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Position Paper for Session 6 - *"Are We Prepared? The Role of the Utility in Cities of the Future"*

Prepared by:	President (International Water Association) Dr Glen Daigger
	Principal Planning Officer (PUB) Dr Kelvin Koh
	Industry Development Executive (PUB) Michelle Ooi
In consultation with:	Strategic Counsel (International Water Association) Paul Reiter

SWULF Session 6 – "Are We Prepared? The Role of the Utility in Cities of the Future"
Drafted by: IWA President Dr Glen Daigger, PPO(PP) Dr Kelvin Koh and IDE(IDD) Michelle Ooi, in consultation with IWA Strategic Counsel Paul Reiter

Introduction

1) As abstract as the session title sounds, external drivers (such as climate change and rising energy costs) and domestic trends (such as changing demographics and swift urbanisation), are showing accelerated changes and will pose further challenges to water utilities. During the next few decades, the management of water supply and wastewater treatment in cities is expected to operate in an increasingly complex and uncertain environment. However, the abovementioned challenges could actually be the much-needed catalysts of improvement in the way utilities function. This paper thus highlights some key problems and opportunities concerning the role of the utility in Cities of the Future. Let us start with the macro issues that could potentially change the way the utility plans ahead.

Rapid Urbanization

2) Today, 50% of the world's population lives in cities. According to the UN, the pace of urbanisation will quicken, and two-thirds of the global population will live in urban environments by 2040. It is anticipated that by 2050, when the world's population is 9.6 billion, 7 out of 10 people will reside in a city.

3) This is urbanisation happening on an unprecedented scale, which means that cities around the world are being confronted by myriad related challenges, such as rapidly burgeoning populations, changing demographics, societal polarisation, and a greater prosperity divide. These phenomena intensify utilisation of resources, including water. A report by McKinsey and Company states that expanding cities will generate another 80 billion cubic metres of municipal water demand by 2025 under a business as usual (BAU) scenario. Such a jump in water demand mounts enormous pressure on urban infrastructures, such as water supply, drainage and sanitation systems.

Ageing Infrastructure

4) As pressures from higher population and economic growth persist, intensified urban land-use for housing, industries and other services will make it ever more costly and even more challenging to develop and renew water infrastructures to meet future needs. This is especially so for high-demand centres in very densely populated areas. If utilities were to conduct their business as usual, they would have to grapple with high conveyance costs (for instance, of pipeline infrastructure development and pumping), and decreasing availability of land for laying infrastructure, which will adversely impact future operations and costs. How could our water infrastructures be made to withstand the "stress-test" of urbanisation in the future?

5) Technology is increasingly viewed as a crucial means to tackle water-related difficulties. There is tremendous potential in applying **smart grid technologies** to help reduce water leakage and ensure optimal maintenance of networks within a denser urban environment. Utilities could also rely on **real-time information** to pick up critical signals and/or trends, which would enable them to effect improvements in their services, such as enhancing supply reliability and helping customers conserve water. For instance, PUB, Singapore's national water agency, is currently exploring the development of a Smart Water Grid which monitors water quality, pressure and detects pipe leaks in the water supply network. This could be done by placing sensors throughout the network to collect real-time hydraulics and water quality data.

6) Moreover, **decentralisation of infrastructure** could provide flexibility to water systems, relieve stress points at high-demand areas, and promote reused water at source vis-à-vis end-of-the-pipe solutions. One example of such decentralisation is the recycling grey water[1], which is an *in situ* process that reduces the municipal load to wastewater treatment plants and replaces the need to lay long pipelines. Grey water can be used for non-potable purposes such as washing cars or flushing toilets. A mixture of centralised and distributed infrastructure has also proven highly effective in a number of water-stressed large urban areas, such as Tokyo in Japan, Southern California in the USA, and Australian cities such as Sydney and Melbourne.

