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Resilient asset management and governance for deteriorating water services infrastructure

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Abstract

This paper argues that strategic asset management and a sound regulatory regime are required urgently if we want to change the current paradigm of aging and decaying water services infrastructure and expand the coverage of improved water services in the developing economies. In the OECD countries access to safe water supply and sanitation has largely been ensured through substantial investment over many decades. Yet, significant investments will still be required to rehabilitate the existing infrastructures, to bring them into conformity with more stringent environmental and health regulations, and to maintain service quality in the future. In the non-OECD countries the challenges are more daunting. Large parts of their population have no access and many suffer from unsatisfactory services. Nearly one billion people lack access to clean drinking water and 2.6 billion people lack access to improved sanitation services. Lack of sound economic regulatory frameworks and enforcement regimes, and poor asset management practices, in particular underpricing of water services is a common problem throughout the world.

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Keywords: aging and deteriorating water services infrastructure; investment gap; strategic asset management; regulatory and enforcement framework; sustainability.

1. Introduction

Supply of drinking water and collection and treatment of wastewaters, i.e. water services, are extremely capital-intensive: fixed costs generally account for 80 percent of total costs. The construction of networks and treatment plants requires a large one-time investment, while maintaining the operability of the water services infrastructure

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demands constant repair, renewal and replacement. Attaining and maintaining appropriate investment levels is challenging because of the nature of water utility assets: long asset life, the labor-intensiveness of the condition assessment of the physical infrastructure, especially in the case of underground locations, differences between book value and fair value, and the difficulty of assessing the costs of deferred investments (Westerhoff et al. 2005).

In the OECD countries, access to safe water supply and sanitation has largely been ensured through substantial investments over many decades (OECD 2009). Yet, significant investments will still be required to rehabilitate existing aging and deteriorating infrastructure, to bring it into conformity with more stringent environmental and health regulations, and to maintain service quality in the future. In non-OECD countries, the challenges are more daunting. Large parts of the population have no access and many suffer from unsatisfactory services. Currently some 0.8 billion people lack safe water supply and 2.5 billion people do not have proper sanitation (UNICEF 2013). While these estimates indicate the order of magnitude of the problems, the number threatened by poor management of constructed systems is much greater (Biswas 2013).

To solve the problems related to greenfield investment projects and, in particular, to sustain infrastructure assets, the methods of long-term planning and strategic decision-making, often referred to as water utility asset management, have to be put to use (see example in Table 1).

Table 1. Components of Seattle Public Utilities (SPU) Asset Management System (Vinnari 2006a).

Component	Implementation activity
Define service levels	Annual customer surveys, stakeholder interviews
Learn about risks	Tracking and tagging of most critical assets by probability of failure/consequence analysis; lower risks by rehabilitation, operations and maintenance
Focus on life cycle costs	Assess life-cycle costs and benefits of each planned project/investment
Use triple bottom line	Prioritize projects/investments based on societal, economic and environmental impacts
Optimize data and data systems	Inventory of technical characteristics, age, location, maintenance history, condition and current value of each asset component
Create strategic asset management plans	Description of current condition of asset components, and operations, maintenance and rehabilitation strategies; risk management plans for operational and economic risks
Clarify roles and responsibilities	Define work team and individual responsibilities, responsibility areas and decision-making authorities
Make large investment decisions via asset management committee	Meets once a week, analyses and finances large investments (> EUR 200,000), ensures that decisions are based on life-cycle cost and triple bottom line principles, approves project plans, decides customer service and environmental standards

According to EPA (2012), asset management can be defined as follows: *"Asset management is a framework being widely adopted as a means to pursue and achieve sustainable infrastructure. It is the practice of managing infrastructure capital assets to minimize the total cost of owning and operating them while delivering the desired service levels. A high-performing asset management program incorporates detailed asset inventories, operation and maintenance tasks, and long-range financial planning to build system capacity, and it puts systems on the road to sustainability."*

2. State of water services infrastructure – Africa and selected OECD countries

We will now have a look on the situation of water services infrastructure in Africa and selected OECD-countries. The first selection is due to the first´author´s professional experience from the region and especially Kenya. The selected OECD countries are those that seem to be forerunners in strategic asset management and thus relevant knowledge is available while Finland is the home country of the authors.

