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On Prerequisites for the Application of Sustainable Development Indicators in Urban Water Management

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Abstract: Semi-structured interviews with 47 key actors were conducted in Swedish water utilities on why Sustainable Development Indicators (SDIs) are or are not used. Important influencing aspects identified included organizational inertia, social capital, the national water sector and authorities. Divergent views of SD and indicators appear to hinder SDI initiatives. Possible explanations are that: (a) not all actors look at decision-making as the kind of rational process the focus on indicators implies, and (b), Swedish urban water systems are widely regarded as sustainable. The water sector itself and regulation are identified as the strongest potential drivers for increased use of SDIs.

Keywords: sustainable development indicators; urban water systems; decision-making; field studies

1. Introduction

Over the past 15–20 years, sustainable development (SD) has become a generally acknowledged, though distant and elusive, goal for all levels of society to strive towards. Interim targets, exemplified by the United Nations Millennium Development Goals [1] are often used to make the objectives specific and concrete. Furthermore, to monitor and assess progress towards the targets and help steer development in the desired direction, sustainable development indicators (SDIs) have been developed for use at many different levels: internationally, for example, in the United Nations [2], EEA [3], and OECD [4]; nationally in several countries, including Sweden [5] and the UK [6]; and at the community level. Initiatives at the community level include the example of the Boston Indicator Project [7], in

which local individuals are involved in SDI development, as well as initiatives on SDIs to be applied within public administrative bodies [8,9]. Finally, SDIs are also frequently applied within business organizations, where one of the most influential actors, and a useful source of information, is the Global Reporting Initiative [10].

Water supply and sanitation are services fundamental to developed societies and indicators covering water are included in most sets of SDIs. From community to international levels, common examples of such SDIs are the percentage of the population with access to drinking water and sanitation, water extraction (sometimes in relation to available water resources), water reuse, and levels of phosphorus and nitrogen in surface waters. At the organizational level, generally speaking, indicators capturing water issues are primarily those covering water consumption and emissions to water. There are also numerous recommendations regarding sets of SDIs designed specifically for use in water utilities, *i.e.*, for urban water systems [11-20]. These sets describe the activities of water utilities (water supply and sanitation) in more detail, capturing aspects such as resource use, emissions, ecosystem impact, reliability, robustness, flexibility, cost of operations, investment in innovation, research and development, health and safety, participation, and community development. There are, however, few reports dealing with the practical application of SDIs in water organizations around the world.

This scarcity of reports on the application of SDIs in managing urban water systems prompted the project described here, to investigate, through in-depth field studies, the preconditions for sustainable development information systems (including SDIs) in Swedish water utilities. This paper reports and analyses the results from these field studies, to explore the key factors influencing the application of SDIs in Swedish water utilities by identifying the drivers for and barriers to their use. The paper adopts a social constructivist approach to research methodology and focuses on describing the use of indicators in an organization from the perspective of the various actors constituting the organization. While this research is relevant primarily to Swedish circumstances, preliminary discussions of the results with an international audience has shown that many of the conclusions have wider validity for planning and decision making in urban water management.

This introductory section proceeds by describing the rationale used in examining sustainable development indicators, and also gives a brief account of the Swedish water sector. Subsequent sections describe the methodology used for the field studies and present and discuss the results.

1.1. Sustainable Development Indicators

Within the overarching rationale of using indicators to guide development away from unsustainable trajectories towards more sustainable ones, SDIs can serve different (sometimes overlapping) functions:

- depicting current conditions, evaluating various management actions for the future, and warning of impending changes [21],
- planning and communication [22,23],
- learning, structuring understanding, and conceptualization [24,25], and
- expanding, correcting, and integrating worldviews [26].

Notably, indicators, generally speaking, are routinely used for planning and control in organizations. The functions of indicators described in the management literature primarily correspond to those in the first two bullet points above, although the vocabulary is different: accounting, reporting, bench-marking and management by objectives. For a review of functions of indicators, including SDIs, see e.g., Palme [27].

An aspect of indicators often disregarded, or at least not explicitly mentioned, is that they are linked to a view of decision-making in organizations as a rational process [28]. Rational decision-making, according to Hatch [28], Thompson and Tuden [29] and Thompson [30], is characterized by agreement within the organization on the goals to be achieved as well as on methods that should be used to reach these goals. As sustainable development issues are often characterized by high levels of uncertainty and conflicting goals, such agreement is often not at hand, which implies an inherent contradiction in the concept of SDIs. Similarly, the kind of rational thinking implicit in much of the sustainable development literature is based on a linear view of strategy development, emphasizing top-down processes, planning and goal achievement [31]. This, however, is not necessarily how decisions are made in organizations [32]. If, instead, strategy is regarded as adaptive (or emergent), with bottom-up processes complementing the top-down processes, planning is still possible and indicators are still potentially useful; However, the view of strategy as adaptive, constantly responding to unexpected events and a changing external environment [27,30], makes indicators less valuable and reliable. Furthermore, the view of strategy as *interpretative* [31] leaves little room for indicators: the surrounding world is regarded as so unpredictable, and the interpretation of it so subjective, that strategic intent can only be executed through symbolic action. Mintzberg [33] elaborates further on the connection between uncertainty and strategy, arguing that a rational model of strategy is relevant for situations with low complexity and low pace of change. This further highlights the inherent contradiction in the concept of SDIs as this description of reality is not typical for most sustainable development decision-making contexts.

The paradoxical nature of using SDIs in decision-making and strategy supports the idea that promoting learning and structuring understanding is possibly the most important function for SDIs, as argued by e.g., Rydin *et al.* [34] and Innes and Booher [25].

The intended function of an SDI, along with its intended users—providers and receivers of information—will affect what information is carried by the indicator, and to what extent this information is aggregated. As described by Mitchell [35], there are two main approaches to indicator design: (1) indices where information is aggregated into one single variable, e.g., the index of sustainable economic welfare (see Mitchell [34] for more examples), and (2) sets of indicators, including many variables, that in their entirety capture the various dimensions of the SD concept.