Climate Change

7) Climate change, involving the increasing frequency and intensity of extreme weather events (such as floods and droughts), has significantly affected water availability and quality, and is likely to continue to do so. According to the Intergovernmental Panel on Climate Change, anthropogenic warming due to human activities could continue for centuries, because of the accumulation of greenhouse gases in the Earth's atmosphere since the 19th century. This phenomenon is significant because even relatively small increases in global average temperatures over an extended period of time can have a major impact on water sustainability. In this century alone, world temperatures could climb by between 1.1 °C and 6.4 °C and sea levels could mount by between 0.18m and 0.59m. With just an increase of 3 °C, there will be increased mortality from unprecedented floods and more frequent and prolonged heatwaves and droughts, with hundreds of millions more people exposed to increased water shortages.

8) How could utilities mitigate the combined effects of climate change and urbanisation? It has been pointed out that resilience in cities also refers to the ability to control water flow in both extremely dry and wet seasons, and is "far more complex than just laying new pipes or constructing dams."[2]

Droughts

[1] Household wastewater that is not from toilets

[2] "In future, let's build our cities around water" article: http://www.ecosmagazine.com/?paper=EC12475#box1

9) The world has been witnessing droughts that can upset our water supply systems. In the USA, 15% of the country is facing moderate to extreme drought events each year. In the first year of a severe drought from 2007 to 2009, the USA's Southeast lost over $1.3 billion due to destruction of major crops such as corn, wheat, soybeans, cotton, and hay. During this unprecedented drought, utility companies in North Carolina enacted **water conservation measures**, while city officials banned filling of new swimming pools, serving of water at restaurants unless requested, and besought hotel guests to reuse towels and linens during their stay.[3,4]

10) Australia is another country which is prone to drought because of its location: an area of sinking, dry, stable air and usually clear skies. Over much of the country, droughts can extend over several years, relieved only by brief transitory rains[5]. Between 1997 and 2009, Australia[6] suffered the worst droughts in 100 years and there had already been 7 major droughts in 110 years.[7] One way of addressing the issue of drought is considering the use of more **weather-resilient sources of water**, such as desalination. We could also regard **all water as "fit for purpose"**, which involves using sources such as rain or grey water to irrigate our urban greenery, while reserving good quality water for drinking. In Melbourne, water is derived from a variety of sources including rainwater, stormwater runoff and recycled sewage[8].

Floods

11) In recent years, unprecedented floods hit many parts of the world including China, Japan and Australia. Singapore has also experienced the confluence of urbanisation and extreme rainfall events. Flood-prone areas in Singapore had decreased from 3200 ha in the 1970s to 66 ha in 2011, and areas in its main shopping district, Orchard Road, had been flood-free for many years. However, with land-use intensification and greater rainfall intensity due to changing weather patterns, flash floods occurred on Orchard Road in 2010 and 2011.

12) Urbanisation also brings about adverse effects on runoff volume and water quality in cities. More built-up areas add to surface runoff, including peak storm flows, and result in higher flood risks. We are also increasingly recognising the diffused sources of pollution in urban settings that increase the different types and amounts of contaminants (such as toxic chemicals, nano-materials and higher nutrients loading) entering our water sources. This may give rise to public health concerns.

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[3] Centers for Disease Control and Prevention, U.S. Environmental Protection Agency, National Oceanic and Atmospheric Agency, and American Water Works Association. 2010. When every drop counts: protecting public health. <http://www.cdc.gov/nceh/ehs/publications/Drought.htm>

[4] Manuel, J. 2008. Drought in the Southeast: Lessons for water management. Environews: Spheres of influence. Apr 116(4):A168-A171.

[5] Australia Bureau of Meteorology (www.bom.gov.au/lam/climate/c20thc/drought.htm)

[6] Australia Bureau of Meteorology (www.bom.gov.au/lam/climate/c20thc/drought.htm)

[7] Worley Parsons, 2012.

