Institutional Development is the Key for Sustainable Water Services in the Built Environment

Tapio S. Katko,
Dept. of Civil Eng., Tampere University of Technology
email: tapio.katko@tut.fi
Jarmo J.Hukka,
Dept. of Civil Eng., Tampere University of Technology
email: omraj@jarmohukka.fi

Abstract

This paper explores the role of institutions in the development of water services – especially community water supply and wastewater. It is based on an extensive research programme on the evolution of water services in Finland that also compares our domestic development with international achievements since WWII.

The term *institution* is here used to mean the "rules of the game" while the term *organisation* is used to mean any of the "players". Institutions include both formal and informal rules, and often a large part of the latter are unseen. The paper deploys a wider view of technology development: (i) artefacts, (ii) processes, and (iii) knowledge how to apply (i) and (ii). It reminds of appropriate technology where we need a variety of criteria for technical, social, and economic appropriateness.

Water services are under continuous need of reassessment. Some changes may seem more dramatic short-term than in the longer term. Yet, they are relative and depend on the time scale used: operational (1 year), strategic (1–10 years) or visionary (20–50 years). Due to path dependence, major strategic decisions may even have an impact lasting over a century – to the futures and to the pasts.

The development paths have hardly ever been linear; on the contrary, the paths have usually divided into new development paths. In some cases, like when selecting a new raw water source, older paths may have been rediscovered. The driving forces seem to be linked to legislation and especially to water pollution control. Instead of dramatic ad-hoc reforms, overall water services evolution in Finland has mainly been based on the principle of continuous development.

In the future, we need to pay worldwide more attention to institutions as well as to management, institutional, policy, and governance issues, including the challenges of pricing and asset management of water services infrastructures.

Keywords: sustainability, institutions, path dependence, pasts, futures

1. Introduction

Water and wastewater systems are of fundamental importance to the development of communities and the welfare of people and nature. Water services – here mainly community water supply and wastewater services – will face huge challenges in the coming decades in Finland, Europe, and the rest of the world. If the current trend continues without major improvements, up to two thirds of mankind will suffer from chronic water scarcity and/or polluted water in 2050. In spite of its problems and challenges, Finland has been among the top countries in many international comparisons of water and environment management. The rapid structural change of society has also been reflected on our water services. A key challenge is to increase the weight of the invisible water services and systems in societal decision-making**.**

While there is a huge demand for further investments in water and sanitation systems worldwide, it is an even bigger challenge to improve the efficiency and functioning of the current systems. In both cases proper institutions, or rules of the game, are required.

Water services are managed and governed at lower levels and scale than water resources. As concerns the wider role of water in development, the International Law Association (2004) pointed out that water and wastewater services are *vital human needs* of communities. In other words, they are the most important purpose of water use (Katko and Rajala 2005). At least in the western world, water services, a fundamental, yet mostly invisible part of the community infrastructure, are taken for granted, assuming that they are available 24/7. As Golder et al. (2013) pointed out, water is one of the most taken-for-granted aspects of daily life. Yet, in most cases in developing economies, intermittent water services pose severe challenges for citizens, especially the poor.

Unfortunately, many developing and transition economies still lack water service systems, or they are inoperational, or provide service only for a few hours a day and cannot therefore be taken for granted. The World Water Development Report 2003 highlighted this major problem as follows: “Sadly, the tragedy of the water crisis is not simply a result of lack of water but, essentially, one of poor water governance” (UNESCO 2003). Accordingly, OECD (2015) reminds that “managing and securing access to water for all is not only a question of money, but equally a matter of good governance”. Thus, there is an urgent need to assess recent experiences, identify good practices, and develop practical tools for assisting different levels of governments and other stakeholders for more effective, fair, and sustainable water policies.

2. Methods and approaches

This paper is based on cumulative experiences of a variety of studies by the Capacity Development in Water and Environmental Services research team at Tampere University of Technology (TUT) since 2000. The paper builds on material and research conducted by the author and the research team in some 80 research projects, 10 doctoral dissertations, and 25 MSc theses. The paper aims to explore the role and significance of institutions and their development within the overall development of water services. The paper is largely based on a project analysing the major findings on water services development within its wider institutional

context after WWII and especially during the last decades, including implications for the futures. This study (Katko 2016) has been supported by several foundations and the Academy of Finland (no. 288153) which is highly acknowledged.

