CRC for
Water Sensitive Cities

Water Sensitive Cities skills and knowledge needs

An Australian and international assessment

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An Australian and international assessment
"Strengthening education programs to foster future water sensitive city leaders" (Project D4.1)
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Executive summary

The first phase of Project D4.1 of the CRCWSC (*"Strengthening education programs to foster future water sensitive city leaders"*) sought to identify the knowledge and skills needs and challenges across urban professionals in relation to capacity for innovation towards water sensitive cities. This knowledge will provide a pathway for translating the research arising from the CRCWSC into learning processes, such as training and educational products, which aim to build the capacity of urban professionals to promote, design and deliver water sensitive cities outcomes in a range of contexts.

This report discusses the findings obtained through interviews with urban water champions from Australia, The Netherlands, Vietnam and Bhutan, representing local governments, state planning and regulation institutions, water utilities and private companies. The interviews aimed to gather insights on what skills and knowledge are needed to transition towards more holistic water sensitive city approaches in different developed (Australia and The Netherlands) and developing (Vietnam and Bhutan) country contexts.

The interviews were structured using a common framework based on the notion of an innovation 'S-curve' (Tidd and Bessant 2005). This framework helped to tease out where organisations and cities are in terms of water sensitive cities innovation uptake. From there discussions focused in understanding how they got there, what is holding them to move forward, and what capacities they need to do so.

In both developed and developing country contexts, results from this research show that the main obstacles for transitioning to water sensitive cities are institutional barriers and inadequate organisational arrangements. Lack of cross-departmental collaboration within as well as outside the organisation hinders the integrative nature of water sensitive cities practices and projects.

The skills and knowledge needs that were more often mentioned by interviewees as being crucial to advance in the water sensitive cities space were:

- Economics of water sensitive cities.
- Policy and regulations regarding water sensitive cities.
- Strategic planning.
- Risk analysis (strategic risks and water related risks).
- Community and stakeholder engagement.
- Management and maintenance of WSUD assets.
- Change management.
- Land use planning (including GIS, modelling, etc.).
- Integrated water management.
- Project management (proposals, planning, management, evaluation).

The needs offer opportunities and guides for translating CRCWSC research into capacity development processes. This report suggests that the following considerations should be taken when designing and delivering these processes:

- Capacity should be delivered through a broad spectrum of courses: ranging from complete Graduate programmes, short graduate level courses, tailor-made intensive programmes to stand-alone workshops aimed at high level management.

- Alternative learning models such as e-learning or coaching programs may play a role in delivering water sensitive cities capacity to urban professionals.

- Water sensitive cities learning should be supported by a large number case-studies to illustrate key issues in different local or regions settings. Professionals want to learn from familiar contexts rather than exclusively using ‘success—stories’ from elsewhere.

- Capacity development programs should be centred on real cases and practical concepts, emphasising content on organisational learning & collaboration within the water domain.

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1. Introduction

Capacity, innovation and the delivery of water sensitive cities outcomes

The successful delivery of water sensitive cities outcomes will occur as a consequence of the capacity of the organisations responsible for managing water, water services and urban planning and development to innovate (change what they do and how they do it) and to then effectively deliver those new services and service delivery modes (what are referred to respectively as product and process innovations – see Francis and Bessant 2005). We know generally that organisational capacity to innovate is complex to understand, manage and develop, but that it is partly:

- a function of the formalised, procedural and less formalised, social ways in which (people in) organisations search, acquire and assimilate new information before implementing it to better achieve their ends (what Cohen and Levinthal 1990 term absorptive capacity);
- a function of the effort and knowledge invested in diagnosing when innovation might be beneficial or need to happen, and the generation, modification and selection of options for change and the range of factors which influence those processes (Spiller *et al.* 2013, 2015);
- a function of the effort invested in and importance attached to learning by organisations, and the ability of organisations to not just deliver better performance, but to question what performance means and how it should be achieved (Argyris 2004, Morgan 1997); and that it is also
- influenced by institutionalised attitudes, beliefs, norms and consequent behaviours and practices (Geels, 2004).

We know that the capacity of organisations to effectively deliver services is similarly complex, subject to the way in which the potential latent in the skills and knowledge of individual employees are released through the structures, processes, systems, policies, procedures and plans present in their organisation and in the external, institutional environment (Alaerts and Kaspersma 2009). Delivery and innovation is particularly complex in the context of urban water management, where roles and responsibilities for different parts of the urban water cycle and for different functions (from policy formulation and implementation through to operations) are split over multiple organisations horizontally and vertically. Innovation in such a context is sometimes termed systems innovation and is a function of the capacity of all the organisations involved – a sort of systemic capacity (Smith *et al.* 2005).

Overview of the report and countries assessed

The ambition of the Cooperative Research Centre for Water Sensitive Cities (CRCWSC) is to play a critical and catalytic role in re-shaping how urban form and urban water are viewed and managed with respect to one another. This involves a cross-sector, cross-discipline, multi-scale agenda that will require the development of capacity in urban planning and water professionals and stakeholders from a wide range of government, utility, consulting and community contexts. The CRCWSC project *"Strengthening education programs to foster future water sensitive city leaders"* (Project D4.1) will provide a pathway for translating the research insights arising from the CRCWSC into deliberately trans-disciplinary learning processes that build the relevant capacities of urban professionals to lead systemic innovation in urban form and function.

The initial phase of Project D4.1 involved identifying the knowledge and skills needs and challenges across urban professionals in relation to capacity for innovation towards water sensitive cities. Individuals will need to acquire new knowledge and skills beyond their areas of specialisation in order

to effect change within and across their organisations and to better engage with community and other stakeholders.

Although the CRCWSC is mainly focussed on the Australian context, it is also seeking to promote water sensitive cities (WSC) approaches in other countries, particularly in Europe and Asia.

This report summarises the results of interviews conducted with water professionals in four countries, to identify the skills and knowledge needed to transition toward a more holistic water sensitive cities approach. Countries included in the interviews were Australia, The Netherlands, Vietnam and Bhutan to provide a range of different developed and developing country contexts.

Australia and The Netherlands provide an understanding of skills and knowledge needs within two different advanced economies, while Vietnam and Bhutan provide an understanding of skills and knowledge needs within developing country contexts.

Each of the four countries had differences in terms of understanding and implementation of WSC approaches, as well as ease with which interviews could be conducted. Different approaches were therefore used to identify the skills and knowledge needs within each country. So while a common framework was developed to structure interviews using the notion of an innovation (or transition in the language of systems innovation) ‘S-curve’ (Tidd and Bessant 2005) to help tease out where organisations and cities are in terms of WSC innovation uptake, the framework was utilised differently depending on context.

This report will discuss the approaches, results and conclusions for each country on a separate basis, followed by conclusions and recommendations across all four countries. The findings from this report will be used to help develop training and educational products that will assist organisations to move toward WSC in a range of contexts.

2. Skills and Knowledge Needs – Australia

This section summarises the results of interviews conducted with "water champions" – people who have played key roles in the transition of their organisations away from conventional management of water in urban settings, and toward a more holistic WSC approach.

Interviews were conducted with water industry professionals from Queensland, New South Wales, Victoria and Western Australia across a range of organisations involved in the delivery or management of water in urban settings.

Results from the Australian assessment will be used to recommend a range topics and delivery options that could translate the research insights arising from the CRCWSC into deliberately trans-disciplinary learning processes which build the relevant capacities of urban water professionals.

2.1 Method

2.1.1 Sampling

A range of survey methods was considered, including questionnaires, workshops and individual interviews with key staff in various organisations. Options were evaluated according to the quality of information that would be obtained and the cost associated with collecting the information.

In the Australian context, it was considered that questionnaires and workshops would not yield the in-depth understanding of knowledge and skills needs within a reasonable time and cost structure. However, there were concerns that individual interviews may not yield meaningful results if the people interviewed did not have an adequate understanding of the concepts of water sensitive cities.

For this research study, we identified a number of "water champions" who had direct experience with helping their organisations make a transition toward water sensitive cities approaches. We considered that these champions have unique insights into the skills, knowledge and roles that are necessary to effect meaningful change within their respective organisations.

An initial list of possible water champions was identified through discussions with CRCWSC researchers as well as senior management at the International WaterCentre. These initial contacts were asked to recommend other potential water champions in a snowballing process.

In order to obtain a broad range of views and experiences, water champions were selected across a range of organisations involved in water management (State planning or regulation, local government, public water utility or private firms) and jurisdictions (Queensland, New South Wales, Victoria and Western Australia).

A total of 13 water champions were interviewed for this research as shown in Table 1. Although this is a limited data set, the aim of the research was to gain an initial in-depth understanding of skills, knowledge and roles needed to promote water sensitive cities within the Australian context.

Table 1. Organisations included in the water champion interviews based on type and location of organisation

State	Type of Organisation	Name
Qld	Local Government	Anonymous
	State Planning or Regulator	Economic Development Qld
	State Planning or Regulator	Dept. of Health Qld
	Private	Bligh Tanner
NSW	Local Government	Blacktown City Council
	Local Government	Marrickville City Council
	State Planning or Regulator	Metropolitan Water Directorate
	Public Water Utility	Sydney Water
	Private	Flow Systems
Vic	Local Government	City of Melbourne
	Local Government	City of Knox
	Public Water Utility	Melbourne Water
WA	State Planning or Regulator	Dept. of Water WA

Note: For confidentiality reasons, names of interviewees have not been included, although all people interviewed were in roles that were central to the implementation of various WSC initiatives within their organisations.

2.1.2 Interview Design

A semi-structured interview approach was utilised, with discussion based around a transition curve of conventional water management to a water sensitive cities approach (Figure 1), in conjunction with a comparative table of conventional and water sensitive cities approaches (Table 2).

The initial discussion focused on developing a common understanding of what a water sensitive cities approach means and how this relates to the organisation that the interviewee works with. (Refer to Appendix 1 for a list of the guiding questions used in the interviews.) Interviewees were asked to reflect on changes in their organisation by describing movements along the curve for their organisation over the last 10 years and what had been necessary for that movement to occur. Similarly, they were asked to reflect on what changes would be needed in order for their organisation to move further along the curve in the future. The main aim of the discussion was to identify job roles, skills and knowledge that were necessary in order to move an organisation along the transition curve. This information could then be used to identify a range of training and education programs to support individuals within these organisations. Many interviewees also offered their opinions on the training and education that would be needed in order to promote the necessary skills and knowledge.

Figure 1. Innovation or transition S-curve used to guide discussions with "water champions", highlighting key changes; skills, knowledge and job roles; and blockages - both internal and external to the particular organisation, that were observed as the organisation moved along the curve

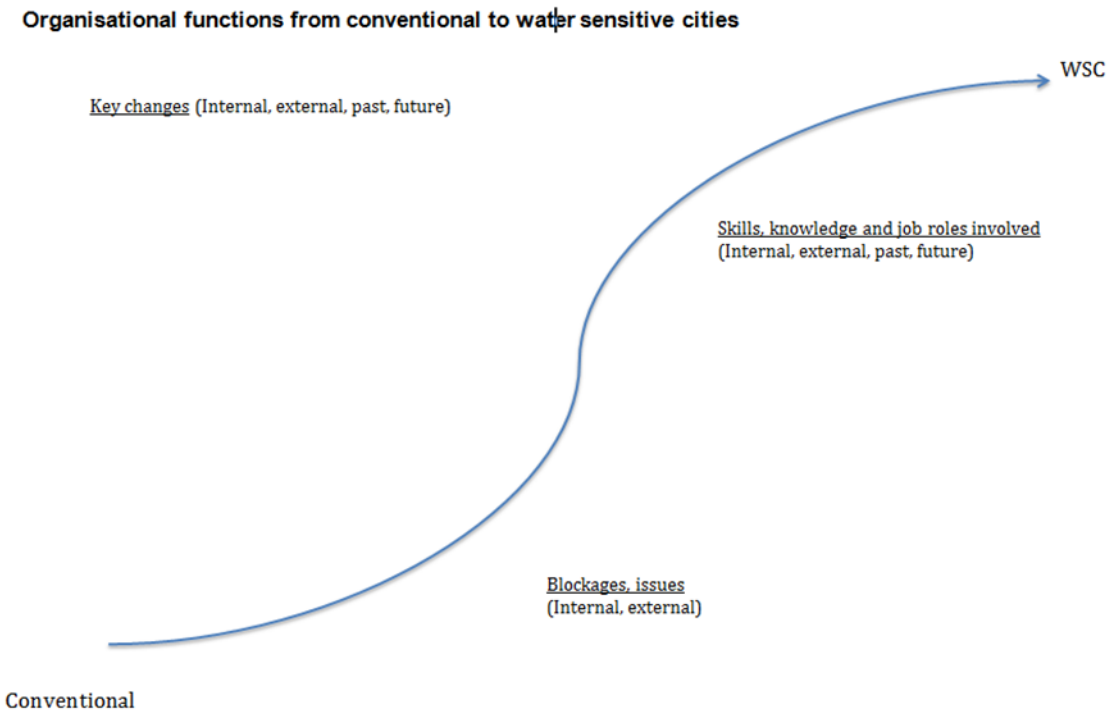


Table 2. Comparison of urban water system attributes between conventional and WSC approaches to managing water, used to guide discussions with "water champions"

