Participation and Globalization in Water System Building

Guest Editors' Introduction

Decision-making processes in water management have drastically changed within just a few decades. The ambitious water development plan for the neighboring islands of Java and Madura, Indonesia, is a case in point. This plan was proposed in 1979 by the retired civil engineer W.J. van Blommestein. Van Blommenstein is mostly known for the Van Blommestein (or Afobaka) reservoir in Surinam, South America. Completed in 1965, this reservoir was crucial for the achievement of independence by this former Dutch colony in 1975. Earlier, in the late 1940s, Van Blommestein presented a "welfare plan" to improve the social and economic position of the western part of Java, which was adopted by the government of the Indonesian republic that was founded in 1949. The 1979 Van Blommestein plan for Java and Madura sought to achieve similar goals by similar means on a larger scale. In order to address the needs of, among others, agriculture, industry and shipping, it was proposed to transport water from the wet west to the dry east of Java and also to the dry Madura through the construction of a number of interconnected reservoirs and a siphon between the islands. The Indonesian government welcomed Van Blommestein's new plan. It seemed to fit well with the existing development needs and technological development trends apparent in Java, however, despite strong support from the Indonesian government, Van Blommmestein's new large scale, multipurpose plan was not executed. The reasons behind this are pertinent to the subject matter of this issue.[1]

In this particular case, the decision making was not dominated by the Indonesian government and not limited to considerations of a sheer technological nature. Decision making took place in a broader, international institutional setting. In this new playing field, the project failed to attract crucially needed foreign capital due to skepticism regarding the viability of the plan. A Dutch mission was negative about the plan, among other reasons because the introduction of new high yielding rice varieties meant that the food needs of Indonesia's population could be met. In addition, engaged scientists and others brought forward objections of a social and

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ecological nature. The construction of large reservoirs would force large numbers of people to move, i.e. produce forced transmigration, and would disturb the delicate relationship between man and nature, e.g. large reservoirs would facilitate the spreading of malaria.

Van Blommestein's 1979 plan aimed at an efficient use of scarce water resources and thus dealt with a problem that has become all too common today throughout the world. Problems of water supply have always been with man, but at the beginning of the twenty-first century these problems seem to be more urgent than ever. Processes like population growth, expansion and intensification of agriculture, urbanization and industrialization have greatly increased the pressure on water resources. Moreover, human interference in nature's water cycle has, despite the obvious beneficial effects of creating the necessary conditions for social development, detrimental effects. Unanticipated problems like subsidence, salinization of agricultural lands, desert formation (e.g. the Aral lake) and declining fish and wildlife habitat further worsen the case. Consequently, the sustainable provision and control of freshwater to support human development has been identified as one of the major challenges of the new century (World Water Commission, 2000).

Water problems not only seem to be more serious than ever, they have also changed character. Here we would like to point to two challenges to water management in particular: "globalization" and "participation." First, as the example of Van Blommestein's 1979 plan shows, water management is no longer a predominantly local concern. Growing populations and increasing interdependency among peoples, due to (economic) specialization, also enlarge the scale of water problems. Correspondingly, these problems are increasingly dealt with in larger, even global institutional settings. Secondly, increasingly various groups and nations, all having their own interests and values, are demanding a say in water management.

Earlier problem solving methods and decision making structures are often disqualified today as too "technocratic" due to the nature of the groups involved with providing the "solution." The engineers and state bureaucrats forming these groups are seen as inadequately qualified and too isolated to deal with modern water problems. In the search for new methods and structures in water management, participation has become a new point of departure. New players and concerns have been granted access to the decision-making processes and, consequently, new types of solutions are being suggested.

This special issue seeks to explore further the character of the current problems in water management and the kind of solutions these problems ask for, especially in view of the diversity of groups, interests and values involved. The new challenges in water management require new theoretical concepts and frameworks of analysis. This issue takes as its point of departure one of the most promising approaches in this respect: the Large Technical Systems (LTS) approach developed by the American historian Thomas Hughes and others (see below for references). This approach emphasizes how hydraulic engineering, like other types of engineering, is being applied within the context of complex networks of technical artifacts and social structures: "large technical systems" or "sociotechnical systems." The LTS approach avoids a one-sided technological development approach, notably a technology push, a market pull innovation or a "technology as applied science" model. It focuses particularly upon the creation and management of sociotechnical systems: it investigates how multiple interests and other concerns are accommodated in the process of "system building."