In this context of water services organisations, the definition of *institutions* by D.C. North, a Nobel Laureate in Economics, is here applied. He used the football (soccer) analogy and defined institutions as the "rules of the game" while organisations are the "players" (North 1990). The rules differ in size and shape. This New Institutional Economies (NIE) calls into question many ideas of the more classical schools of thought.

Andrews (2013) uses the iceberg metaphor for reminding that "a large part of institutional logic is unseen or below the water line because it is informal". He further reminds that institutional reforms can only work if they are tailored to the local context and therefore the so-called best-practice reforms tend to fail. Whereas, for instance, the World Bank links "institutional context" typically to laws and other regulations, Scott (cited by Andrews, 2013, 43) points out that institutions include regulative, normative, and cultural-cognitive elements.

Based on a sustained institutional framework, a distinction between service *provision* and *production* should be also made, as articulated by Ostrom (1990, 31) and Oakerson (1999). This distinction is important since in most countries such as Finland legislation puts municipalities in charge of providing or arranging the services, whereas services are produced or implemented by utilities or cooperatives. Yet, professional literature seldom recognises this fundamental difference (Katko and Hukka 2015).

Another key definition refers to the concept of *technology*. Here, technology is considered in a wider context which covers (i) technological artefacts, (ii) procedures, and (iii) knowledge required how to apply both (i) and (ii) (Leppälä 1998). A somewhat similar definition was presented by Jacob Bigelow (cited by Hughes 2004, 2–3) already in 1831 when he stated that "technology involved not only artefacts but also the processes that bring them into being".

Hughes (2004) further pointed out that technology is not limited to technological practices – often considered engineering – but ought to include also the processes that bring technology into being, namely invention and human ingenuity. Regarding engineering sciences, Naukkarinen (2015) identified five categories of doctoral dissertations at TUT: experimental design science, mathematical design science, naturalistic design science, explanatory inquiry, and interpretive inquiry. The categories may also overlap and they do not necessarily follow any faculty borders, showing the diversity of engineering sciences and technology development. Hukka et al. (2007) addressed the need for methodological and even philosophical diversity in water management since a single approach cannot answer to all of the research needs, and the fact that a bias in favor of a single research approach may prevent finding adequate answers to wider governance issues. Indeed, it is possible to create most valuable findings in areas that are between various disciplines.

In the late 1970s, Pacey (1977) discussed the dimensions of *appropriate technology*, and concluded that technology alone is not enough, but in addition we need a variety of criteria for

technical, social, and economic appropriateness. In order to discuss technologies Pacey (1983) also introduced two major spheres: *user sphere* and *experts sphere* and argued that "good technology" should take advantage of both of these major spheres. Futures researchers have pointed out the *evolutionary nature of development.* This means that development and technology are not deterministic, but at certain points we will face bifurcation or turning points (Mannermaa 1991).

The relationships between the empirical data collected from the real world and the various theories used in this research programme and by the wider CADWES team are shown in Figure 1. Empirical data from the real world are to be tested by various methods, often according to the so-called PESTEL framework which categorizes environmental influences into six main types: political, economic, societal, technological, environmental, and legislative. The PESTEL framework has proved useful since it forces one to assess development in a wider institutional and socio-economic framework.

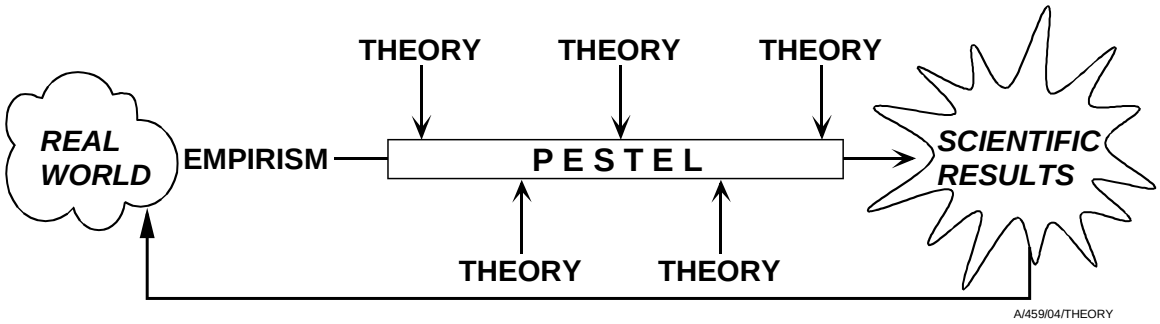

Figure 1: The major approach of the programme: relations between real word, empirism, research theories, and scientific results (Eskola 2001, 138; modified by the author)