Urban water system attributes	Conventional approach	Water sensitive cities approach
Purpose	Water supply Sewerage Drainage and stormwater Flood control Public health protection	Multiple purposes for water – waterway health; other needs (transport, recreation, amenity, micro-climate, energy, food) Fit for purpose water Reuse of water – consumption and waste are closely linked
Management approach	Compartmentalised by functions (planning, supply, wastewater etc.) Optimisation of individual components of urban water cycle	Integrated management across functions Managed as a total water cycle Adaptive Multiple purposes considered
Expertise	Engineering and economic focus	Interdisciplinary (including planning, ecology, health, hydrology, community participation) Multi-stakeholder learning across social, technical, economic, political, design, ecological spheres
Service delivery	Centralised and linear Engineering and economic efficiency Service organisations act independently of each other	Decentralised, interconnected, flexible Engineering and economic efficiency plus social and ecological benefits Service organisations collaborate effectively.
Role of public	Water managed by government on behalf of communities	Co-management of water between government, business and community
Risk	One size fits all risk management	Risk management tailored to context
Service sustainability	Based on maintenance and capital investment of water infrastructure Technical and legislative solutions for flood and drought planning	Built in resilience to change (climate change, population increases etc.) through diversification and decentralisation Multifunctionality of assets (e.g. green spaces for recreation and flooding)

2.1.3 Analysis

Interview notes were initially analysed to identify commonalities and differences across types and location of organisations. Common themes were then identified according to:

- blockages that impede a move toward water sensitive cities;
- job roles and organisational systems that are needed in order to move along the transition curve;
- skills and knowledge needs for WSC (based on the key aspects described in Figure 2 below); and
- types of learning programs that would help individuals and organisations gain the necessary skills and knowledge.

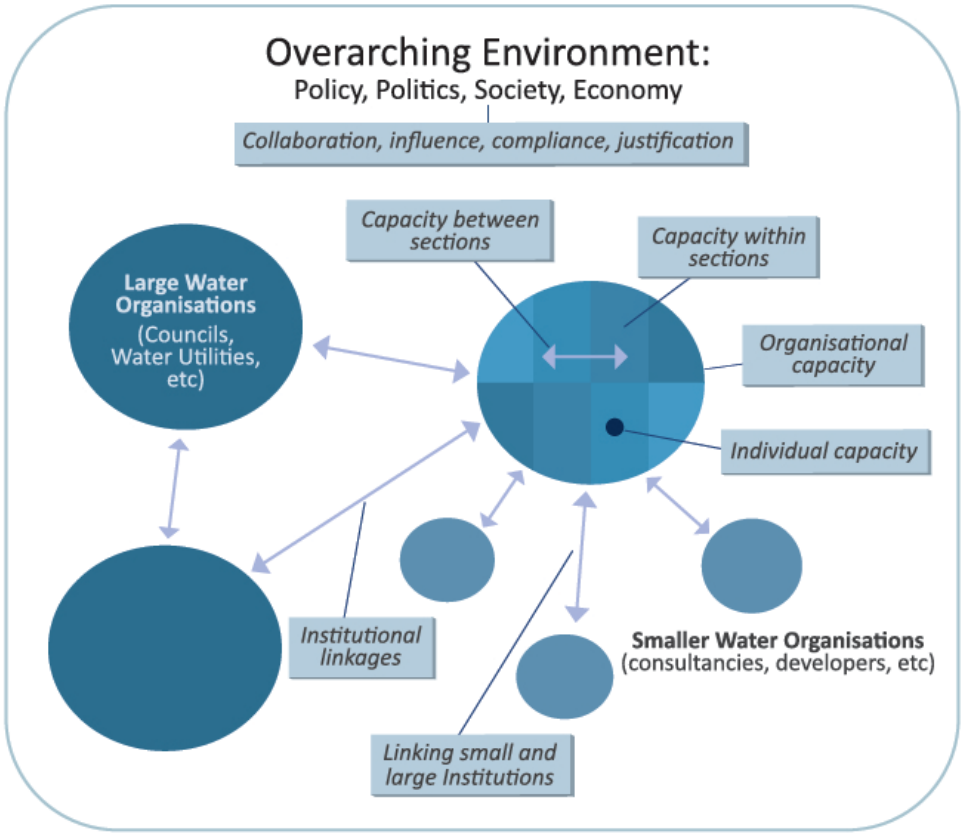
The analysis was used to make recommendations for future learning programs that will support the skills, knowledge and job roles needed to promote WSC in the Australian context.

2.2 Results and Discussion

Figure 2 below shows a representation of the environment for promoting change toward WSC. Organisations involved in the management and delivery of water exist within the broader context of society and community expectations, which are reflected in policy, political and economic considerations. In order to promote WSC, these organisations need to develop capacity to better engage with the broader community and with political leaders, as well as improve their collaboration and linkages with each other. They should have an understanding of policy and regulatory settings, as well as the imperative for economic sustainability.

Organisations, especially larger entities, tend to be compartmentalised, with each section acting semi-independently of the other. Building capacity for change starts at the individual within an organisation, but needs to focus on developing capacity and linkages within and between sections of the organisation.

Figure 2. Organisational environment for promoting change toward WSC, highlighting the aspects (in boxes) where capacity needs to be developed (figure copyright IWC)



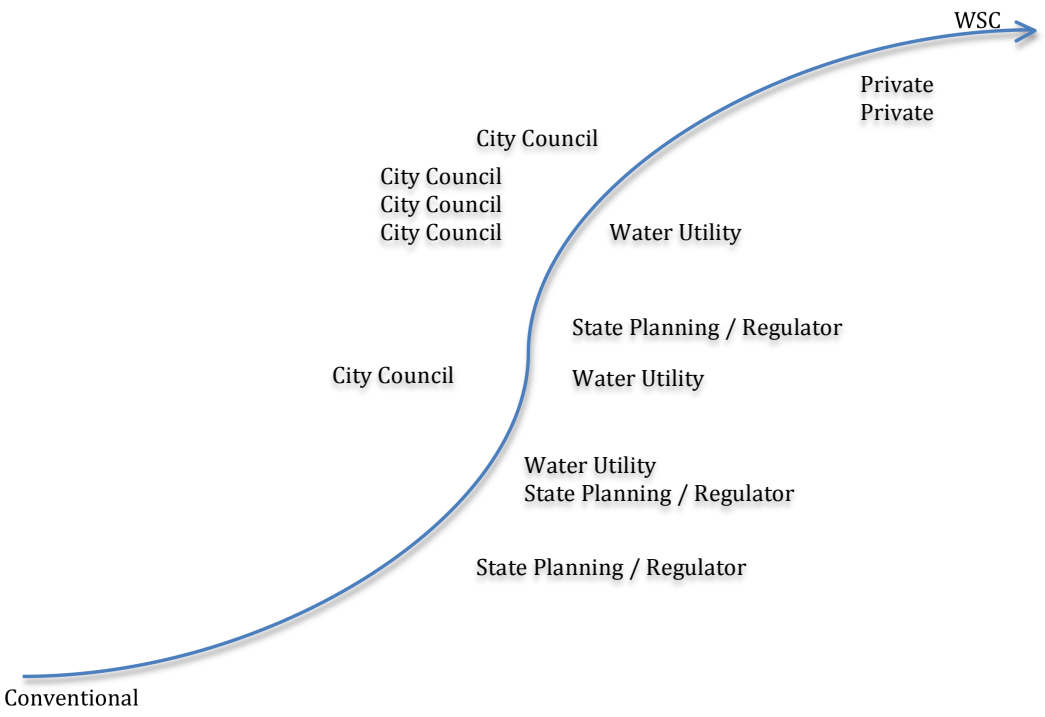
Results from interviews strongly supported the need to develop capacity in the areas highlighted in Figure 2. Some technical skills are still needed, especially for city councils in the area of asset construction and maintenance. However, the major knowledge and skills requirements, especially for larger organisations relate to developing capacity for collaboration internally and externally, along with better understanding of economic, policy and regulatory considerations.

2.2.1 Position of organisations on the transition curve

In general, the large water utilities and State planning and regulatory organisations felt that they were at the lower to mid levels of the transition curve. Local government organisations felt that they were somewhere in the middle to upper middle levels, and the private companies felt that they were near the top of the curve (Figure 3).

Note that this was a very subjective positioning of organisations and that movement in either direction along the curve could occur quite quickly, given the right conditions.

Figure 3. Water champion's opinion of their organisation's position on the transition curve



Some organisations felt that they had moved back down the curve since the end of the drought, as political will to develop water sensitive cities waned. However, some of the utilities and most of the councils felt that they were still moving in the right direction as their leadership was committed to WSC approaches and systems and strategies were being developed to move them along. Organisations could move back and forward along the curve depending on current internal and external conditions (e.g. government policy settings, types of projects being considered, importance given by senior management to water sensitive cities approaches).

The middle of the transition curve is the steeper sloping part of the curve, and some interviewees noted that this was an appropriate representation. They felt that it was easy to make a start along the transition curve, but part way along it becomes more difficult for an organisation to move further. At this stage of the curve, there may be overall support for water sensitive cities and good strategies in place, but poor coordination and integration make it difficult to progress and can lead to frustrations.

Many organisations are currently at this part of the transition curve and they will need to develop new knowledge and skills in order to move further along the curve. Recommendations from this report will focus on skills and knowledge that will assist organisations to change their overall culture of how water is managed to move further along the transition curve.

2.2.2 Differences between States and types of organisation

Each State has slightly different political and regulatory settings that affect their ability to implement WSC approaches. However, there were no major differences between States in the skills and knowledge needs identified by the champions. As such, recommendations from this report have not been categorised according to the location of organisations.

Organisations were grouped into four categories: Local government; State planning or regulator; public water utility; and private firms (consulting and private water utility). Champions from all of these groups recognised the need for capacity building in the areas highlighted in Figure 2 above. Local government organisations also expressed a need for skills and knowledge in management, maintenance and compliance of water sensitive urban design (WSUD) assets.

Champions from private firms felt that they already had good internal capacity for water sensitive cities approaches, but that other organisations (State planning or regulators, public utilities and Local governments) needed support to develop capacity in the areas described in Figure 2 above. Champions from the other types of organisations supported these views.

2.2.3 Blockages that impede a move toward water sensitive cities

Although there were no specific questions on blockages, some interviewees mentioned them in discussions about changes that were needed in order to achieve water sensitive cities. Table 3 shows the list of blockages that impede movement toward water sensitive cities approaches with the number of water champions who mentioned the blockage.

These blockages correlate closely with the skills and knowledge needs identified by interviewees.

Table 3. Blockages to WSC approaches as mentioned by water champions

Blockages to WSC	No. of respondents who mentioned blockage
Compartmentalisation within and between organisations (vertical and horizontal blockages)	4
Lack of political drivers for water sensitive cities	3
Lack of tangible examples of how WSUD and water sensitive cities can be successfully integrated into developments	3
Inertia – don't see imperative to change	3
Aversion to risk – worry over health aspects as well as the risk of running and maintaining complex assets without clear economic benefits	2
The lack of a crisis (e.g. drought) to continue driving change	2
Lack of clear policies at State and local levels for water sensitive cities	1
Lack of economic justification for implementing water sensitive cities	1
Regulations that do not fit with a whole of water cycle approach and the need for flexibility	1
Limited skill sets beyond engineering / technical backgrounds for managing water	1
Compliance costs for smaller, innovative designs	1
Inability for some key people (especially elected officials at various levels of government, where there is regular turnover) to understand the technical and economic aspects of water sensitive cities	1
The cost and inflexibility of legacy infrastructure	1

> *"The biggest challenges are institutional and governance: 1) lack of political drive to promote water sensitive cities; 2) risk aversion; 3) understanding cost-effectiveness of alternative solutions; 4) onerous compliance systems for alternative water supplies; and 5) generally conservative attitudes that are not prepared to look outside the box which leads to inertia"*
> (Private organisation)

2.2.4 Job roles and organisational systems that are needed to move along the transition curve

A number of roles were consistently mentioned in order to effect change. The main driver for initiating change was to have one or more champions within the organisation who can bring others with them. These people, plus supportive management, will start the organisation moving in the right direction. Policies and strategies will also then be necessary to give direction to the organisation.