The purpose of indices within an organization may be explicit, but single indicators making up a set of SDIs, as described above, may be no more than a conventional performance (or service) indicator when taken out of the set. For example, a common indicator in the water sector is mg/l of nitrogen in the effluent from the wastewater treatment plant. This is normally regarded as an environmental performance indicator rather than an SDI (*i.e.*, an indicator used to monitor, assess and steer progress towards sustainable development), but certainly the emissions to water of nitrogen are highly relevant from a sustainable development perspective. Because of the difficulties at the organizational level of

distinguishing SDIs from various (key) performance indicators, it was decided in this work to consider a very broad range of indicators, including all that have been recommended and/or applied in the water organizations studied to convey information concerning any aspect of sustainable development *and* which form part of a set of indicators that in its entirety also captures other aspects of sustainable development. The definition used is deliberately broad so as to include all relevant information. Furthermore, SDIs are not regarded as necessarily novel but include developments of existing indicator sets.

1.2. The Swedish Water Sector

The Swedish water sector is entirely public, and its constituent organizations are either publicly (municipally) owned companies or parts of local public administrations. Altogether, 99% of the sector's costs are covered by tariffs, smaller municipalities sometimes subsidizing service provision out of local taxes [36].

The activities of Swedish water organizations are supervised by a range of authorities, which implies a great deal of mandatory reporting. At the local level, municipal committees for environment and health are responsible for drinking water quality, water protection and, in the case of small plants, permits to discharge treated sewage. The County Administrative Board is responsible for water protection at the regional level, and issues discharge permits for most plants. The central supervisory agency for drinking water quality is the National Food Administration, while the Environmental Protection Agency is responsible for the protection of water resources. Discharge permits for the largest plants are issued by the Regional Environmental Courts [36].

By and large, the design of Swedish urban water systems follows what Wilderer [37] calls "the classical concept of urban water supply and sanitation," according to which the flow is linear from the source (the water reservoir) to the sink (the receiving water) and the main purpose of wastewater treatment is conversion and destruction of materials rather than recovery. However, the aim of increased nutrient recycling is set forth in the Swedish Environmental Objectives, according to which phosphorus should be recycled from urban to rural areas without risking human health or the environment [38]. This is part of an overarching strategy for achieving resource-efficient material cycles free from hazardous substances.

2. Field Study Methodology

The research described here followed what Yin [38] calls a holistic multiple-case design, which means that the study consists of several (three) cases and that each case (field study) is a unit of analysis. Municipalities were selected for the field studies according to two criteria: (1) they should possess water systems representative of Swedish urban water systems, and (2) they should include the most important organizational forms assumed by Swedish water utilities. The logic behind the choice of criteria was primarily that of literal replication, *i.e.*, no major differences were expected between the organizations. It was recognized, however, that the design chosen could yield contrasting results due to differences in basic water system features or organizational form. If the results proved to reveal such

differences, additional field studies could be made in future to explore any patterns, *i.e.*, following a logic of theoretical replication where contrasting results are expected for predictable reasons [39].

The methodological perspective is one of social constructivism to the extent that organizations and their use of information are regarded as social constructions. This implies emphasis on qualitative rather than quantitative results [40]. Interviewing was therefore chosen as the central research method in the field studies. Quotations from these interviews constitute the raw data of the study and are used in the presentation of the results to convey the interviewees' view of reality in their own words.

Semi-structured interviews were held at interviewees' workplaces, which included waterworks, sewage-treatment works, and offices. Interviewees in the chosen organizations were selected through conceptually driven sequential sampling or "snowball sampling" [41]. Initially, leading employees from all departments were interviewed; these interviews uncovered matters that needed to be investigated in more detail. Based on these findings, new interviewees were selected who could give more in-depth or complementary information.

In the interviews, the concept of SD was normally approached using existing policies for sustainable development of the organization in question as a point of departure (see interview guideline in Appendix). The subject was then shifted to information used and/or required in that context, and to indicators. Whether or not SDIs were explicitly mentioned depended on how familiar the interviewee appeared to be with the subject. If SDI was not a familiar term, the discussion was focused on economic, environmental and service indicators rather than on SDIs.

The issue of what information should ideally be captured in indicators was approached using an inventory of important flows of information to and from each interviewee, referred to as "network" in the interview guideline in Appendix; "information" is used here in a general sense, not necessarily pertaining specifically to sustainable development. The resulting networks were useful in identifying important actors and information flows, and as a basis for discussing indicator content; they were also useful in identifying factors that were determinant of why certain information flows, SDIs included, were or were not requested, or were even restricted for some reason. Figures 1–3 show simplified versions of the overall networks built up for each of the organizations as a result of superimposing the individual networks.

The interviews lasted for 30–120 minutes and were normally recorded. Each interview was introduced by asking the informant for consent to (a) record the interview, and (b) publish the results under a chosen level of anonymity and after approval of the Swedish report manuscript [42–44]. Notably, a vast majority of informants did not ask for any anonymity, while 1–2 informants in each field study preferred job function and fake initials. The latter was therefore adopted as the level of anonymity for all interviewees. Transcripts of the recorded interviews were sent to the interviewees for additional comments and/or corrections. The returned or, rarely, the original transcripts (if the interviewees did not comment on/correct and return them) were subsequently analyzed by coding all content relevant to the research. In the process of coding, phrases were used as units of analysis, and the codes applied were a mix of descriptive and interpretative codes [41] directly linked to the research questions. The analysis was made in accordance with the open approach applied in grounded theory; *i.e.*, no predetermined classification of answers was used. The key factors presented here were identified mainly through analysis of the answers to the question on SD and information flows in the interview guideline (Appendix, Question 3), but also, as already mentioned, of the discussions around

the information networks identified. To enhance the interview results, they were complemented by analysis of strategic documents and observations, an approach described in the qualitative methodology literature as “triangulation” [39,45,46]. All quotations from the interviews and the field study documents, originally in Swedish, have been translated into English by the author.

2.1. The Field Study Organizations

The municipalities studied were Uppsala, Borås and Stockholm. The Uppsala field study was based on 19 interviews and the Borås study on 16; the interviewees in both studies included public officers, works engineers at the waterworks and wastewater treatment plants and local politicians serving on the Sanitation and Streets Boards (in Uppsala and Borås, respectively). The Stockholm Water Company (SWC) study was based on 12 interviews with SWC employees having known experience with and/or responsibility for indicator work in the company, with two politicians serving on the board and one representative of the owner, Stockholm Stadshus AB.