For this reason, the LTS approach provides a suitable framework that connects the different papers in this issue. Some of these papers draw on historic cases to investigate water system building. Others search for innovative strategies in current water management projects. Some papers explicitly use the LTS approach, others use theoretical notions drawn from other disciplines. All, however, explore how hydraulic system building may respond to the challenges posed by actors and concerns in the domain of water management. We shall therefore use the LTS approach as our privileged point of view from which historic and modern water management issues can be put in perspective.

The study of Large Technical Systems

The background of the Large Technical Systems approach deserves a few words, as we should be aware that different forms of systems thinking exist in many scientific disciplines. The LTS approach was developed in the 1980s explicitly to study infrastructural technologies and is currently used by a growing research community with its characteristic discourses, conferences and publications. In historical and sociological technology studies, the LTS approach now counts as the most prominently used approach to study infrastructures. Of course we must hasten to say that many other disciplines are studying infrastructures in fruitful ways. Along with Edwards (1998), however, we believe that the LTS approach can accommodate the relevant insights from these other studies.

This capacity obviously derives from the systematic nature of the LTS approach. In this respect it resembles other systems theories proclaiming to study the "whole" instead of isolated elements, perhaps expressed most ambitiously in General Systems Theory (Von Bertalanffy, 1969; Ropohl, 1979). Thomas Hughes (1983), generally considered a founding father of the field, advocated a shift from concentrating on isolated artifacts that had traditionally been the domain of the history of technology, to the totalities of which the artifacts were functional parts. Edison was not merely the inventor of an incandescent light bulb. Instead, his great achievement was to invent a new technical system for electricity supply, of which the bulb was one of many interrelated elements. The design characteristics of the new type of bulb resulted from an innovative design of a (parallel) distribution network, which also demanded a new type of electricity generator. Moreover, a fully integrated part of Edison's innovative effort was to apply for patents; to define a new economic concept of public electricity sales; to create a number of companies; to secure research funding; to negotiate with local governments; and to advertise his products in a way that made the public aware of the various possibilities generated from the invention of his light bulbs. This focus on the development of sociotechnical systems brought into historical view both the systemic character of many technical innovations and the sociotechnical nature of technological change, the "seamless web" (Hughes, 1988) of technology and society.

The attraction of the LTS approach also derives from various features that make it very different from General Systems Theory, systems engineering, and the like. Practitioners of the latter approaches stress formalization and mathematics in what might look like a bout of "physics envy" (Hughes and Hughes, 2000, p. 8), while the LTS approach, in contrast, was originally conceived as an "extremely informal" framework of analysis characteristic for historical work. Conceptualization should inspire sociohistorical imagination, but still respect the messy complexity of historical reality. For this reason the LTS approach consists of a few guiding concepts rather than a modeling of reality, also, and this may strike many scientists as strange, sharp a priori definitions are avoided, as these will impede and obscure rather than clarify the investigation. In the LTS field a variety of definitions exist, perhaps reflecting the many aspects of the topic (Joerges, 1996, 1999). In this special issue, we shall leave it to the authors of the individual papers to define their subject matter.

Another feature of the LTS approach, likewise stemming from its roots in history, is its actor perspective. Historians focus upon individuals (like Edison) or organizations (like General Electric) who actually mold messy reality and create relatively stable sociotechnical structures. Thus they account for the creation and change of sociotechnical systems, a well-known problem of more "structural" approaches to sociotechnical systems.

The leading concept in the LTS approach is that of the *system builders*, originally denoting individual persons like Edison that manipulate and juxtapose technical and non-technical elements to form a sociotechnical whole. Historical case studies enabled further conceptualization of different types of system builders dominating certain eras or stages of the innovation process and using different strategies of system building. System builders often start with addressing *reverse salients*, backward elements that hamper further development of the system, translating these bottlenecks into *critical problems* that serve to drive their system building efforts. In a next stage of system building, the Large Technical System expands and gains *momentum*, which gives it an apparent autonomy in terms of personal, financial and material vested interests. Finally, system builders may display *technological styles* that are suited to specific local conditions (Hughes, 1987). These concepts have been subject to considerable discussion as the field has grown. We shall not review these debates in detail here, but refer you to some key publications (Joerges, 1996; Mayntz and Hughes, 1988; La Porte, 1991; Summerton, 1994; Braun and Joerges, 1995; Coutard, 1999; Blomkvist and Kaijser, 1998).

