

Capturing different perspectives on integrated urban water management issues

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Abstract

Integrated urban water management (IUWM) involves a complex web of organisational interactions. Each organisation has its own priorities and unique perceptions of problems. This study offers two contributions to the research on this topic. First, 14 major issues in IUWM infrastructure planning were determined through industry consultation and a literature review. Second, an industry survey investigated which issues were most important to which organisations, and results show significant differences across organisational types. While there were significant differences between organisational types, the survey found that across the entire sector, most issues were ranked similarly in importance with two clear outliers, collaboration and integration being clearly the most important and post-evaluation the least. If the industry can develop an understanding of these differences in organisational perspectives, it will provide a starting point for better collaboration in integrated water infrastructure planning processes.

Keywords: Barriers; Enabling environment; Integrated urban water management; Water infrastructure planning

Introduction

Integrated urban water management

Under the traditional water management paradigm water infrastructure augmentations have generally been planned in a centralised and reactive manner. Water supply, sewerage, and drainage systems are managed by independent departments and/or organisations with specified service targets (CSIRO, 2010; Mukheibir *et al.*, 2014). This has allowed water infrastructure planners to monitor specific issues and upgrade the system reactively as required, creating a process that is relatively straightforward from a planning and governance perspective (Furlong *et al.*, 2016a).

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In recent decades, population increases, urbanisation, changing environmental and climatic conditions, and increased community concern for environmental factors are causing increased pressure on existing water infrastructure systems (Connor *et al.*, 2017). There is an ever growing understanding within public water organisations globally that these issues cannot be addressed efficiently with the traditional water planning approach of segregated services and reactive planning (Brown, 2005; Marlow *et al.*, 2013). At its heart the emerging integrated urban water management (IUWM) paradigm aims to integrate the planning of infrastructure portfolios across all water services (Global Water Partnership, 2012). Proactive and systematic, as opposed to reactive and disorderly, planning in order to create the best possible social, environmental, and economic outcomes for the entire community is also central to this paradigm (Mitchell, 2006; Closas *et al.*, 2012).

Corresponding to the shift in management and planning style promoted by IUWM, there are generally associated effects on physical water infrastructure outcomes. The practical ‘on-the-ground’ outcomes of the adoption of the IUWM paradigm in Australia have been the implementation of ‘integrated’ water infrastructure projects which are typically involving wastewater reuse, stormwater quality/quantity management, and/or stormwater reuse (Hunt *et al.*, 2006; Khouri, 2006; Institute of Sustainable Futures, 2013). Alternative water source projects such as recycled wastewater and stormwater provide benefits to multiple services and are seen by many as a valuable addition to the water infrastructure portfolios (Wong & Brown, 2009).

The concept of IUWM is closely linked to many other concepts including water sensitive urban design (WSUD), sustainable urban drainage systems (SUDs), and low impact development (LID) (Fletcher *et al.*, 2015; Mathews *et al.*, 2015; Furlong *et al.*, 2017b), as well as climate change adaptation and nature based solutions (Mees & Driessen, 2011). However, IUWM as a concept specifically alludes to the broader governance, institutional and governance issues that are inherent to the implementation of all of these associated concepts (Furlong *et al.*, 2016c).

Understanding stakeholder priorities to support IUWM delivery

As the water management field is rooted in the tradition of engineering, water infrastructure planners have a tendency to treat planning processes as relatively straightforward and linear, implying that an expert-driven, centralised and top-down planning model used by many engineering-related sectors would be appropriate, even for the more innovative ‘integrated’ projects (Mukheibir *et al.*, 2014; Furlong *et al.*, 2016b). However, in practice, the planning of this infrastructure has proven to be complex on multiple levels of planning and implementation (Bell, 2015). Some of the main reasons for this complexity revolve around the ‘institutional maze’ and competing objectives of water authorities, bulk water suppliers, planning agencies and regulators (Brown, 2005; Institute of Sustainable Futures, 2013). Other reasons relate to valuation of benefits, timing issues and risk assessment methods (Dobbie & Brown, 2013; Marsden Jacob Associates, 2013; Turner *et al.*, 2016).

Research has found that IUWM infrastructure projects often reach a stage of business case development, but then come up against challenges which result in the cancellation, or long-term postponement of their implementation (Furlong *et al.*, 2017a). A significant proportion of these challenges is related to the relationships between the various organisations involved in IUWM, and also with the community stakeholders. Examples have been found of projects which have been cancelled due to excessive stakeholder demands and a lack of trust between organisations (Furlong *et al.*, 2016a). Also, it has been found that in some cases stakeholder consultation is not well targeted and results in a view from

stakeholders that it has involved wasted resources (Furlong et al., 2016c). Guthrie et al. (2016) include many examples of engagement performing poorly and actually resulting in greater distrust from stakeholders, because the methods were not targeted to specific stakeholders with clear intent prior to the engagement.

For these reasons, there is significant value in determining which organisations involved in IUWM are interested in particular components of (or issues relating to) IUWM planning, so that stakeholder consultation can be better targeted, resulting in a higher proportion of IUWM projects being successfully implemented, and a higher degree of satisfaction within planning participants.

Melbourne, the capital city of the south-eastern Australian state of Victoria, is progressive within the IUWM space (Roy et al., 2008; Green, 2014; Furlong et al., 2016c) and accordingly, has been selected as the case study region for this research. In the methodology there is a detailed description of the major organisations that are involved in IUWM within Melbourne in order to give the background to the subsequent analysis.

Planning phases

Different issues occur in different phases of water infrastructure planning (that is, from when an infrastructure challenge or project is first considered until infrastructure solutions are physically built and beyond). Therefore, it is useful to consider infrastructure planning as something that occurs across a number of generic phases/stages. Lichfield et al. (1975) argued that a planning process can be split into two different functions: decision analysis and decision taking. The decision analysers are the project team, who complete analysis and offer infrastructure recommendations to the decision takers for final approval. Decision takers act as either internal or external regulators who review the decision analysis and have power to accept or modify planning recommendations. While in practice these two functions are sometimes completed by the same actors, the authors believe it is important to make this delineation. Further, CSIRO (2010) highlighted the importance of policy setting as something which affects later infrastructure planning processes. The Lichfield and CSIRO frameworks were chosen because they are considered by the authors to be major step changes in infrastructure planning methodologies.

With this previous research in mind, for the purposes of this paper, the authors propose three major infrastructure planning phases as: (1) Policy setting, (2) Decision analysis, and (3) Decision taking. Both the Lichfield and CSIRO methodologies do not indicate how much time or resources are appropriate to spend in the different phases as this should be specific to the context. However, in general, the higher level the strategy the more time and resources should be spent on the policy setting and decision analysis phases, when getting closer to on ground impacts, more time and resources should be spent on decision taking. This conceptual breakdown of the IUWM infrastructure planning process is shown in Figure 1.

Aims of this paper

Although significant research has been conducted into issues affecting IUWM implementation, no previous research has investigated the relative importance of these issues in the eyes of different institutions. This research therefore seeks to provide initial exploration of this issue, in order to facilitate more detailed research on this topic in the future. A tentative hypothesis is proposed that: institutions are most concerned about the issues that they directly manage.

