WWW.EFMN.INFO The European Foresight Monitoring Network

Regional Infrastructure Foresight

Foresight Brief No. 116

Authors: Eckhard Störmer (eckhard.stoermer@eawag.ch); Annette Ruef (annette.ruef@eawag.ch); Bernhard Truffer (bernhard.truffer@eawag.ch)

Sponsors: Swiss National Science Foundation, National Research Programme NRP 54: Sustainable Development of the Built Environment

Type: single issue: regional sanitation systems; development of strategic planning methodology

Organizer: Eawag, The Swiss Federal Institute of Aquatic Sciences and Technologies; Empa, Material Science and Technology; Fraunhofer Institute for Systems and Innovation Research; University of Berne; Swiss Federal Institute Zurich

Duration: 7/2005-6/2008 **Budget:** 215'700 EUR **Time Horizon:** 2030+ (25 years) **Date of Brief:** Sept. 2007

Purpose

"Regional Infrastructure Foresight" enables municipalities, engineers and decision makers in regional sanitation systems to develop a middle- to long-term strategy for a sustainable sanitation infrastructure. Identification of uncertainties and future challenges of the regional infrastructure's context is carried out in a participatory scenario process. A broad range of possible integrated solutions for the sanitation system is evaluated from different stakeholders' views. This approach allows handling of uncertainties of frameworks and of complexity of the system to find more adaptive system configurations for a sustainable sanitation system.

Foresight for Sustainable Infrastructures: Handling Uncertainties and Enabling a Systems Change

Water infrastructures are characterized by a stable socio-technical system: Inert long-living technologies and corresponding expert systems of planners, technology suppliers and regulators exhibit strong path dependencies. The system tends to perpetuate predominant paradigms and thus to risk missing out on more sustainable alternatives. New incremental or more radical technologies are on the market or in development but have only little chances to grow out of niche markets.

Sanitation infrastructure in industrialized countries was primarily erected in the 1960ies to 70ies. Nowadays many elements of the sanitation system reach the end of their lifespan and solutions for re-investments have to be found. The solutions have to face new challenges like increasing variability of waste water streams, micro pollutants, stronger regulation etc.

As an answer to enormously increasing resource use and rising burdens on environment and human health, the Swiss National Science Foundation research program "sustainable development of the built environment" (NRP 54) is developing scientific principles that will help to bring about a more sustainable development in Switzerland's towns and cities, as well as in its infrastructures.

Within this program, the research team of Eawag Cirus developed a foresight and strategic planning approach which allows to integrate uncertainties and to find innovative solutions for a more sustainable sanitation system. The method is tested in three case studies in different Swiss regions. The project is carried out conjointly with national and regional water management agencies, the national water pollution control association and engineering consultants which see the need for a critical reflection of established systems.

Focus on Pragmatic Planning Tools

The "Regional Infrastructure Foresight" (RIF) methodology is developed to support strategic decision making for sustainable infrastructure planning. The foresight approach shall empower local and regional authorities, and sanitation professionals to decide on mid- to long-term strategies for infrastructure development and to manage potentially sustainable innovations in a strategic way. RIF therefore combines elements of meth-

The EFMN is financed by the European Commission DG Research. It is part of a series of initiatives intended to provide a 'Knowledge Sharing Platform' for policy makers in the European Union. More information on the EFMN and on the Knowledge Sharing Platform is provided at WWW.EFMN.INFO

ods for regional governance, strategic planning and technology assessment.
The methodology itself is the result of the project. It provides a framework for strategic planning in the sanitation sector with the potential to transfer the approach to sectors with similar characteristics. Main purposes of the methodology are

- identifying particularly uncertain future challenges of the regional sanitation system;
- assessing a broad range of solutions including radical alternatives to think off the beaten tracks. In particular, conventional system boundaries, such as the size of the catchment area or the range of the organization's infrastructure tasks, shall be questioned;
- mapping out the goals and targets of the public task sanitation to integrate multifaceted expectations of different stakeholders. A broad range of perspectives and value positions shall be involved to mobilize broader resources of knowledge stocks and to enhance the acceptance of innovative options;
- developing a strategic plan in terms of a recommendation of principal long-term pathways for a sustainability oriented regional sanitation system.

