to have to operate with diversity, so they will have to be, you know, you'll want an economist, someone who's got an economic degree and an engineering degree." (water management organisation)
Individuals respect others' points of view SUWM solutions will require different stakeholders to be engaged and interact with respect for differences	"people have to be more willing to listen to what other people have got to say and take those things on board and try and build on what they're saying and work with that rather than resist that." (state government) "there's a real need for individuals who are genuinely and prepared … to engage in it in a multi-disciplinary way." (state government)
Individuals have a systems perspective of the urban water management sector Urban water professionals need to have a systems view to understand how they, different organisations, professions and communities contribute to SUWM	"You need to have a good view across the scientific, technical, the triple bottom line approach to things. … You need to know about how that works within systems as well, so how, say a water business fits into the scheme of things in terms of government and other agencies, regulatory agencies and things like that." (state government) "we need people who understand and implement full systems thinking to water management." (developer)
Improving society through SUWM is a key value and principle for urban water professionals An individual's values contribute to their motivation for finding solutions to urban water problems	"they'd be very passionate and excited and motivated and really keen to make a difference" (water management organisation) "You really do need somebody who's passionate enough to push it through the obstacles." (developer) "You need to be motivated … open minded and also to have a sort of pioneering attitude I think" (local government)

the TWUM regime, there were four common characteristics that permeated all regime spheres. These were collaboration and inter-disciplinarity, leadership, innovation and a common strategic vision. Each characteristic was expressed slightly differently across the regime spheres. For example, leadership was discussed at the administrative and regulatory sphere in the context of political leadership while at the inter-organisational level interviewees expressed the need for actors to effect change through leadership and at the intra-organisational sphere leaders were important in influencing organisational culture change. Interestingly these characteristics are mainly 'soft' or informal attributes (Healey 2006), such as innovation which is considered a cultural attribute at the intra-organisational sphere and a personal quality of thinking laterally at the individual sphere. A few attributes, such as agreements or memoranda of understanding between organisations, were highlighted as structural ('hard') attributes. The informal nature of most of these permeating characteristics poses significant challenges to realising these capacities because soft attributes are widely recognised as being substantially more difficult to develop than hard attributes (Healey 2006). A structural attribute can be changed through enacting laws or re-structuring organisations, while informal attributes involve influencing values and social norms.

Despite these challenges, some evidence of regime change was observed during the research. The interviews and policy documents revealed that the current urban water management regimes of Sydney and Melbourne have moved somewhat beyond the TUWM regime. For example, partnerships between stakeholders, such as local government, the private sector and Sydney Water Corporation have been formed to support innovations such as sewer mining at Beverley Park in the Kogarah Council area (Sydney Water 2008). Additionally, a number of different stakeholder organisations appear to be undergoing some changes that integrate some of the identified sustainability capacity attributes, as these interviewees reflected:

"I've only been here, well almost three years and there's been an enormous change in people's views on different things which is, I mean water is probably the best example. They've gone from a water sensitive urban design is something we have to do to, yeah that's just part of the development process." (Developer).

if I can just reflect more on the last five or ten years as a starting point. When I started, this company was very much a traditional engineering firm that basically employed engineers or the occasional scientist. Now we're a company of professionals, architects, scientists, management consultants. So there's been a broadening of the way we think and the type of projects that we've been trying to get involved in and services that we offer. (Consultant).

Furthermore, recent policy documents for Sydney (*2006 Metropolitan Water Plan* (NSW Government 2006)) and Melbourne (*Central Region Sustainable Water Strategy* (DSE 2006)) provide policy rhetoric and support indicative of some of the SUWM regime capacity attributes. Generally they are starting to emphasise the need for water management planning, highlighting the importance of providing water for human and environmental uses and prioritising learning through investing in research into climate change impacts. Not withstanding this, a significant majority of the interviewees emphasised the inertia of the current regime and discussed their disappointment with the announcement of new and massive infrastructure investments seen as traditional solutions. This included the construction of a desalination plant to provide additional water supply for Melbourne in 2007 (DSE 2007) and a desalination plant is also under construction for Sydney at Kurnell on the south east coast of the metropolitan area (NSW Government 2009).

While the current regimes of Sydney and Melbourne appear to be changing, this at present seems limited to some shifts at the intra- and inter-organisational regime spheres. Key areas in the current regime identified by interviewees as different from the sustainable regime were often expressed in terms of frustrations at the relationship level between various stakeholders. Issues relating to a lack of common organisational drivers and operating constraints, and a lack of trust were considered as exacerbating this frustration and retarding progress towards SUWM. Clearly there is significant progress to be made before SUWM is fully enabled in the case locations.

CONCLUSIONS

The challenge of transitioning to SUWM is substantial and significant progress has been made in the scientific and technological fields. Socio-institutional barriers remain and there is little known about the regime capacity attributes that will proactively enable SUWM. This paper has contributed to this knowledge gap by identifying capacity attributes for a SUWM regime, generated through two Australian case studies involving 127 leading urban water practitioners.

The results reveal that the capacity attributes are likely to be significantly different from the TUWM regime, particularly with the shift to more collaborative inter-organisational relationships, inter-disciplinary operation and the systemic perspective of urban water professionals. While there has been some advancement in regime change in the individual cities towards enabling SUWM, further progress is required. The attributes of innovation, leadership, collaboration and a shared strategic vision were identified as common characteristics across the four regime spheres and provide a potential focus for concentrating capacity building programs or reform efforts. However these informal or 'soft' capacity qualities are generally considered difficult to develop and require further investigation into the strategies that most effectively support their development. Overall, the difference between the traditional and the sustainable urban water management regime attributes highlighted here suggests there may need to be a systemic shift in the way urban water is governed.

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