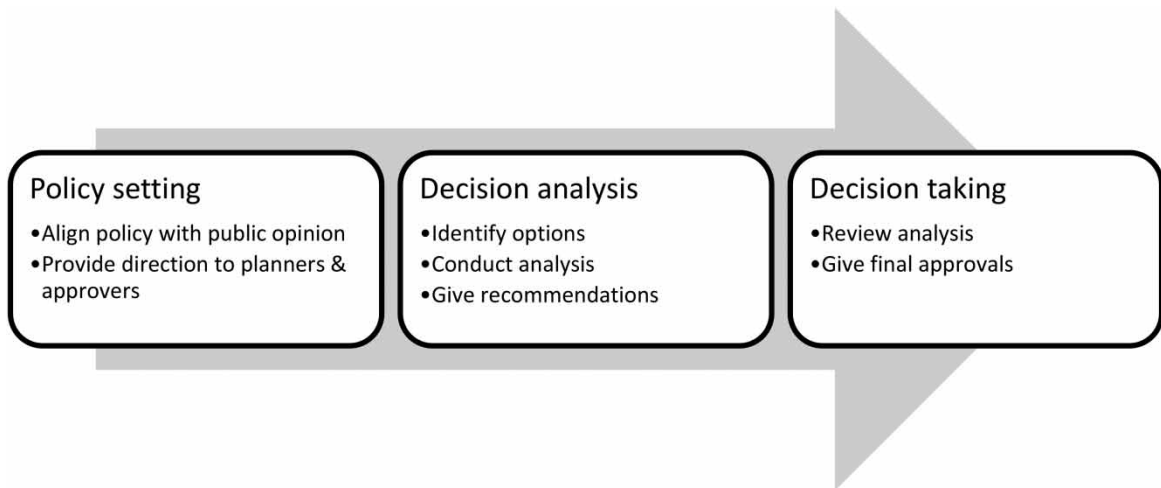


Fig. 1. Proposed delineation between the infrastructure planning phases of Policy setting, Decision analysis, and Decision taking.

Using an extensive industry consultation process, this study aims to build on previous research on IUWM by:

1. creating a comprehensive list of IUWM infrastructure planning issues, including those already identified in the literature and categorising these issues into the planning phases of policy setting, decision analysis, and decision taking;
2. understanding which issues are of a particular concern to which organisational types and how this can be leveraged to improve engagement outcomes.

This research has utilised Melbourne as the study location and IUWM infrastructure planning as the process being investigated. The specific results of this research are unique to IUWM planning within Melbourne, although the implications, principles and methodology behind this work extend to any infrastructure planning process which requires engagement with a variety of stakeholder types.

Method

Overall there were two main objectives of this study, firstly, to develop a list of the issues affecting IUWM planning and then, secondly, to determine the importance of each of these to different organisations.

The first objective involved collection of data through consultation with a group of water industry experts. A consultation group of 19 water planning experts, from a variety of academic, public and private organisations, was compiled through a combination of two techniques. The first technique, known as Snowball Sampling, uses expert's recommendations to find additional experts for consultation. The second sampling technique used was Maximal Variation Sampling, where the selection process is steered by a desire to ensure a diversity of expert backgrounds (Baumgartner & Pahl-Wostl, 2013). Consideration was given to what types of organisations had not already been consulted and seeking expert recommendations for contacts from suitable organisations. After the interview, meeting minutes were reviewed by each expert for corroboration, and then analysed to generate recurring themes and issues.

The list of issues that was generated was then compared with six other well regarded lists of issues affecting IUWM from existing literature. Some of these issues were negatively referred to as barriers, or major challenges, positively as critical success factors, or neutrally as thematic lessons or relevant issues. These lists were collated and compared in order to determine areas of alignment and overlap and a truth-table was created to demonstrate the interfaces between each. From this exercise a total of 14 issues were selected for use in the following research stage. These issues were then categorised according to the planning phases; as a result a list was created that can form a framework for understanding IUWM challenges across the infrastructure planning pipeline.

A survey was then conducted to determine the importance of each of the issues according to the opinions of industry experts. In total, 43 usable responses were received. The survey gave a description of each of the 14 issues identified and then asked each expert to rank them in order from one to 14, one being the most important and 14 being the least important.

Once the survey results were collected, an analysis could be made to determine (1) the level of importance of each issue overall and (2) which issues certain organisations placed a greater level of importance compared with other organisations.

Table 1 provides descriptions of the organisation types that were included in the analysis. According to the Australian Water Association's *State of the Water Sector Report*, these organisation types make up 84% of the Australian water sector (Australian Water Association, 2015). Following the survey, the authors decided that there were not enough responses from research organisations, therefore responses from researchers were considered in the 'average' responses but results for the research organisations individually have not been presented.

The specific organisations that were engaged with, either in the consultation group or the survey, are included in the Acknowledgements. This group included all the major water organisations in Melbourne and several local government agencies.

Following the survey, analysis was completed to determine the average importance of each issue and the importance each organisation type placed on each issue. The authors compared the number of survey responses from each organisation type with the Australian Water Association's *State of the Water Sector Report* (Australian Water Association, 2015). While this report did not use the same organisation type breakdown, the response percentages were similar and therefore it is most justifiable to calculate the average by giving equal weighting to each of the survey respondents. For example, the local government responses (six responses) were given six-thirteenths the value of the bulk suppliers (13 responses).

Table 1. Organisation types considered in study.

Organisation type label	Description	Number in consultation group	Number completed survey
Bulk supplier	Manager of bulk water supplies and bulk sewerage treatment	5	13
Consultant	A consultant in the area of water planning	3	8
Government body	Government bodies regulating the areas of water, environment, health or land use planning	3	8
Local government	A local government agency (council)	1	6
Retailer	Customer interface for water and sewerage	5	6
Research	Academics involved with water research centres and/or universities	2	2

In order to demonstrate the differences in opinions between organisation types, this study has produced spider charts that show the difference between the average ranking for each organisation type and overall for all respondents.

Melbourne stakeholders in the study

Melbourne has many different water-related organisations, most of which have additional responsibilities outside of water services, for example councils also manage roads, waste collection, and many other services. Melbourne has four public water organisations: Melbourne Water is the bulk supplier for water and sewerage services, then City West Water, Yarra Valley Water, and South East Water are all retailers, providing water and sewerage services to the public in their jurisdictions. There are also 32 councils working across many services for their area and state government regulators working across the state in the sectors of health, finance, etc.

Melbourne Water manages the large infrastructure, such as potable water dams and the two main sewerage treatment plants. They treat and sell the potable water to retailers who then resell and distribute to customers. Sewerage is managed in a similar way, with the retailers acting as the customer interface and delivering the sewage to Melbourne Water's large sewers and treatment plants. Stormwater is managed separately, with councils managing local parks and small drains, and Melbourne Water responsible for large drainage infrastructure, with a catchment of more than 60 ha (including many wetlands).

To add to this complexity, there are several government departments and statutory bodies that are stakeholders in Melbourne's water sector. The Department of Environment, Land, Water and Planning is concerned with water and land use planning, and provides policy direction to Melbourne Water and the water retailers. Additionally, there is the Department of Health and Human Services (regulatory role in human health), the Department of Treasury and Finance (regulatory role in spending for large infrastructure projects), the Environmental Protection Authority (controls licenses to all stormwater and treated sewage discharges), and the Victorian Planning Authority (responsible for co-ordinating and approving precinct structure plans).

Finally, there are also a number of private organisations included in the water sector. The largest two groups of these would be consultants that are contracted by public water organisations and developers that build a great deal of the infrastructure in green and brown field developments. Consultants have been engaged with during this study to give their opinions; however, the researchers were unable to contact developers but have been consistently told that the Victorian Planning Authority could be considered an appropriate representative for developers.

