THE REGULAT

The U.S. Environmental Protection Agency (EPA) is implementing significant new regulations under the Safe Drinking Water Act with respect to distribution systems and has proposed 24 rule changes under the Clean Water Act, including three final rules. Water and wastewater utilities must comply with these new rules while maintaining standards set by the old ones.

In 2004, industry leaders reported that their top concerns resulted from trying to comply with current regulations (*Journal of the American Water Works Association*, November 2005). Seventy-one water and wastewater utility and academic leaders participated in the Delphi Poll, which was conducted by Malcolm Pirnie Inc. (White Plains, N.Y.). For wastewater utilities, key challenges included how to

- improve asset management,
- reduce nonpoint source pollution,
- provide better watershed protection,
- comply with new discharge requirements, and
- reduce sanitary and combined sewer overflows.

Each regulation typically requires physical facilities, responsible staff, and specific work practices and compliance activities, as well as information gathering, analysis, and reporting. The burden of compliance falls on every worker in a utility, guided by a few experts. Each utility must determine which of its performance functions may be at risk for noncompliance (see sidebar, p. 89) and devise appropriate mitigation plans.

TION DELUGE

Lesser-known software can ease the rule burden

David W. Harris and Esteban Azagra

Figure 1. Probability-Impact Matrix for Certain Compliance Related Risks

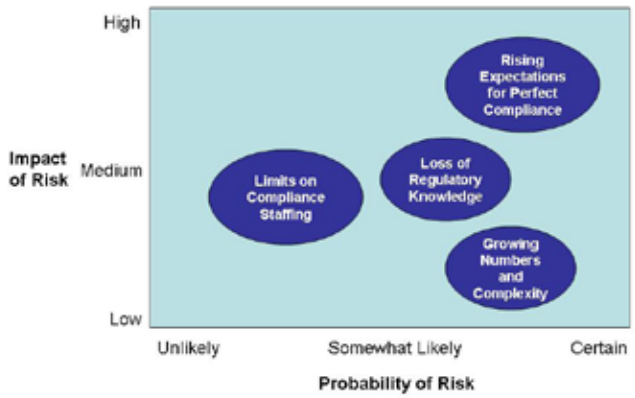

Figure 2. Technologies to Mitigate Compliance Related Risks

	Content Management	Enterprise Integration	Compliance Software
Growing Regulatory Burden		★	★
Loss of Knowledge	★		
Limits on Staffing		★	★
Rising Stakeholder Expectations	★		★

★ = Primary beneficial technology

Figure 3. Example of an Environmental Health and Safety System Screen

Many mitigation plans and even entire compliance functions are held together by information technology (IT). Some utilities already use supervisory control and data acquisition (SCADA) for process monitoring and control, and laboratory information management systems (LIMS) for sample and data management. Some lesser-known ITs — content management, enterprise application integration, and specialized compliance software — can provide substantial benefits (see Figure 2, below). In the future, utilities of all sizes will view IT as an indispensable part of their compliance management portfolio.

Content Management

A content management system (CMS) captures, organizes, and reuses knowledge. It can be used with information from all areas of utility operations. The system commonly is used to develop electronic operations manuals for treatment facilities. For regulatory compliance, a CMS can create a shared, easily accessed and updated information resource, which could contain policies and procedures, emergency response and contingency plans, incident and response forms, and interim and final regulatory reports.

Typically, a CMS is accessed through a Web browser on a utility's intranet (the secure internal network). The actual content is presented as Web pages of information and documents in various electronic file formats. Text, pictures, drawings, and other files are categorized and cross-referenced in a database so that users can search and retrieve information in various ways.

This type of software reduces compliance risk by moving knowledge from both paper documents and undocumented sources, such as staff "know-how." The information becomes consistent, shareable, and easily updated. Use of a CMS also reduces the probability that knowledge will be lost and may even highlight other opportunities for applying previously underused information. Finally, this software extends utility knowledge to such internal stakeholders as the operations staff, who gain more confidence in the compliance function as they use the database.