3. Major Frameworks for Institutional Development

Water services in Finland are provided and produced at least at four different levels through various modes: from on-site to cooperatives, municipal utilities, and various types of inter- and supramunicipal arrangements (Table 1). These four levels are often connected to each other by various means. Municipal utilities are under public law whereas cooperatives are private. This diversity and multi-level governance describes both organisations and institutions. For some it may seem fragmented but in the Finnish conditions this "insdiversity" – different ways of providing services – gives flexibility to operate case by case based on local conditions. This is not to understate the challenges that they also have. In any case, the overall development is to take into account the connections between the various levels, bearing in mind the poem by Limerick (2012): "Rural and urban places, Are tangled together like laces. They´re like sister and brother, They have never been opposite cases".

As articulated by Ostrom (1990, 31) and Oakerson (1999), a distinction between service provision and production should be, however, made. This distinction is a major concern in most countries where legislation often puts municipalities in charge of providing or arranging the services which are produced and implemented by utilities. This distinction goes undetected by

almost all parties involved and literature generally uses only the term “provision” without explaining its more accurate meaning.

Table 1. Four key levels of water services in Finland with their key characters (Katko 2016 forthcoming)

Level	*Features*	*No. of systems*	*Population served (%)*
On-site systems	*Dispersed rural areas*	*many*	*10*
Water Users Associations	*Villages and towns*	*1400*	*5**
Urban water and wastewater undertakings	*Water and wastewater often merged*	*300*	*50*
Inter- and supra-municipal systems	*Inter-municipal agreements* *Wholesale water* *Wholesale wastewater* *Regional water and wastewater companies****	*many*** *24* *12* *3*	*n.a.* *n.a.* *n.a.* *28*

** some 20 in large villages and towns* *** some continuous, some as reserve*
**** 2 stakehold companies owned by municipalities, 1 federation* *n.a. not available*

Through mere legislation and requirements, water services have many stakeholders and interest groups (Figure 2). Water entities at various levels produce services that in Finland are arranged by municipalities except for small and on-site systems. In fact, globally municipalities or other public authorities are owners of some 90 percent of water utilities, 95 percent of wastewater systems, and likely close to 100 percent of stormwater systems. Water utility board members are elected officials. Likely the core resource of any utility is competent personnel. Activities require economic resources obtained, ideally, by charges from customers – such as the case is in Finland – rather than through taxation. Local administration supervises the actions through regulations. The State and the European Union are in charge of legislation, policy, and regulation that are controlled by regional authorities.

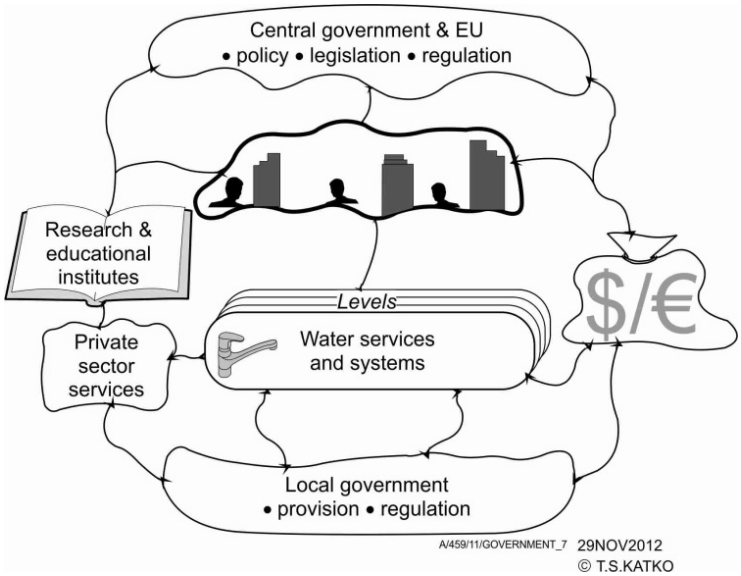

Figure 2: Overall Cooperation Framework of Water Services and systems: major stakeholders and their relationships (Katko, forthcoming 2016)

Water utilities buy services from the private sector as they have done since the beginning of the water systems (Juuti and Katko 2005). For the purposes of this study, we call this *public-private cooperation* instead of *partnership* that has been misleadingly used for the promotion of multinational companies and their long-term contracts, thus in practice reducing competition (Hukka and Katko 2003). Educational and research institutes create the basis for competences and human resources. As for lobbying for water services, the Finnish Water Utilities Association and the Association of Finnish Water Cooperatives are major actors. In addition, we have other direct or indirect stakeholders, which have their own specific roles. These include, e.g., health authorities, water protection associations, and regional councils. In any case, it is essential for each of the stakeholders to have a role that fits to the totality in the most appropriate way.