Due to the large number of potential stakeholders and responsible organisations each with different responsibilities and strategic objectives, by necessity Melbourne has developed into a world leader in IUWM planning and thinking. While Melbourne is a relatively well planned city, becoming an IUWM leader has been driven by multiple major governance reforms and environmental drivers, most notably the 'Millennium Drought' (Goldsmith *et al.*, 2008; Furlong *et al.*, 2016c). As such Melbourne is often the focus of IUWM research and case studies and therefore is appropriate as the base of this study.

The general community and community groups are not typically directly involved in IUWM planning processes in Melbourne (Guthrie *et al.*, 2016). In the majority of cases, local government are considered to be an appropriate proxy for the community. In Melbourne, non-governmental organisations (NGOs) do not play a significant role in the planning of water infrastructure, and so have not been directly considered in this analysis. However, in other countries, it is likely that NGOs would be another important group to address.

Results and discussion

Identifying IUWM planning issues

Substantial research has been conducted into the various issues that obstruct IUWM planning. These issues can be discussed in a positive way as aspects that, when considered, improve the likelihood of successful IUWM planning, in relation to ‘critical success factors’ (Farrelly & Brown, 2011), or ‘bridges’ (Sendzimir *et al.*, 2008). They can also be discussed in a negative way as aspects that will be significant inhibitors to IUWM planning if not considered by the process including ‘major challenges’ (Mukheibir *et al.*, 2014), ‘key aspects of resistance’ (Farrelly & Brown, 2011), ‘planning problems’ (Briassoulis, 2004), or ‘gaps’ (OECD, 2011). There are also terms used that are neither positive nor negative such as ‘thematic lessons’ (Markey *et al.*, 2008), and ‘relevant issues’ (Rauch *et al.*, 2005). This study has grouped them all together and given them the non-judgemental name of ‘issues’.

The first consultation stage of the research involved consulting with 19 experts to determine a list of issues affecting IUWM planning, as seen by the industry experts. The industry experts mentioned 12 issues that impacted the success of IUWM planning and these were then sorted by the authors according to where in the planning phases the issue would be most relevant. These issues are shown in planning phase order in Table 2, column 2.

The authors then cross-referenced this list with ‘issues’ found in six highly-cited journal papers about barriers to IUWM, to create a succinct list of issues. A ‘truth-table’ was then developed to compare each of the lists with one another and to determine if any extra issues needed to be included, this truth-table is shown in Table 2.

The six articles are shown below (in addition to the list developed through consultation), including the name used by those authors:

1. Twelve issues and themes generated from interviews with 19 water planning experts (the current investigation).
2. Twelve barrier types found by Brown & Farrelly (2009).
3. Nine relevant issues found by Rauch *et al.* (2005).
4. Ten major challenges found by Mukheibir *et al.* (2014).
5. Twenty critical success factors and key aspects of resistance found by Farrelly & Brown (2011).
6. Ten strategic planning barriers found by Wang *et al.* (2007).
7. Five water governance gaps found by the OECD (2011).

It is important to note that no one list, including the one that the researchers created through industry consultation, included all the issues which were eventually identified. Therefore, the resulting final list shown in Table 2 is an extension on previous research.

IUWM planning issues in more detail

The succinct list of ‘issues’ that were identified earlier were then broken down into three categories according to relevant IUWM infrastructure planning phase. As explained, in the introduction, the researchers have adopted the categories of policy setting, decision analysis and decision taking. The

Table 2. Collated list of IUWM issues in comparison to those identified through consultation and six lists from the literature.

Final framework	Industry consultation	Brown & Farrelly (2009)	Rauch <i>et al.</i> (2005)	Mukheibir <i>et al.</i> (2014)	Farrelly & Brown (2011)	Wang <i>et al.</i> (2007)	OECD (2011)
1. Changing context & drivers	Discussed in consultation	Discussed regarding lack of political & public will	Discussed regarding local political support and commitment to communities	Discussed regarding no clear drivers or sense of urgency and a lack of leadership and political will	Discussed regarding iconic project status	Not discussed	Discussed regarding a policy gap
2. Scales of planning	Discussed in consultation	Not discussed	Not discussed	Not discussed	Not discussed	Discussed regarding the size of business	Not discussed
3. Planning pipeline	Discussed in consultation	Discussed regarding no long-term vision, strategy	Not discussed	Discussed regarding planning and collaboration	Not discussed	Discussed regarding inadequate knowledge of planning processes	Not discussed
4. Collaboration & integration	Discussed in consultation	Discussed regarding uncoordinated institutional framework and poor communication	Discussed regarding organisational structures and norms, transdisciplinarity, and institutional capacity	Discussed regarding planning and collaboration, culture and capacity, and poor systems thinking and integration across water	Discussed regarding continuity of individuals from stakeholder representatives	Discussed regarding the reluctance to share strategic ideas and the type of industry	Discussed regarding the administrative gap
5. Public/private interface	Discussed in consultation	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
6. Appropriate level of engagement	Discussed in consultation	Discussed regarding limited community engagement, empowerment & participation	Discussed regarding participation methodologies used were largely unsuitable for the target communities	Discussed regarding citizen engagement	Discussed regarding critical mass of early key stakeholder buy-in, enrolling extended stakeholders in vision, lack of broad stakeholder engagement, and subversive stakeholder tactics	Not discussed	Not discussed
7. Option evaluation	Discussed in consultation	Discussed regarding technocratic path dependencies	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
8. Technical capabilities of planners	Not discussed in consultation	Discussed regarding lack of information, knowledge and understanding	Discussed regarding modelling, professional norms and practices were not adequate, and the capacities of communities to participate were overestimated	Discussed regarding uncoordinated methods and processes for data collection	Discussed regarding 'over-engineering' the project, the capacity and skills of industry practitioners, the unexpected technical feasibility of outcomes, and persistent and dedicated individuals	Discussed regarding lack of expertise and time and employees & others	Discussed regarding the capacity gap
9. Risk management	Discussed in consultation	Not discussed	Not discussed	Not discussed	Discussed regarding the mechanisms for sharing risk and government risk aversion	Discussed regarding environmental uncertainty/turbulence	Not discussed

(Continued.)

Table 2. (Continued.)

Final framework	Industry consultation	Brown & Farrelly (2009)	Rauch <i>et al.</i> (2005)	Mukheibir <i>et al.</i> (2014)	Farrelly & Brown (2011)	Wang <i>et al.</i> (2007)	OECD (2011)
10. Cost and responsibility apportionment	Discussed in consultation	Discussed regarding unclear, fragmented roles & responsibilities and poor organisational commitment	Not discussed	Discussed regarding the lack of an agreed unifying vision	Discussed regarding the mechanisms for defining roles and responsibilities, the distribution of costs, and the unclear future management responsibilities	Not discussed	Discussed regarding the information and accountability gaps
11. Appropriate level of regulation	Discussed in consultation	Discussed regarding the limits of regulatory framework	Not discussed	Discussed regarding legislation and regulation	Discussed regarding regulatory approval(s)	Not discussed	Not discussed
12. Funding and finance	Discussed in consultation	Discussed regarding insufficient resources	Not discussed	Discussed regarding economics and finance	Discussed regarding external funding	Not discussed	Discussed regarding the funding gap
13. Decision implementation	Discussed in consultation	Not discussed	Not discussed	Not discussed	Discussed regarding sustaining stakeholder commitment and clear and unwilling stakeholder partners	Discussed regarding the internal implementation barriers and business life-cycle/stage of development	Not discussed
14. Post-evaluation	Not discussed in consultation	Discussed regarding little or no monitoring and evaluation	Not discussed	Not discussed	Approaching the project as a learning opportunity	Not discussed	Not discussed

final list of 14 issues are shown in Table 3 with issue descriptions. Each issue is explained in greater detail in this section.