Once this has started, the main job roles that were identified as key to promoting change were to have a dedicated person or team for promoting integration or development of water sensitive cities approaches. These people or teams should sit outside of the silos within an organisation, although they need to develop good communication with representatives from all sectors of the organisation and develop ways of integrating these sectors. They also need to engage effectively with the public.

Finally, a reliable and on-going source of funding is needed to develop and maintain WSC assets.

2.2.5 Skills and knowledge needs for water sensitive cities

As mentioned previously, technical skills for implementing water sensitive cities approaches were generally not considered to be an issue except for the need for better training in building and maintaining WSUD assets within local government. The main skills and knowledge that are needed relate to improved capacity to effect change within an organisation and to better engage with internal

and external stakeholders. In addition, improved understanding of the economic, regulatory and policy aspects of WSC are key areas to develop.

> *"Fifty per cent of our business is justifying an investment on economic terms; 25% is managing the regulation and legislation; 15% is developing customer systems; and 10% is building the infrastructure and technology. The technology is proven and standardised, so this is not an issue."*
> (Private organisation)

The following section discusses in more detail the skills and knowledge needs that were identified by the water champions, based on the aspects described in figure 2 above: economic justification of WSC approaches; policy and regulatory considerations; planning and risk analysis; and developing internal and external capacity for collaboration.

a. Economic justification for water sensitive cities

This aspect was mentioned by six of the water champions. A consistent theme across organisations and States was the need for a better economic understanding of water sensitive cities approaches. There should be a good economic rationale for implementing water sensitive cities. If new approaches are promoted, there should be the ability to conduct an economic analysis showing who will pay for it, who will maintain it, what are the costs, and where the revenue will come from.

Economic skills identified include:

- budgeting for integrated projects;
- economic analysis of water investments that includes externalities such as health and environmental aspects; and
- economic analysis that incorporates small scale and large-scale water sensitive cities investments (household to catchment).

> *"There is a need to understand rudimentary economic concepts and environmental economics, such as contingent valuation and hedonistic pricing, as these are being used to evaluate projects"*
> (Local government)

> *"Calculating ROI from an economic value, but also how to value health and wellbeing and environmental services to compare options while thinking about multiple benefits"*
> (Local government)

> *"We need modelling of costs and volumes and business cases for precincts and greenfield areas. How to make a case for change and take this to the decision makers. This is a skill set that is still developing."*
> (State planning / Regulator)

b. Policy and regulations for water sensitive cities

This was identified by four of the water champions. They felt that councils and developers don't have sufficient understanding of the regulatory and compliance regimes, which can slow down the development process. State planning and regulatory organisations can also inhibit developments due to lack of flexibility in their application of regulations.

> *"More training is needed in regulatory requirements so that developers and councils realise what is needed. It is not onerous."*

(State planning / Regulator)

"At the moment each State has their own view and system and they can be pedantic about their regulations. They are risk averse and if they stick to regulations then they are safe."
(Private organisation)

Other knowledge and skills identified within this category were:

- Policy development within organisations for WSC approaches (2 respondents)
- Awareness raising and influencing politicians and decision makers (2 champions)

"The more we can influence the elected people the better chance we have of building consistence and longer term policies. This requires good education of why these policies should be in place."
(Local government)

c. Strategic planning and risk analysis

The need for skills in strategic planning was mentioned by three of the water champions and risk analysis was mentioned by four of the champions. Organisations should consider long-term business and strategic planning, linked with regulatory regimes (understanding the context), best use of existing assets and strategic risks.

"There needs to be a strategic approach to looking at economic aspects. A total planning concept that includes supply and demand; micro and macro; and broader aspects such as health, liveability and energy consumption"
(State planning / Regulator)

"We *see the need for change because a lot of our assets will have to be replaced in the next 10-20 years. So do we just replace them or are their alternatives that could result in better investments? Community values are changing and the environment is changing. So what are the best options and what are the risks to ensure that your long-term investments are robust? Engineers are still stuck in the single loop learning cycle, whereas we need double loop learning."*
(Public Water Utility)

"The old system tended to have engineers at the front of the planning process. This is gradually being swapped around to have strategic planners calling the shots and working together with community to develop integrated approaches. The engineers are then at the end of the process and asked to develop possible solutions to fit the requirements of the collaborative planning process."
(Local government)

Risk analysis also includes a better understanding of health risks in fit for purpose water systems.

"At the moment we have an industry where people accept the status quo and don't question if things could be done differently and too easily say it can't be done. They use health and risk as an argument against it."
(Private organisation)

d. Community and stakeholder engagement and collaboration

Community engagement was identified as a key skill by four of the water champions, although all types of organisations mentioned the need to involve or respond to the community in the planning process. An important element of implementing WSC is to involve the community in planning and implementing change. This approach creates positive reinforcement with policy and decision makers and minimises the risk of unexpected outcomes. Communities are the end users of any WSC approach and they should be included as much as possible in the decision making process.

> *"Community engagement skills are in short supply…..There is a need for support and training in how to collaborate effectively with the community and the benefits of taking the time to build this collaboration."*
> (Local government)

One local government water champion felt that it was important to properly engage the community. There was initial criticism that too much time was being taken to collaborate and engage the community and too little was being done on the ground. Neighbouring councils were seen to be doing things more quickly. But this local government persisted as they felt it was important to build a base of support. Now, in the absence of grants they can see that other councils stop doing things, whereas they continue on with small projects that work toward their overall strategy.

Stakeholder engagement and collaboration includes community engagement but also involves other internal and external stakeholders for an organisation. This was a key skill identified by four of the water champions.

> *"[one public water utility] realises that they can't silo around professions anymore and it has restructured to be process oriented. However, many people are still not prepared for working with people from different disciplines and don't understand the different mindsets. It is understood as an issue but we have not worked out how to solve this yet due to the changes in thinking needed and the broader IWM abilities needed."*
> (Public water utility)

> *"There is room for small, niche businesses that could link utilities and government with developers and other small utilities. They could help in aspects such as regulatory liaison and developing relationships with government. They would be specialist hubs and centres of knowledge."*
> (Private organisation)

Effective stakeholder engagement and collaboration also requires effective communication skills and three of the water champions mentioned this as an important aspect. This applies to communication with decision makers (how to make a good case for WSC approaches), as well as communication across disciplines within an organisation.

> *"What is the language we use? How to frame ideas in a positive way?"*
> (Local government)

> *"How do we break down siloed teams and promote not only experts in a particular field but also understanding across fields. If you have 10 experts around a table, how do you make it efficient and functional and how do they understand each other's perspectives?"*
> (Local government)

e. Management, maintenance and compliance of WSUD assets

Councils' staff need technical training for them to better build and maintain WSUD infrastructure. This was mentioned by three of the water champions.

> *"Many contractors didn't understand why WSUD was designed in a particular way and so modified it, which led to poor construction. There is a need for builders to understand it so that it is built in the right way."*
> (Local government)

> *"Staff were taught how to manage the UV systems for stormwater harvesting but it was a complicated process and many of them didn't feel confident to manage this. There needs to be better on-going support and a better training system put in place for some of the complex aspects of WSUD."*
> (Local government)

f. Other skills and knowledge needs

A number of other skills and knowledge needs were mentioned by some of the water champions, although these were not discussed in detail. These suggestions are categorised below, with numbers in brackets indicating the number of water champions who identified it as a need.

- Managing change
  - Institutional barriers to change (2)
  - Critical thinking (2)
  - Leadership (1)
  - Change management (1)
  - Adaptive management (1)
- Land use planning
  - Land use planning and natural resource management (2)
  - Mapping and GIS (2)
  - Catchment modelling (2)
  - Soil ecology and hydrology (1)
- Whole of water cycle assessments
  - Integrated water cycle assessment (stormwater, wastewater and drinking water) (2)
  - Energy and water flows for developments (from big to small) (1)
- Project management
  - Writing submissions for complex water projects (1)
  - Interdisciplinary project management (1)
  - Evaluation of projects (1)
  - Business planning for project options (1)

2.2.6 Types of learning programs

There was a strong desire (identified by seven water champions) for more case studies and demonstration sites that show the practicalities of how to implement water sensitive cities. These should be sites where researchers can test new ideas, developers can see how these ideas can be incorporated into their plans, and councils and water utilities can understand how they work in practice. It should be possible to look at individual aspects without having to implement the whole package.

> *"One of the big gaps is that urban designers and urban planners lack tangible examples of how WSUD and water sensitive cities can be integrated into*

> *developments. To show them how they can look good, be well designed and function well. They don't know the options and need to see how it could be integrated at the start."*
> (Local government)

> *"There is a real need in Western Australia for demonstration sites at precinct and street scale. Real demonstration sites to see it, smell it, feel it, and get hard data to back it up"*
> (State planning / Regulator)

> *"Demonstrations are essential to the economics and the practicalities of how to do it and who manages it long term. If developers and councils could see and manage the risks and also see the economic benefits, they would come on board."*
> (State planning / Regulator)

Case studies and demonstration sites could be used to promote collaboration and develop new ideas in practice. They could be incorporated into learning programs and provide a means for researchers, practitioners and decision makers to work together.

> *"Many people see the research as having to provide a solution in a package. But it should be more of a collaborative process of trying things on the ground together with researchers and working out what works and what doesn't for particular circumstances."*
> (Local government)

> *"Celebrate wins and promote them well. It creates support. But also include learnings of what went wrong so that others don't make the same mistakes."*
> (Local government)

The water champions expressed a desire for a range of educational options from workshops to Masters level. If possible, education products should be industry or university accredited to provide more legitimacy to the course. All types of education should be practically based and allow individuals to apply what they learn in their workplace.

> *We need a range of options from Masters courses to workshops. Budgets are limited so we need to be selective on the training courses we go to."*
> *(*Public water utility)

> *"Demonstration sites are valuable but it is getting the non-converted to these events that is difficult. Training courses should be industry certificate accredited to provide legitimacy and help get doubters to the courses.*
> (Local government)

2.3 Recommendations

The following recommendations for training and learning programs are based on the above skills and knowledge needs assessment. These recommendations would generally be applicable across all of the organisational types and locations included in the survey. However, educational content would need to be adaptable to the differing policy and regulatory circumstances in each State, as well as the different types of organisational systems.

Learning programs could be developed around a series of 'modules' that relate to the key skills and knowledge identified in this report. These modules would be developed for delivery at university Masters level but could then be adapted for a range of delivery modes.

Options for delivery would range from:

- Modules to be taught as part of an overall coursework Masters Program, such as a 'Master of Urban Water Management'. This would provide the opportunity for a few key water professionals to have an understanding of the broad range of skills needed to manage change within their organisation and to play a key role in developing links within and between organisations.
- University accredited modules that would allow participants to gradually build up to a Graduate Certificate, Graduate Diploma or a full Masters if they wish. Participants could choose topics that are most relevant for their immediate workplace needs, but have the option to gradually build a broader range of skills.
- Industry accredited short courses that would provide broader legitimacy for completing the courses. Not all water professionals would have the desire to undertake a university level course, with the associated study and assessment requirements. However, an Industry accredited course would still be beneficial to professional development and could be run over a three to five day period.
- Non-accredited short courses of three to five days. These would be useful to develop some key skills needed within the workplace and would be priced to allow a larger number of water professionals to attend.
- One day workshops either directed at key decision makers or at broader sectors within a workplace. These would be designed to provide a broad understanding of the need and direction for change within an organisation.

Topics to be covered in education and training programs:

- Economics for WSC, including economic analysis of WSC projects; budgeting; environmental economics; developing WSC project and program business cases.
- Policy and regulations for WSC, including local, State and Federal regulatory and compliance regimes; application of policy and regulations to WSC projects; policy development.
- Strategic planning for integrated water management.
- Risk analysis, including strategic risks and health risk assessments for fit for purpose water use.
- Community and stakeholder engagement, including collaboration and communication.
- Management and maintenance of WSUD assets.
- Managing change, including leadership and critical thinking.
- Land use planning, including mapping; GIS; modelling; soil ecology and hydrology.
- Integrated water management, including urban water and energy flows.
- Project management, including planning, managing and evaluating projects; writing project submissions.

All of the above options should be developed with practical learning outcomes in mind. Learning programs should incorporate case studies and visits to demonstration sites wherever possible, and to encourage participants to apply what they learn to their current workplace issues.

The Master of Integrated Water Management run by the International WaterCentre, would be a good starting point to develop individual topics as well as an overall Masters Program for Water Sensitive Cities. It would need to be redeveloped to be more applicable to urban water professionals, but many of the topics covered in this Masters Program relate directly to the needs identified by the water

champions. It is based on a problem based learning system that can be adapted to the particular interests and experience of students, and it is focussed on real world problems and solutions.