The first field study, in Uppsala, was conducted from April to July 2004. Uppsala is a university town in eastern-central Sweden, close to Stockholm, with a publicly owned and governed water organization serving approximately 190,000 people. Since 1 January 2003, the city’s water supply and sanitation have been handled by two organizations—the Sanitation Office and parts of Direct Services—which formerly comprised one organization. The Sanitation Office (a “client-side office”) is now responsible for all water and sanitation activities, while Direct Services (a “production administration”) has been commissioned to carry out the actual operations. The entire Uppsala public sector is organized correspondingly: the client-side offices and production administrations implement decisions made by local politicians serving on the respective client-side and production boards, in this case the Sanitation Board and the Direct Services Board.

The second field study was conducted from March to May 2005 in Borås, a smaller city with a textile industry tradition in southwest Sweden. In Borås, the publicly owned and governed water sector serves approximately 86,000 people. In contrast to Uppsala, the sector is organized according to a more common Swedish model, in which both water and sanitation services are duties of the Streets Office, overseen by local politicians serving on the Streets Board.

The third field study was conducted at the Stockholm Water Company (SWC) from late October 2005 to March 2006. SWC is a publicly owned company operating the municipal drinking water and wastewater systems in Stockholm and Huddinge. Its activities encompass the production and distribution of drinking water for over one million people and the handling and treatment of wastewater from 900,000 people.

2.2. Present Use of Indicators

Like all Swedish water utilities, the organisations studied also report to authorities regarding the quality and quantity of water, wastewater, and sludge. Furthermore, their activities are subject to national environmental quality objectives that apply at the municipal level, primarily concerning good-quality groundwater, flourishing lakes and rivers, zero eutrophication and a non-toxic environment.

Swedish water utilities also report yearly to the Swedish Water and Wastewater Association (SWWA) on taxes and operations. As an example, a total of 468 parameters (referred to as key ratios) were delivered to SWWA from Borås in 2002–2003 (field study material). Of these parameters, 316 were financial, while the remaining 152 captured aspects of administration, environment, water balance, personnel, operations, quality, and renewal and renovation.

In Uppsala, nine environmental indicators regarding water issues were reported in the municipal environmental report [47], of which, six referred to the quality of the sewage sludge produced, two to the river water quality (nitrogen and phosphorus) and one to per capita water consumption.

In Borås, two initiatives regarding targets and indicators have been launched: one in the local Agenda 21 office (part of the Planning Office and the coordinator of municipal sustainability initiatives) and the other in the Water Division. Though these initiatives are partly linked, they were launched independently. The Agenda 21 initiative is linked to the national environmental quality objectives [48]. At the time of the field study, the initiative consisted of eight targets but included only four indicators relating to water issues. These indicators were very similar to those reported in Uppsala, with two referring to the quality of sewage sludge and two to river water quality. The Borås Water Division initiative, which involves management by objectives, does not explicitly relate to sustainable development; nevertheless, the targets defined largely concern sustainable development, whether implicitly or explicitly [49]. There were also a number of preliminary indicators for following up these objectives. Furthermore, at the time of the study, the head of the Water Division was preparing for the initialization of an environmental management system (EMS), which implies increased application of performance indicators.

Of the three utilities studied, the Stockholm Water Company had by far the most advanced indicator system. The practice of applying standard performance indicators at the company dates back more than 10 years, as is demonstrated by the regular publication of indicator reports [50,51]. Over the last few years, Stockholm Water's indicator system has become integrated with the "integrated management system" (ILS) [52] applied by the city of Stockholm to monitor the five overall objectives established by the municipal council. These overall objectives are to: (1) improve welfare and municipal activities; (2) build housing and develop Stockholm; (3) make Stockholm an ecologically sustainable metropolis; (4) reverse segregation and deepen democracy and (5) take responsibility for the economy [53]. The Stockholm Water indicator report for 2005 [54] contained 27 indicators for the entire company, presented under the following headings (number of indicators in parentheses): economic platform (12), personnel (8) and energy (5). The remaining indicators are organized into groups pertaining to the various processes in the company, from drinking water production to wastewater treatment. In these groups, the indicators in the report are not further classified, but here they have been roughly categorized to give an idea of what aspects the entire set of process-related indicators captures: operations (17), service quality (13), environment (12), and economic factors (7). Stockholm Water has also developed a customer satisfaction index, built up by the simple addition of two environmental and eight service indicators on a yearly basis [55]. Finally, Stockholm Water has had an EMS since 2003 into which the performance indicators, developed prior to the EMS, have been integrated.

3. Key Factors Influencing Whether and How SDIs Are Applied

This section presents factors identified in the field studies as critical for whether and how SDIs are applied in Swedish water utilities; *i.e.*, the drivers for and barriers to using SDIs, as established from the interviews through the analytical process of coding described above. As the entire study has approached the subject of SDIs from *within* the organization, this is also how the presentation is structured; beginning at the core of the organization, and subsequently following a continuum from strictly internal to increasingly external. The quotations selected either represent a frequently expressed opinion, *i.e.*, a widely held view, or the opposite, *i.e.*, an extreme point of view that stands out from more common opinions; which case each quotation represents will be clear from the context.

3.1. Attitude towards SDIs

The (potential) value generally attributed to the use of SDIs (defined as described in the final paragraph of Section 1.1) in the individual organizations can be summarized as low to moderate in Uppsala and moderate to high in Borås and Stockholm. It was obvious in all three organizations that, as will be described below, attitudes varied between the various groups of people interviewed, *i.e.*, operational personnel, planners, and local politicians; naturally, the variation within each of these groups was also considerable too.

3.1.1. Professional personnel

The professional personnel interviewed formed a varied group including works engineers, laboratory personnel, project engineers, and managing officers. All referred to the use of performance indicators as something necessary and well established in the sector for monitoring and controlling operations. The indicators referred to in this context are those capturing primarily technical/operational and economic aspects, including customer service and mandatory environmental aspects. Views on broadening the scope of these indicators to encompass sustainability issues more explicitly covered the full range from “waste of time” to “very good idea”. The reason given by those rejecting explicit SDIs was never that sustainability issues were not important; rather, sustainability issues were considered to be so integrated into the activities of the organization that no explicit indicators were deemed to be needed. Goals or targets were regarded as potentially useful to make sure that no important issues were neglected, but SDIs were not. This view was especially widespread in Uppsala, but also appeared occasionally in the other two organizations.

The motivations *for* using explicit SDIs, on the other hand, were primarily their usefulness in supporting development towards increased sustainability (or away from unsustainability), especially as tools for benchmarking and control in management. The latter application was often considered to be neglected.