Another major feature of water services management is related to time. Nowadays futures and strategic thinking is used in many sectors for identifying and having influence on the development of services. The former "prediction" by futurologists has been replaced by futures research and forecasting that rather tend to have active influence on preferable futures and development paths. (Bell 1997) Yet, it is good to remember the argument by George Santayana (1863–1952) " those who cannot remember the past are condemned to repeat it".

Water services' futures can be explored through three different timeframes (Figure 3): operative daily actions (one year), strategic thinking (5–10 years), and visionary leadership (10–50 years). The thinner the rectangle, the less time is generally spent on it. The core of visionary thinking is that a sector or organisation tries to identify a state of futures which seems most preferable. Thereafter, from this visionary state, alternative development paths and strategies will be explored for reaching the identified state. Due to path dependence, major strategic decisions may even have an impact lasting over a century – to the futures and to the pasts (Kaivo-oja et al. 2004). Sometimes the argument "we are not interested in history, we are interested in the futures" is actually presented seriously. However, history and futures do not exclude each other. This misconception is mainly due to the path dependence of water services infrastructure development (Melosi 2000); certain strategic decisions have unavoidable long-term impacts.

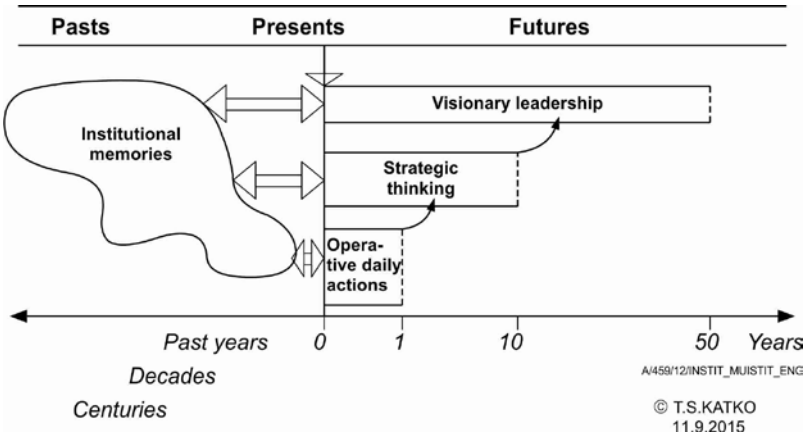

Figure 3: Timeframe for futures thinking and leadership: from operational to strategic and visionary thinking (Katko, forthcoming 2016)

At least in Finland, the selected major paths have hardly ever been linear; on the contrary, the paths have usually divided into new development paths. In some cases, such as selecting a new raw water source, older paths may have been rediscovered. The driving forces seem to be linked to legislation – especially to the requirements of water pollution control (Katko et al. 2006).

Water services are under continuous need of reassessment. In the short-term some of the changes may seem dramatic, but they are not necessarily so in the longer term. Such changes are anyhow relative and depend on the viewpoint and timeframe (Figure 4). In fact, the timeframe of water services development is exceptionally long, up to 125 years to the pasts and 125 years to the futures. Therefore, instead of one year "the quarter of water services" needs to be counted from a millennium, a fundamentally different timeframe. By no means is this to deny that daily operations are to be managed as well as possible; they should not be ignored.