[8] "In future, let's build our cities around water" article: http://www.ecosmagazine.com/?paper=EC12475#box1

13) One possible solution to the effects of urban flooding lies in **bio-engineering**. For instance, under Melbourne Water's "10,000 Raingardens Programme", raingardens have been constructed to trap stormwater runoff from hard surfaces (such as roofs) and filter out pollutants in such water. Cleaner stormwater can hence enter rivers and creeks at reduced rates and volumes[9].

14) We could also look to **multiple uses of infrastructure**, especially for cities which are experiencing growing land-scarcity. For example, Kuala Lumpur's SMART (Stormwater Management and Road Tunnel) represents the significant investment that cities can make to concurrently flood-proof themselves and reduce traffic congestion. This project under Malaysia's Federal Government aims to alleviate the flooding problem in the centre of Kuala Lumpur. The stretch of Sungai Klang was flood-prone. This, coupled with the fact that the river is further constrained by the low Jalan Tun Perak Bridge, caused the surrounding areas to become flooded. With the SMART system in place, there is now a holding pond, bypass tunnel and storage reservoir to convey large volumes of flood water away from the Sungai Klang stretch. This will lower the flood-water level at the Jalan Tun Perak Bridge and prevent spillover. Moreover, SMART also features an integrated motorway tunnel which alleviates traffic congestion at the main Southern Gateway to the city centre[10].

Rising Energy Costs

15) In the past decade, geopolitical influences and events have been key determinants of the reliability of supply and volatility in energy prices. Energy price and its volatility have been rising due to factors including: growing energy demand from emerging economies such as China; political tension in the Middle East; market speculation; and insufficient refinery capacity to meet escalating demand. Crude oil price has almost quadrupled from around USD$30 per barrel in 2003 to about USD$100 a barrel today, with a sharp spike from USD$90 a barrel in January 2008 to a record high USD$145 per barrel in July 2008. Should energy price volatility become a norm, how would this affect utilities' efforts to guarantee water sustainability?

16) For a start, we could consider progressively closing the loop of urban water and treatment for more substantial gains in water-use efficiency, energy and nutrient recovery. We could also explore ways to catalyse the development of other breakthrough-solutions for water management, such as less energy-intensive desalination and wastewater treatment. An increasing number of utilities are setting the goal of **energy neutrality** and some are achieving this. For example, the wastewater treatment plants in Strass, Austria and the East Bay Municipal Utility District (EBMUD) in Oakland, California, have not only become energy neutral but are, in fact, net producers of energy. In the Netherlands, some

[9] "Raingardens", http://raingardens.melbournewater.com.au/content/what_is_a_raingarden.asp
[10] http://smarttunnel.com.my/smart/what-is-smart/

water boards[11] have constructed "energy factories" on their wastewater treatment plants, where sludge is digested to produce biogas to meet the plants' energy needs in treating wastewater.

Future Utility Models and Roles in Integrated Urban Planning

17) In the face of the challenges we have come across, Cities of the Future should be "sustainable, resilient and liveable", and sound water utility management is critical to achieve this. Besides merely addressing various issues as they arise, utilities would hence need to do more – in other words, their roles would need to evolve to realise our vision for such cities. How, then, could challenges be used to effect a paradigm shift in how utilities function?

18) This paradigm shift could be driven by important ideas behind water management in cities including: urban water systems that can withstand global change pressures; interventions over the whole urban water cycle; reviewing how we use and reuse water and greater application of natural systems for treatment[12]. In short, utilities need to rethink how we construct the water systems which support our cities.[13]

19) Urban water systems which focus only on single objectives such as water supply or used water disposal (taps and toilets) may become inadequate. However, such systems could be transformed into **multiple-objective, flexible systems** that integrate various sources of water, operate through a combination of centralised and decentralised systems and deliver a wide range of services to communities, such as ecosystem services and urban heat mitigation[14].