3.1.2. Planners

People involved in planning, either in the Division of Water and Sanitation (or corresponding unit) or at the level of the local political administration, all expressed a positive attitude towards the use of SDIs in the water sector (or elsewhere, for that matter). The planners often work closely with the decision-makers, the local politicians, who are considered by the planners to be a group of people who think less positively of indicators, as the quotation below from an interviewed city planner implies:

But indicators ... Politicians don't have much faith in them. They just don't. It's more the Streets Office and the Environmental Protection Office that monitor the development with their indicators...

3.1.3. Politicians

Three of the six politicians interviewed confirmed the picture of them as rather negative towards SDIs, as did the representative of Stockholm Stadshus AB (not a politician himself, but employed to implement politicians' decisions). Two politicians were not negative, but stated clearly that they would not themselves initiate an increased use of indicators. Only one of the politicians was entirely positive towards the use of indicators and this person also described himself as somewhat unusual in this respect as compared to his colleagues.

However, the interviewees who expressed a negative attitude towards SDIs emphasized that this was not immutable; rather, their reservations concerned the number of SDIs and how they were designed:

PA: Another thing I find important, is not to drown information in more information. Having a large number of indicators is not automatically a good thing. [...] What's important is that they be good indicators. The organization tends to create a few extra, just to be on the safe side. If nothing else, you'll have a line of retreat, because at least you've done the reporting. But as a politician, if you have a couple of pages of indicators for a department, it takes several years before you figure out how to read them.

PB: For the last ten years now there have been requirements in terms of some sort of quality assurance and reporting with goals and indicators, as a result of which all administrations and companies have worked with them in some way. SWC and some others, are advanced in this aspect ... But I think they may have taken it a bit too far. Right now, we're looking at SWC in terms of efficiency and organization, and, for example, there are so many goals that they can hardly get them all out into the line organization ... They need to scale it back.

The two individuals quoted above were both concerned with receiving too much information, and also, in the case of PB, with the personnel at SWC wasting time on processing indicators. What is considered too much by one person, however, may be perfectly satisfactory for another. The following

quotation is from an interview with an SWC board politician (PC), and refers to the same set of indicators that was criticized in the quotation above:

I (Interviewer): The indicators in use, are they good?

PC: Yes, they are very good. They provide indications of development over the years in terms of economy, and also the environment. They are based on goals that have been set, and they are easy to read.

I: So it's a good format?

PC: Yes, very clear and informative.

I: And what about the number of indicators?

PC: Well, you can't take in too much information, but this is good.

There are of course many potential explanations to why the two persons quoted above, PB and PC, have such contrasting views on the indicators in question. An aspect worth considering, however, bearing in mind the comment by PA above that "it takes several years before you figure out how to read them [the indicators]" may be the fact that PC has been on the board of SWC for considerably longer than PB has had his position.

3.2. Time

In all three field studies, the need for practicality was underlined by nearly all interviewees. People at all levels in the organizations studied expressed a fear that more effort spent on SDIs would mean increased administrative burdens squeezed into already tight work schedules. One person chose to turn the question about room for indicators around by questioning other activities in the organization.

There is room, or we can make room [for indicators]. We are already working with goals and indicators. I think that we have to set aside time for what is important. Following up goals is important. We also need to examine our work responsibilities so that we can eliminate less important ones.

This quotation points to a difficulty linked to the use of lack of time as an argument against any innovation: it is in most instances a matter of prioritization. "We have not got the time" or "We cannot afford to" may just be an indication that the informant or their supervisor does not consider a change sufficiently important to justify the time or money required for implementation.

3.3. Environmental Management Systems

In the three field studies, how far the environmental management system (EMS) had developed in an organization was found to be correlated with the organization's general attitude towards indicators. The key features of EMS include goals, and indicators to gauge progress towards these goals (see, e.g., Sheldon [56]). An established EMS could hence be expected to influence attitudes towards the application of indicators generally. The causality could also be the converse: in an organization where

management by objectives and indicators to gauge these objectives are established, the adoption of an EMS comes naturally as it follows the same line of logic.

Uppsala was the one of the three organizations where people, on the whole, were least interested in SDIs; this was also the organization where no environmental management system had been applied:

We don't have an environmental management system—we haven't worked on those issues. But we generate indicators every year, and they concern finances, operations, emissions, *etc.* There are many different ones, and of course they have some value... in maintaining a high quality. Indicators can also be helpful when you look at what reinvestments to make.

In Borås, SDIs were ascribed a greater value, and in addition to the two indicator initiatives that had already been started at the time of the field study, preparations were being made for the development of a quality and environmental management system:

My aim is that we should develop a quality and environmental management system for the water and sanitation department. [...] The Public Cleansing division is well on the way in this. They have a full-time employee who can devote all his time to this issue. And I think that's precisely what is needed. During the year I hope to hire someone for that position as well. That will give us a chance to pick up the thread that we have lost in our administration.

Again, the importance of prioritizing the issue by devoting time (personnel) to it is emphasized. It is worth noting in this last quotation that preparations for the quality and environmental management system in Borås are being initiated by a division in the streets department, in a sort of "middle-up and down" process. Finally, in Stockholm, both indicator use and an environmental and quality management system were well established and integrated into everyday practice.

3.4. Organizational Structure

Inertia associated with administrative systems has previously been identified as possibly the most important barrier to advancing sustainable urban water management [57]. In this study, inertia in the flow of information through the organization was identified as problematic in both Stockholm and Borås. In Stockholm, this was mentioned in the context of management by objectives, which does not function if the objectives in question are not known and accepted throughout the entire organization. The interviewee is an employee with responsibilities within research and development projects at Stockholm Water.

I guess it's good to use management by objectives all the way from the ownership to the foot soldiers, so that both Stadshuset AB and the company have some sort of shared description of reality, and an idea of where we are heading. The problem is probably not that we have had too much management by objectives, but rather too little. It got stuck somewhere in the middle, in the management group. They have been very aware of this,

they and perhaps the supervisors immediately under them, but it feels like management by objectives has not extended upwards, or properly downwards either.

A somewhat similar situation, *i.e.*, objectives that have little impact because they have become “stuck” somewhere in the organization, emerged in the case of Borås. In Borås, the sustainability objectives as approved by the municipal council, and the lack of monitoring of these objectives, was criticized by one of the employees at the water treatment plant:

I don't think that I have set it [the ambition for sustainable development] higher than the municipal management has, centrally. But an organization like this one has such enormous inertia that, even if I didn't care at all, no one would raise an eyebrow. You can't reach down into the organization. There is no control function when it comes to sustainable development. [...] It's entirely up to the individual whether you want to care about it or not.

