Management of Wastewater Treatment Plants on the Test Stand

Each year, two billion tons of waste water are collected from urban areas, then treated and returned to the natural water cycle. In order to process such an enormous volume of water, the technical and logistical processes must work together flawlessly. Weak links in the organizational process are not only economically relevant, but may pose a safety risk. Evaluation and optimization of the logistical and organizational frameworks should, therefore, be a fixed part of the overall operation. EAWAG has developed a new procedure for self evaluation and process reengineering, allowing wastewater treatment plants to conduct extensive process analysis and to improve them where necessary.

Wastewater treatment no longer has the status it had only a few decades ago. Problems regarding streams and lakes appear to be solved, urban water hygiene has been accomplished, and drinking water quality meets regulatory requirements. Today, the average citizen expects high system reliability, transparent use of public funds, and democratic involvement in decisions that have far-reaching implications (Tab. 1). As a consumer, a citizen desires low supply and disposal fees, no limitations on his/her personal freedom (7 x 24 hours availability), and fast, uncomplicated permitting procedures for new hook-ups. Wastewater treatment plant operators are, therefore, experiencing ever increasing pressure to provide the best possible service at an increasingly lower cost.

Organizational Deficits

Currently, there are organizational obstacles that impact the economical operation of wastewater treatment plants and make it difficult for operators to maintain the function and value of the plant over the long term. Such deficits include, for example, poor functional job separation, excessive controls and regulations on the operational side with a simultaneous lack of control of strategic aspects, and ill-defined assignments of responsibilities. As a consequence, the entire organizational structure is characterized by a high number of internal interfaces, an excessive need for coordination, long delays in dealing with issues, and relatively high stress load on managers. In addition, decisions often have to be made based on information that is incomplete, of poor quality, or altogether unavailable. This is often due to ill-defined job assignments; if it is unclear who carries which responsibilities, it will also be unclear who needs what information.

It is rare to find operational goals that go beyond numerical water quality criteria for the water that is discharged. According to a survey of the VSA (Swiss Water Pollution Control Association), 54 % of communities or treatment cooperatives do not have any or only early stages of further reaching goal statements and multi-year plans [1]. The picture is even bleaker with regard to mission statements: only 25 % of the surveyed entities reported that they examine questions regarding their own organization or their future development (Fig. 1). Consequences of lacking goals that define the corresponding control mechanisms include unrealistically high or low expectations about quality, inadequate preparation for unexpected events, and the assumption of power according to the size of the budget, the number of employees or the value of the plant.

Interested Party	Interest
Citizen	▪ Clean streams and lakes/clean drinking water ▪ Democratic participation ▪ Protection from service disruptions ▪ Low emissions (e.g., noise, odors) ▪ Information and transparency
Customers	▪ Inexpensive connection and disposal fees
Industry/Large customers (“Key Account”)	▪ Industrial management advantages (e.g., liquidity of assets) ▪ Flexible contract conditions ▪ Rapid, uncomplicated permitting process
Private customers/small businesses (Property or house owners, wastewater producers)	▪ Low connection and disposal fees ▪ Rapid, uncomplicated permitting process ▪ No restrictions on personal freedom
Cantonal agencies	▪ Compliance with regulations and codes ▪ Reasonable monitoring effort ▪ Acceptance of imposed measures

Tab. 1: Selected interested parties in wastewater treatment issues and their interests [2].

Assessing the Need for Change

It is not trivial for individual enterprises to identify organizational shortcomings, a situation worsened by the fact that various services related to wastewater treatment are protected by “monopolies”. Examples include a police monopoly on the permitting process, the more obvious monopoly given by the need to use the existing sewage system, and the fairly direct legal monopoly incumbent in the requirement for making connections to the existing network. These monopolies have the disadvantage that wastewater treatment is not embedded in a functioning market environment, and self-regulating mechanisms, which would nor-

mally lead to better efficiency and efficacy in the service provided, are not in play.

Despite all of this, there are a number of parameters that can be used to evaluate distinct performance criteria of an individual wastewater treatment plant.

Performance indicators: Certain indices allow us to compare the service provided by different organizations (i.e., hook-up fees or operational fees). There are a number of national and international projects currently attempting to identify reliable performance indicators for wastewater treatment plants. Experience shows, however, that it is difficult to develop indicators that correctly account for different boundary conditions and other unique circumstances, (e.g., required cleaning efficiency, the type and size of the sewage system, topography, billing methods).