3. Skills and Knowledge Needs – The Netherlands

3.1 Respondents

The target group on which the interviews were focused consisted of two specific communities that within the Dutch context can be considered as the main drivers of WSUD:

- water champions within municipal and provincial departments that are considered as frontrunners in urban water management;
- planning and architectural design offices with a specific water oriented focus;

The majority of the respondents were first identified in the Dutch Knowledge for Climate funded project: Climate Proof Cities (CPC, 2014) that is focusing on strengthening the adaptive capacity and reducing the vulnerability of the urban system against climate change and to develop strategies and policy instruments for adapting our cities and buildings. The four-year project brings together the science community, practitioners as well as policy makers, working on cases at different scale levels: regional, urban, neighbourhood and building/street level. Consultation of the project management team, lead to an initial list of respondents from which 9 participated in the assessment. These nine were primarily working for Dutch municipalities as either policy advisors or practitioners. Additionally, three Dutch architecture and/or urban design offices were identified that have contributed to some of the most successful WSUD-oriented projects in The Netherlands.

Table 4. Organisations included in the water champion interviews based on type and location of organisation

Type of Organisation	Name	Role
Municipality	Dordrecht Municipality	Programme Management Water
Municipality	Rotterdam Municipality, Dept. of City Development	Advisor Climate Adaptation
Municipality	Rotterdam Municipality, Dept. of Water Management	Programme Manager Water, Climate Adaptation
Municipality	The Hague Municipality, Dept. of City Development	Planner, Advisor Water & Coast
Municipality	Nijmegen Municipality, Dept. of soil and water	Senior Advisor Water & Green
Municipality	Nijmegen Municipality, Dept. of soil and water	Consultant Urban Water Management
Municipality	Amsterdam Nieuw-West	Programme Manager
Municipality	Arnhem Municipality, Dept. Environment, Water, Soil and Public Space	Senior Advisor Public Space, Water and Ecology
Province	Province of Noord-Brabant	Senior Advisor Water Management and Climate Change
Design office	De Urbanisten, Urban research and design	Principal Designer
Design office	D.EFAC.TO, Architecture & urbanism	Principal Designer
Design office	Waterstudio.NL	Project architect

3.2 Interview method

The semi-structured interviews were setup along four themes (described below in sub-sections 3.2.1 to 3.2.4) that focus on the major factors that contributed to the development of the water champions as well as on the potential future challenges that the champions identify in the transition towards WSC. Special emphasis was put on the role of knowledge in the development of the water champions.

The interview data was then first of all transcribed, followed by an analysis where common responses across interviewees were grouped and ranked as more broad statements. These statements can be regarded as the main results and are described in section 3.3.

Theme 1 (Retrospective): Identifying essential knowledge domains in becoming a champion
In this line an attempt is made to identify some of the most important factors that in the opinion of the respondent lead to the establishment of their role as water champion. These focus on the key-projects in terms of knowledge development, impact and contribution to their leadership. An important assumption was that these do not necessarily coincide. Furthermore the champions are asked which departments, stakeholders or organisations in their opinion need training in order to improve the mainstreaming of water into urban development. Other aspects that are discussed are:

- the role of international projects and the transferability of knowledge to the local conditions;
- essential knowledge domains and skills; and
- the differences between knowledge acquired through experience (i.e. 'learning by doing') and more formal training.

Theme 2 (Organisational): Transitioning towards WSUD
Within the second theme the respondents are asked to make an assessment where in the transition towards the water sensitive cities their organisation is positioned. To do this, the questions and a figure illustrating five phases of organisational development for adopting sustainable forms of water management are used (Brown, 2008). The questions focus on integration of roles (including champions), resources and WSUD-related knowledge in the organisation.

Theme 3 (Prospective): Identifying current and future knowledge gaps, hurdles to fully embrace/enable WSUD
The third theme focuses on the challenges ahead, by asking the respondents about specific knowledge domains or skills they believe are emergent, are saturated or can be regarded as innovative and promising. Additionally questions are asked to assess how the respondents differentiate between knowledge and skills/abilities and which they value more.

Theme 4 (Training format): Identification of effective and attractive training types
In the last theme the requirements for knowledge acquisition (i.e. learning) are identified. Would the respondents join future training program? Should those be case-based or focus more on specific topics? Important is also how to assess the role of e-learning.

3.3 Results

An important observation regarding the responses of the municipal water champions was the tendency to focus on the process management and organisational aspects of the transition to a water sensitive cities, even when specifically asked to focus on the issues of learning and knowledge. Many respondents tended to focus in the difficulties of creating partnerships, trust and shared

responsibilities between the different departments whenever a project is initiated that integrates different aspects, domains and budgets. Clearly, the complex organisation framework, the struggle to allocate budgets from and across different departments as well as the pressures created by politics and decision makers define to a large extent the playing field in which the respondents operate in. The issue of knowledge and training is therefore often regarded as a 'luxury' and therefore often dismissed as being of secondary importance.

a. Training, knowledge development should be organised around a case (respondents who mentioned this - 9)

It seems intuitive when interviewing practitioners: most respondents prefer learning from an actual case study. Many seem almost terrified of a more structured and theory-based learning program, presenting operational and theoretical knowledge as an opposition. "I mostly appreciate practical experience instead of abstract knowledge", a respondent answered. This is exemplified by the fact that almost none of the respondents spend time on additional studies outside the workplace. Yet, this does not necessarily mean that the practitioners are only interested in operational knowledge, some of them are interested in understanding water related issues from a broader system's perspective. The system perspective should preferably be presented though from an existing case.

b. Learning by doing is the most efficient way to acquire operational knowledge (respondents who mentioned this - 7)

Almost all respondents emphasise the importance of operational knowledge. Such knowledge is according to them primarily acquired during actual projects instead of "in a classroom". Many respondents though even opposed to investing in knowledge if it didn't immediately paid-off or applied to practice. The reasons for this varied between for instance limited faith in the persistence of knowledge acquired in this way ("After a month I will forget all I've learned") and dismissing such knowledge as being "too general" or "too abstract". Furthermore, some respondents noted that there simply was "too much to learn" and therefore preferred to streamline their learning by experience based knowledge.

The fact that 'learning by doing' often implies a less structured knowledge development process was not regarded as an obstacle by the respondents. Yet, this might in some cases lead to a partial or fragmented knowledge and impede a comprehensive understanding of the issues as well as the potential opportunities and solutions in relation to the water sensitive cities. The drive towards implementation and the required process to achieve this, does not necessarily lead to consistent embedding of knowledge in the participating organisations.

An important aspect of 'learning by doing' is that knowledge is often acquired implicitly in the form of experience. This causes that the knowledge is embedded within individuals and is possibly lost when those individuals change roles or even leave the organisation. Especially when pioneering innovative projects that pave the way for a wider application, the developed knowledge needs to become available to a wider user base. This is acknowledged by many of the respondents and is indeed identified as a potential obstacle for faster moving along the transition curve. Especially in the municipalities, little resources are available to disseminate or even formalise the obtained knowledge for broader use. Coaching as well as cross-departmental and cross-organisational traineeships are identified by some of the respondents as important opportunities to overcome this barrier.

c. Single integrated plan (e.g. municipal water plan) is essential to create a 'kick-start' for WSUD champions (respondents who mentioned this - 6)

Many current Dutch water champions where catapulted into their roles by participating in a single large water centred project. For instance for many of the Rotterdam champions from both design

offices as well as from the municipality, the formulation of the Rotterdam Water Plan proved to be instrumental in the establishment of their role. Due to the fact that the plan partially coincided with the water centred architectural biennale in Rotterdam which ensured momentum and exposure, the key contributors quickly where regarded as frontrunners and offered the opportunity to pursue their vision including the required resources, support and autonomy. Only a few respondents argued that becoming a water champion occurred gradually.

An important aspect of such plans is the reward in relation to the learning curve: many respondents felt that the combination of learning in a (for them) new domain combined with a substantial and relevant project, increased their willingness to "go the extra mile"; to do more than was initially asked from them as a contribution.

d. Coaching model (e.g. cities coaching cities) is productive model for knowledge exchange (respondents who mentioned this - 6)

Both respondents from the design offices as well the municipalities were in favour of coaching models where frontrunners create partnerships and help followers to start facilitating WSUD-practices/integrated water management. They especially note that many stakeholders (including cities) "don't know where to start when putting water more explicitly on their agenda". Case-based projects providing room for knowledge exchange are favoured. Furthermore, coaching could include staff exchange or traineeships. A former Dutch program in which so called "water ambassadors" were stationed for one day a week in cities at the beginning of their transition was regarded as highly valuable and effective.

e. Basic methodologies (e.g. ATP) are essential knowledge for many stakeholders (respondents who mentioned this - 6)

While the majority of respondents had a preference for case-based learning, learning by doing and generally tended to avoid more structured education programs, many indicated the importance of skills related to long term thinking and uncertainty management. Possibly since such methodologies are not necessarily related to WSUD-issues or even the water domain in a broader sense, adoption was regarded as essential. Many representatives from the municipalities indicated that they hoped that such expertise would be common knowledge across all departments: "from maintenance to land development". Especially methods that explicitly incorporate long-term perspectives where regarded as valuable since they would stimulate a more strategic approach, combining both spatial and temporal scales. The fact that some of the methods/skills are relatively new (e.g. adaptive management practices) and sometimes complex in application did not seem to provide a barrier. The majority of the respondents had extensive experience in the application of scenarios in a workshop environment. A subset of them did some practice in robust decision making.

f. Participation in international projects hardly contribute to knowledge development (respondents who mentioned this - 5)

A small portion of the respondents explicitly states that participating in international projects, even when they are focusing on WSUD, is not particularly beneficial for knowledge acquisition. This belief is driven by the notion that conditions abroad are often fundamentally different which hampers the transferability and ultimately the adoption the applied strategies, methods and subsequent observations and insights. Nevertheless, participation in foreign projects is considered important to assess the relative progress and position in the transition to water sensitive cities. “International projects were very important in putting your own issues in perspective” mentioned one respondent working in the municipality. Another remark made by a different respondent was: “In international projects you learn relatively little for each other, but a lot about oneself”. Additionally, international

projects seem to help setting the agenda since issues might be addressed that were initially overlooked. For instance calculations beyond the design storm of the drainage system, which in some cities are common practice, might be adopted in others when the consequences of extreme rainfall events are presented. Finally, international projects often provide inspiration and (initially superficial) legitimacy of implemented examples and pilots towards local decision makers. Showing an implemented state-of-the-art project abroad provides confidence that such an approach could be feasible.

g. No major knowledge gaps, innovations or fields are identified that are regarded as essential for adopting WSUD (respondents who mentioned this - 5)

Almost half of the respondents did not identify new knowledge domains, topics, technologies or methods that they regard as important in the development or delivery of WSUD. They mostly regard new WSUD-related knowledge related to new technologies that might ease in improve implementation but are only marginally important. This could be partially attributed to a lack of exposure to the state-of-the-art. Respondents are mainly practitioners that do not necessarily spend resources on knowledge development (e.g. visiting conferences) provided beyond the projects they are involved in.

Ironically, some the respondents do emphasise the importance of relatively new methods that can cope with uncertainties including the use of scenarios as well as more advanced instruments (e.g. Adaptation Tipping Point method, robust decision making, etc.). Yet, when asked, they acknowledged that exposure and subsequent adoption of such instruments only recently occurred after academics applied them in the various projects the respondents were involved in. This suggests that a good overview of the state-of-the-art including development in the forefront, is lacking. Judgments about the insignificance of new developments for further adoption and application of WSUD principles should therefore be treated with some degree of scepticism. Furthermore, this issue was mostly witnessed among respondents working in municipal organisations that might have a bias to overestimating the organisation and process related structures while only attributing limited importance to role of knowledge in the transition towards WSUD. When pushed, many of the respondents reluctantly admit that they would like to learn more about alternative financing strategies as well as monitoring methods for WSUD-related projects.

h. The amount of actual WSUD champions in an organisation is limited, yet that is not an obstacle for a wider uptake/mainstreaming within the organisation (respondents who mentioned this - 5)

Even though for instance Rotterdam and Dordrecht have a position as national and international frontrunners in flood resilience and more generally in climate adaptation, the amount of champions within the municipality as well as in other organisations is limited. When confronting the respondents with the limited amount of water champions, even in a city of considerable size like Rotterdam, most of the respondents were not surprised. This is to some extent due to the fact that many departments "work on incidents"; dealing with operation issues. A clear, widely supported culture (e.g. based on WSUD principles) does therefore not exist. Finally, in smaller cities, support and championing is very much dependent on local politics: if the alderman is providing support to the water champion, the vision can easily be disseminated across the various departments. If on the other hand support is lost, departments tend to pull back and stick to their responsibilities and liabilities. This can be also witnessed on a more formal level, where for instance the 'Rotterdam Climate Proof' was initiated and operating as a highly successful cross departmental body but was dissolved due to lack of resources during the economic crisis.