Monitoring and following up the *internal* targets of the water and sanitation division appears to function much better, possibly because of the participatory process used in their development and/or because of the proximity to the division head. The following quote is from an interview with one of the officers at the water and sanitation office, but similar statements appeared in most interviews with informants working either at the water or wastewater treatment plant or in the office.

I think it's a bit dangerous to say that it [the water and sanitation department's goal document] is finished. Things can change. I believe the situation is quite dynamic. And you have to be able to run a little check at year-end: have we lived up to these goals? We need to think about these things now and then throughout the year. N [Head of Division] will certainly ask...

Another reason why the *internal* objectives in Borås appeared comparatively functional may be that they did not have to be communicated across any sharp organizational boundary (Figure 2). This stands in marked contrast to the communication of objectives from the municipal council to the professional personnel, or, in the case of Uppsala, between clearly distinct organizations. In the new organization in Uppsala, where what was formerly one department had been split into two—a principal and a “doer” (the two circles in Figure 1)—dysfunctional information flows were associated with the boundary between the two organizations:

If something goes wrong, it's regulated in the order, how we are to report to our customers [the principal]. But in the other direction, when problems are reported to our customers, there are often deficiencies in the information flow. Those routines are not at all as good as when we find out about something. ... What our people [also] lack is information about plans from the Sanitation Office. [...] We often find out that we are supposed to build something only by reading about it later in the newspaper.

3.5. Trust and Conflict

Whether dysfunctional information flows are the cause or effect of mistrust is difficult to tell, but the two coincide. For example, lack of trust or confidence (see Earle and Siegrist [58] for a distinction between the two concepts) extending across the boundary between different parts of the organization (or between organizations, depending on how “organization” is defined) was reported in Stockholm, specifically concerning the relationship between SWC and its owner, Stockholm Stadshus AB (Figure 3). In this example, lack of trust was accompanied by an impression of inadequate communication:

In the management group we have a board, and then we have the owners. And I have to say that communication with the owners has not been all that good. We have not had the exchange of information that we would have needed, and we find that there is a lack of confidence in our organization. We think that we are doing a good job, and that the owners should be able to see that. But the owners do not appear to see it, or at least they don't say anything about it.

Institutional trust is part of the “social capital” that is frequently referred to as a prerequisite for sustainable development in organizations [59,60]. In Borås, one politician explained that he had learnt from the public officers about the values and potential usefulness of indicators, while the other politician interviewed underlined the importance of trust and confidence in the professional employees:

Concerning water and sanitation issues, we have great trust and confidence in the professional personnel. That's necessary as we're dealing with technical issues. After all, I'm a history teacher, I don't know anything about this. I may sound like a water and sanitation engineer to someone who doesn't know these things. But to be honest, I don't really know much about it.

In this case, where the politicians for various reasons are skeptical over the (increased) use of SDIs, the level of trust and confidence they hold in the proponents of SDIs appears to be decisive. The issue is two-tiered as it concerns the idea of indicator use as a tool and/or a process on the one hand, and the conception of sustainable development on the other. In Uppsala the situation was unproblematic as the interest in SDIs and the concern for sustainable development were both comparatively low and evenly shared throughout the organization. In Borås, the views on indicators as well as on sustainable development were more diverse, *i.e.*, the level of conflict was higher (or at least more open), but combined with the atmosphere of trust established in the organization, this conflict appeared to promote action towards sustainable development rather than to stall it. In Stockholm, on the other hand, there was obvious conflict between the owner and (some of) the employees regarding the level of sustainable development to aspire to and how to approach this aspiration, and this tension appeared to be most strongly manifest over the organization's indicator program. Combined with what some of the professional personnel perceived as a lack of confidence from the owners, these conflicting opinions had led to a stalemate in Stockholm at the time of the study.

Well aware that the sample is limited, it is worth noting that the situation in the three organizations described above happens to match the idea in modern organization theory of a correlation between performance and the level of conflict in an organization. This model does not explicitly mention trust but does emphasize related aspects such as levels of cooperation and integration, which are highest at the intermediate, “optimal” level of conflict [28], a situation of which Borås could serve as an example. Both too little conflict, as in Uppsala, or too much, as in Stockholm, lead to lower levels of performance (in terms of progress of sustainable development initiatives, including SDIs, in this case).

3.6. The Municipal Context

The Swedish water sector belongs to the public domain, the individual organizations being either publicly owned companies, like Stockholm Water Company, or part of the public administration, like the water organizations in Uppsala and Borås. Judging from the international literature (referred to in the introduction of this paper), the application of SDIs at the organizational level has advanced further in the private sector. Despite this, the fact that water utilities are municipally owned non-profit organizations was put forward as an argument *for* the application of SDIs by one of the members of the management group at SWC:

A public monopoly must, in my opinion, take every opportunity to present and report on the quality of its operations. Because we cannot measure ourselves on the so-called market in terms of red and black numbers—which is, after all, the method for all other enterprises—we have to express the usefulness, quality, or added value generated by what we do in some other way. As a result, all such measures are incredibly valuable and important for us.

The municipal directives were demonstrated to have a strong effect on the prioritization of sustainability issues by the professional personnel. Several interviewees in all three field studies referred to the official municipal policy documents in these terms: “This is our mission; this is what we have to do” (“commission” in Figures 1, 2 and “owners’ directives” in Figure 3). Notably, the missions referred to are products of the municipal decision-making process. Important actors in that process are the civil servants in the administrative office and the local politicians, including those specially assigned responsibility for water and sanitation. The extent to which the professional personnel from the water and sanitation division (or equivalent) are consulted or included in the process varies from one municipality to another.

The increased use of indicators and management by objectives in municipal activities is part of a transition towards more business-like management of the public sector, a movement known as “new public management” [61-63]. According to an interviewee heading one of the water treatment plants, the effects of this transition include an increased administrative burden (similarly, many interviewees expressed a fear of an increased administrative burden associated with SDIs, as was earlier discussed concerning availability of the necessary resources):

The movement of municipal operations towards more “private” performance, but without the resources of the private sector, pushes people into an overly pressured situation.

Several interviewees commented on the increasing administrative burdens they were experiencing, but no one other than the person quoted above made the connection to the “businessification” of the public sector.