Changing context and drivers. Many of the experts raised the issue of ‘changing context and drivers’ in relation to the fact that while water planning is being done, the outside world and its priorities do not remain static. Factors outside of the control of planners such as government (election cycles), regulatory, environmental, or public opinion situations may undergo changes which have a serious impact on planning outcomes. The consulted experts described specific examples of water projects which have not been built, or were not utilised as expected, because of these factors which are entirely external to the planning process. In order to plan effectively in the modern world, planners must begin to consider these issues as relevant to the infrastructure planning process (for detailed discussion on this issue, see Furlong et al., 2016b).

Scales of planning. Scales of planning was discussed extensively by the consulted experts working in government bodies. The general idea being that in reality planning is done on multiple scales, by different organisations, but should not be conducted entirely independently from other scales. Rather, high

Table 3. Issues separated into categories with their descriptions.

Issue	Description
<i>Policy setting</i>	
Changing context & drivers	Accounting for constantly shifting context and drivers
Scales of planning	Understanding planning across multiple scales, with larger scale planning informing the direction of smaller scale planning
Planning pipeline	Ensuring that built infrastructure projects are preceded by and informed by infrastructure strategies
Collaboration & integration	Organisations in the water industry should integrate their planning
<i>Decision analysis</i>	
Public/private interface	Understanding the different priorities of public and private organisations, in particular with developers
Appropriate level of engagement	The community and stakeholders must have the opportunity to contribute to the planning process, but engagement must be efficient and effective
Option evaluation	Justifiable assessment of both market and non-market impacts of potential options in a transparent manner to determine realistic planning recommendations
Technical capabilities of planners	It is important to ensure that there are adequate technical expertise and capacity of the individuals involved
Risk management	Ensuring that risk assessments are comprehensive and are considered in option evaluation
<i>Decision taking</i>	
Funding and finance	Includes how much funding is available for planning recommendations and where it can be collected from, this can be either a barrier (lack of funding) or enabler (grants)
Cost and responsibility apportionment	Costs and responsibility for planning recommendations must be apportioned and agreed upon by all parties
Appropriate level of regulation	Ensuring level of regulation for planning recommendations is appropriate
Decision implementation	Ensuring that planning recommendations are implemented if they are realistic and justified
Post-evaluation	Evaluation of the planning process to maximise learning

Note: Technical capabilities of planners and Post-evaluation have been bolded to indicate they were found only in the literature.

level and large-scale infrastructure planning processes should set the directions for smaller scales of infrastructure planning. For example decisions around water supply projects at the city-scale should inform decisions around water supply projects at the development-scale (for detailed discussion on this issue, see [Furlong et al., 2016a](#)).

Planning pipeline. Similarly to scales of planning, the issue of the planning pipeline was discussed, not in relation to different geographical scales of planning, but in relation to chronological phases that an individual planning process goes through. Experts believed that ideally infrastructure planning (at any given scale) should include the initial setting of clear policies and objectives, holistic analysis of options, and selection of the best option, before specific infrastructure projects are designed, approved (decision taking) and implemented.

Collaboration and integration. Unsurprisingly, given the popularity of the concept of integration (a core premise of IUWM), this was raised as an issue by a number of experts. Integration here meaning both within and between organisations, is widely agreed to be a crucial element in effective water planning.

Public/private interface. The interface between public and private planning was discussed mainly in relation to the idea that in some cases it is private companies, such as land developers, or large business owners, who fund and make decisions on water infrastructure in particular areas. In these situations, the planning interface between the private and public organisations needs to be well managed. Private companies often have different objectives and priorities to public companies, tending not to value externalities (such as environmental or social benefits) as highly as their financial bottom line ([Brookes et al., 2011](#)).

Appropriate level of engagement. The issue of community engagement was recognised as an important issue by many experts. Although, contrary to what was expected, engagement was often discussed in relation to the idea that there is such a thing as ‘too much’ ([Furlong et al., 2016c](#)). This opinion was held strongly by some experts who had been involved with particular projects that had been stopped or slowed due to over-engagement with community with either a ‘not in my backyard’ attitude or uniformed bias that could not be swayed by evidence (e.g. believing that recycled water was unsafe and unsuitable for all uses). One expert also gave an example where feedback could not be incorporated into planning outcomes, leaving the community feeling the engagement was disingenuous and less empowered. While every expert stressed the importance of engagement as they are mandated to act in the best interests of the public, the consulted experts believed that community engagement also needs to be appropriately designed so as to not overly delay the planning process, reduce community empowerment by not incorporating expressed community concerns, or manipulate its outcomes by focusing on minor complaints rather than major objectives.

Option evaluation. Option assessment and valuation is a major issue within Melbourne’s water industry, as there is still little agreement on the best way to determine preferred options and calculate the value of externalities. If the valuations for non-market impacts are too high then there is a risk of expensive environmental and social projects being built, increasing domestic water bills. The discussion on this topic revolved around two key points, firstly the hierarchy of valuation from noting but not considering externalities, or non-market values being considered but not valued, through to full inclusion in cost

benefit analysis. Secondly a lack of confidence in the decision support systems being used sometimes causes the calculated ‘preferred option’ to not be adopted with planners opting for more financially conservative options for inclusion in the infrastructure portfolio (Furlong et al., 2017b).

Technical capabilities of planners. The technical capabilities of planners was not raised during the consultation but added to the list of issues from the literature review. The literature noted that many organisations lacked appropriate resources required to conduct effective infrastructure planning processes, in terms of the capacity of staff. If this was not addressed, the planning processes would often fail because of the inexperience and lack of understanding of the people working on them.

Risk management. Risk management issues were mentioned by a number of the consulted experts. These discussions were mainly focused around the need to consider a wider variety of risks than are traditionally considered when evaluating options. Traditional risks in an engineering based field like public water management usually revolve around public health, ensuring adequate supply, basic financial risks, etc. In recent times a growing number of water infrastructure projects have highlighted the need to consider other risks such as climatic, political, regulatory, and growth and demand forecast risks (for detailed discussion on this issue, see Furlong et al., 2017a).

Funding and finance. Funding and finance is a very important issue currently in the Australian water sector. The main way that this issue was discussed by the experts was regarding how the financing is often out of the control of planners (separation between decision analysis and decision taking as explained earlier), especially with large projects where politics becomes involved. Some examples were given of projects that were assessed to be net present value (NPV) positive, but were not implemented as the financial regulator would not permit the capital expenditure. Another issue that was raised was the idea of implemented projects that are not NPV positive, that have only been constructed because of being allocated government grants. These funding arrangements and the politics that are associated with them, distort the outcomes of planning processes, resulting in large projects only going ahead if they receive political support. While some experts were disgruntled because they had projects that did not get supported by government and therefore not implemented, the majority of the experts reflected on this positively. Projects that brought social or environmental benefits were more likely to be implemented even if the financial analysis did not stack up (Guthrie et al., 2016; Furlong et al., 2017a).

Cost and responsibility apportionment. The consulted experts considered apportionment of cost and responsibility a very important area because getting this right ensures that costs are fairly distributed to the organisations that receive the benefits. It is also important that these organisations reach agreement over who pays and is responsible before an option is recommended for implementation. The experts mentioned several occasions where planners have selected a preferred option, expecting the construction and/or maintenance costs to be paid for by others, without first gaining agreement (Guthrie et al., 2016).