Enterprise Application Integration

Enterprise application integration (EAI) refers to the way separate information systems or software ap-

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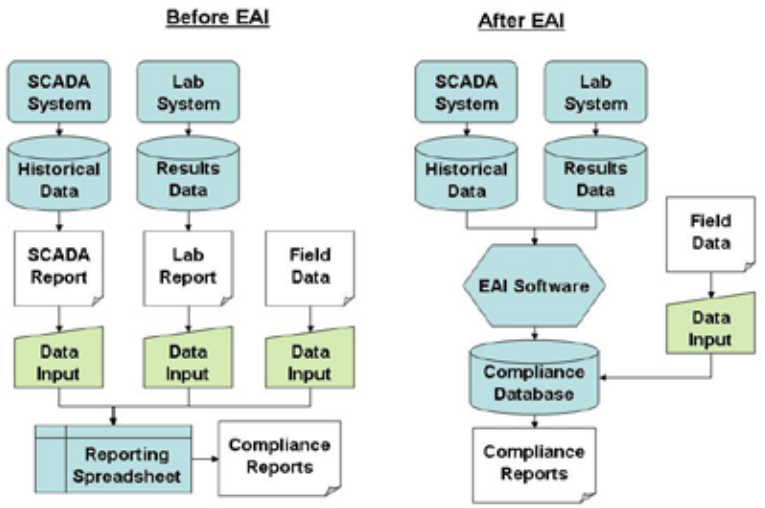
plications are wired together to create a single, cohesive system.

EAI uses consistent methodology and tools to integrate separate systems. During the past 5 years, the IT industry has introduced products that accomplish many integration functions, reducing the extent of custom programming, lowering overall implementation cost, and minimizing ongoing support needs.

Use of this software can result in improved reporting and decision-making, as well as fewer data-handling errors. EAI can be used to streamline and improve report generation, such as monthly discharge monitoring reports (see Figure 4, right). The typical process, which has staff manually entering data at multiple points and reporting with an insecure spreadsheet, can produce slow-moving data and errors. With EAI and a protected relational database, information flows almost instantaneously, and most errors are eliminated. All of these features will lower compliance risk as the regulatory workload expands and staffing is limited by cost concerns.

Figure 4. Example of Enterprise Application Integration (EAI)



Compliance Software

Specialized software now can directly address the compliance management needs of water and wastewater utilities. This software can create an inventory of requirements, schedule and track activities, collect related data into a single repository, manage and generate date-sensitive reports, and provide *ad hoc* analysis and reporting.

Smaller utilities may want to consider compliance software through Internet-based services, which are available for a low initial cost and typically cost less than $1000 per month. For large utilities, custom software may be appropriate for critical tracking and reporting needs. These programs can be created from scratch or based on one of the "business intelligence" software suites that provide data analysis and reporting capabilities.

Sizing Up Compliance Risks With Impact Matrix

The Probability-Impact Matrix, a tool for analyzing risks, can help utility managers determine how to address their regulatory compliance issues. Using a comprehensive list of risks, the matrix can map each risk and help managers visually prioritize them for mitigation.

Each utility should create a small working group, brainstorm the specific regulatory risks they face in the coming 2 to 3 years, and then rank the risks with respect to anticipated impact and probability. These rankings are based on the collective judgment of the working group.

Many water and wastewater facilities may have similar compliance-related risks (see Figure 1, p. 88). In this generic example, the risks are

- more rules and greater complexity,
- less knowledge as experienced staff retire,
- fewer staff devoted to compliance, and
- greater public expectations.

More regulations, as well as more complex regulations, are expected in the future across all aspects of the utility business. This risk appears almost certain because increasing regulation has been a trend for the past 35 years. The impact, however, is uncertain and may be lessened if utilities effectively manage compliance.

Utilities have been experiencing a loss of knowledge as seasoned veterans retire. This, in turn, reduces critical decision-making capacity. This risk is likely and could be managed by utilities that pay attention to succession. However, many utilities are experiencing a moderate impact from the ongoing "brain drain."

Cost pressures have been limiting staff available for compliance functions. This risk appears somewhat likely. However, utilities could moderate the impact by emphasizing roles and responsibilities, streamlining processes, and using technology.

Customers, regulators, and government leaders have come to believe that compliance should be near-perfect. This risk appears almost certain, and the organizational impact can be dramatic, depending on the nature of the issue, the relationship with regulators, and the political climate.

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Phoenix Chooses Custom Data Management

The City of Phoenix Water Services Department serves the water supply and wastewater treatment needs of approximately 1.3 million people within a 1295-km^2 (500-mi^2) service area. Within the department's Environmental Division, the Compliance and Regulatory Affairs Office deals with most of the regulatory compliance program's development, tracking, and reporting functions.