Participatory Foresight Approach

Structural characteristics of the RIF methodology are the following

- Three levels of intensity in participation:
  - Core team of about 4 local decision makers which analyze the relevant steps and prepare the stakeholder workshops.
  - 15 to 25 stakeholder representatives collaborating in the identification of future scenarios and the evaluation of options.
  - actual decision makers in the region reflect the gathered results and decide about the next steps in the planning process.
- Reflexivity with regard to the object of analysis and its potential extensions: definition of time scale and regional application area of the planning procedure; specification of relevant stakeholder groups in the region with regard to the conventional planning and decision processes in the regions concerned.
- Open and participatory approach to decision making: Decision makers have to open their decision making processes to more public discourse and involve diverging inputs form different stakeholders. The result of the planning shall serve as a starting point for more detailed planning and decision processes.

Based on these structural characteristics, a foresight process has been carried out with the following phases.

- *Preparatory phase*: analysis of situation, delimitation of object of analysis, identification of key stakeholders, establishment of performance contract with research team.
- *Analytical phase*: identification of relevant context conditions and options, elaboration of value tree and sustainability visions in the region. This step is worked out in the core team and in the context of a two day stakeholder workshop.
- *Evaluative phase*: assessing the strategic options against the background of the context scenarios and the values weighted by the preferences of different stakeholder groups. This leads to specific rankings of stakeholder groups and identification of conflict lines (one day stakeholder workshop).
- *Implementation phase*: presenting the results to the decisions bodies, determining the application context of the identified alternatives, resolving an agenda for a more detailed planning process.

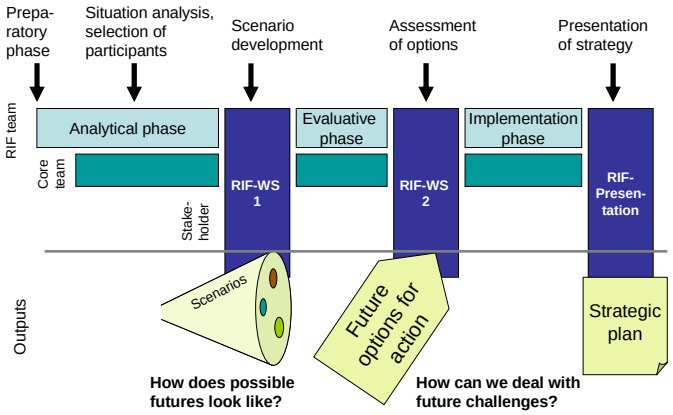

Figure 1: Process scheme of RIF

Scenarios, Goals and Options

In the following, the main generic results of the case studies are presented. These are context scenarios of regional development, value trees, and technical and organizational constructions of options.

1. From 'Blooming Growth' to 'Catastrophe'

Regionally specific context scenarios were built in the stakeholder workshops. Regionally relevant factors were identified by the participants. Major factors and drivers of the scenarios are mainly economic and societal developments which influence settlement structures, consumer and production patterns, as well as regulatory questions of waste water pollution control. A problem oriented categorization of the scenarios developed in the case studies can be described by two main dimensions of problem pressure and problem solving capacity. Problem pressure is described by the requirements for the sanitation system, such as the variability of waste water streams and regulatory and societal demands for the system. Problem solving capacities for the public task sanitation depend on the economic capacity of the region and on the fragmentation of the community structure of the region.
Three generic types of context scenarios, which result from an analysis of the specific participatory built scenarios in the case

studies, showed possible but uncertain developments. Main drivers were economic growth and the amount of pressure on the sanitation system:

- "Region light" is a shrinking region with decreasing demands on the sanitation system. The key challenge is a low ability to pay for infrastructure services. Problem solving capacity is low, but problem pressure is also low. Maintenance and operation of infrastructure on a moderate level is usually possible.
- "Blooming growth" is a situation where quality of life is an important driver for the attractiveness of the region. High environmental standards are requested by the inhabitants. High problem pressure with high problem solving capacity lead to a situation where efficient and effective infrastructure services can be established and operated.
- "Strong globalization" is a picture of a region which is driven by decisions of global headquarters which open and close their production sites on short-term request of the international market. With this situation unemployment rates go up and the economic situation is more or less precarious. It is nearly impossible to plan the variability of waste water streams. Problem pressure is high and problem solving capacity is quite low. This situation can lead to a "catastrophe" where infrastructure cannot be maintained any more.

In addition, possible impacts of climate change are considered in one or several scenarios. In the case studies the scenarios were regionally specified and vary from these generic types.

2. Value Tree of Sustainable Sanitation

The sanitation system as a public task of water pollution control and safeguarding of hygienic standards pursues a range of goals within the whole range of sustainability pillars:

- ecological aspects are water pollution control, minimizing resource use and recycling of resources, risk prevention
- social aspects are health promotion, accessibility to the service, equitable and affordable cost of the services, and intergenerational equity
- economic aspects are efficiency and effectiveness, cost transparency and adaptability and openness for innovation
- governance aspects are political participation and legitimacy, controllability, and ability for coordination.

These goals vary in their relevance in different context scenarios; which can be critical or supportive of meeting the challenges of the scenario worlds. The goals are assessed with different priorities and values from different stakeholder groups. This makes conflicts about different demands on the sanitation system transparent and helps to anticipate possible sustainability deficits.

3. Technical and Organizational Options

Main trends in sanitation systems and technologies in general are on the one hand heavy increase in WWTP sizes as an intensification of today's dominant design. On the other hand, decentralized on-site WWTP improve their technologies and therefore their reliability and user friendliness with a decrease in costs. Beside these incremental to radical technological innovations, other elements of the sanitation system have to be taken into account for an integrated view.

In the RIF process, strategic options are developed in the core team by analyzing the major technological and organizational elements that might form a future sanitation infrastructure. A few basic parameters define the configuration of a sanitation system and offer different possibilities for change according to the regional situation. These are:

- degree of centralization within the catchment area (e.g. central plant, on-site preliminary purification, decentralized WWT),
- technology of sewerage (e.g. combined or separated sewer system),
- sludge treatment (e.g. drying, digestion, gas production),
- thematic focus of infrastructure services (e.g. operating only WWTP, or including sewerage, drinking water system, waste management),
- organizational form (e.g. association, public firm, private firm in public ownership, privatization),
- allocation of fees (e.g. uniform fees, polluter pays principle).

Basic strategic options can be derived by combining these parameters into coherent system configurations. The options developed in the case studies represent corner stones of a continuum of options. Two characteristics can be identified as the main dimensions:

1) The size of the catchment area has at the one end a wide enlargement of the perimeter by a technical merger of two or more neighboring sanitation systems. It aims at realizing economies of scale in large waste water treatment plant and at buffering the variability in waste water streams. At the other end, a highly localized on-site treatment of waste water in small plants for each dwelling or production site is conceivable. It enables a radical polluter pays principle and internalizes the need to care for the variability of changes in waste water flows.

2) The second dimension can be identified as the thematic spectrum or the range of tasks of the sanitation organization. At the one end is the concentration on core competencies of waste water treatment: only cleaning the water with no frills (i.e. a highly fragmented sanitation system, e.g. giving fresh sludge to a specialized processor). At the other end, the sanitation system can be merged with other infrastructure services to a multi utility to benefit from synergies between more or less similar tasks.