Appropriate level of regulation. Several experts noted that regulations are too stringent in some aspects of infrastructure planning and too relaxed in others. One example of regulation that is seen by some to be too relaxed is that in Melbourne only new large-scale developments are subject to

stormwater regulations (requirements for stormwater management infrastructure such as wetlands), while the degradation of the watercourses around Melbourne is continued through urban densification. An example of a regulation that may be too stringent is the difficulty obtaining approval from financial and health regulators for projects that provide overall community benefits (Furlong *et al.*, 2017a).

Decision implementation. There was a strong perception from some experts that decision implementation (after approval is received) has not always been adequately considered during past planning processes. Experts mentioned several recent high level planning recommendations that were unrealistic and very unlikely to be implemented. In these situations, the time, effort and money that has been expended in the planning has essentially been wasted, as there have been no practical benefits achieved for the community.

Post-evaluation. Like the technical capabilities of planners, post-evaluation was only added to the list of issues after the literature review. The literature noted that planning processes were rarely viewed as a learning opportunity and that often little or no monitoring was undertaken. Parallel case study research by the authors of this study has sought to directly address this issue (Furlong *et al.*, 2016a; Guthrie *et al.*, 2016).

Survey results on importance of each issue

The survey results from 43 participants were tallied and each issue given an average ranking across all the respondents. In Table 4, the lower the value is, the higher the perceived importance of the issue. It should be noted that these ratings could be skewed by what is current practice, for example a rating of high importance may be saying that the respondent thinks that while it is not a critical issue it still should receive more attention than it currently gets.

Table 4. Average ranking and importance ranking of each of the issues.

Issue	Average ranking	Importance ranking
Changing context & drivers	7.7	7
Scales of planning	6.1	2
Planning pipeline	7.8	8
Collaboration & integration	3.0	1
Public/private interface	8.9	13
Appropriate level of engagement	6.9	5
Option evaluation	7.1	6
Technical capabilities of planners	7.9	9
Risk management	8.5	11
Funding and finance	6.7	3
Cost and responsibility apportionment	6.8	4
Appropriate level of regulation	7.9	9
Decision implementation	8.7	12
Post-evaluation	11.0	14

The average was calculated by giving equal weighting to each of the survey respondents. Therefore the local government responses (six responses) were given six-thirteens the value of the bulk suppliers (13 responses).

The majority of the issues received an average rank between six and nine, meaning that 12 of the 14 issues were within 1.5 of the median ranking of 7.5. There are two outliers to this, collaboration and integration which received an average rank of 3.0 (high importance), and post-evaluation receiving an average ranking of 11.0 (low importance). Table 4 shows the average ranking of each of the issues and has then ranked them according to the overall level of importance.

Results by organisation type

The survey rankings for each of the issues were also calculated for each organisation type. These calculations are shown in Table 5 below.

The majority of the issues received mid-range average scores demonstrating that there is limited consensus between the experts as to what is the most important issues for IUWM. Many of the issues received high scores from some experts and low from others, resulting in an overall mid-range score. This is a similar finding to what was found in the literature that experts may disagree about what IUWM actually is (for example whether it is a broad overarching objective or specific method or process) and what is important in it (Furlong et al., 2016d). However, the survey did find two outliers.

Firstly ‘Collaboration & integration’ was considered by industry to be the most important of all the IUWM issues, receiving the highest ranking from all the organisation types. This issue was also the only issue identified in some form by all of the seven lists, shown in Table 2. In a wider literature search this issue was sometimes talked about in terms of co-operation between sectors or disciplines (Rauch et al., 2005; Wang et al., 2007; Raadgever et al., 2008; Brown et al., 2011), governmental administration

Table 5. Ranking for each issue for each organisation type.

Issue	Bulk supplier	Consultant	Government body	Local government	Retailer	Average ranking
Changing context & drivers	8.2	7.4	7.0	9.8	6.3	7.7
Scales of planning	5.5	7.5	5.9	5.8	6.0	6.1
Planning pipeline	7.2	7.8	6.5	9.2	9.6	7.8
Collaboration & integration	4.1	3.3	2.4	3.2	1.6	3.0
Public/private interface	7.8	6.8	9.3	8.8	11.6	8.9
Appropriate level of engagement	6.2	6.3	10.8	5.8	5.1	6.9
Option evaluation	7.3	7.3	8.0	6.8	6.3	7.1
Technical capabilities of planners	8.0	8.4	8.4	5.0	8.0	7.9
Risk management	9.3	8.5	8.0	9.8	7.1	8.5
Funding and finance	6.5	7.3	6.5	6.8	7.6	6.7
Cost and responsibility apportionment	7.2	8.0	4.3	8.4	6.0	6.8
Appropriate level of regulation	6.8	7.9	7.4	10.2	9.1	7.9
Decision implementation	9.8	7.5	8.6	8.4	8.3	8.7
Post-evaluation	11.2	11.4	12.1	7.0	12.4	11.0

levels either across hierarchies or juridical boundaries in policy (Markey et al., 2008; Raadgever et al., 2008; OECD, 2011) or institutional arrangements (Rauch et al., 2005; Sendzimir et al., 2008; Brown & Farrelly, 2009; Brown et al., 2009), and sometimes leading to difficulties defining problems (Briassoulis, 2004). This issue was also discussed in the literature regarding communication and creating structures that facilitate and foster better communication (Brown & Farrelly, 2009), integration (Mouritz & Shepherd, 2006; Farrelly & Brown, 2011) (Wang et al., 2007; Brown et al., 2011; Mukheibir et al., 2014), and capacity building between stakeholder organisations (Mukheibir et al., 2014). When one considers that this IUWM issue has been researched so thoroughly and considers so many important elements, it is not surprising that practitioners found it to be the most important issue even though they cannot agree on what IUWM actually is (Furlong et al., 2016d).

Secondly 'Post-evaluation' was considered by industry to be the least important of all the issues. This was also evident from the literature as relatively little research had mentioned it with only two studies, both by the same researchers, including post-evaluation (Brown & Farrelly, 2009; Farrelly & Brown, 2011). The fact that experts ranked post-evaluation as low as they did clearly demonstrates that the IUWM experts do not believe that post-evaluation is an important aspect of IUWM. This may indicate that the industry has an unwillingness to look back at the success or failures of IUWM planning. More research in the future may be warranted in regard to why experts consider post-evaluation to be a low priority.

In the rest of the results sections, the results are discussed relative to the average and the language used is always in reference to the average ranking for that issue. For example, local government placed ranked integration and collaboration at 3.2, and post-evaluation at 7.0. The averages for integration and collaboration was very high (3.0) and very low for post-evaluation (11.0). Therefore, local government ranks integration and collaboration similarly to other stakeholder groups (−0.2), and post-evaluation much more highly than other stakeholder groups (+4.0).

Difference in priorities between organisations

Survey results appear to indicate that organisations place a higher importance on the issues that relate to phases of the planning process that they are most involved in. This is shown in Figure 2. Bulk suppliers, and consultants, who are required to take a broad perspective in their work, including policy, analysis and approvals, view all phases of planning to be equally important. Retailers and local government consider analysis to be the most important, whereas government bodies consider issues relating to analysis to be the least important.

The following sections go into detail regarding priorities within each of the organisation types. To show the difference between opinions of different types of organisations, this study has produced several spider charts. The spider charts show the average ranking for each organisation type compared with the overall average ranking. For example, in Figure 3, compared with the average, bulk suppliers place the same level of importance on the appropriate level of engagement, a higher level of importance on the appropriate level of regulation, and a lower level of importance on decision implementation. To make them easier to read the charts also include a black filled area to indicate zero.