Process benchmarking: In process benchmarking, the performance of a particular plant is compared to that of the best providers. This allows the evaluation of individual processes and their costs. It also provides for a mechanism for identifying weaknesses and for recommending appropriate measures for improving performance.

Customer surveys and citizen complaints: Systematic complaint management can be a valuable source of information for improving service (i.e., complaints about traffic, odor emissions, unfriendly customer service). Continuous or periodic customer surveys are another tool that could, for example, be used during permitting procedures.

Controlling: Controlling compares specific services to the costs that were incurred. This requires, however, that the demands for the various services are clearly defined and that compliance can be strictly monitored.

Employee surveys and employee forums: Particularly in larger organizations, information about sick leave and employee turnover can provide valuable insight.

Self-monitoring: Self-monitoring provides information about the technical performance of a plant and the quality of current plant management.

Each of these parameters gives information about certain aspects of an operation. It is not possible, however, to gain a complete picture based solely on these parameters, or to identify potential organizational deficits.

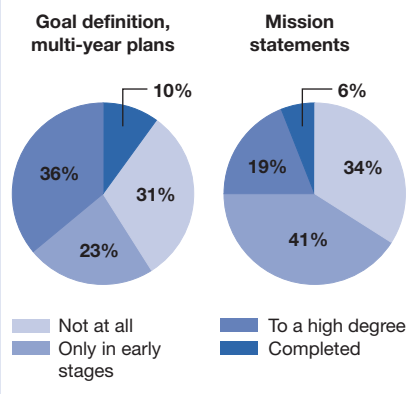

Fig. 1: Realization of goals and work on mission statements in 50 Swiss communities and cooperatives [1].

Instrument for the Evaluation of the Organizational Process

This is where EAWAG wants to supply help. In collaboration with the VSA, a comprehensive tool for the evaluation of all organizational processes has been developed [2]. The tool considers all major processes relevant to a community or cooperative (Fig. 2) and is based on the model for public service and social service institutions as established by the European Foundation for Quality Management [3]. The original model was adapted to the particular mission and terminology of wastewater treatment and enhanced by additional criteria appropriate in this field. The resulting tool incorporates relevant legal criteria (particularly with respect to the Swiss legislation on water protection), Federal operation guidelines for wastewater treatment plants, as well as guidelines for organization, optimization and quality assurance in wastewater treatment [4].

In the form of a self-evaluation tool, a questionnaire with 250 detailed questions is completed by the organization under consideration. If the legal framework allows it, the answers can be weighted by the organization: each question not only asks about a degree of compliance or fulfillment, but also for an assessment of how important that particular issue is for that organization. This

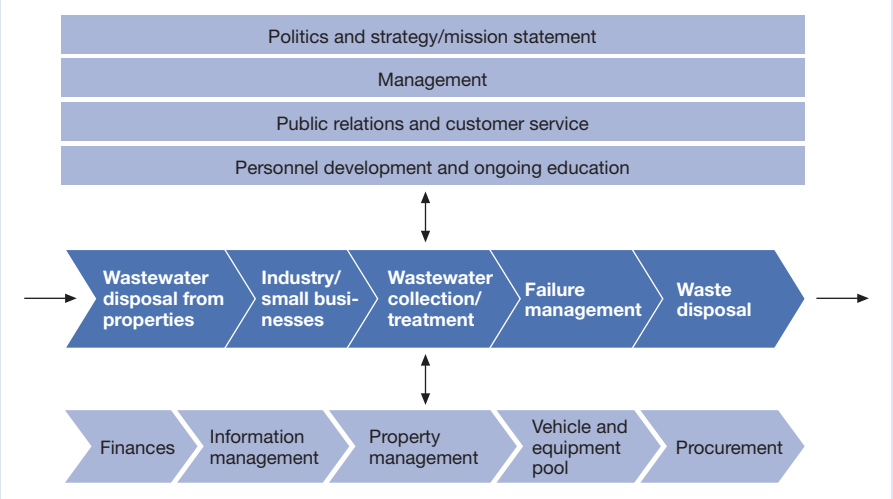

Fig. 2: Process model for the wastewater disposal system for communities and cooperatives.