Africa. The coverage of improved water services in Sub-Saharan Africa is still rather low. In 2012 urban drinking water coverage was 85 percent, rural drinking water coverage 53 percent, urban sanitation coverage 41 percent and that of rural sanitation 23 percent (WHO and UNICEF 2014). Due to operational and efficiency problems, however, the real service coverage figures are lower.

Underpricing of water is widespread across Africa. By underpricing water, the sector forgoes at least USD 1.8 billion a year in revenues (0.3 percent of GDP). In the worst countries, underpricing can mean that utilities collect less than 40 percent of the revenues they need which can shrink GDP by 0.7–0.9 percent. Underpricing has also

contributed to an average of 30 percent of African water services infrastructure assets being in need of rehabilitation (Foster and Briceño-Garmendia 2009).

A study was carried out on the water tariffs of 45 water utilities in 23 African countries in 2006–2007. It showed that only 36 percent of the utilities surveyed covered their full operation and maintenance (O&M) costs through tariffs, and only 9 percent covered their O&M costs plus part of their capital costs, through tariffs, even in the highest tariff blocks (Banerjee et al. 2009).

If all costly inefficiencies of the African water sector could be addressed, a financing gap of USD 9.34 billion a year (1.45 percent of GDP) would still exist. The gap in capital requirements—USD 6.60 billion—–is more than twice that in operation and maintenance—USD 2.74 billion, suggesting that the main challenge is expanding access to improved water sources and rehabilitating existing assets in poor condition. (Foster and Briceño-Garmendia 2009)

In Kenya, for example, the O&M cost coverage rates were 113 percent for urban water service providers (WSPs) and 104 percent for rural WSPs in 2012/13. That means that only a small part of capital costs are recovered. The non-revenue water (NRW) rates are 42 percent for urban WSPs and 55 percent for rural WSPs. The loss in financial terms due to NRW can be estimated at a staggering USD 126 million, slightly more than one third of the development budget of the water services sector. (WASREB 2014) This gap threatens the financial sustainability of the whole sector and indicates that considerably more funds could be collected to increase access and improve service delivery.

United Kingdom and Wales. In Britain, the state of the water services infrastructure was rated B (on a scale of A–E) (ICE 2010). In England and Wales, private water companies can use their own methods to set prices. A limit for price increases is set by the regulating agency (the Water Services Regulation Authority–OFWAT) at five-year intervals. There are no other requirements for setting water prices (EEA 2013).

A large private water and wastewater company stated that in terms of water services regulation, there are a number of limitations in the existing arrangement, which can undermine long-term infrastructure resilience. The current economic regulation of the water industry can encourage short-term efficiency savings at the potential cost of failing to ensure that vital infrastructure is maintained and improved to meet future requirements, long-term sustainability goals and customer needs. Therefore, it simply cannot cope with issues that require investment beyond the five-year regulatory cycle. (ICE 2009)

Norway. In Norway, the state of the drinking-water systems was rated 3 (on a scale of 5–1) and the state of the wastewater systems was rated 2 in 2010. The combined value of the systems was estimated at USD 79 billion, and USD 18 billion was the estimated cost of upgrading the systems to level 4 (Rådgivende Ingeniørers Forening 2010). In accordance with the act and regulations on water and wastewater charges, the pricing of these services is based on the principle of full cost recovery, which means that income must not exceed costs. Each municipality decides its own tariffs which is why water service prices vary a lot from one municipality to the other. (EUREAU 2009)

Finland. A recent report by water and wastewater experts on the state of the built environment in Finland (ROTI 2013) revealed that water and wastewater network failures have not increased significantly, although the rehabilitation, renewal and replacement investment funding gap is continuously widening. Yet, whenever there is a pipe breakdown, its consequences are more severe than earlier and the disruptions last longer. Even in the bigger cities, the actual condition of the water and wastewater network is not known accurately enough, since there are no feasible and cost-effective condition assessment tools and methods. The water and wastewater infrastructure condition received a rate of 7 (on a scale of 10–4) from the expert panelists (ROTI 2013).