Bulk suppliers. As shown in Figure 3, the bulk suppliers' average ranking is quite similar to the overall ranking with no issue having an average ranking difference greater than 1.1. Also, Figure 2 shows a relatively even distribution between the three planning phases for bulk supplier results. These two



Fig. 2. Comparison between the overall average ranking and the average ranking of each organisation type of the planning phases.

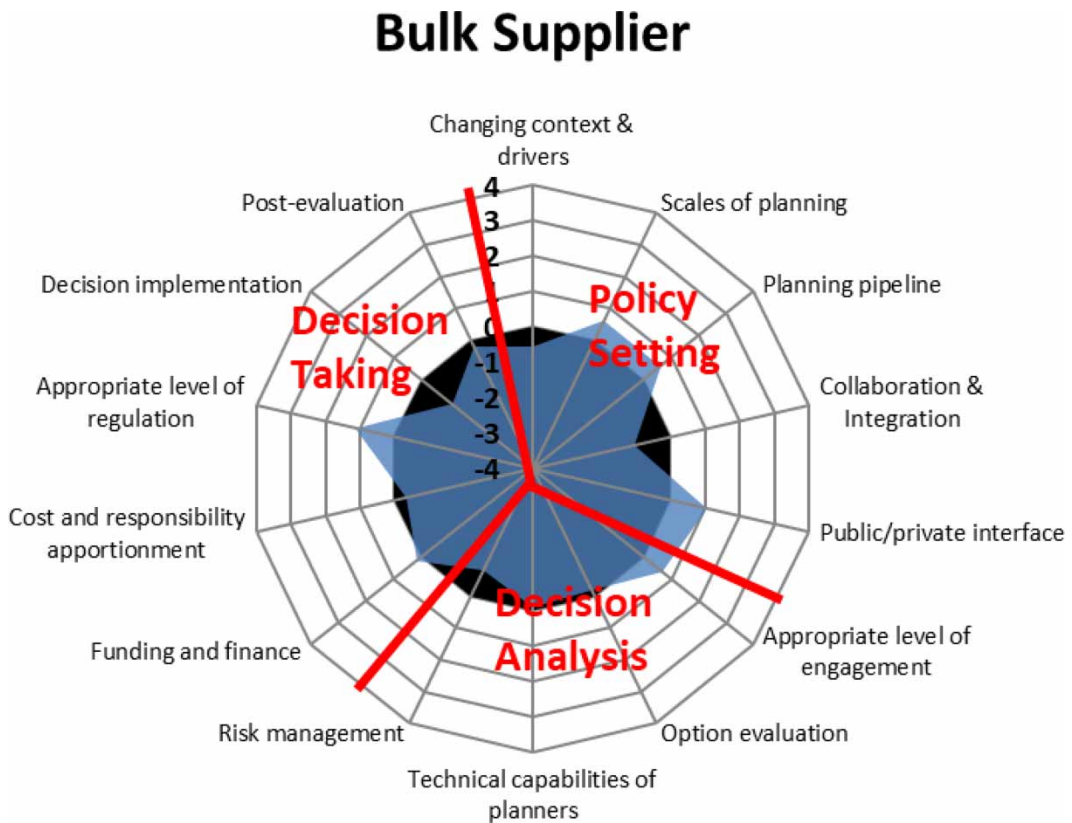


Fig. 3. Difference between average ranking of the bulk suppliers and the overall average ranking.

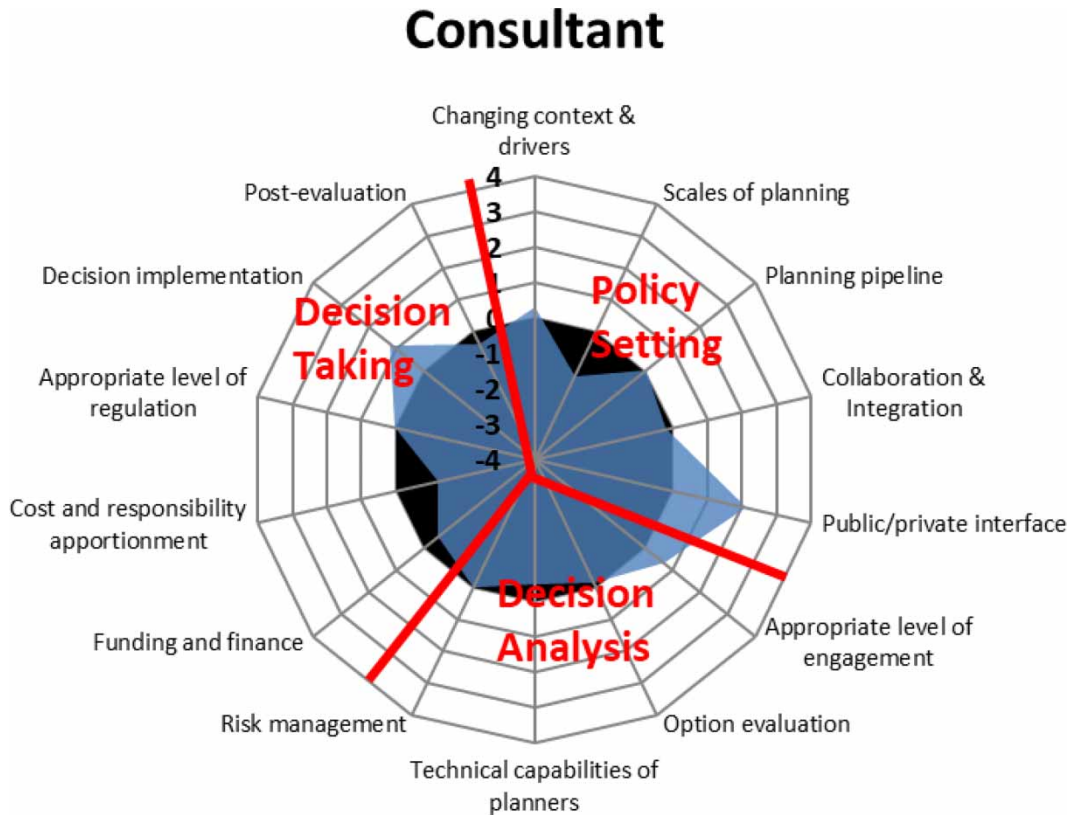


Fig. 4. Difference between average ranking of the consultants and the overall average ranking.

things show that the opinions of bulk suppliers are very closely aligned with the overall opinions of the IUWM sector and are active in all parts of IUWM planning. This finding was expected because the bulk suppliers are involved in every phase of IUWM and need to have a strong working relationship with all stakeholders throughout the water industry.

Consultants. Like the bulk suppliers, the consultants have given all the issues and each planning phase a similar average ranking to the overall, the only exception being a greater importance placed on the public/private interface (Figure 4). This is expected as consultants work across all planning phases and with all stakeholders, therefore their views should closely reflect that of the broader sector. However, being the only non-public group it was expected that they would place a greater importance on the public/private interface as they would have this more centre of mind than other organisation types.

Government body. When ranking the planning phases, the government bodies placed less importance on decision analysis and more importance on decision taking and policy setting (Figure 5). In regard to specific issues government bodies have placed a greater importance on cost and responsibility apportionment and less on the appropriate level of engagement. The reason for this may be that the government bodies are most involved in the policy setting and decision taking, but rarely involve themselves directly in decision analysis planning phases or engage with the community directly.