3.7. Customers/Users

In the field studies, the customers, *i.e.*, private citizens and enterprises (as regards wastewater treatment, predominantly small and medium-sized enterprises connected to the municipal plant), were often regarded as having very little interest in *how* the urban water system works, as long as it does work from their perspective, *i.e.*, as long as good drinking water is delivered, and drainage and sanitation function. A growing environmental interest among the general populace is, however, expected to make users increasingly interested also in the environmental impact of their urban water systems. The customers were often cited as an indirect driver of SDI application, the direct driver being the importance attached to user information by the professional personnel at different levels of the water organization.

3.8. The Water Sector

The organizations studied were all part of the Swedish water sector, several features of which were revealed in the interviews as influencing whether and how individual organizations apply SDIs.

One important feature of the water sector in this context is that its actors are well accustomed to applying performance indicators to monitor and control operations, as expressed by one of the works engineers:

We follow up extensively on the indicators, but it’s something that we’ve always done—number of leaks per km of pipe, number of stoppages, *etc.*

The fact that water sector actors are well accustomed to using indicators does not appear to be an obvious driver of developing established indicator sets so that they better capture the entire concept of sustainable development. Familiarity with indicators would nevertheless be expected to facilitate their increased and extended use as it means that systems for collecting basic data and for reporting are established and, possibly more important, people are used to the line of logic underlying the use of indicators.

The water sector also consists of its individual constituent organizations. All of the interviewees mentioned other water organizations, or specific individuals in these organizations, as important actors in their networks. Other water organizations are a potential driver of SDI application, especially in benchmarking, although as yet none of the organizations studied specifically benchmark SD issues. The potential of benchmarking projects is however shown *e.g.*, by the participation of Stockholm Water Company in the Scandinavian Six-Cities Group for the performance benchmarking of water and wastewater systems [64]. As mentioned in the section on present indicator use in the organizations, a kind of benchmarking is also carried out on basis of the statistics collected yearly by the Swedish Water and Wastewater Association (SWWA). This data collection initiative focuses on information

regarding taxes and operations, though occasionally special enquiries are performed. For 2005, for example, SWWA collected information on a voluntary basis from water and wastewater utilities regarding their use of energy [65]. This project, “The water utilities’ contribution to increased energy efficiency in Sweden” (VA-verkens bidrag till Sveriges energieffektivisering), was financed by a grant from the Swedish Energy Agency. The ordinary parameters reported to SWWA, however, are predominantly financial.

An interviewee with long experience of indicator work in the Swedish water sector gave the following account of the background to the collection of statistics by SWWA:

In the 1980s we were attacked by the private sector, by the contractors, who said that they could maintain our systems much more economically than we could ourselves. At that time we didn’t even know what it cost to maintain the system. That was actually how it all began. And then we produced a whole lot of financial metrics, but with time we eventually got involved in disturbance indicators, indicators with links to environmental factors and the like, which are actually the ones we use to manage our operations. Especially if you develop a customer perspective. The customer can consist of individual people, but it can also be the environment, so to speak.

The interviewee quoted above describes how the private sector was leading in the measurement of financial performance in the 1980s. The influence of the private sector in this respect could be regarded an impulse leading away from rather than towards sustainable development, considering the one-sided focus on financial performance. On the other hand, the system developed for data collection, reporting, and benchmarking may, as noted above, prove useful in supporting the sustainable development of the sector.

There are many formal contacts (e.g., meetings and committees) between water organizations in Sweden, but most of the interviewees especially praised the *informal* contacts. Other water utilities and municipalities were referred to as somewhere to turn for advice, mainly on technical and operational issues but occasionally—and increasingly so—also on the use of indicators.

3.9. National and International Objectives and Regulations

In Uppsala and Borås, the national environmental objectives were obvious drivers of the formulation and application of local sustainable development goals and indicators at the Environment and Health office (Uppsala) and the municipal Environment and Planning office (Borås). In neither Uppsala nor Borås, however, had the water utilities been significantly involved in the respective efforts. Both organizations had reported only parameters that they would have monitored anyway, and the national objectives did not appear to have had any recent and/or obvious effect on either of the water organizations with regard to their use of indicators.

National *regulation* is on the other hand the obvious driver of many performance indicators in use today, as these indicators have to be reported to permitting authorities such as the Environment and Health office (or corresponding unit). This implies that to the extent that national regulation reflects the national environmental objectives, the latter affect the water organizations and their use of

indicators via regulation rather than via local SDI initiatives. Despite the obvious influence of authorities on the water sector reporting practices, or possibly because the reporting practices in question are so routine, authorities as well as regulations and objectives at a regional or higher level were mentioned very rarely in the interviews. One of the very few such explicit references was made by one of the politicians in Borås:

The problem is that we don't always know what the new requirements are, like the EU ones. [...] With regard to both nitrogen and phosphorus pollution, which are the most important types, we have to strive constantly to get below the limit values. We don't have planned activities, we're just putting out fires as they arise.

Several interviewees cited the sometimes unpredictable behavior of authorities to explain why the formulation of internal targets may appear futile: an authority's sudden change in the legal or economic premises of operations may render fruitless the effort expended to formulate indicators as well as targets. The broader implications of unforeseeable changes in the water sector are discussed further by Dominguez and Gujer [66].

3.10. Results in Summary

In Figures 1–3, some of the factors identified as key in the previous sections have been depicted as drivers or barriers. Factors such as attitudes towards indicators, resources, EMS, and social capital have not been depicted individually, but are reflected by the fact that the organizational core in Borås and SWC functions as an SDI driver, whereas in Uppsala no such driver function could be discerned.

Figure 1. Key actors and information flows in Uppsala water organization.