Over 30 percent of water supply pipes and 37 percent of sewer pipes are already over 30 years old in Finland (MoAF 2008). The current rehabilitation and replacement rate of the water and wastewater network is totally inadequate. It should be increased from the current annual rate of USD 88 million to about USD 270 million for the next 15–20 years. Even that would only enable maintaining the current condition of the water services infrastructure.

One of the key principles of the Water Services Act (119/2001) is, however, that water and wastewater user charges should cover all the investment, operation and maintenance costs of an undertaking. Yet, subsidies for water services from the municipality, the State and the EU are still possible. (Hukka et al. 2006) The owner also cannot earn more than a “reasonable rate of return” on the capital invested, but the Act does not provide an accurate definition of the term “reasonable”, even though the government legislative proposal (HE 85/2000) that preceded the Act (119/2001) referred to the average effective interest rate on the government’s long-term debt as a possible

benchmark. (Vinnari and Hukka 2010) The State Treasury's assessment should be based on the previous year's effective interest rate calculation.

The objective of the government legislative proposal (HE 85/2000) is to base water service charges on the actual costs of the water services, and prevent the use of water service charges as "hidden taxation" (The Government 2000). In addition, the amended Water Services Act (681/2014) further stipulates that water service and stormwater drainage charges must cover the water undertaking's new, replacement and rehabilitation investments and costs over the long-term.

Yet, according to Vinnari (2000b), one of the main reasons for the low level of rehabilitation, renewal and replacement by the biggest Finnish water undertakings has been that their owners—the municipalities—are taking out rather large amounts of money from their utilities. Vinnari studied 15 large water services undertakings, and concluded that their average rate of return was 7.9 percent, and the average share (incl. the rate of return, the installments of the loans, the loan interest payments, and other regular payments) of the turnover transferred to the municipality was 23.2 percent in 1997–2003.

The 2013 annual reports of Tampere Water, Turku Water Utility, Oulu Water, Helsinki Region Environmental Services Authority HSY (Helsinki Water, Espoo Water, Vantaa Water and Kauniainen Water Utility), Pori Water Utility and Vaasa Water show their rates of return (Table 2). It should be noted that in accordance with the State Treasury's assessment, the effective nominal interest rate was 1.2 percent, and the real interest rate -1.6 percent in 2013 (State Treasury 2013). These interest rates are considerably lower that the rates of return of the selected water services undertakings.

Table 2. Rates of return of selected Finnish water services undertakings in 2013.

Water services undertaking	**Rate of return on basic capital (%)[1)]**	**Rate of return on annual turnover (%)[2)]**
HSY	13.2[3)]	28.5[3)]
Tampere Water	14.9	22.4
Turku Water Utility	3.7	9.7
Oulu Water	15.1	13.5
Pori Water Utility	5.0	11.0
Vaasa Water	4.5	8.9

1) Return on basic capital divided by basic capital
2) Return on basic capital divided by turnover
3) No return on basic capital, the interest paid to the owner municipalities on the loans is used only for comparison.

The government legislative proposal HE 218/2013 indicates that the rate of return of many large water services undertakings is about 10–15 percent based on total capital, not only on the capital invested by the municipality (basic capital). When municipalities have changed the organizational structures of their water services undertakings, the actual value of the transferred fixed assets has often been found to be 1.5–2 times higher than the book value. The interest rates on the owners' loans exceed clearly the market rates of interest, and the installments of the loans paid to the owner can be sizeable. The stewardship of the water services undertakings is not always transparent, and the rates of return cannot be investigated and compared reliably. (The Government 2013)

Vinnari and Näsi 2008 reviewed in their study the changing of the organizational structure of a water services undertaking under municipal ownership, where the municipality—most likely the City of Jyväskylä (the authors' note)—sold its undertaking to its own energy company. This dubious and malicious operation involved the revaluation of the fixed assets and helped the municipality balance its budget and accounts. On the other hand, it forced the energy company to increase its water service charges, which is contrary to the principles of the Water Services Act and the accounting guidelines for public undertakings.