An interesting observation by one of the respondents representing the Rotterdam municipality was that there can be a substantial disparity between the external and internal position of the city in the transition curve. Rotterdam has been heavily investing in the development of an international network, in which it operates as one of the frontrunners. The city participates in many projects in which knowledge transfer is essential. For the outside world, Rotterdam is well underway in the transition to a water sensitive city. Yet, this success in combination with the limited number of champions and the subsequent scarce resources sometimes hampers the uptake and mainstreaming of WSUD-principles across the many departments within the municipality.

i. E-learning is not the format for effective knowledge acquisition (respondents who mentioned this - 5)

Although the respondents embrace the use of modern IT-technologies, about half of them explicitly state that e-learning-based knowledge acquisition is unsuitable for them. Most of them believe that e-learning is passive and unidirectional; they strongly believe that physical interaction with a lecturer/tutor is a requirement for learning. The sepsis about e-learning is directly related to the preference for ‘learning by doing’ as well as the case-based knowledge development that the majority of the respondents seem to promote.

j. Pilot projects are essential to initiate a transition (respondents who mentioned this - 4)

A number of respondents indicated the importance of delivering pilot projects to initiate or speed up the transition to making WSUD practices mainstream. "Pilot projects inspire decision makers as well as the public...they are tangible products of a water centred approach", a respondent noted. The intuitive notion that pilot projects are important in showing but also testing and monitoring WSUD principles seems obvious. This was especially important for frontrunners that are often confronted with high expectations in relation to the delivery of actual change. Pilot projects act as sign posts that signify that "things are actually happening".

Yet, there were also respondents (2) who suggested that the realisation of pilot projects could hamper the transition. The reasoning was that pilot projects often profit from the special conditions created to facilitate implementation. For instance, the regulatory framework might be relaxed to accommodate experimentation; budgeting and responsibilities of departments are changed in order to ensure execution. "At the moment things are 'business as usual’; mainstreaming similar projects in actual practice is as difficult or even more difficult than without the initial pilot. (...) The expectations created by the implementation of the pilot project can create obstacles for widespread implementation". These obstacles are mostly institutional in character: e.g., municipal departments expect similar conditions for widespread implementation of projects as were created for the pilot. After the realisation that these do not exist, the departments often become reluctant and passive. Furthermore, pilot projects often have a tendency to "be spectacular", in order to create media attention, public support and to ensure that the responsible decision maker has something to show for. Subsequent widespread implementation of projects with similar functionalities is often implemented with more limited budgets, resulting in simpler versions. This sometimes results in a decrease of attention and motivation to support and implement projects in this phase.

k. The growth of the organisation causes fragmentation of knowledge (respondents who mentioned this - 4)

Especially respondents from some of the design offices indicated that they had difficulties with their knowledge management. In particular, increasing the staff size often resulted in a decentralisation of knowledge among staff. The question how to make that knowledge transferrable was answered as being "difficult". Since there are often no resources available (including time), no effort is made to distribute knowledge in a consistent, structured manner within the organisation. Thus, knowledge

becomes often implicit and largely based on experience. This often means that "the wheel has to be invented again" for new projects. This problem seems mostly related to the growth of the number of project leaders/designers that act as pivot points for a supporting staff, including specific domain experts.

I. A major change compared to 'the past' is that water has a prominent place on the agenda (respondents who mentioned this - 4)

Within urban planning, landscape design and to some degree in architecture, water seems to have a more prominent position than before. Respondents note that both in education as well as in practice water related issues have become mainstream and are not regarded as specialties."(...) there is more room to go 'in depth' than before". In educations this means that design projects are either focused around some water issue (e.g. flooding, resource management, drought or a combination of themes) or are regarded as important constrains/factors that should be considered when formulating design proposals. One respondent noted that "One of the reasons (e.g. for the integration of water) is that in many (urban) design commissions the topic of water is explicitly mentioned. (...) The topic of water moved from landscape architects to urban planners and from rural to urban".

3.4 Transitions and phases

Both the respondents from the municipalities and those from the design offices positioned the respective cities they were mainly operating in (i.e. Amsterdam, Arnhem, Dordrecht, Nijmegen Rotterdam and The Hague) somewhere in the middle of the transition curve. Often cities mentioned that Dordrecht and Rotterdam where regarded as the main frontrunners. No cities were appointed that were considered to be clearly behind. Yet, the use of the transition curve seems somewhat problematic since the criteria and scale used for positioning is somewhat arbitrary. This is why the somewhat more expressive framework by Brown (2008) was used, where the transition is divided into 5 phases: Project, Outsider, Growth, Insider and Integrated. Classification is based on a set of characteristics that for instance focus on the allocation of resources, the role of champions or the collaboration between agencies. Based on the interviews with the relevant respondents, an attempt was made to classify the City of Rotterdam, which is in the Dutch context regarded as one of the frontrunners.

Table 5. Classification of Rotterdam within the framework by Brown (2008), all relevant statements are marked in bold.

1. Project

- WSUD work often coordinated by a technical officer (e.g. an engineer) with relatively little experience
- WSUD seen as a short-term low-priority, one-off project that is not related to 'core business'
- WSUD implemented when needed to meet regulatory requirements
- Few resources for WSUD
- Little community involvement with WSUD projects
- Low Performing water agencies with respect to implementing WSUD

2. Outsider

- WSUD often driven by an environmental officer or group ('outsiders')
- Role-related conflict between environmental officers(s) and other parts of the agency;
- **Still a small budget and low priority for WSUD**
- Poor inter-agency relationships
- **The focus of WSUD leaders is to build external support and resources**

3. Growth

- **WSUD driven by a team of people within the agency**
- Growing resources (human and financial) for WSUD
- Growing commitment for WSUD at the community, managerial and political level
- WSUD roles and responsibilities are still unclear, and there is some intra-agency tension
- Inconsistent delivery of WSUD (i.e. still ad hoc)
- **Strong extended stakeholder network**
- Proficient at accessing external funding for WSUD projects
- Effective champions are becoming apparent

4. Insider

- **WSUD often driven by a high profile champion(s)**
- Champions play an important networking and knowledge brokering role across organisational boundaries
- **Stronger inter-agency relationships but collaboration is limited to some units**
- **Strong relationships with research and non-governmental organisations**
- Pilot projects foster collaboration
- Agency wants to demonstrate WSUD leadership

5. Integrated

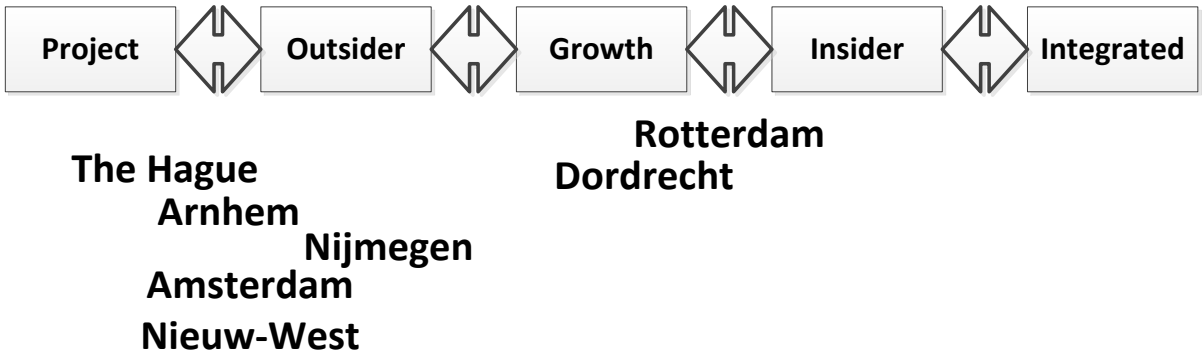
- WSUD is typically driven by many leaders within the agency
- WSUD is now 'core business'
- The culture values corporation, learning, research, community participation and principles of sustainability
- High levels of commitments and resources for WSUD
- Strong policy related to WSUD leadership (i.e. the agency delivers outcomes beyond regulatory requirements)
- High performing agencies

An important observation of this exercise is that it is virtually impossible to position Rotterdam in a single phase; statements of the Outsider, Growth and Insider phases are all appropriate to describe how Rotterdam is trying to integrate WSUD-practices. Depending on the fact if one can weigh the statements equally, one could argue that Rotterdam can be positioned at least in the Growth phase and more likely in the Insider phase. On the other hand, when it comes to financing WSUD, the city

seems to be still stuck at the Project phase. This is partly due to the major austerity measures on municipal level in The Netherlands, resulting from the ongoing financial and economic crisis.

A similar exercise has been performed for the other cities from which water champions have been participating in the interviews. The outcomes are shown in Figure 4.

Figure 4. Classification of cities in the framework by Brown (2008)



The assessment shows that no cities reached the end of the transition yet (i.e. they are clearly in an Insider or even integrated phase). On the contrary, most cities are still moving between the Project and Outside-phase which indicates that WSUD-principles are still mostly applied at an ad hoc basis and little to no support and collaboration exists between different municipal departments. Actual water champions have not been established.

3.5 Conclusions and Recommendations

One of the major outcomes of these interviews is that any educational or capacity development programme should be organised around actual cases, actively involve participants in a project oriented manner and focus on skills and operational knowledge. Skills should be focussing on the integration of a long term perspective by offering tools that operationalise flexibility and/or robust policies, strategies and measures. Both the frontrunners in the municipalities and design offices seem to require little training in more 'fundamental knowledge'.

An important asset of frontrunners might be their enthusiasm for coaching programmes between cities, municipal departments and/or other agencies. A 'train the trainers'-approach might therefore be an effective way to make WSUD-practises available to more cities. Training of water champions on the other hand seems most effective when through large multi-disciplinary projects. For practitioners and policy advisors, participation in international projects does not necessarily help in their development.

Finally, the use of e-learning platforms is still facing many barriers: only few respondents have faith a in a digital learning environment. This is partly due to the limited motivation for self-study.

4. Skills and Knowledge Needs – Vietnam

4.1 Respondents

To assess the potential group of respondents for the training needs assessment for Vietnam an initial inventory was made within the Post-Graduate Research Programme on Adaptation to Climate Change (ProACC) Phase 2, Urban-project as well as from the Netherlands Initiative for Capacity development in Higher Education (NICHE) Vietnam project that involve a number of local representations of federal agencies, municipalities and academia. The projects not only provided a relatively wide group of representatives, but also ensured accessibility of the respondents within a limited timeframe.

Table 6. Organisations included in the water champion interviews based on type and location of organisation

Type of Organisation	Name	Role
Government Institution	Department of Agriculture and Rural Development (DARD)	Water manager for agriculture (irrigation)
Government Institution	Department of Natural Resources and Environment (DONRE)	Planner/Designer urban development
Government Institution	Flood Control Steering Centre of Ho Chi Minh City	Water manager for flood related issues (pluvial & fluvial)
Municipality	Can Tho Municipality Department of Public Works	Planner construction works
Municipality	Can Tho Municipality Department of Planning & Design	Planner/Designer urban development
University	Can Tho University	Lecturer/Researcher
University	Viet Nam National University Ho Chi Minh City	Lecturer/Researcher

4.2 Interview method

Conducting unstructured or semi-structured interviews in Vietnam proved to be difficult, if not impossible due to the limited English language skills of the respondents. While on approach would be to conduct a limited amount of interviews facilitated by an interpreter, the choice was made to setup a translated questionnaire. This would ensure a larger, more representative group of respondents yet possibly sacrificing the more in-depth discussions in an oral setting. Furthermore, using a questionnaire would more easily integrate within the framework of a professional training workshop within the NICHE-programme, organised in Can Tho, Vietnam in March 2014.

Since most of the workshop participants, and therefore the sub group of respondents, were not familiar with the concept of water sensitive cities and WSUD, an introduction lecture, a group work exercise and a plenary discussion were organised. Here too, the requirement of translation imposed limits to the degree of interaction and the question remained if the concepts were successfully transferred. Following the lecture on water sensitive cities, the participants were asked to answer the questionnaire in groups based on organisations/cities (e.g. Can Tho municipality in one group, DONRE in one, Can Tho University in One, etc.) Then the groups were invited to share their findings on one question in the plenary. The responses were discussed. After this step the individuals were asked to fill in the questionnaire within a one hour period and submit it.

The questionnaires were aiming (i) to identify where in the transition to WSUD the respondents would place their organisation, (ii) identifying the obstacles for adopting WSUD-practices and (iii) to indicate in which particular topics the respondents identified knowledge gaps or insufficient skills. The questionnaires are attached in Appendix 3.