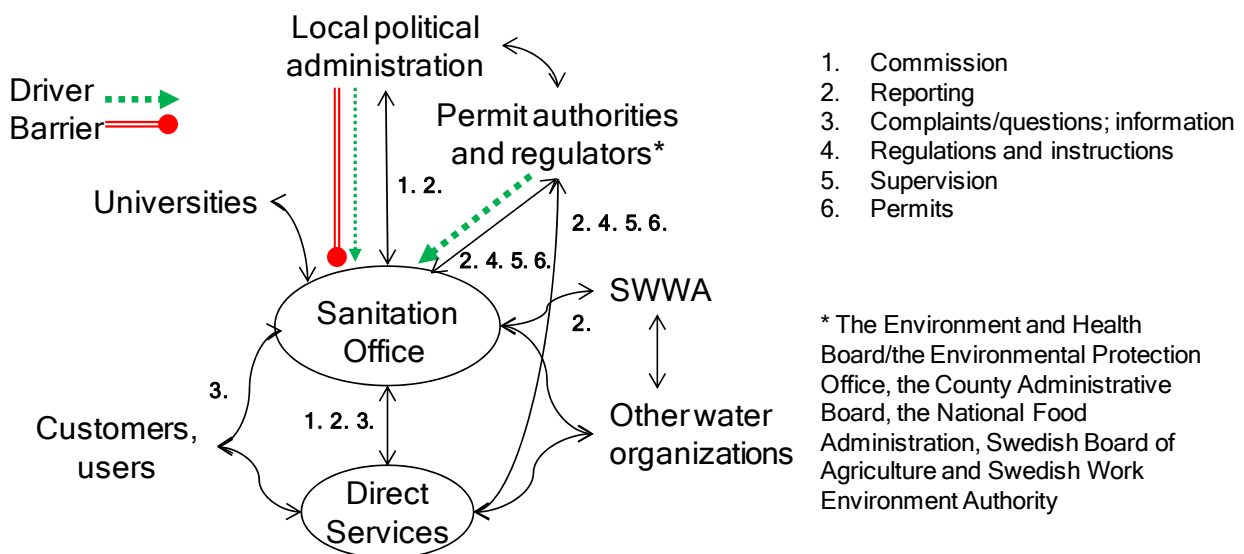


Figure 2. Key actors and information flows in Borås water organization.

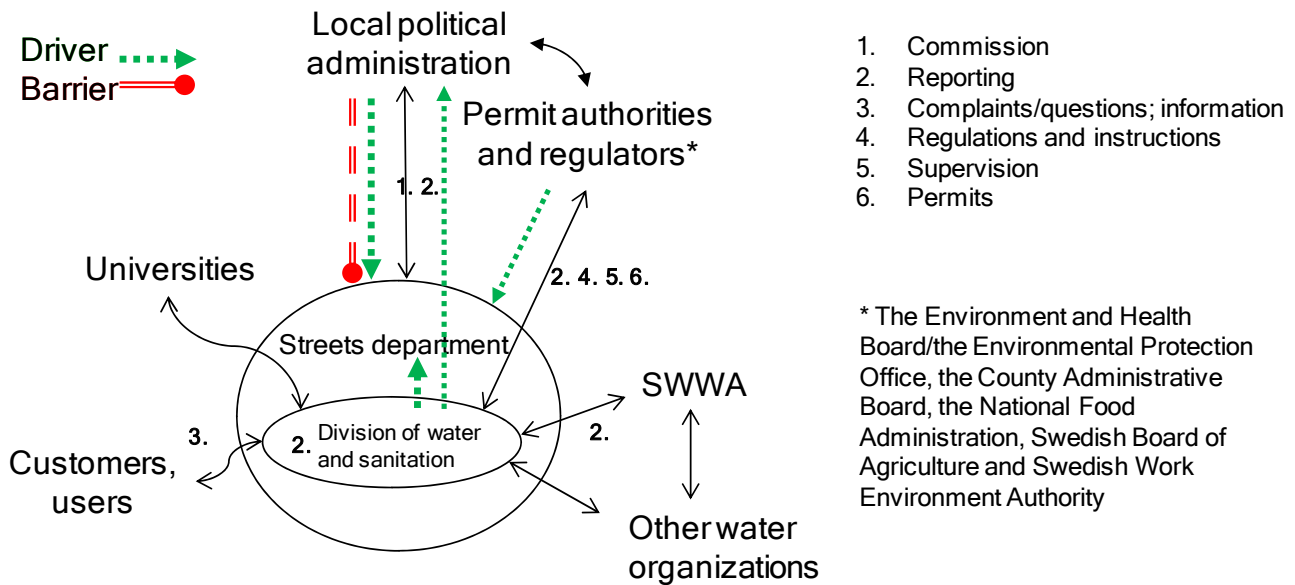
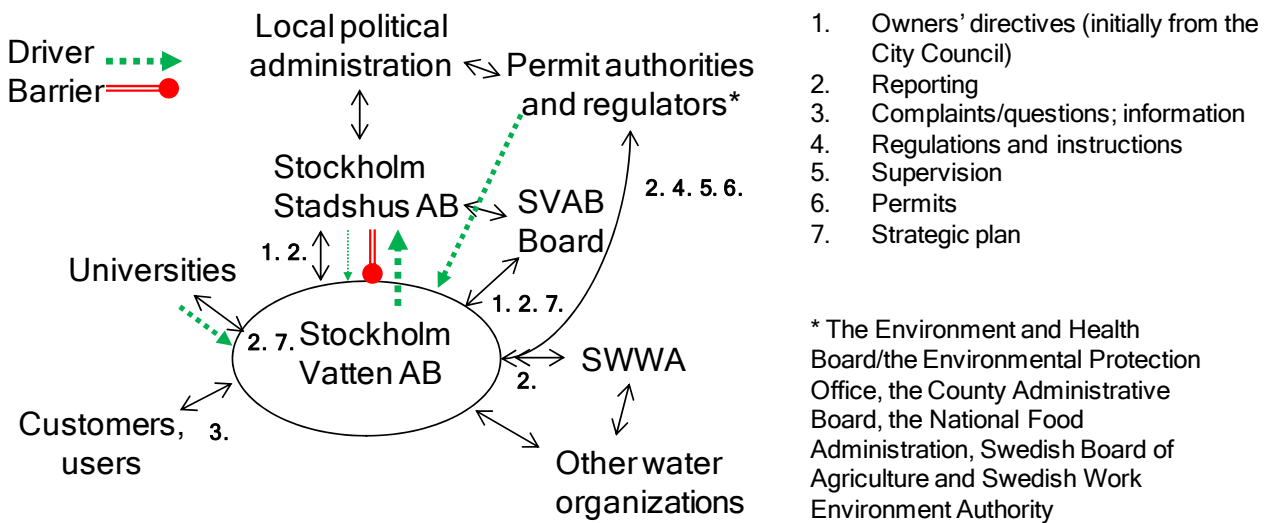


Figure 3. Key actors and information flows in Stockholm water organization.