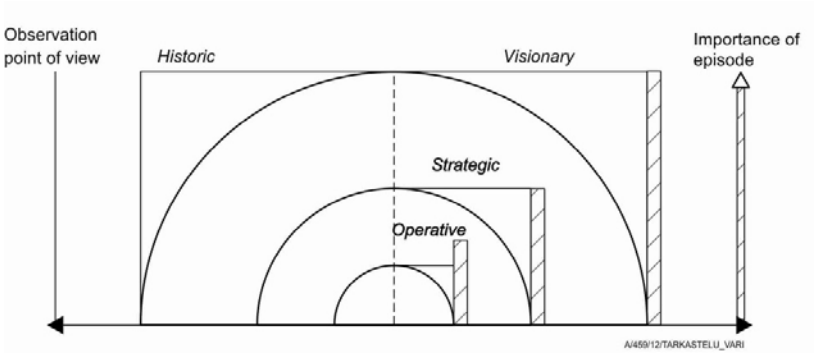

Figure 4: Suggested timeframe for water services of a quarter of a millennium: 125 years to the pasts and another 125 to the futures. The relative importance of change depends on the viewpoint and timeframe used. (Katko, forthcoming 2016)

4. Core and non-core activities of water utilities

In water services production public-private cooperation (PPC) has been practised in Finland since the early days. From strategic point of view one of the key questions is the division of core and non-core activities of utilities (Figure 5) and to what extent it is possibly feasible in various conditions to outsource the latter. Core activities may include main responsibility for required investments, strategic asset management, financial management, ownership, strategic thinking and management, bidding, business development, reputation and stakeholder management, as well as customer relations. Non-core activities, on the other hand, may include design, construction, equipment, spare and chemical supplies, vehicles and machinery, repairs, inspections, laboratory services, accounting, training, billing, meter reading, operation and maintenance, water and wastewater treatment activities, and research & development.

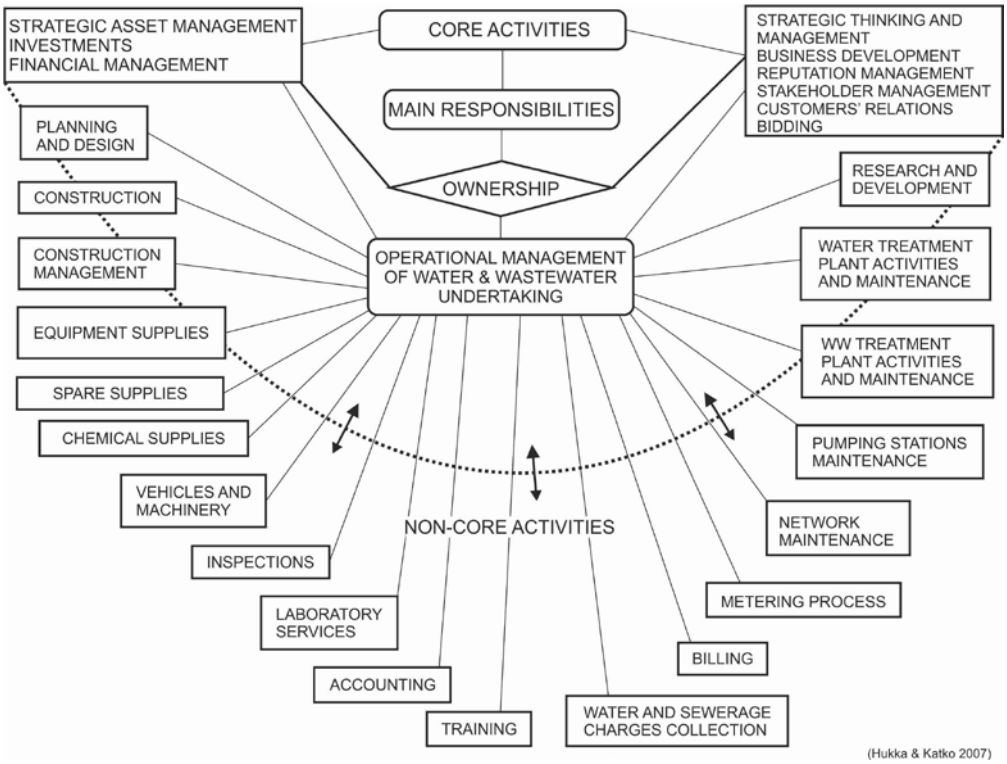

Figure 5: Core and non-core activities of water and wastewater utility (Kraemer 1998, 324; modified by Hukka and Katko 2003, modified by the authors)

Bearing in mind the difference between provision and production described earlier, the above-mentioned core and non-core activities are likely different for municipalities and, on the other hand, for water utilities. These may also be assessed through three different strategic functions: the first category being those obliged to municipalities by legislation, the second those being of major strategic importance to utilities, and the third other strategic functions.

