

Additional Features Sought in the Monitoring Framework

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The purpose of the September 2003 IMPACT issue has been to provide an enhanced understanding of the *framework for monitoring* and has emphasized the importance of maintaining a ‘systems’ view of the mechanics necessary to produce scientifically sound water quality information in support of management. The IMPACT papers described how the current “state of the art” can be employed to promote improved consistency and comparability in the data and information collected. The papers also provided a glimpse into where additional information, guidance, and tools are needed for agencies to more easily collaborate, and share, water quality information in an effective manner.

The monitoring framework, proposed by the National Water Quality Monitoring Council, consists of six ‘cogs’ or major sequential steps, from identifying information objectives prior to collecting data to conveying the obtained information. In between, the monitoring system, with all its components, is designed; samples and data are acquired; data are managed (stored and retrieved); and data are converted into information via data analysis and interpretation. Surrounding the six cogs is the need for extensive collaboration, communication and coordination, if water quality data and information are to be consistent and comparable.

During the 3rd National Monitoring Conference, and afterwards, the exact organization and content of the monitoring framework has been debated, often with suggestions for adding cogs to cover key topics deemed absent, or not emphasized sufficiently, in the current ‘six-cog’ framework. The purpose of this paper is to summarize the recommendations received and discuss follow up responses of the NWQMC.

These recommendations to improve the monitoring framework, from all sources, can, in general, be classified in four categories:

1. Identify data users
2. Engage monitoring partners
3. Monitoring program evaluation
4. Use of information technology to connect framework cogs

Each of the categories of suggestions will now be discussed in more detail, as a way to further define the monitoring framework.

Identify Data/Information Users

Water quality monitoring is often designed for narrow discipline or agency purposes without much thought given to a future opportunity to share data with other disciplines

and/or agencies. The argument surrounding the recommendation to add an ‘Identify Data Users’ cog goes something like this:

If data consistency and comparability, in support of data sharing, is truly a goal of the framework, then the designers of the monitoring system are obligated to identify, *up front*, users of data and information beyond the narrow, initial, purpose of the monitoring program.

This is a strong argument for adding another cog to the framework, before the monitoring objectives ‘cog’. If all potential data users are involved at the initiation of planning for a monitoring program, then the information objectives can reflect the needs of all potential users. The NWQMC reflected upon this recommendation at length, but felt that if the information objectives portion of the framework were organized to include ‘identifying data users’, there would not be a need for another cog.

Engage Monitoring Partners

To illustrate the purpose of this proposed cog, consider the design and operation of a monitoring system occurring in a watershed where 14 other monitoring efforts are underway. If the goal of a framework is to share data, those already collecting data should be engaged to search for opportunities to share monitoring effort and data. In many ways, the role of monitoring councils, such as those currently operating in Texas, Maryland, and Colorado, provide a forum for engaging monitoring partners in the search for ways to coordinate monitoring effort and share resulting data.

The NWQMC, again, felt that the encompassing circle of ‘communication, collaboration, and coordination’ provided a strong focus on the need to ‘partner’ in approaching the task of planning and operating water quality monitoring programs with consistency and comparability sufficient to share data and information.

Identifying data users and partners are, both, key elements of designing a water quality monitoring program, and, thus, a part of a monitoring framework. A monitoring framework, however, can be approached from two points-of-view: (1) we are going to collect data and must go search for users; or (2) we won’t collect any data not needed to meet the specific purpose driving the design in the first place. Both perspectives, in many ways, are involved in all monitoring designs. There is an information goal for each monitoring program – a goal that drives and funds creation of the monitoring effort in the first place. However, there is also a desire to be efficient in obtaining the information, thus the need to search for others who collect data AND offer our data to others who may need it. Thus, the identifying data users can quickly be viewed in the context of engaging monitoring partners, all as part of identifying information goals and designing the program.

Monitoring Program Evaluation

A cog, at the end of the monitoring framework, was proposed to insure that monitoring designers and operators understood the need to be accountable for the data and information produced (when compared to the information objectives established originally).