In order not to hamper the free expression of views by the language barrier, respondents were allowed to respond in Vietnamese. The responses were processed by our Vietnamese counterparts, and summarised into a set of main statements for which a distinction was made between academic scholars and (local) government representatives. This unfortunately led to a loss of information since they assumed that only the "main conclusions" should be kept. As a consequence, the outcomes lack expressiveness as well as a solid understanding how representative the conclusions are for the total group of respondents.

4.3 Results

An important outcome is that almost all respondents were not familiar with the term water sensitive cities or WSUD. Generally, they acknowledge the importance of urban planning practices in relation to urban water management but especially government representatives had little or no idea how to turn that awareness into practice.

a. Familiarity with the water sensitive cities concept and WSUD principles

None of the respondents had previously encountered the terms water sensitive cities and WSUD. Most of the respondents were familiar with an integrated approach to urban water management, but mostly as a vague notion; they were aware of the urban water cycle but could not place the concept of its integrated management in their everyday practice. Yet, many (especially the university respondents and several government officials) were familiar with concepts and many measures promoted in WSUD. They were aware of "textbook examples" of best practices in storm and surface water management, low impact development measures, sustainable urban drainage, rain water harvesting as well as broader concepts like "eco-cities". The majority of (local) government representatives though were not so familiar with these principles, techniques and measures.

b. Limited knowledge of organisational aspects of WSC/WSUD

Governance in Vietnam is organised in a dominantly top-down fashion. Especially the academic scholars, therefore had very little knowledge and experience in organising stakeholder consultations, governance structures or any process or organisation related issues concerning water management. The stakeholder spectrum is limited to the government agencies and (to a very little extent) universities.

c. Obstacles for future adoption of WSC/WSUD practices

All respondents agreed that there are many barriers that for now limit the possibilities for adoption of WSC/WSUD practices. The respondents mentioned the following issues as most prominent:

- *Lack of knowledge*. As mentioned earlier, *operational knowledge* of how to apply water sensitive cities/WSUD practices is lacking. Most respondents feel they are unable to transform the concepts into applicable concrete measures within their local context. This includes an overview of tools, examples, management and maintenance systems as well as financing issues. There is little knowledge about integrating best practices of integrated water cycle management for (urban) development activities. The ‘text book’ knowledge that the universities possess are not often grounded in local examples of practice.

- *Lack of skills*. Respondents mostly pointed at the very limited abilities of effective collaboration: cross-departments, scales, institutional levels as well as domains. In a city, this would typically include the problematic relation between the municipal water supply company and the drainage company, the municipal departments (e.g. public works and planning) but also between city, province and central government.
- *Lack of integrated view*. While many issues, including climate change, are considered as urgent, integration of the issue into a consistent policy, strategy and associated portfolio of measures is absent. In practice this means there is little or no follow up from the many discussions across the different institutions.
- *Financial Issues*. The problematic conditions for an integrated view are further exacerbated by a lack of resources for integrated projects. Most funding mechanisms promote sector-based developments. For instance funding for climate adaptation is separate from funding for drinking water supply. Construction activities where most of the investment funds go into operate in isolation from climate and water cycle integration concerns. In spite of a general lack of funding (which should, at least in theory encourage looking for efficient means) no synergies are developed within an environment where resource allocation is scarce.
- *Legal issues*. Many laws and regulations are outdated and seem to provide obstacles for WSUD. Furthermore, enforcement of existing regulations and laws is weak. This is exemplified by creeping urbanisation; much of the urban development is taking place outside the existing zoning plans with sometimes devastating impacts on the urban water cycle, subsequent flood risk and water quality.
- *Problematic science-policy interface*. Especially the academic scholars emphasised the lack of knowledge exchange between the knowledge institutes and policymakers/practitioners.

d. Potential measures to overcome barriers preventing adoption of WSC/WSUD practices

The government representatives first of all feel a lack of leadership in relation to a more integrated approach in water management related issues. They would like a stronger role for the central government in developing policy, a regulatory framework and the required responsibilities, actions and financial means to facilitate WSC/WSUD. Yet, they do acknowledge that training of higher and medium level government institutions is required to actually make this process operational. This should also proceed along a top-down trajectory, where first they higher government level should be trained before lower levels. Furthermore, they want better promotion of a collaborative environment instead of a competitive environment; currently many mid-level government institutions are competing with each other for financial allocations, increased legitimacy and ultimately, power, by increasing (and often exaggerating) the urgency and exposure of their work over other departments. This prevents fruitful collaboration and leads often to trust-issues between departments.

The academic scholars on the other hand, focus more on mid to low-level study groups, learning alliances and other platforms to exchange knowledge and experiences. Furthermore, they emphasise the importance of pilot projects that promote 'learning by doing'. They stress that cross-sector collaboration will only appear in actual projects, thus starting new initiatives is essential.

e. Need for both theoretical and practical knowledge

The two different groups of respondents seemed to have complementary ideas about the different training and educational needs. The government representatives mostly identified typical water related knowledge domains as currently lacking. Water management (e.g. auditing, policy making, integrated water management) as well as water related technologies (e.g. *asset management and water cycle management, waste water treatment*) were mentioned.

The academic scholars on the other hand, were keen on *learning from practice*. They identified training needs that focus on the *delivery of pilot projects*, *actual case studies from both home and abroad* to be essential.

f. Better fit-for-purpose governance

While on the one hand, the government representatives looked upwards for water sensitive cities/WSUD-related policy and regulation, they identified some level of decentralisation of the Vietnamese governance structure as essential for better future facilitation. Together with a better knowledge exchange and collaboration, they would like to be empowered to take a bigger responsibility in the delivery of water sensitive cities/WSUD practices. To improve collaboration they proposed initiating a new role for cross departmental officers and/or experts that enhance collaboration. The academic scholars add to this a more general effort *to increase awareness of water sensitive cities/WSUD concepts and practices*.

g. Need for incentives

Establishing water sensitive cities/WSUD related initiatives is difficult without the 'proper incentives'. The government representatives agree that their departments can start collaborating to implement WSUD, but *lack the incentives to do so from higher government levels*. There is no incentive for cities to become frontrunners due to a limited sense of urgency, lack of reward system (liabilities instead of rewards) and limited amount of champions in key positions.

The academic scholars see a role in their task as educators; they want to make *water sensitive cities/WSUD part of their curricula*. Furthermore, universities open up their campuses for experimentation (i.e. pilots).

4.4 Conclusions and Recommendations

There is a strong need to influence the national policy in order to activate the change at municipal level. Climate adaptation is high on the countries agenda, however, an integrative view (looking from an urban water cycle viewpoint) is lacking. Without this there is no incentive for various sector organisations to collaborate. In contrast to the situation of for instance The Netherlands, the context in Vietnam calls *not only for a need to develop skills but basic training/education on topics related to water sensitive cities. Especially 'integrative' topics like Urban Water Cycle management, Asset Management of Urban Water Systems.* One of the opportunities to accelerate WSC transitioning could be pilot cases.

5. Skills and Knowledge Needs - Bhutan

5.1 Introduction

Bhutan is a small landlocked country in the Himalayas in South Asia. The population of the country is about 750,000 of which the majority lives in the capital Thimphu. The population is growing at an annual rate of about 1.15%. The economy of the country depends mainly upon the hydropower generation and tourism. Because of the small population, governance structures can be compared to those of a large city.

During the UNESCO-IHE and Asian Development Bank initiated Asia-Netherlands Water Learning Week, a delegation arrived from Bhutan that were interviewed concerning their training needs in relation to integrated water management and water sensitive cities / WSUD in particular.

5.2 Respondents

The delegation consisted of 4 water champions, from both federal ministries and municipalities.

Table 7. Organisations included in the water champion interviews based on type, organisation and role

Type of Organisation	Name	Role
Ministry	Department of Engineering Services (DES), Ministry of Works and Human Settlement	Director
Ministry	Project Management Unit, Department of Engineering Services, Ministry of works and Human settlement	Project Director
Municipality	Phuentsholing Municipality	Project Director
Municipality	Thimpu Municipality	Project Director

5.3 Interview method

An important tool for setting up the interview is the diagram by Wong and Brown (2008) in which the evolution of cities is presented as a series of transformations in the delivery of water services. The respondents were provided with an explanation of the diagram and a broad characterisation of the concepts of water sensitive cities and WSUD.

Due to the limited capacity and time contains, the assessment was setup as unstructured group interviews in which the following topics were covered:

- familiarity with WSC and WSUD related concepts and practices;
- estimation of where in in the transition their organisation was positioned using the Urban Water Management Transitions Framework from Wong & Brown (2008);
- obstacles for a more integrated approach in which water has a more central role;
- limitations in knowledge and skills; and
- Policy, governance as well as implementation issues related to water sensitive cities and WSUD.

5.4 Results

All the organisations felt that they were in the beginning of the transition curve. The placed themselves as the cities transitioning from a Water Supply City to a Sewerage City. They were also fully aware of the lack of water supply coverage; acknowledged the fact that Thimpu would take about

5 – 6 years to have complete water supply coverage, 8-9 years for complete sewerage coverage. Universal coverage of water supply and sewerage would be possible only in a distant future in other cities in Bhutan. Professionals from DES were of the opinion that most of the objectives of a Water Sensitive City or the like could be accomplished in Thimphu municipality in about 20 -25 years. The Structure Plan 2027 for Thimphu Municipality in their view addressed some of the aspects such as Water supply, sewerage and drainage to an extent in transitioning towards a water sensitive city. All the water professionals stated that there is a greater momentum on the activities related to urban water than it was ten years ago.

The professionals interviewed and their organisations were only involved in planning the engineering activates and implementing them on ground. They had very little or no say in planning at a policy level. *Lack of coordination between various departments* was cited as the reason hindering the transition to a higher level and all of them felt that a better coordination between the departments at all levels would enable smooth transition. Lack of capacities was also mentioned as the main reason for lack of foresight in planning, delayed implementation, operation and maintenance of water related utilities. Professionals from DES were of the opinion that there was lack of capacities at all levels: at the directorate level and at cites with respect to planning, implementation and Operation & Maintenance. *Lack of capacity for planning* was seen as bottleneck that needs to be addressed on an urgent basis as it had direct implication on implementation and *Operation & maintenance*. There was emphasis on the need towards *training and capacity building in Urban Planning*. At the city level the professionals from municipality stressed on the needs for capacity building towards *implementation, operation & maintenance, asset management aspects and best management practise* (higher level training) along with Do's and Don'ts for ground staffs such as fitters and plumbers (technician level training). Though urban floods do not cause destruction to life and property they felt there is a need for training on flood management due to the changing climate scenarios.

DES had already carried out a detailed training and needs assessment for the departments in the Ministry of Works and Human Settlement. Also DES has been looking for an active cooperation from capacity building agencies abroad to bridge the gap and enhance their skills. Also the professionals felt there they could benefit by knowing more about the emerging concepts such as *city greening* and *business case development*. When specifically asked about to comment about the challenges that their organisation might face as professionals with enhanced skills might move abroad seeking better employment, they were of the opinion that the proportion of attrition is very less and even those who leave the organisation set up their own consultancy or businesses supporting development of water services and that there no net loss and only gains due to capacity building. However according to them the attrition due *lack of capacity is more prevalent in private sector* than in the public services

5.5 Conclusions and Recommendations

Due to the modest development of water related services in Bhutan and a relative lack of general knowledge and skills to initiate a rapid transition, much ground work still needs to be done. Capacity Development and training are urgent requirements. Yet, due this very fact of being in early stages of urban development, there seems an opportunity to leap-frog Bhutan across many of the typical evolutionary steps many cities cross before reaching more evolved stages of water service delivery. Particularly developing and educating new water champions in Bhutan combined with a 'hands-on' approach to implementing best practises could have big and very positive future impacts.

6. General Conclusions and Recommendations from both Australian and international needs assessments

6.1 Findings and discussion

Across most of the countries, an overwhelming number of respondents identified institutional barriers and inadequate organisational arrangements as the major obstacle for the transition to WSUD and ultimately water sensitive cities. The lack of cross-departmental collaboration within as well as outside the organisation seems to obstruct the integrative nature of water sensitive cities practices and ultimately projects. Yet, the identified institutional arrangements and subsequent organisational/managerial changes are not necessarily related to the domain of water sensitive cities. Many contemporary projects with an integrative character require such arrangements. Thus, explicit focus on the domain of water sensitive cities is not always essential; the required skill-set stretches beyond this knowledge domain and seems to be more generic. Even so, an additional important identified requirement from this assessment was the necessity to include actual cases around which the training should revolve. In Australia, The Netherlands as well as in Vietnam and Bhutan, operational knowledge was valued high. Thus, new fit-for-purpose governance arrangements that provide the framework for the delivery of real-world water sensitive cities /WSUD projects (project-based learning/training) could very well serve as focus points in training. This could also ensure the engagement of champions and frontrunners in the actual courses or provide the incentive for a coaching model that seems to be favoured by many of the Dutch respondents.