The first mentioned core activities in Figure 5 are those closer to municipalities as utility owners. Utilities have their own strategic and operational functions. Under the latter, core activities and non-core activities can be identified. Thus, in reality the core activities and non-core activities in Figure 5 become even more complicated. In any case, it is of high importance that activities seen of strategic importance should not be outsourced.

From the point of view of education and research, it seems surprising how the current education and curriculum seem hardly to cover such strategic issues and the role of core activities. It is very obvious that these fundamental core issues cannot be left merely to continuing education and on-the-job training only. In spite of some trials on MSc Programmes or MBA programmes on Water Utilities Management, they seem not to get much ground. This is likely due to the prevailing focus on natural sciences and treatment technologies which are of course important as such. However, they are not able to give any answers to wider management, institutional, policy and governance (MIPOG) issues, such as the challenges of appropriate pricing and feasible asset management. Indeed, worldwide we have a huge challenge of proper asset

management and need for rehabilitation to rates that are likely two- or even threefold compared to the present reinvestment rates. (Hukka and Katko 2015)

5. Discussion

Instead of dramatic ad-hoc (one-time) reforms that are not uncommon in developing economies, overall evolution in Finland has mainly been based on the principle of continuous development and determined policies. This has been very evident especially in water pollution control since the 1960s. On the other hand, it may be that flexibility could have been practised more. Perhaps an example of this overall finding is the Decree on Water Pollution Control in Dispersed Rural Areas passed first in 2003. In 2011 it was revised (196/201) and in 2015 it is on the Parliament table again. Changing rules of the game for several times does not sound feasible, although there might have been some obstacles in drafting the first version.

Most likely the biggest challenge of water services in the coming 20 to 30 years in Finland and also elsewhere will be aging infrastructure, especially deteriorating networks (Heino et al. 2011; Hukka and Katko 2015). The current state of the networks in Finland is satisfactory and it will get worse unless clearly more resources are directed to rehabilitation. Compared to the experiences gained from water pollution control it seems evident that we need better “rules of the game” and institutional arrangements if we want to avoid the collapse of the current water infrastructure systems. In the case of water pollution control clear requirements and enforcement were needed. In the case of aging water infrastructure more clear requirements on long-term investments will be needed, respectively. Sector professionals and utility managers also have to take this more seriously than so far in order to convince decision-makers on the matter.

As a whole, the ways of implementing water services are in any case highly dependent on *local conditions*. Available options should be always seriously considered and accumulated knowledge be used. In water services, private, non-profit systems are justified whereas international instances on profit-maximization have produced warning examples. However, the successes of any water services can finally be assessed only from the point of view of the results: how well they have fulfilled their societal objectives.

The challenge is proper asset management and need for rehabilitation to rates that are commonly two- or even threefold compared to the present reinvestment rates. In order to improve this situation it is necessary to pay more attention to institutions, the rules of the game.

6. Conclusions

The following major conclusions can be drawn on this paper:

(i) The timeframe of viable water services development is exceptionally long, up to 125 years to the pasts and 125 years to the futures, thus a quarter of a millennium.

(ii) In education and research on water services undertakings clearly more attention should be paid to strategic functions of municipalities as owners and on the other hand those of utilities.

On the whole, it is evident that to reach more sustainable futures and water services we need to pay more attention to institutions, "rules of the game", and even wider to management, institutional, policy and governance (MIPOG) issues including the acute challenges of appropriate pricing and feasible asset management.

References

Andrews M (2013) *The Limits of Institutional Reform in Development, Changing Rules for Realistic Solutions*, New York, Cambridge University Press.

Eskola J (2001) "Laadullisen tutkimuksen juhannustaiat" (Magic tricks of qualitative research). Laadullisen aineiston analyysi vaihe vaiheelta. pp. 133–157. In: Aaltola J. & Valli R.(Eds.) Ikkunoita tutkimusmetodeihin II (Windows to research methods II). Metodin valinta ja aineistonkeruu: virikkeitä aloittelevalle tutkijalle. PSkustannus 2001. (In Finnish)

Bell W F (1997) *Foundations of Futures Studies, History, Purpose and Knowledge of Futures Studies—Human Science for a New Era*. Vol. I. Transaction Publishers.

Golder C, Trowsdale S and Fisher K (2013) "Writing and photographing 'little water'." *Australasian Journal of Environmental Management*. **20**, 3: 242–255. DOI: 10.1080/14486563.2013.820152

Heino O.A, Takala A.J. and Katko T.S. (2011) Challenges to Finnish water and wastewater services in the next 20–30 years. *E-WAter*. http://www.ewa-online.eu/e-water-documents.html

Hughes T P (2004) *Human-Built World. How to Think about Technology and Culture*, The University of Chicago Press, Chicago and London.