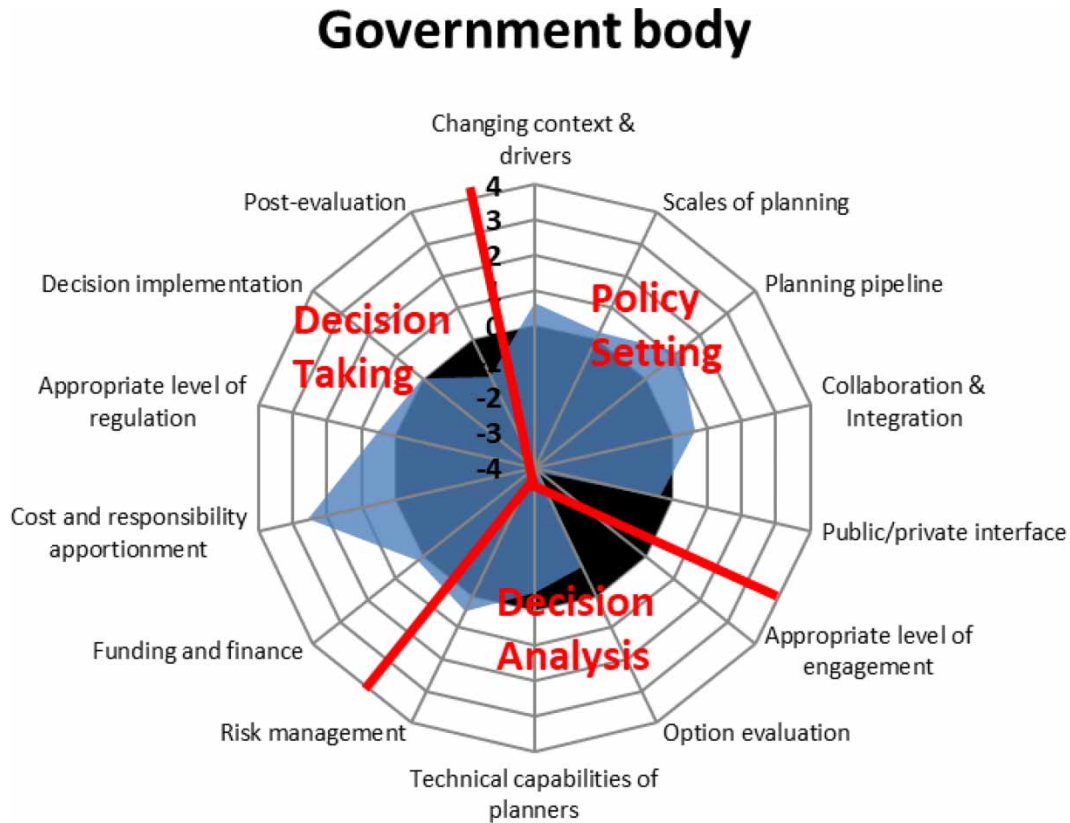


Fig. 5. Difference between average ranking of the government bodies and the overall average ranking.

The findings of this study show that cost and responsibility apportionment are very important to government bodies. Therefore, future planning processes that require approval from government bodies should ensure that cost and responsibility for implementing what is outlined in the strategy is fully considered and agreed upon during the planning process.

Local government. Local government showed the greatest difference in their average ranking compared with the overall average, with four of the issues having an average ranking difference greater than 2 (Figure 6). This shows that there is a high amount of segregation between local government and the rest of the sector. Local government placed a much higher level of importance on decision analysis, and a lower level of importance on policy setting.

Local government placed a high priority on technical capabilities of practitioners and post-evaluation. This may indicate that (a) local government is concerned about their lack of capacity to develop and implement IUWM strategies and projects and (b) there is concern around maintenance and long-term performance of council projects (Dobbie & Brown, 2013). Therefore it is important when completing an IUWM planning process, that if local government will be involved, then their technical capacity needs to be considered and long-term performance and maintenance of assets has been considered.

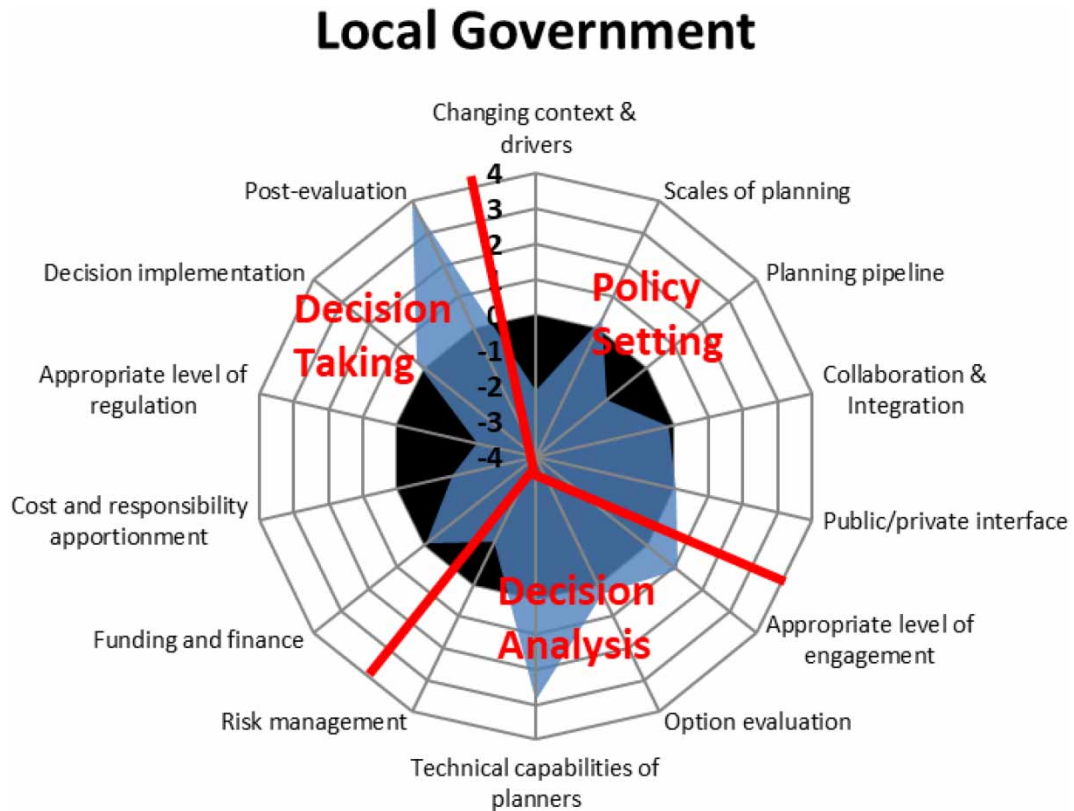


Fig. 6. Difference between average ranking of local government and the overall average ranking.

Retailer. Retailers placed a higher level of importance on decision analysis but gave equal level of importance to decision taking and policy setting compared with the rest of the sector (Figure 7). This is because like local government the majority of their work is in decision analysis but they are somewhat involved in both policy setting and decision taking.

There was only one issue on which they were significantly different from the average and that was the public/private partnership. This was a surprising result as retailers work closely with developers from the private sector. This may indicate that retailers consider their interests and the developers' interests to be closely linked and therefore see the interface between them as an easy relationship to manage. More research could be warranted to understand this relationship between retailers and the private sector.