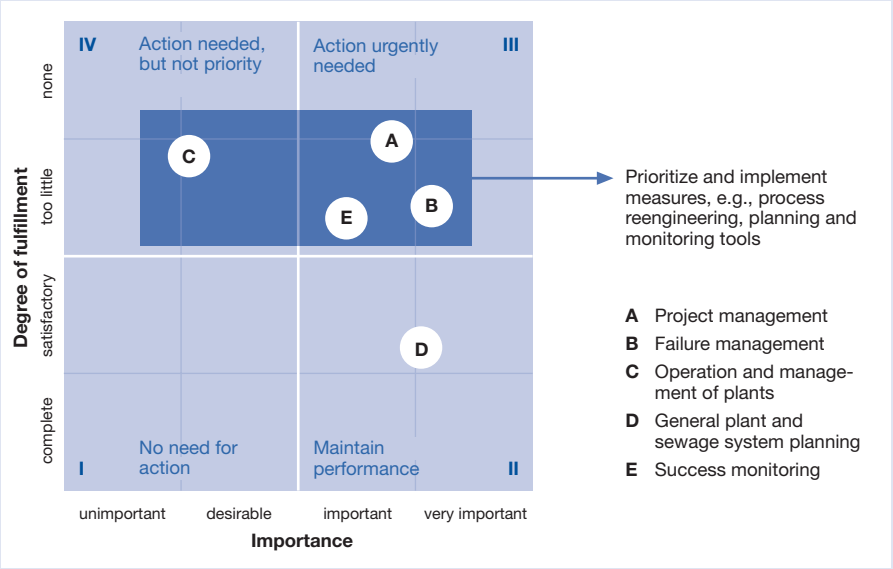

Fig. 3: Priority matrix resulting from self-evaluation.

creates a matrix of four fields, in which a given process is assigned (Fig. 3).

This subjective weighting of relevance not only reveals the need for change, but also the degree of readiness for implementing such change. Past experience has suggested that it is more fruitful to start with the implementation of changes that exhibit a high degree of readiness. This minimizes initial resistance and builds experiences which can then be applied to other areas.

The Swiss community of Hergiswil in the Canton of Nidwalden was the first to use this self-evaluation tool. Several processes were determined to be in need of improvement (Fig. 3): important management processes, as well as multi-year planning and annual success evaluations, were inadequate. There were also some deficiencies in project management and in the handling of problems in plant operation, as well as in normal plant operation and maintenance. Good marks were obtained, however, for general planning, both for the plant itself and for the sewage system as a whole.

Identification of Organizational Deficiencies – What now?

The self-evaluation tool only serves a purpose if the identified shortcomings can be systematically examined in more detail and if the corresponding measures for process reengineering can be developed according to some general guiding principles. For this reason, EAWAG has also developed a tool for process reengineering [5]. In the first step, the current work flow, responsibilities, information and data sources, implicit goals, costs and services as well as interfaces to other processes are analyzed. If the weaknesses of a particular process are already known, the task is simply to clearly define performance targets for the process. Since there are usually only a very few cases in which specific performance criteria have been agreed upon between the plant operators and the carrier organizations, criteria for process reengineering are normally based on exemplary performance agreements and process targets [5]. When developing these agreements and targets, we must consider not only technical demands, but also legal requirements, financial means and demands of the customers and citizens.

In Hergiswil, systematic analysis and the definition of clear goals led to a detailed action plan which has already largely been implemented. For the community of Hergiswil, this meant that in the short-term, a significant effort had to be made, but positive outcomes are already being realized:

- Hergiswil now has a performance agreement with the water plants, where their duties, goals and measurement parameters are clearly defined. Compliance with this agreement is checked annually by the town council; additional action will be taken as necessary.
- Long-term plans for the plant itself and for the operation were also established, allowing the plants to incorporate these goals into the general planning for maintenance and updating of the infrastructure and the general sewage system.
- Plans for the maintenance of the value of the infrastructure are implemented in the form of project management by the community, where particular attention is given to the monitoring of on-going projects. Plans to maintain infrastructure value are directly coupled to the general accounting for the plant.
- Disruptions in plant operation, particularly due to flooding, will be handled more efficiently, thus avoiding negative impacts on the environment.
- By linking newly established performance criteria, by establishing a maintenance schedule for sewage pipes and by introducing a competitive bidding process, an annual savings of approximately 30% was achieved for sewer cleaning.
- In the general operation and maintenance of the wastewater treatment plant, potential annual savings of roughly 13% were identified, although these savings have not yet been realized.

Today, Hergiswil is one of the few communities whose wastewater treatment plants and drinking water supply plants are certified according to ISO 9001:2000. All of the implemented changes are by now well established, and the new management tools have gained a permanent place in the planning structure of the community. This high degree of acceptance may be attributed to the fact that from the beginning, all affected parties were fully integrated in all projects and actively participated in working towards solutions.

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