Hukka J and Katko T (2003) *Water privatisation revisited – panacea or pancake?* IRC Occasional Paper Series No. 33. Delft, the Netherlands (available online: http://www.ircwash.org/sites/default/files/Hukka-2003-Water.pdf [accessed on 24/11/2015])

Hukka J J and Katko T S (2015) "Appropriate Pricing Policy Needed Worldwide for Improving Water Services Infrastructure." *Journal of American Water Works Association.* **107**:1: E37-E46. http://dx.doi.org/10.5942/jawwa.2015.107.0007

Hukka J J, Katko T S, Mattila H E, Pietila P E, Sandelin S and Seppala O (2007) "Inadequacy of positivistic research to explain complexity of water management." *International Journal of Water*, **3**, 4: 425–444.

International Law Association (2004) *The Berlin Rules on Water Resources*. 20. "Vital human needs".

Juuti P and Katko T (Eds, 2005) *Water, Time and European cities, History matters for the futures.* Printed in EU (available online: http://tampub.uta.fi/handle/10024/65706 [accessed on 24/11/2015])

Kaivo-oja J Y, Katko T S and Seppälä O T (2004) "Seeking for Convergence between History and Futures Research." *Futures, Journal of policy, planning & futures studies*. **36**: 527–547.

Katko T S (forthcoming 2016) *Finnish Water Services – Experiences in Global Perspective*. Finnish Water Utilities Association. www.finnishwaterservices.fi

Katko T S and Hukka J J (2015) "Social and Economic Importance of Water Services in the Built Environment: Need for More Structured Thinking". 8th Nordic Conference on Construction Economics and Organization. *Procedia Economics and Finance*. **21**: 217–223.

Katko T S, Juuti P S and Pietilä P E (2006) "Key long-term decisions and principles in water services management in Finland, 1860-2003." *Boreal Environment Research*. **11**, 5: 389–400. http://www.borenv.net/BER/pdfs/ber11/ber11-389.pdf

Katko T S and Rajala R P (2005) "Priorities for fresh water use purposes in selected countries with policy implications." *IJ of Water Resources Development*. **21**, 2: 311-323.

Kraemer A (1998) "Public and private water management in Europe", pp. 319-352, In: Correia F N (ed.) *Selected issues in water resources management in Europe*, Vol. 2, A.A. Balkema.

Leppälä K (1998) "Miten tekniikkaa oikein tieteellisesti tutkitaan?" *Tiedepolitiikka* 2/1998. (In Finnish)

Limerick P L (2012) *A Ditch in Time. The City, West and Water*. Fulcrum. Golden, Colorado.

Mannermaa M (1991) *Evolutionaarinen tulevaisuudentutkimus* (Evolutionary Futures Research). Acta Futura Fennica no. 2. (In Finnish)

Melosi M V (2000) *The Sanitary City*, Baltimore & London, The John Hopkins University Press.

Naukkarinen J (2015) *What Engineering Scientists Know and How They Know It Towards Understanding the Philosophy of Engineering Science in Finland*, Tampere University of Technology, Doctoral dissertation no. 1344.

North D C (1990) *Institutions, Institutional Change, and Economic Performance*, New York, Cambridge University Press.

Oakerson R J (1999) *Governing local economies: Creating the civic metropolis*, ICS Press, Oakland, USA.

OECD (2015) OECD Programme on Water Governance (available online: http://www.oecd.org/governance/watergovernanceprogramme.htm#.VXkEMXF6HSw.gmail [accessed on 24/11/2015])

Ostrom E (1990) *Governing the Commons. The evolution of institutions for collective actio*n. New York, Cambridge University Press.

Pacey A (1977) Technology is not enough: the provision and maintenance of appropriate water supplies. *Aqua* **1**, 1: 1-58.

Pacey A (1983) *The culture of technology*. London, Blackwell.

Scott W R (2008) *Institutions and Organizations.* Thousand Oaks, California, Sage.

UNESCO (2003) *Water for People, Water for Life*, World Water Development Report 1. (available online: http://www.un.org/esa/sustdev/publications/WWDR_english_129556e.pdf [accessed on 24/11/2015])