Evaluation program as a driving force for efficient operation and maintenance of waterworks

Su-Il Choi*, J.Y. Yoon** and S.K. Hong***

*Department of Environmental Engineering, Korea University, Jochiwon, Choongnam, 339-800 Korea
(E-mail: eechoi@korea.ac.kr)

**School of Chemical Engineering Seoul National University, Seoul 151-742, Korea
(E-mail: jeyong@snu.ac.kr)

***Department of Civil Engineering, Korea University, Seoul, 136-701 Korea
(E-mail: skhong21@korea.ac.kr)

Abstract One of the practical means for waterworks to compete with each other for efficient operation is implementing an evaluation program. The evaluation program, coinciding with public notification, was prepared and implemented as a trial in Korea in 2003. However, several unexpected issues arose during the implementation. The evaluation scheme has been revised and described in this paper. The water quality might better be used as a qualification barrier for the further evaluation process. It may also be reasonable to consider that the evaluation team might visit on a very exceptional day for the plant, therefore it might be better to let the evaluation team have enough time to assess plants more extensively. The collateral case study reports should be used as a manual to maintain consistency between the evaluation teams. Although the case study took place in Korea, the revised principles from this experience may be beneficial to other countries.

Keywords Driving force; evaluation; operation; waterworks

Introduction and background

A driving force for efficient operation

An evaluation program makes it possible to compare water treatment plants by scoring the operation performance of each plant. If the program coincides with public notification, competition between the plants may be triggered because residents would blame the low scored plants. An evaluation program, if it works as desired, could be an effective driving force for the water treatment plants to increase their efficiency in operation and maintenance.

An evaluation program may also increase the efficiency of water treatment plants by helping them to get necessary support from government. The local water treatment plants need manpower and money to improve operation efficiency and, in turn, water quality. However, even if the government would like to invest resources in the water treatment plants, it is sometimes difficult to select the water treatment plants which needs the most resources. The evaluation program may reveal that the lowest scored plants need the money and manpower urgently.

In the case that local governments do not pay attention to the waterworks while they have responsibility of supplying drinking water to residents, the federal (or central) government needs a tool for them to invest their manpower and budget to the water treatment plants. A local governor, who allocates limited resources of the local government to the public works, is a politician. Although he takes charge of supplying drinking water to the residents, he usually does not pay much attention to the waterworks because constructing roads instead of improving water facilities pay back more during an election. Waterworks have to attract the governor’s attention. The evaluation program matched with public
notification is one of the most powerful means for the local governor to pay more attention and invest resources to the water treatment plants. By opening the resulting scores of the evaluation program to the public, residents may know the score of the treatment plant that supply drinking water to them. Residents may naturally compare the score of their plant with those of neighbours. This may add great pressure to the local governor who must confront election every four years. Competition between local governments may also be triggered.

In either case, one of the practical means for the waterworks to get desired support is by implementing an evaluation program. The plant may repair the old facilities and the control system to improve their efficiency.

Waterworks in Korea

Potable water has been considered as a public necessity instead of merchandise. In Korea, providing potable water to the residents is the responsibility of the local governor and the waterworks are under the direct supervision of the local government. Government has striven to provide water to most of the residents at low cost. As a result, the water rate has been set below the production cost. In other words, the waterworks are public enterprises that cannot make both ends meet. The government has covered the deficiency with other revenue. Although the local governments support the water supply, they also have little revenue and usually allocate money only to operate the waterworks. Since waterworks have a lack of money and manpower, many plants are old and operated inefficiently. The water quality parameters from some water treatment plants are on the borderline of water quality standards. Although the local government usually does not collect enough revenue to support itself, it has money to allocate between businesses under the jurisdiction. However, the waterworks usually are regarded not as a high priority. The limited resources of the local government have been distributed for road construction, stadium building, and so on. The Ministry of Environment (MOE) would like to make the local government pay more attention to the waterworks and to allocate more funds. For that purpose, the MOE has adopted a program to evaluate and score the operation and maintenance of waterworks. At the end of the evaluation, the scores would be open to the public so that citizens might know how good their local government is in supplying their drinking water. The MOE has intended to trigger competition between the local governments so that the waterworks get more funds from their local government to improve water quality through efficient operation and maintenance. The MOE has prepared a proposed evaluation scheme and conducted a trial on the 424 water treatment plants in the country. The trial implementation result showed that the scoring sheet and evaluation scheme should be modified for the waterworks to agree on the score they have been assessed.