The curriculum of training programs should be versatile. These should range from a complete Master's program/specialisation on for instance urban water management to tailored one-day workshops aiming at key decision makers. The latter is especially important for the development of champions, which was identified as one of the key ingredients for initiating projects and starting the transition towards WSUD and water sensitive cities. To deliver such a diverse curriculum of WSUD/water sensitive cities -related training, a large number of individual modules are required that can serve in comprehensive program (i.e. building up to a Graduate Certificate) as well as a standalone module about a specific topic. Thus, there seems to be a need for versioning of courseware; topics should be tailored to for use in comprehensive graduate programmes, short courses or even one-day workshops targeted at for instance higher management. This requires close collaboration of content providers, the availability of different case studies (incl. sufficient background material) and a relative open structure of courses in which resources can be easily exchanged and adapted.

Although especially the Dutch respondents have reservations against the use of e-didactics and distance learning, such an approach could potentially target a much larger audience including those from developing countries. Hybrid models (blended learning) that mix actual classes with e-learning based self-study could very well provide both the depth and breadth required by some of the participants. Alternative training models (e.g. coaching of cities or institutions) should not by ignored since a major part of the knowledge regarding especially the implementation of WSUD projects is grounded in experience and often beyond the academic realm. Partnerships between traditional knowledge institutions and “frontrunners in the field” should therefore be pursued and fostered.

For many respondents the application of more fundamental concepts in actual cases seems particularly difficult. Especially for developing countries (i.e. Vietnam and Bhutan), there is a clear

demand for acquiring a basic skill-set with a focus on operational knowledge. An in-depth overview of the state-of-the-art in current tools and technologies is requested. This provides many opportunities to directly use or adapt existing training modules into the different types of WSC-focused training. In general though, knowledge gaps appear particularly outside the scope of traditional engineering related topics. Especially knowledge on the assortment, requirements and potential benefits of applying green infrastructure in urban environments are often limited. Also knowledge about monitoring, performance assessment and management (i.e. asset management) of water related services is in high demand.

An important observation from the needs assessment is the limited focus of the process (both the questionnaire and the respondents' views) on the issues concerning water sensitive urban planning and design. While the development of design criteria, the collaboration with designers to develop high quality urban environments as well as the appraisal of design proposals is essential for transitioning to water sensitive cities, this seems underexposed in the needs assessment. This might to some degree be attributed to the planning and design traditions that differ per country. In The Netherlands for instance, urban planning and the design of public space and infrastructure has a long tradition. This is probably an exception. In many other countries, urban planning and design might be less regulated and emphasis is more on the compliance within a regulatory framework. Nevertheless, it seems essential to both address and integrate urban planning and design in the proposed curriculum of training modules to create a design culture in which water related issues and in particular water sensitive design becomes standard practice. To some extent this is already realised in The Netherlands where water became an important element in urban planning and design. Yet, on the scale level of architectural design (i.e. building scale), the integration of water sensitive principles is practically absent.

Finally, it is important to realise that knowledge gaps are not the only obstacle for transitioning to WSUD and water sensitive cities. The needs assessment clearly showed that many of the barriers are institutional. In some areas (e.g. in Vietnam) the lack of incentives and initiative in a predominantly top-down governance structure is identified as a leading cause. The proper mandate to initiate WSC-related actions is therefore missing. For example many urban development related organisations are restricted in their aspirations due to legal, regulatory and governance systems. Many individuals understand and appreciate the need for inclusive and integrated thinking in urban development, but point out that such integrations lay outside their mandates. Therefore a sort of governance/institutional reform is very much required as well. In other areas, the basic infrastructure is lacking and the role of WSUD is more 'basic' by helping to facilitate a basic level of water services. On the other hand, this provides opportunities for leapfrogging. Cities may jump many steps forward instead of having to 'repair past mistakes'. To achieve this, education is essential.

The presented assessments of training needs in the Australian context as well as for countries in Europe and Asia all somewhat differ in scope. Nevertheless, the all focused on interviewing "water champions" with different institutional backgrounds. In some respect, many of the outcomes are remarkably similar across countries and institutions. This provides a common ground for setting up training modules that have a scope and impact that transcend their initial scope and reach, thus providing a potential for cross country collaboration.

6.2 Knowledge and skills domains

Throughout the interviews, particular knowledge domain or skills were often mentioned as crucial for the integration of WSUD practises into the organisation. These topics and skills could be regarded as essential within the provision of a future curriculum of training programmes, individual modules or standalone workshops.

WSC knowledge and skill development areas:

- Economics of water sensitive cities.
- Policy and regulations regarding water sensitive cities.
- Strategic planning.
- Risk analysis (strategic risks and water related risks).
- Community and stakeholder engagement.
- Management and maintenance of WSUD assets.
- Change management.
- Land use planning (including GIS, modelling, etc.).
- Integrated water management.
- Project management (proposals, planning, management, evaluation).

6.3 Recommendations

From the needs assessment, the derived conclusions and discussion a set of recommendations has been comprised that provides a general direction for forthcoming initiatives.

- Develop a broad spectrum of courses: ranging from complete Graduate programmes, short graduate level courses, tailor-made intensive programmes to stand-alone workshops aimed at high level management.

- Ensure that courseware is open: use, adapt and offer courseware to a network of trainers and knowledge providers within the CRCWSC.

- Collect and develop a large number case studies to illustrate key issues in different local or regions settings.

- For various courses/programmes attempt to develop local case studies from familiar contexts rather than exclusively using case-studies and ‘success—stories’ from elsewhere.

- Emphasise content on organisational learning & collaboration within the water domain.

- Knowledge and skills should be centred on actual cases.

References

Alaerts, G. and Kaspersma, J. (2009), Progress and Challenges in Knowledge and Capacity Development, In: Blokland, M.W., Alaerts, G.J., Kaspersma, J.M. and Hare, M. (2009), *Capacity Development for Improved Water Management*, UNESCO-IHE, Delft.

Argyris, C. (2004), *Reasons and Rationalizations, The Limits to Organisational Knowledge*, Oxford University Press, Oxford.

Brown, R. (2008). Local institutional development and organisational change for advancing sustainable urban water futures. Environmental Management, 41, 221-233.

Brown, R., Keath, N., Wong, T., (2008). Transitioning to Water Sensitive Cities: Historical, Current and Future Transition States. Proceedings of the 11th ICUD, EICC, Edinburgh, Scotland. 31 August - 5th Sept. ISBN 978 1899796 212.

Cohen, W. and Levinthal, D. (1990), Absorptive capacity: a new perspective on learning and innovation, *Administrative Science Quarterly* 35(1): 128-152.

CPC (2014). Final report Climate Proof Cities 2010-2014, Foundation Knowledge for Climate, Utrecht.

Francis, D. and Bessant, J. (2005), Targeting innovation and implications for capability development, *Technovation* 25(3): 171-183.

Geels, F.W., (2004), From sectoral systems of innovation to sociotechnical systems: insights about dynamics and change from sociology and institutional theory, *Research Policy* 33: 897–920.

Morgan, G. (1997), *Images of organisation*, Sage, London.

Smith, A., Stirling, A., Berkhout, F. (2005), The governance of sustainable socio-technical transitions, *Research Policy* 34:1491-1510.

Spiller, M., McIntosh, B.S., Seaton, R.A.F. & Jeffrey, P.J. (2013), Implementing pollution source control –learning from the innovation process in English and Welsh water companies, *Water Resources Management* 27:75-94.

Spiller, M., McIntosh, B.S., Seaton, R.A.F. & Jeffrey, P.J. (2015), Integrating process and factor understanding of environmental innovation by water utilities, *Water Resources Management*, 29: 923.

Taylor, A. (2010). Sustainable urban water management: The champion phenomenon. PhD Thesis. Monash University: Melbourne, Victoria.

Wong T. and Brown R. (2008). Transitioning to Water Sensitive Cities: Ensuring Resilience through a new Hydro-Social Contract, Paper submitted to the 11th International Conference on Urban Drainage, August 2008, Edinburgh.

Appendix 1 - Skills and needs assessment process

Interview questions:

1. Could you describe what your organisation does with regards to water management and what your role is within the organisation? *Discuss the WSC transition curve and Organisational Functions table*

2. What has changed over the last 10 years in how your organisation is involved in managing water? Could you give some examples of programs, projects or activities that have changed and are now done differently? How successful were they? What was your role?

3. Where on the transition curve do you think your organisation was 10 years ago and where do you think they are now? What are your reasons for placing it there?

4. What internal changes were necessary to move your organisation to where it is now? What blockages and issues did you or others encounter? What kinds of job roles (functions or disciplines), and what skills and knowledge were involved?

5. What external changes were necessary to move your organisation to where it is now? What kinds of job roles (functions or disciplines), and what skills and knowledge were involved in organisations other than your own?

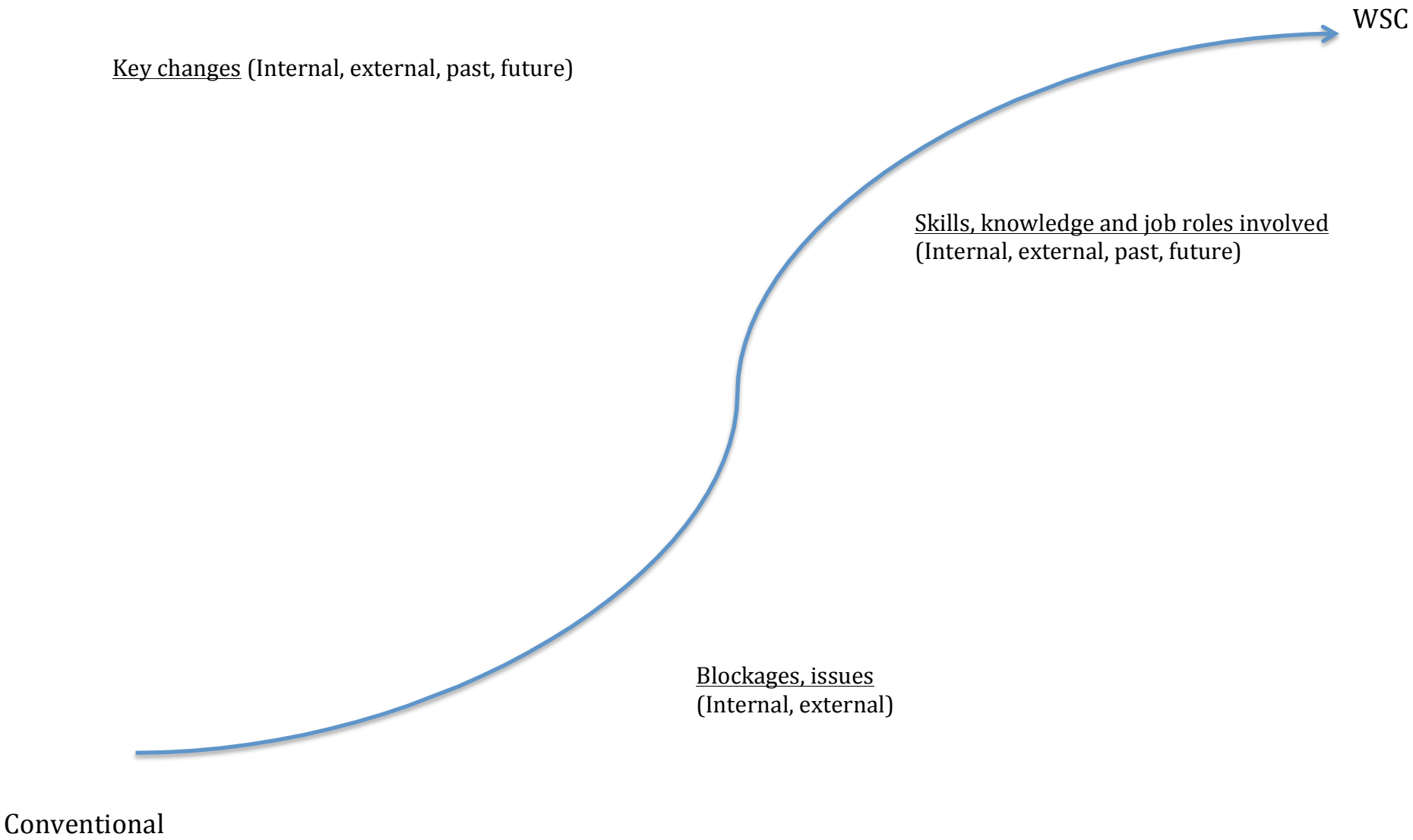
6. What internal changes would be necessary to move your organisation further up the spectrum toward playing a full role in implementing WSC? What kinds of job roles (functions or disciplines), and what skills and knowledge do you think will be needed?