In the stakeholder workshop tapered options close to the edges of the continua are assessed to get clear differentiations and trade-offs between the options. Within this field various subvariants are possible. For the final recommendations, the basic options are enhanced to coherent combinations of their sustainable elements to new options.

4. Sustainability Assessment of Strategic Options

With the assessment of the given options by different stakeholder groups in different scenario contexts a broad field of arguments pro and contra the options is delivered. Different preferences of options between stakeholder groups in one scenario world show potential dissent and conflict lines. This procedure simulates a virtual political decision, and opportunities and threats for the sustainability of their implementation are drawn out. The comparison between the assessments of options in different scenarios provides the framework conditions under which options are more or less appropriate. It also gives advice to sanitation professionals, which context developments have to be under control in a kind of trend monitoring to use early signals for the fine-tuning of strategic plans.
These results allow delivering a detailed overview of strategic options and suitable sub-variants, considering uncertainties of context development, technological innovations and organizational possibilities.

Regional Infrastructure Foresight as a New Governance Approach

Infrastructures typically have a long lifetime. They are usually not flexibly adaptable but have to be appropriate over the whole time span of 25 years in the case of WWTPs. To find long-term fitting solutions, planning faces high requirements. However, conventional sanitation planning approaches have deficits: they do not deal with uncertainties of future developments of framework conditions in a transparent and comprehensible way. For several reasons they are usually not open for innovative technologies of system configurations. With the RIF methodology, we propose a different kind of planning with comprises uncertainties and opens the discussion on a broad range of integrated sanitation system solutions. Moreover, the highly participative methodology can be seen as a new governance approach to infrastructure management.

1. Participation for Visioning and Learning

The scope for action on infrastructures in general, and sanitation systems in particular, is becoming more dynamic and being confronted with growing uncertainties due to globalization, liberalization in infrastructure markets and technological innovations. Foresight helps to think ahead to be prepared for new challenges and to integrate adaptability and flexibility of solutions from the beginning.
The RIF method uses a participatory development of context scenarios and evaluation of options for two reasons: to integrate tacit knowledge of different groups on possible future developments, to build awareness of the range of possible futures with their variety of relevant challenges, and to allow a critical reflection of the opportunities and threats of conventional and innovative solutions.
The intense work of the core team of local decision makers in the sanitation system opens a learning process on strategic long-term planning. The assessment process which is usually carried out in a black box by planning engineers is made transparent and traceable. The stakeholder discussions simulate political decisions and deliver argumentations for the real policy process. In the RIF procedure, the participating stakeholders are multipliers for the favored solution.

2. Dissemination of Strategic Infrastructure Planning

With the official from the regulatory body of the Swiss canton participating, i.e. federal state, lessons from one exercise can be transferred to other organizations in the same canton. It could become a core activity of the cantonal office to support this kind of strategic planning processes in the different regions and to support synergies between the different processes. If carried out in different cantons this may ultimately create a background for national organizations and federal offices do discuss and implement radically new technologies in sanitation. A coordinate set of RIF procedures could then create momentum for reforming the whole sector.

3. Key Requirement and Limitations of the RIF Approach

To carry out a RIF procedure, open-minded participants are needed especially in the core team. Core team members have to be part of the decision making bodies. They have to be prepared to reflect the today's system with its goals, habits and standards. Additionally they need a basic ability for strategic thinking.
Obstacles to radical, system-changing innovations are high, even in this open process. Uncertainties of their feasibility in area-wide application and trust in their reliability are too high to be accepted today. In contrast to conventional planning processes however, radical options such as decentralized WWTPs are discussed and recommended for use in pilot cases and niche markets.
A RIF procedure delivers a recommendation for a strategic orientation of the regional infrastructure system. This provides the base for policy making in the public sanitation boards. Technical planning with feasibility studies can then be undertaken according to the results of the RIF process.
The RIF methodology thus offers a new governance approach to sustainable infrastructure planning at the regional level.

Sources and References

A German handbook on the method will be published in 2008

www.nfp54.ch
www.cirus.ch