In the world of water quality monitoring the term “evaluate” is most often applied to items such as analytical results or monitoring design. Indeed, there are many benefits gained by evaluating each step of the process used to design, monitor, manage data and report findings on water quality. However, as the Framework graphic clearly illustrates, the process of evaluation should also be applied to all facets of the monitoring process. In addition to evaluating each step of the process, we should also step back and examine the program as a whole. The evaluation process should reveal not only the strengths and weaknesses of the individual steps but the process as a whole. In other words, even if the individual steps appear to be well designed and implemented, does the process as a whole accomplish the expected goals? For example, even the most detailed and accurate monitoring program can fall short in its purpose if it does not clearly communicate the results in an appropriate manner to its target audience. The goal of any monitoring program should be to deliver the most accurate information in an effective and insightful manner. In addition, the process of program evaluation should look not only at strengthening the current program but also attempt to account for any future needs. An evaluation process that attempts to both strengthen the current program and prepare for future needs is bringing about an evolution in both the individual steps and the program as a whole. This evolutionary process should be a key component of any monitoring program because it assures the continued improvement of the program. Therefore, a process for regular and thorough program evaluation should be considered a cornerstone of any monitoring program to ensure its present and future success.

To further illustrate the content of a monitoring evaluation, consider the following questions as examples that illustrate the probing nature of an evaluation:

- Were information user needs met?
- Were information objectives and purposes met?
- Did the monitoring design specify details of the operations in sufficient detail to assure data and information consistency and comparability over time and space?
- Were samples collected in a representative manner using ‘standard methods’?
- Were standard methods used in the laboratory?
- Are data stored and retrieved in manner that supports data sharing?
- Are data stored with meta data?
- Were the data analyzed and interpreted using consistent and comparable methods?
- Are reports, conveying the resulting information users, routinely evaluated for accountability?
- Were monitoring operation problems identified and solved?
- Could costs be reduced through collaboration and sharing of data and information?
- Are there additional opportunities to communicate, coordinate and collaborate?

A formal monitoring program accountability-assessment methodology is not common in water quality monitoring. Should there be an evaluation ‘cog’ to emphasize this critical accountability evaluation step? Again, the NWQMC recognizes the connection between conveying results and identifying information objectives, but deferred in creating a separate cog.

Monitoring program evaluation, in many ways, is using the entire monitoring framework to carefully examine each aspect of the monitoring effort individually and, then, collectively. Thus, to use the monitoring framework, itself, is to evaluate a monitoring program.

Role of Information Technology to Operate the Monitoring Framework

Information technology has not been employed in water quality monitoring from the standpoint of system management of a total monitoring program, in the way, for example, a business employs supply chain software to operate its various components in a highly integrated manner. To illustrate, note the following description of a supply chain software supplier, Viewlocity:

“About Viewlocity

Viewlocity is a global provider of Supply Chain Event Management (SCEM) solutions. Our TradeSync™ Suite allows companies to monitor their extended supply chain for events and exceptions that could impact their ability to fulfill customer orders, satisfy inventory needs, and manage shipping requirements. When exceptions are detected, Viewlocity's products notify the affected parties, recommend corrective actions, and enable collaborative resolution.”

Are monitoring system managers able to view the operations of all ‘cogs’ in the manner a business is now able to view its supply chain? Effective and efficient monitoring of water quality in the U.S. requires that monitoring designers and managers ‘connect’ the cogs in the monitoring framework with modern information technology. This will, in turn, facilitate quality control/quality assurance, method comparability, accountability for meeting information goals, data sharing, and overall monitoring system management.

At present the NWQMC Council is exploring expanded use of information technology in the design and operation of a total water quality ‘information’ (monitoring) system as a way to both enhance efficiency of monitoring as well as the quality of its information product. The monitoring framework, itself, is the best ‘cog’ for organizing an information technology approach to improving water quality monitoring.

Thus, while it is realized that a monitoring framework involves an extensive range of information goals, disciplines, activities, and inter-relationships, these details are best

categorized into broad ‘cogs’ to facilitate the overall nature of monitoring. If too many dimensions of monitoring are graphically included, the overall structure and need for organization is lost in the noise of the display. Thus, the monitoring framework keeps its six cogs, its six basic categories of monitoring functions, and expands the explanation of each, as well as the relationships between the cogs, to cover the many dimensions of monitoring.

Concluding Remarks

The process that led to the NWQMC proposing a water quality monitoring framework, including preparation of September 2003 issue of Water Resources IMPACT, has forced all of the participants (i.e. NWQMC members, lead authors, and collaborators) to carefully examine exactly what we mean when we discuss water quality monitoring with other colleagues and the public. We view the monitoring framework enhances the dialogue that leads to consistency and comparability in water quality monitoring data and information which, in turn, supports fair and equitable water quality management decisions based on sound science.