7. What external changes would be necessary to move your organisation further up the spectrum toward WSC? What kinds of job roles (functions or disciplines), and what skills and knowledge do you think will be needed in organisations other than your own?

8. Has your organisation conducted any training and education needs analysis? If so, could we have access to this information?

9. Could you suggest anyone else (internally or in other organisations) who we should speak to about this topic?

Organisational functions from conventional to water sensitive cities



Organisational functions from conventional to water sensitive cities

Urban Water system Attributes	Conventional approach	WSC approach
Purpose	Water supply Sewerage Drainage and stormwater flood control Public health protection	Multiple purposes for water – waterway health; other needs (transport, recreation, amenity, micro-climate, energy, food) Fit for purpose water Reuse of water – consumption and waste are closely linked
Management approach	Compartmentalised by functions (planning, supply, wastewater etc.) Optimisation of individual components of urban water cycle	Integrated management across functions Managed as a total water cycle Adaptive Multiple purposes considered
Expertise	Engineering and economic focus	Interdisciplinary (including planning, ecology, health, hydrology, community participation) Multi-stakeholder learning across social, technical, economic, political, design, ecological spheres
Service delivery	Centralised and linear Engineering and economic efficiency Service organisations act independently of each other	Decentralised, interconnected, flexible Engineering and economic efficiency plus social and ecological benefits Service organisations collaborate effectively.
Role of public	Water managed by government on behalf of communities	Co-management of water between government, business and community
Risk	One size fits all risk management	Risk management tailored to context
Service sustainability	Based on maintenance and capital investment of water infrastructure Technical and legislative solutions for flood and drought planning	Built in resilience to change (climate change, population increases etc.) through diversification and decentralisation Multifunctionality of assets (e.g. green spaces for recreation and flooding)

Appendix 2 - Skills and needs assessment process – European context

Interview questions:

Theme 1 (Retrospective): Identifying essential knowledge domains in becoming a champion

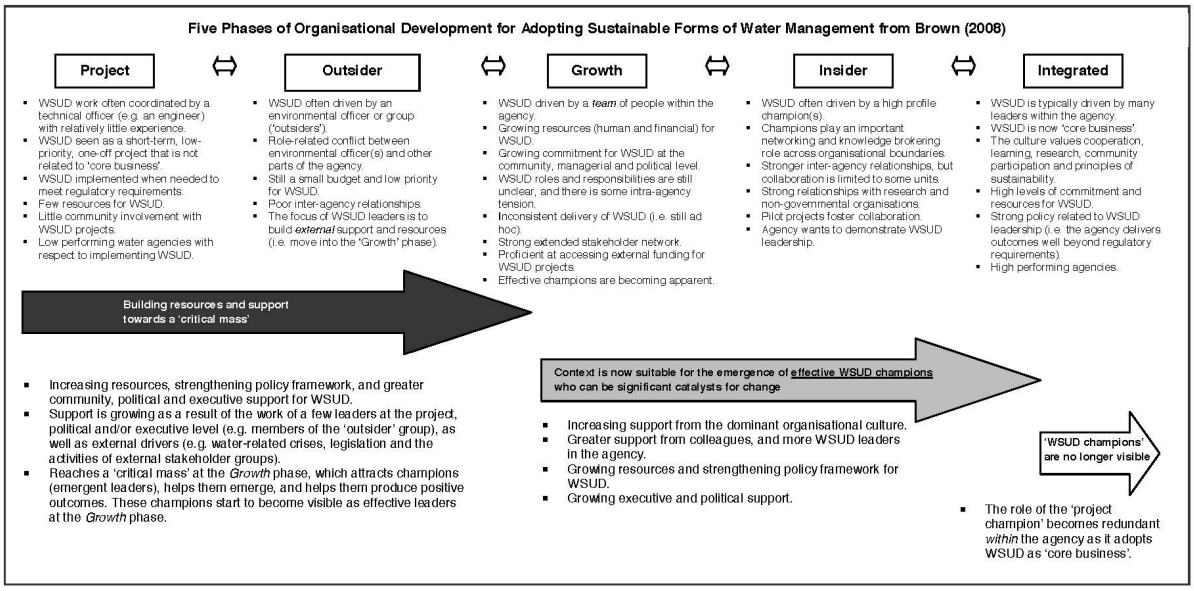
Over the past years you have lead your municipality to a more water sensitive practice, integrating water cross sectoral, cross modal.

1. Which 3 projects over the past years have provided you with most knowledge in relation to WSUD? What knowledge did you obtain?
2. Which 3 projects over the past years have had the biggest impact in adopting WSUD in your municipality? What where the factors that enabled this?
3. Which 3 projects over the past years enabled you to become a champion in WSUD? What aspects ensured this (e.g. required leadership, innovation, cross departmental collaboration)?
4. How important do you consider the role of international projects in the adoption of WSUD principles?
5. How do you currently evaluate knowledge driven project proposals? Which key aspects should they incorporate to make them valuable for your organisation?
6. If you would train a successor, which knowledge domains/skills would you identify as essential?
7. If you could choose other individuals/departments to follow training, who would you pick and what knowledge should be transferred?
8. How do you assess the ratio between 'common knowledge', 'domain specific formal knowledge' and experience based knowledge (i.e. implicit knowledge) in your WSUD practice?

Theme 2 (Organisational): Transitioning towards WSUD

1. What is your role? Is WSUD explicitly mentioned in your role description or have you adopted it? How many roles are typically connected to WSUD in your organisation? How many champions would you identify in your organisation?
2. How do you actively integrate WSUD-knowledge in projects and/or policy? Is there a big difference?
3. How is the integration of WSUD regarded financially? Do you have to justify that WSUD could be cost effective (short/medium/long term)? On what basis are your appraisals trusted?
4. How is WSUD embedded within the different agencies?
5. Is knowledge of WSUD a selection criterion in collaborations with for instance the private sector?
6. Do you target specific communities when promoting WSUD? Different dissemination strategies? How do you facilitate uptake from communities?

Figure 5. Five phases of organisational development for adopting WSUD and the relationship between these phases and the 'champion phenomenon' (modified from: Brown, 2008; and Taylor, 2010)



Theme 3 (Prospective): Identifying current and future knowledge gaps, hurdles to fully embrace/enable WSUD

1. What knowledge domains in relation to WSUD do you consider 'emerging'/new?
2. Do you consider that knowledge within or between specific knowledge domains?
3. What knowledge domains would you like to obtain training for?
4. Do you need projects to make knowledge tangible/applicable/operational?
5. Is there in your opinion a clear difference between knowledge and skills in relation to WSUD? If yes, are there specific skills you would like to acquire?
6. Do you always trust the outcomes in projects of your scientifically oriented partners? Do you feel equipped to evaluate the outcomes effectively?
7. If you wouldn't have WSUD related projects how long do you think it would take your knowledge would become 'out-dated'. Which knowledge specifically?

Theme 4 (Training format): What types of training would effectively lead to more empowerment and/or adoption of WSUD principles (format, specificity (e.g. project based)?

1. Is there time/budget in your organisation to participate in training? If yes, how does your organisation evaluate the benefits of that training?
2. How you prefer training around a specific topic or around a specific case (project)?
3. Would you be willing to follow online courses/training modules?
4. How important do you consider the role of internationally oriented examples and cases?
5. Would you like to be involved in making your knowledge available to third-parties? (i.e. making implicit knowledge explicit)?
6. Do you embrace the use of 'gadgets' (e.g. tablets, smart phones) and/or social media in learning and/or projects?
7. Do you use those media to keep up to date about the current state-of-the-art?

Appendix 3 - Skills and needs assessment process – Vietnamese context

Interview questions:

Theme 1 (Retrospective): Identifying essential knowledge domains in becoming a champion

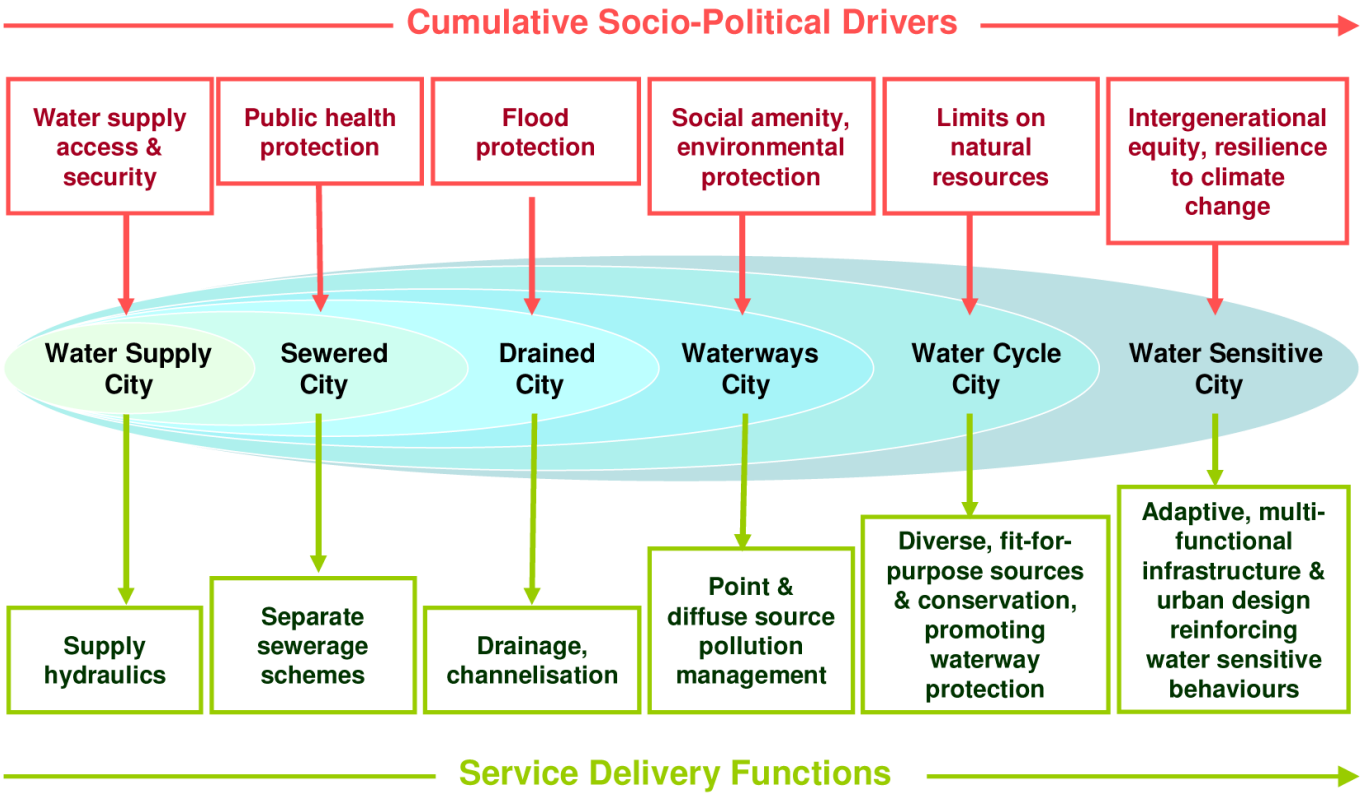
Over the past years you have lead your municipality to a more water sensitive practice, integrating water cross sectorial and cross modal.

1. Could you describe what your organisation does with regards to water in urban settings and what your role is within the organisation?
2. How well do you think people in your organisation understand WSC best practice? Why?
3. What do you see are the main issues that limit your organisation to better work toward WSC? (knowledge, skills, tools, systems, processes, organisational cultures, leadership, intra and inter-organisational relationships, legislation, policy, planning, finance, governance, incentives, etc.)
4. What are your suggestions for overcoming any of these issues in terms of job roles and functions, or occupational changes?
5. What are your suggestions for any training or educational needs at various levels within your organisation to help it to achieve WSC? (Topics: e.g. Asset Management, Water Cycle management, Technology focused topics: e.g. Hydrology, Wastewater technology, etc., Leadership, Social sciences, governance.., Levels: Higher management level, middle management, technical levels, etc.)
6. Are there other things that should be considered for improving the ability of your organisation to achieve WSC?
7. Do you think your organisation can make a significant transition to WSC, or you think it should start from a different organisation/level (e.g. central government policy, a sister-organisation starting the initiative?)

Appendix 4 - Skills and needs assessment process – Bhutan context

Figure used to focus the discussion:

Figure 6. Urban Water Management Transitions Framework (Brown et al, 2008)



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