The evaluation scheme

The original evaluation scheme (MOE, 2002) consisted of several stages as shown in Figure 1. First of all, the head of each regional office of Ministry of Environment (MOE) may organize (at most) three evaluation teams and one assessing committee. Three evaluation teams are mobilized because there are usually more than 60 plants under the jurisdiction of one regional MOE office. The assessing committee is included because there is a need to review and adjust the scores from three different evaluation teams. An evaluation team may consist of five experts and the assessing committee may consist of ten people including regional officers and senior operators selected from waterworks in other areas.

Then, the evaluation teams should visit the water treatment plants under the jurisdiction of the regional MOE office to examine the operation and maintenance status of the
plants. They also take a water sample to examine the water quality. The evaluation team members score the plant according to the inspection items on the scoring sheet. The scores on an item from the five members will be averaged and the sum of the averaged score of each item will be the total score for that plant.

Then, the scores of water treatment plants will be gathered to the assessing committee and the assessing committee will review any issues which arose out during the site evaluation. They finally grade the plants and report the result to the head of regional MOE office. The plant will be positioned in a grade based on the total score. There are four grades: excellent; good; common; inadequate. The heads of regional MOE offices should report the result of each year to the Minister of MOE until 28 February 2006.

The head of regional MOE office may demand repair of the facilities or improvement of the operation if any significant problem has been revealed during the site evaluation. The waterworks has to fulfill the demand unless there is any admissible reason. The head of regional MOE office has to monitor the waterworks and impose proper restrictions until it fulfills the demand.

**Issues which arose during the trial implementation**

The MOE has assessed the 424 water treatment plant in Korea and found that the evaluation scheme need to be modified before it is enforced (MOE, 2004a).

Several issues have been pointed out.

- One problem was an consistency of the evaluation. More than 20 evaluation teams were been mobilized because 424 water treatment plants should have been evaluated. Although there was the scoring principle, the scoring yardstick was different from one team to another. The result showed that the scores of the plants were quite dependent on the evaluation team members.
- The short evaluation time was also pointed out. Since an evaluation team visited and examine more than 20 water treatment plants and the teams were mobilized for a momentary mission, a team did not have enough time to assess detailed problems. Sometimes the evaluation was conducted for just one day. Such plants have complained that they were not evaluated seriously.
- Some waterworks have insisted that the evaluation team has visited the plant only once during an exceptional time such as just after the heavy rain. They also insisted it was natural that the water sample taken at the visit did not meet the quality standards.
- The problem was also with the scoring sheet. The scoring sheet contained five evaluation fields: of manpower; water quality; operation; maintenance; and services to customer. The point assigned to each field was shown in table 1. The proportion for the

---

**Figure 1** Composition and task of evaluation team and committee

![Figure 1](http://iwaponline.com/ws/article-pdf/5/3-4/115/417866/115.pdf)
water quality was low enough so that some waterworks did get a good rank regardless of the treated water passed the water quality standards.

- The scoring sheet consisted of 48 inspection items in five fields. Some of the inspection items had nothing to do with the small plants. Thus, those items were not scored and the total score of the plant was normalized based on the score of effective items. During the first trial implementation, it was revealed that the small plants usually got a higher score than the large plants while the large plants have relatively better facilities and manpower. The score sheet may better be prepared separately at least for rapid sand filter, slow sand filter, and valve-less small pressure filters.

- An evaluation team consisted of five people including local waterworks officers and regional MOE officers. While many teams were mobilized throughout the country, it might happen that some people who were not quite familiar with water treatment plants were included in the evaluation teams. After the site evaluations were completed, some water treatment plants complained against the evaluation team and doubted suitability of the evaluators.

Revision of the evaluation scheme

The most important and working idea of the evaluation program is opening the scores to the public because opening the scores may trigger competition between the local governments. However, if the MOE would like to open the evaluation scores to the public, the evaluation scheme should be fair and acceptable for the local governments. As mentioned in the previous section, trial implementation of the initial evaluation scheme has revealed that several points should be revised (MOE, 2004b). The following reinforcements have been considered as a trouble shooting idea.

- Water quality should be considered more seriously. Since the evaluation has focused on the proper operation of water treatment plants, the point assigned for the operation field was too high so that the plants were able to achieve high ranks regardless of whether the water quality met water quality standards. Although adequate operation would be very important, the water quality is the final yardstick for the plant. It does not seem to be fair for those plants to be placed on high ranks. To avoid this confusion, it was pointed out that the water quality field might better be separated from other fields and used as a qualification barrier for a further evaluation process. That means if any plant were not able to meet the water quality, the plant may be placed in the ‘inadequate’ grade (see Figure 2).