Discussion, recommendations and conclusion

There is an ever growing consensus within water management literature and practice across the world that the water sector is evolving from being a top-down, segregated, engineering-dominated field, towards a collaborative, integrated, cross-disciplinary field (Bell, 2015). This shift can be described using any number of emerging terminological framings such as IUWM, water sensitive urban design, low impact development, nature based solutions, etc. However, one common thread across all emerging

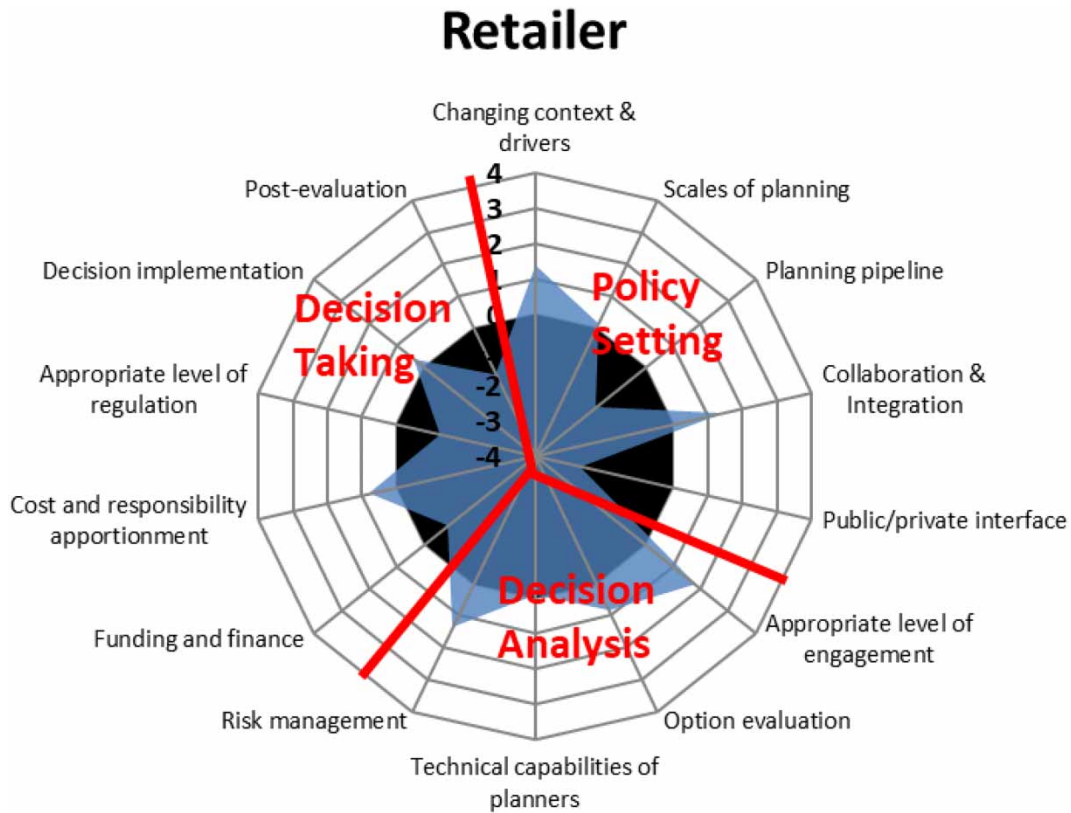


Fig. 7. Difference between average ranking of retailers and the overall average ranking.

paradigms is the need for increased collaboration, and therefore, stakeholder engagement. This means that institutions will increasingly need to understand the interests and priorities of their stakeholders, in order to enable more productive collaboration and engagement.

Extensive research has previously been conducted into the barriers to the adoption of IUWM and related ideologies in Australia. However, no prior research has ever compared the relative importance that is placed on these issues, across different organisation types. The current research progresses the existing body of knowledge in three key ways.

Firstly, a list of issues affecting the implementation of IUWM is created through the combination of the literature review and the industry consultation, and then categorised in terms of where they fit into the planning phases of: policy setting, decision analysis, and decision taking. Categorising issues in this way is an important step towards moving somewhat abstract issues towards issues that practitioners are able to address barriers in their day-to-day work.

Importantly, the issues presented in this paper are not purely hypothetical, but have been validated through in-depth case study research that has been conducted in parallel with the current research (Guthrie et al., 2016). The references listed in this paper provide interested readers with further in-depth exploration of these issues by the authors, for example on planning scales (Furlong et al., 2016a), funding and financial regulation (Furlong et al., 2017a), and appropriate levels of engagement

(Furlong *et al.*, 2016c). The intention in this paper has not been to provide in-depth discussion on these issues, but rather a comprehensive and categorised list.

Secondly, this research is the first paper that quantifiably ranks the importance of different IUWM issues to different institutional types in Australia. It has provided an initial exploration of this issue, and confirmed the hypothesis that, in general, practitioners are most concerned about issues that they deal with directly.

Results from the survey show that different institutional types have significantly different opinions around which IUWM issues are most important. This is most evident from Figure 2, which shows, for example, that water retailers and local government care primarily about analysis and design of strategies and projects, whereas state government is primarily concerned with policy setting, regulation and approvals. These priorities align directly with their work areas.

While these results are not surprising, they are certainly important. As stakeholder engagement literature has noted, it is very important to tailor engagement actions and materials to the stakeholder you are engaging with (Carson, 2008). It is equally important to move away from Habermasian, purely ‘fact based’ and ‘power of the better argument’ approaches to participation of the 1980’s (Healy, 2009). This is not unique to the water sector, with parallels that can be drawn to almost all professional fields including: the energy sector (Hall *et al.*, 2013; Jami & Walsh, 2014), community and international development (Brown & Wyatt, 2010; IDEO, 2015), and waste management (Healy, 2009). The current research has not attempted to provide a comprehensive how-to guide for engagement within the water sector, but it does highlight the importance of tailoring engagement towards what target audiences are most interested in, which is, whatever issues they have the most contact with in their work.

Thirdly, some specific outcomes from the survey are interesting in their own right. For example, when engaging with government bodies it is important to focus on responsibility and cost apportionment, and when engaging with local government it is important to focus on technical capabilities and post-evaluation. Some of the results from the survey were not expected and could warrant further investigation, including: (1) why Melbourne’s water sector, other than local government, places a lower importance on post-evaluation; and (2) why local government rankings were so drastically different to all other stakeholders, perhaps implying a lack of effective communication channels.

These specific survey results cannot be generalised to other cities and countries. In particular, water governance arrangements vary across the world, and the organisational types presented in this study are specifically those found in Melbourne. In other cities, different stakeholder groups would be relevant, for example in many countries NGOs may have an important role in the planning of water infrastructure.

However, the authors propose that the core conclusion of the research, that different organisation types place different priorities on issues depending on their exposure to those issues, can be generalised to all cities and countries. Water sector organisations are not homogeneous in their visions, values and what they believe, and it is critical that these differences are considered when engaging with them. Guthrie *et al.* (2016) developed five recommendations to improve stakeholder engagement including:

1. Working relationships between stakeholders should be built, maintained and used often to keep communication channels open. These communication channels unlock potential opportunities for IUWM.
2. Stakeholder engagement should begin with the alignment of visions, and discussion of ‘why’ the strategy is being done, rather than moving straight onto practical solutions.

3. Strategy creators should ensure that they ‘close the engagement loop’ by letting all involved stakeholders know how their input has impacted on the strategy. This prevents the perception of disingenuous engagement.
4. In some situations, financial contributions into strategies can increase stakeholder buy-in.
5. Effective engagement involves asking the right stakeholders the right questions at the right times. This often requires multiple stages of engagement, with different methods at each stage to target stakeholders with different technical literacy and interests.

Applying these recommendations and understanding stakeholders better, will lead to engagement processes tailored to the needs of specific stakeholders. With this study it is hoped that the water sector can advance their methods of stakeholder engagement towards more stakeholder-centred approaches with better outcomes for all.

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