The LTS approach includes many different forms of and eras in system building: the history of system building ranges from the extremely informal strategies of the independent inventors of the late 19th century to the highly formalized decision making models of the post war management sciences, systems engineering and the like (Hughes, 1989, 1998; Hughes and Hughes, 2000). In the past few decades, system building has been shifting from a hierarchical top-down form of formalized system building to a more horizontal form of open system building. Technocratic system builders are no longer dominant as more parties have gained access to system building processes. This transition between two system building forms or eras is of crucial importance in this issue.

The systemic yet flexible character of the LTS approach and its actor perspective, so important to the historical study of messy complexity, have no doubt inspired and certainly facilitated this approach in its migration from history to the realms of science, technology and society studies. The LTS approach met the challenges of the 1980s and 1990s to be fit to conceptualize sociotechnical change in a messy and complex postmodern world. It also inspires us to investigate the current challenges of heterogeneous actors and concerns in hydraulic system building. So far, the LTS approach has hardly been applied to water management. LTS studies have mostly focused upon "hard" infrastructures such as railroad systems and electricity supply systems. Recently, however, Kaijser (1998) explicitly argued for the need to extend the perspective to "loosely coupled systems" including water management. This is what we do in this issue.

Contents of this volume

The contributions are divided in three sections, presenting applications of LTS theory to historic cases and addressing current challenges of participation and globalization. The first section deals with historic system building in the Netherlands and Sweden. The second section delves further into participation in water management using cases drawn from Egypt, the Netherlands, the USA and India. In the third section we investigate global aspects, using cases drawn from the past, the case of the Netherlands East Indies and the present, Canada and the USA.

Water system building in historic Northern Europe

The first two papers in this issue provide historic accounts of water system building in two Northern-European countries. Disco and Van der Vleuten open this issue with a historical analysis of water system building in the Netherlands. Taking a long-term perspective, they distinguish four distinct models or "regimes" for balancing potentially conflicting uses of water. They subsequently focus on the regime of technocratic system building to illustrate the interplay of the management of diverging uses of water and the physical shaping of hydraulic technologies. Thus they argue that the current transition from closed, technocratic system building to open, 'postmodern' system building faces simultaneously institutional and material changes.

Jakobsson provides a second historic account of water system building, in a paper on Swedish hydropower development. Based on the Swedish case, this paper describes the development of human control over water systems. For this purpose Jakobsson introduces the concept of"industrialization of rivers", indicating that the flow of Swedish rivers has gradually been turned into a commodity, serving the purposes of economic rationality and efficiency. The paper shows how legal arrangements and social institutions have shaped the process of industrializing Swedish rivers, and how they influenced the outcomes of water related conflicts.

Participatory system building in contemporary water management

The transition of closed, technocratic system building into open, participatory system building in water management is dealt with in this section. These papers explore contemporary water system building efforts, addressing water system building from a public policy perspective, focussing on water policy and on the public management of water resources.

In the first paper, Hermans, El-Masry and Sadek explore the possibilities to facilitate water policy development by supplementing the "traditional" systems analysis of the physical water system with an analysis of the different actors involved. They describe their experiences with the analysis of options approach to support the development of a new water policy in Egypt, using this approach to support ongoing policy development, rather than using it for ex-post interpretation. Two different applications are explored, an analysis of actors to support the policy analysts, and a gaming effort for generating and sharing knowledge among participants.

The new open water system building approach involves various policy makers and requires them to include a wide range of specific interests and values. This makes it difficult to assess the information needs of the various policy makers, and to match these needs with the knowledge that is generated by scientists and research professionals in the field. Hoorens and Bots address this issue and present a new method for identifying the information needs of policy makers and helping agenda setting for knowledge development. Based on the metaphor of an information market, their method models the gap between information demand and supply. They illustrate their method with an elaboration of the Dutch groundwater protection policy case.

The historic accounts of water system building already provide an indication of the tension between man and nature, particularly Jakobsson's concept of the industrialization of rivers, where free flowing natural rivers are harnessed to form human controlled rivers. Van Eeten, Loucks and Roe describe a similar phenomenon in contemporary water management, identifying the tension between ecosystems rehabilitation versus public service reliability. They provide new empirical data on how agencies in different watersheds in the United States are managing the competing demands for water systems. Based on studies of water management in the Everglades, the Columbia River Basin and the San Francisco Bay-Delta, they identify five areas of innovation in striking tradeoffs between ecological rehabilitation and human service reliability. Participatory modeling and gaming exercises are presented as one of the areas of innovation, and they are explored in more detail in the paper.