- The water quality should be examined at least twice and the examined values should be averaged. The raw water may be of bad quality several times in a year. That is why the turbidity standard in the USA is established for more than 95% samples rather than for 100% samples. The standard presumes exceptional cases for 5% samples. The evaluation team may visit the plant on that exceptional day by chance. If this would be taken into account, it may be reasonable to examine the water quality more than once and take the averaged value for judgement.

- It may better to limit the number of water treatment plants evaluated in each year so that the evaluation team has enough time to assess plants more accurately and extensively. The MOE cannot hire evaluators as regular officers because of the total number limit regulated by government. Usually the evaluation team has been mobilized

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Point distribution in the evaluation fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>Manpower</td>
</tr>
<tr>
<td>100</td>
<td>10</td>
</tr>
</tbody>
</table>

Sung-il Choi et al.
temporarily among the pool for three or four months. The evaluation team members are professors, researchers in the government-supporting institute, experts from waterworks in other districts, and so on. The team members have their own jobs. Their companies usually allow them to help MOE while it does not significantly impact on their own work. Since the examination should take at least two days, it is almost impossible to access more than one treatment plant in a week. Therefore about 10 or 12 plants per team would be the limit. During the trial implementation period, a team has evaluated about 20 treatment plants. To maintain the consistency of the evaluation results, it may better not to mobilize many teams. The less the better. The best way is to MOE hire the full time officers for evaluation program.

- The evaluation team should be composed of very experienced experts who are trained to maintain consistency in evaluating various situations at the water treatment plants. This would be increasingly difficult as more evaluation teams are mobilized. Thus, the number of evaluation teams should be decided by considering both the member pool and the number of plants they have to evaluate. The balance between the quality and quantity should be considered. Once the evaluation teams have been appointed, they have to be gathered and the evaluation principles and the yardstick should be explained to then to maintain the consistency. If they have found very vague points to determine during the plant evaluation, the issues should be brought to the committee and the committee may have authority to fix the issues. The issues and the solutions should be reported to the MOE to make an annual case study report. The collateral case study reports should be used as the education manual. An education system that may endorse the consistency of the evaluation should be prepared.

- It would not be reasonable to evaluate the rapid sand filter and slow sand filter by one scoring sheet. The scoring sheet may better be classified into more than three types to be fitted to the filter types: slow sand filter, rapid sand filter, valve-less pressure filter and, if necessary, membrane filter.

**Establishment of evaluation scheme**

Establishing the evaluation scheme may need an agreement process because the scheme may be enforced for the local waterworks. The process may consist of three steps:

- The MOE organizes a reviewing committee with professors, managers and operators of water treatment plants. The reinforced evaluation scheme may be discussed in the reviewing committee to shape up the scheme better.

- The revised evaluation scheme should be distributed to the local waterworks to present their suggestion on the scheme. This is necessary because they have their own specific

---

**Figure 2** A proposed schematic diagram for the evaluation process

![Evaluation Process Diagram](image-url)
situation to take into account. The MOE needs to know every possible situation that the implementation of the scheme may encounter.

- The MOE needs to discuss the suggestions from local waterworks in the review committee to determine whether the evaluation scheme has to be modified by considering the suggestions.

Once the evaluation scheme has been fixed, the MOE has to announce it not only to the local waterworks but to the public, so that they can predict what they should have to do under the program.

**Summary**
The evaluation program was prepared and was implemented as a trial in Korea in 2003. The evaluation program was intended to trigger competition between the waterworks for better operation. However, several unexpected issues arose during the implementation. The evaluation scheme has been revised and has been described.

The water quality might better be used as a qualification barrier for a further evaluation process. If it would be taken into account that the evaluation team might visit the plant on an exceptional day by chance, it may be reasonable to examine the water quality more than once and take the averaged value for judgement. It also has been pointed out that it might be better to limit the number of water treatment plants evaluated in each year so that the evaluation team has enough time to assess plants more accurately and extensively. The evaluation team should be composed of very experienced experts who are trained to maintain consistency in evaluation of various situations at the water treatment plants. The collateral case study reports should be used as the education manual. At last, it has been suggested that the scoring sheet may better be classified into more than three types to be fitted to the filter types: slow sand filter; rapid sand filter; valve-less pressure filter and, if necessary, membrane filter.

The trial implementation has been conducted in Korea. However, the experience and the principles of the evaluation program to improve efficiency of water treatment plant may be beneficial to other countries in a similar situation.

**References**