Canada. The first national report card on the state of Canada's municipal infrastructure in 2012 provided an assessment of four primary asset categories of municipal infrastructure: drinking-water systems, wastewater and stormwater networks, and municipal roads. This benchmark study gave an overall rating "good" (on a scale of "very good" to "very poor") to the wastewater infrastructure. The replacement cost of the wastewater infrastructure in "fair" to "very poor" condition was estimated at USD 44 billion. Since wastewater infrastructure is now subject to

more stringent federal regulations, even "good" or "very good" wastewater infrastructure may require upgrading or replacement. (Canadian Construction Association et al. 2012)

The Canadian drinking-water infrastructure obtained an overall rating "good", and the replacement cost for the drinking-water infrastructure in "fair" to "very poor" condition was assessed to be USD 29 billion. (Canadian Construction Association et al. 2012)

The United States of America. The report *"Failure to Act: The Economic Impact of Current Investment Trends in Water and Waste Treatment Infrastructure"* revealed that the water-related infrastructure was clearly aging, and investments were not able to keep up with the need. If this trend continues, the required investment would be USD 126 billion by 2020, and the predicted gap in funding that needs to be filled to sustain water delivery and wastewater treatment infrastructure would be USD 84 billion. (ASCE 2013a)

The grade for drinking water and wastewater infrastructure was D (on a scale of A–E) in the 2013 Report Card for America's Infrastructure (ASCE 2013b). The state of water and wastewater infrastructure was also clearly the most important issue identified both in the 2013 and 2014 surveys (AWWA 2013 and AWWA 2014). Many water systems built decades ago are in need of significant renewal or replacement, but because of financial challenges, such as inadequate revenues to cover costs, some municipal utilities have deferred necessary maintenance. As a consequence, fixed assets, especially water mains but also pumping stations and treatment plants, have deteriorated and need to be restored or replaced. (AWWA 2013).

The authors have summarized the estimated condition and funding gaps in water and wastewater infrastructure in Canada, Finland, Norway and the U.S. (see Table 3). These funding gap estimates do not cover the rehabilitation, renewal and replacement financing requirements of stormwater infrastructure and house connections, which most likely are also considerable. Although the data and the scales used are different and not directly comparable, they in any case show the severity of the problem. The purpose is not to compare the selected countries as such but rather to show the current situation as they have assessed themselves.

Table 3. Estimated investment gap in water services infrastructure in selected OECD countries.

Country	Population	State of water services infrastructure (Scale)	Estimated current funding gap (USD)	Estimated funding gap per capita (USD)
Canada	35 182 000	Good (Very good–very poor)	72 100 000 000	2 050
Finland	5 426 000	7 (10–4)	6 580 000 000	1 210
Norway	5 043 000	Water networks 3 (5–1) Sewers 2 (5–1)	18 120 000 000	3 590
USA	320 051 000	D (A–E)	556 800 000 000	1 740

Note: Currency exchange rates on 3 March 2014; Population figures: UN-DESA, 2013.

3. Regulatory regime for asset management in selected countries

Vinnari and Hukka examined the regulatory approaches concerning asset management of water services undertakings in England and Wales, Australia, New Zealand and the United States. They vary according to institutional setup and structure and organization of water services production as shown in Table 4. (Vinnari and Hukka 2010)

Table 4. Comparison of international asset management policies.