20) So, how could utilities develop and/or enhance integrated urban water management to work with such systems? One way is through exploring/adopting a holistic approach to dealing with various aspects of the water cycle. This would improve understanding of positive and negative interactions between the different parts of the urban water system. Negative aspects include poor sanitation which contaminates potential water sources and treated drinking water; positive facets would entail identifying ways to reuse, recycle and harness the potential of alternative sources for water, such as stormwater. In sum, by understanding the interactions within the urban water system, we can capitalise on the opportunities and reduce the threats to urban water management[15]. Singapore itself presents one of the most integrated and holistic examples of the benefits achievable via this approach, as it manages the entire water cycle, from rainwater collection to the purification

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[11] Water boards (also known as regional water authorities) are decentralised public authorities which are responsible for managing water resources, including flood management, water quality and sewage treatment in their respective regions.

[12] "Urban Water Management in Cities of the Future: Emerging Areas in Developing Countries" by Seneshaw Tsegaye, Jochen Eckart, Kala Vairavamoorthy in On the Water Front, 2011

[13] IWA at Stockholm World Water Week, 2009

[14] Prof Tony Wong, CE of Monash University's Center for Water Sensitive Cities, SIWW Blue Paper 2012.

[15] Urban Water Management in Cities of the Future: Emerging Areas in Developing Countries" by Seneshaw Tsegaye, Jochen Eckart, Kala Vairavamoorthy in On the Water Front, 2011

and supply of drinking water, to the treatment of used water and its reclamation to produce NEWater[16].

Integrated 'Green and Blue' Planning

21) **Integrated 'Green and Blue' planning** could also change our approach to tackling urban water issues, including dwindling water resources and management of the 'waste' water generated from cities[17]. Utilities could work with other key stakeholders (such as government agencies and private companies) to ensure that water management, treatment and delivery systems in cities are harmonised within urban planning, so as to minimise the use of scarce natural resources and expand the coverage of water and sanitation. Furthermore, in line with the view of water as fit for all purposes, we could develop systems which integrate it from various sources (for instance, rainwater, stormwater runoff, recycled sewage). Another possible solution is mixed land-use development that encourages cascading water uses between domestic, industry and agriculture sectors [18]. For instance, the city of Philadelphia in the USA is integrating green infrastructure into all aspects of city development and to address combined sewer overflow issues. The dream of a 'green city' is not only addressing water quality but also providing other benefits such as reduced crime and increased property values.

22) Furthermore, utilities could collaborate with other decision-makers such as city governments, urban planners and engineers, to promote the concept of **water as an environmental asset** that helps develop scenic and liveable cities. In fact, water is a tool to "sculpt" a city – we can wield it to develop lakes and waterways which have multiple functions beyond their use as water resources, such as enhancing the beauty of cities, providing recreational spaces for urbanites, and serving as a cooling "lung" during a heat wave.

Conclusion

23) It is easy to glance over the role of the water utility as just a supporting one, particularly where other key sectors of a country's industry take precedence. It is in this respect that all the more, the utility ought to be an integral part of the network of essential services for cities in the years ahead. To perform this task successfully, utilities will need to look beyond their immediate roles of operating, maintenance and delivery, to reflect on what the future will ask of them.

[16] NEWater, a product of Singapore's PUB, is high-grade reclaimed water produced from treated used water, which is purified further using advanced membrane technologies, delivering water which is 'ultra-clean' and safe to drink.

[17] SIWW Blue Paper 2012

[18] "Urban Water Management in Cities of the Future: Emerging Areas in Developing Countries" by Seneshaw Tsegaye, Jochen Eckart, Kala Vairavamoorthy in On the Water Front, 2011

For Further Discussion:

1) What would be some other solutions to the abovementioned challenges (such as rapid urbanisation, climate change and rising energy cost)?

2) How could utilities transform other challenges into opportunities to improve services for their customers?

3) What are some other approaches that could thus be developed to manage risks in ensuring continuity of services (provision of water supply and sanitation) in the long term?

4) What are some barriers to much greater use of the proven approaches which already exist, and how can we overcome them?

5) What are other future utility models and roles - related to integrated urban planning – that could evolve / be generated?