Customers have not been depicted as drivers, as they were identified as having only an indirect, passive role. In all three organizations, cooperation with universities was mentioned as a potential support (and driver) for developing SDIs. Only in Stockholm, however, did such cooperation actually take place. The influences originating from the municipal context, as seen from the figures, are two-fold in all three cases (depicted in relation to the owner company in the case of SWC). This reflects, on one hand, the fact that the planners in local administrations generally regard SDIs positively; furthermore, the national environmental objectives *should* be followed up at the local level (only in Borås, however, was the local Agenda 21 initiative apparently active). On the other hand, several politicians regarded indicators in a less positive light, acting more or less explicitly as barriers by slowing down the process of developing SDIs. The driver function assigned to permitting

authorities and regulators in Figures 1–3 arises mainly from the requirement to report to these authorities regarding, for example, nitrogen and phosphorus effluents discharged to receiving waters. These parameters are, like most of the indicators included in the study, not called SDIs, but they do capture some important aspects of sustainability.

4. Concluding Discussion

Of the drivers and barriers identified in the study and summarized above, the key features appear to be attitude to SDIs, trust and communication, the national water sector and regulation, for reasons that will be discussed below.

The attitude to SDIs is central in the sense that it influences and is influenced by several of the other conditions. It consists of two components: (1) indicators as a management tool and (2) sustainable development as a vision and/or normative political goal. The extent to which indicators are appreciated as tools in decision-making, planning and strategy varied considerably between different groups of actors in the study, irrespective of whether sustainable development was considered important or not. In accordance with the theory on SDIs in the introduction, not all actors in the field studies agreed with the use of indicators and the related rational ideal for decision-making. This aspect of indicator use is overlooked in much of the extensive literature on SDIs.

An alternative to SDIs in organizations where the attitude towards them varies from one actor to another could be to concentrate less on the developed SDIs and more on the *process* of developing these indicators and on the possibilities such processes offer in terms of fostering learning and understanding. This appeared to be an often forgotten role of indicators in the utilities studied, only mentioned once in the interviews, the predominant approach to the use of performance indicators being a much more rational one.

Another alternative, or complement, to the rational approach to decision-making would be to focus more on the vision of sustainable development, as was the preferred strategy in Uppsala. The importance of a shared vision—or at least not mutually exclusive visions—of sustainable development is supported by authors such as Rydin *et al.* [34] and Klostermann and Cramer [67]. A precondition for a shared vision of sustainable development appears to be clear communication between the actors involved. Similar findings were made by Wibeck *et al.* [9] in a study of management by objectives in Sweden. Clear communication is facilitated by trust which, in a reciprocal process, can in turn be cultivated by good communication. In the utilities studied, trust and clear communication appeared to be particularly important across organizational boundaries, a conclusion which is consistent with findings in the field of knowledge transfer in organizations (see e.g., Argote and Ingram [68]). The potential drivers, or facilitators, for the development of SDIs are obviously entangled and this study sheds no light on how they relate to one another. *If*, however, SDIs were clearly desired in an organization, trust and communication are aspects that would need to be considered, especially so as SDIs need to “travel” across organizational (system) boundaries to co-ordinate different parts of an organization.

The other component in the attitude towards SDIs is the sense of urgency perceived with regard to the sustainability of present systems. Swedish urban water systems are regarded as sustainable in their present state by many of their actors. Thus, if there is a shared vision of Swedish urban water systems

in this instance, it is that they perform fairly well from a sustainability perspective; whether this is valid is not addressed here. What is important here, though, is that there appears to be a correlation between the perception of how sustainable the sector is and the value attached to SDIs: perceived high sustainability of the water system managed correlates to little interest in SDIs (but perceived low sustainability does not necessarily imply a high interest in SDIs, as discussed above apropos the attitude towards indicators as management tools).

The existence of a (more or less) commonly shared vision of the sustainability performance of the sector and the fact that the professional personnel underline the importance of support from and networking within the sector both fit well with the idea of organizational fields in institutional theory [69]. Organizational fields consist of organizations that are institutionally bonded to each other because they perform similar tasks or for some other reason depend on and interact with each other. According to DiMaggio and Powell [68], organizations in the same line of business and within the same organizational field tend to become more similar. The authors identify three mechanisms for such *institutional isomorphic change*, two of which are highly relevant in this context. One stems primarily from professionalization, of which education and professional networks are important aspects, the other from pressure from other organizations, e.g., authorities or other influential organizations. This theory confirms the findings above that the sector itself (through more or less formalized networks and the sector organization) and authorities (through regulation) are important potential drivers for any change in attitude towards sustainable development and a more widespread use of SDIs in urban water management.

Water systems around the world are facing enormous challenges due to population growth, increased use of chemicals and increasing effects of climate change. This is likely to lead to an intensified discussion of what kind of water systems are required to meet these challenges, and possibly (but not necessarily) an increased and widened interest in SDIs to support the process of developing appropriate urban water systems.

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Appendix. Interview Guideline

The following guideline, or list of main points, was used in the field studies. The guideline should be read as an instruction to the interviewer on what to capture in the interviews and a *suggested* order and formulation of questions.

1. Work situation
 - (a) Briefing on background and education
 - (b) Present occupation and responsibilities

2. Decision-making and information
 - (a) What kind of decisions do you (often) make in your work?

- (b) What information contributes to settle your decisions? (Laws, regulations, commissions, guidelines, objectives, experience, tradition, culture, colleagues, common sense etc?)
 - Who does that information come from (if it is external) Draw network.
 - Format and content?
 - (c) Does it ever happen that you get too much or too little information or information that is poorly adjusted to your specific work situation? If yes, specify content, format and sender.
 - (d) Whom do you send information too and why? Continue the drawing of the network.
 - What kind of information is it (format and content)?
3. Sustainable development and information
- (a) Start by quoting whatever the commission (owners directives in the case of SWC) say about sustainable development—is the policy familiar, does it affect your work and if so how?
 - (b) Does the water organization, in your opinion, develop in accordance with the policy? Explain.
 - (c) What would a sustainable urban water system look like?
 - (d) How could the conditions for sustainable development be improved?
 - (e) Whom do you think it is important that the water organization co-operates (more) with to advance sustainable development of the urban water system?
 - (f) Are there information flows that are or would be particularly important regarding sustainable development of the urban water system?
 - Sender, receiver?
 - Content, format—SDIs?
 - Integration with other information?
 - (g) Is there room for such information in the organization today (or would that require major modifications of information routines)? Explain.
4. Others I should talk to, documents I should look at or sites I should visit?