Country	Fixed asset ownership	Policy driver	Main organizations involved	Asset management planning
England and Wales	Private	Water Industry Act 1991	National regulator	Required by regulator. Currently five-year plans, anticipated future requirement 25 years.
Australia	Public	Accounting Standard 27, Council of Australian Governments' (CoAG) principles	State regulators; professional associations	Required by some of the regulators. Length varies according to state.

New Zealand	Public	Local Government Act 1989; 2002	Local governments, professional associations	Statutory minimum requirement 10 years; in practice up to 40 years.
United States	Mostly public	Governmental Accounting Standards Board Statement 34 (GASB 34)	Environmental Pollution Agency (EPA), professional associations	Not specified.

The private ownership of large drinking water companies in England and Wales has resulted in an elaborate and detailed arrangement directed by a strong national economic regulator, OFWAT. For the purposes of a significantly smaller industry with publicly owned assets, the OFWAT's regulatory regime as a whole is most likely too complex, burdensome and costly. Yet, certain aspects of the structure could also be applied in other countries, including the practice of regularly reviewing the business and asset management plans, the likely extension of the planning period to 25 years, and the obvious willingness of the regulator to develop practices by consulting all stakeholders and independent experts. The infrastructure renewals accounting approach also would appear worth further scrutiny as it seems to reflect better the aging and investment profile of underground assets than regular depreciation accounting. (Vinnari and Hukka 2010)

In New Zealand, the procedures for managing water service assets are included in the 10-year financial plan required by all local governments. In Australia, the water and wastewater undertakings are expected to make annual provision for medium- to long-term asset renewal, and in some states to implement asset management systems. In Australia and New Zealand, the comprehensive asset management handbooks also complement the formal guidance with the best international practices produced by the prominent industry associations.

In the United States, mainly the professional organizations have been promoting the use of water utility asset management practices. Legislation has not yet caught up with the needs: the Governmental Accounting Standards Board Statement 34 (GASB 34) does not require that utilities adopt asset management practices unless they choose an unconventional method of depreciation. Even if the special committee suggested to the Senate is established, it will take several years before any new statutes are implemented. Therefore, in the meantime, asset management practices in the US will most likely be introduced and adopted mostly in the form of informal professional norms and practical applications. (Vinnari and Hukka 2010)

4. Discussion and concluding remarks

The above examples show that unworkable asset management practices and lack of sound economic regulatory frameworks and enforcement regimes have a clear and overarching consequence: a growing funding gap in rehabilitation, renewal and replacement of aging water services infrastructure. It's also extremely questionable how justified, fair and ethical is the Finnish practice, i.e., the citizens have to pay to the municipalities the rate of return on the investments the citizens themselves have already paid for directly through water services charges and/or taxes.

Therefore, the authors highly recommend that the current paradigm with regard to the ambiguous asset management of water services undertakings and the related arbitrary regulatory governance be changed urgently. The future paradigm must be based on the principles of good governance (see Fig. 1), good management practices, and scientific research.

The owners of water services undertakings, however, have the main responsibility for guaranteeing that a sound asset management system is introduced (see example in Table 1). They should also follow the principles of related legislation and be more open, transparent and accountable to citizens. The national authorities should ensure that a lean regulatory framework and enforcement mechanisms are in place. They should also require that water services undertakings introduce a proper asset management system. Further scientific research and development on asset management and regulation in the water services sector is also required to safeguard the continued provision of invaluable water services to future generations.

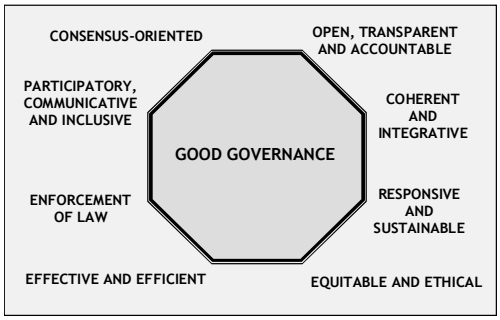

Fig. 1. Characteristics of good governance (UNESCAP, 2002, modified by Seppälä 2004).

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