The last paper in this section covers water system building with a specific orientation on agricultural policy. Raina and Sangar give a clear account of the production oriented agricultural institutions in India, and how these are dealing with the degradation of water quality in the States of Punjab and Huryana. They use Dryzek's framework of administrative rationalism to show how a circle of resource degradation is continuously being reinforced by the technocentric solutions proposed by the agricultural science and policy institutions, and the practices of Indian farmers who have no choice but to follow the rules set by these institutions.

Water system building in a global setting

Water system building seems increasingly to take place in a global setting, following the enlargements of scale in economic, institutional and other domains. The development of a modern irrigation system in colonial Java described by Ravesteijn, shows that the global dimension of water system building is not in every respect an exclusive feature of the present. This paper links the development of the irrigation infrastructure in Java to the process of colonial state formation in the Dutch East Indies and the transformation of the colonial administration into the independent republic of Indonesia. The roles of civil servants, irrigation engineers and agricultural experts receive specific attention, as an understanding of the different conflicts and coalitions between these groups helps to explain the outcomes of irrigation system building. The paper shows that the concept of "technological regime" and some other concepts from technological development theory as well as the sociological structuration theory may be used effectively to supplement the LTS approach and explain the system building processes.

Obeidi, Hipel and Kilgour bring us back to modern times, as they present a case that shows the kind of controversies that can arise when international trade laws, which stress competition and profits, conflict with environmental and social laws. Their paper describes the conflict over water exports from Canada to the US, resulting from the American NAFTA free trade agreement. This conflict is analyzed at international and national levels, and the analysis includes a discussion of the international conflict between the Canadian federal government and the privately owned US Sun Belt Co., and the national conflict between the Canadian federal government and the different Canadian provincial governments. The graph model for conflict resolution is applied to this case, illustrating how strategic conflicts of this type can be better understood and managed.

Water system building in this issue

This issue deals especially with changes in water management from a multi-actor system perspective. The theory offered by the Large Technical Systems approach provides the connecting tissue. Although not all the papers are based on the LTS approach, the contributions provide a good illustration of water management as a driving force of system building processes. The LTS approach distinguishes between internal and external factors that play a role in system building. The growth of scientific knowledge and the development of technology change a system from within: because we know more and we can do better, we change our way of doing things. Internal forces such as knowledge development play a prominent part in some contributions, most notably with Hoorens and Bots, and Raina and Sangar. External forces concern the influences of changing society, e.g. population growth, industrialization and urbanization. Other relevant external forces are long-term social changes such as the growth of an economic world system and the accompanying cultural change of water progressively becoming a commodity, alongside the political process of scale enlargement from village to nation to world politics and the (associated) increasing significance of democracy and participatory approaches, i.e. government by the people and only administrational powers with professional politicians and experts. Most contributions in this issue concentrate on external forces, dealing with participation and globalization and addressing conflicts between actors and their different concerns and between more structural system aspects such as economy versus ecology.

This issue particularly covers the transition from a hierarchical top-down form of technocratic system building to a more horizontal form of participatory open system building. The historic papers focus on the technocratic system building era but it becomes clear how, over time, the use of water has diversified, the number of actors has multiplied, and how inevitably conflicts have arisen. The contributions that address present-day cases, cover a new situation of participatory, open system building. The historical solutions are no longer desirable or possible and new types of solutions have to be found for the further development of water systems. These new solutions should address the interdependencies between increasing numbers of actors, and this can be qualified as a reverse salient that is emerging in the era of open system building. The promising directions for solutions are the better co-ordination of research and policy and an increasing involvement of all concerned actors. Several methods for adequate actor involvement are dealt with, notably the analysis of options approach, participatory modeling and the graph model for conflict resolution.

The contributions of this issue cover water system building over a wide range of time and space. The focus on actors and systems found in the Large Technical Systems approach can be used to connect these contributions, as the LTS approach can be used to link technological development of water systems to the social processes taking place between actors. We hope that this multidisciplinary, flexible yet uniting focus on actors and systems, as applied and explored in this issue, will give the debates on, and studies of, problems in the field of water management interesting input and add to their coherence.

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Guest Editors

Note

1. See for Van Blommestein and his plans Ravesteijn, 1997. The idea for this issue originated from a workshop on Water Management Infrastructures at the 5th International Conference on Technology, Policy and Innovation, "Critical Infrastructures", Delft and The Hague (the Netherlands), June 26-29 (Herder and Thissen, 2001).

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