During the past several years, the compliance office has been using information technology to cope with increasing regulatory demands. Its software includes a custom content- and document-management system and a specialized compliance tracking program, known as the Electronic Drinking Water Regulatory Database (EDWaRD).

The Water Services Department developed a general purpose content- and document-management platform called the Information Access System (IAS). The system has multiple knowledge "containers." Initially, the department used IAS to develop electronic operations and maintenance manuals for its wastewater treatment facilities. More recently, IAS was used to incorporate capital improvement program information, standard specifications, and an information technology master plan.

The compliance office has implemented an Environmental Health and Safety System (see Figure 3, p. 88) as part of IAS. The major plans found in this container include

- integrated contingency;
- spill prevention, control, and countermeasures;
- stormwater pollution prevention;
- emergency response; and
- emergency operation.

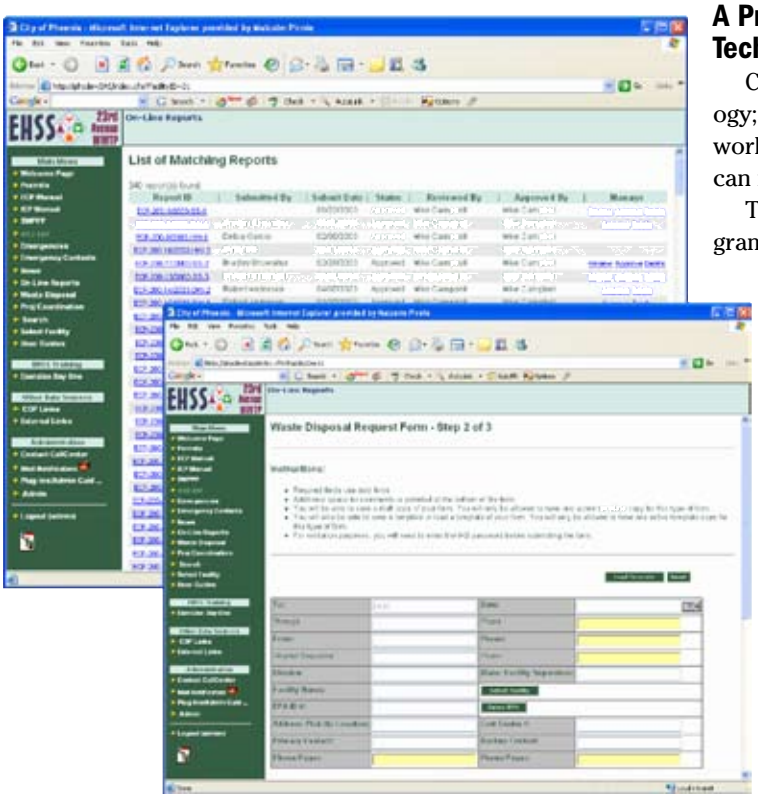
The compliance office alone maintains the content of the system, in the form of dynamic Web pages and electronic document files.

The office also has developed a few functions, such as the hazardous materials tracking process, within IAS to automate common work (see Figure 5, below). This application provides a single repository, a common system used by all employees, automated notification, and effective reporting using a simple interface.

Because the Phoenix facilities are large and complex, the compliance office also uses EDWaRD (See Figure 6, p. 9). This custom software application

- integrates with the sampling work order and historical data systems (laboratory information systems and supervisory control and data acquisition);
- applies complete regulatory compliance logic, as promulgated by the state regulatory agency;
- presents the compliance status for the three water systems in an easy-to-read dashboard;
- provides traceability of each compliance issue to the precise regulatory rule; and
- generates fully formatted reports for submission to the state regulatory agency.

Figure 5. Waste Disposal Tracking Module Screens



A Program To Leverage Information Technology

Compliance relies on a lot more than technology; it also depends on strategies, people, and work processes. But a programmatic approach can improve compliance management.

The heart of a compliance management program should be a repeatable process for pursuing continuous improvement. Fortunately, the ISO 14001 (environmental management system, or EMS) standard provides such a repeatable improvement process, which is much better than an *ad hoc* approach. The process is based on a Plan–Do–Check–Act process and has been proven through use at thousands of organizations worldwide. It is supported by tools, training, and service firms. EPA encourages utilities to adopt this approach (see www.epa.gov/ems/position/position.htm).

If they have not already done so, utilities must establish the core information systems that provide data for compliance monitoring and reporting. These systems include SCADA, LIMS, a work order system,

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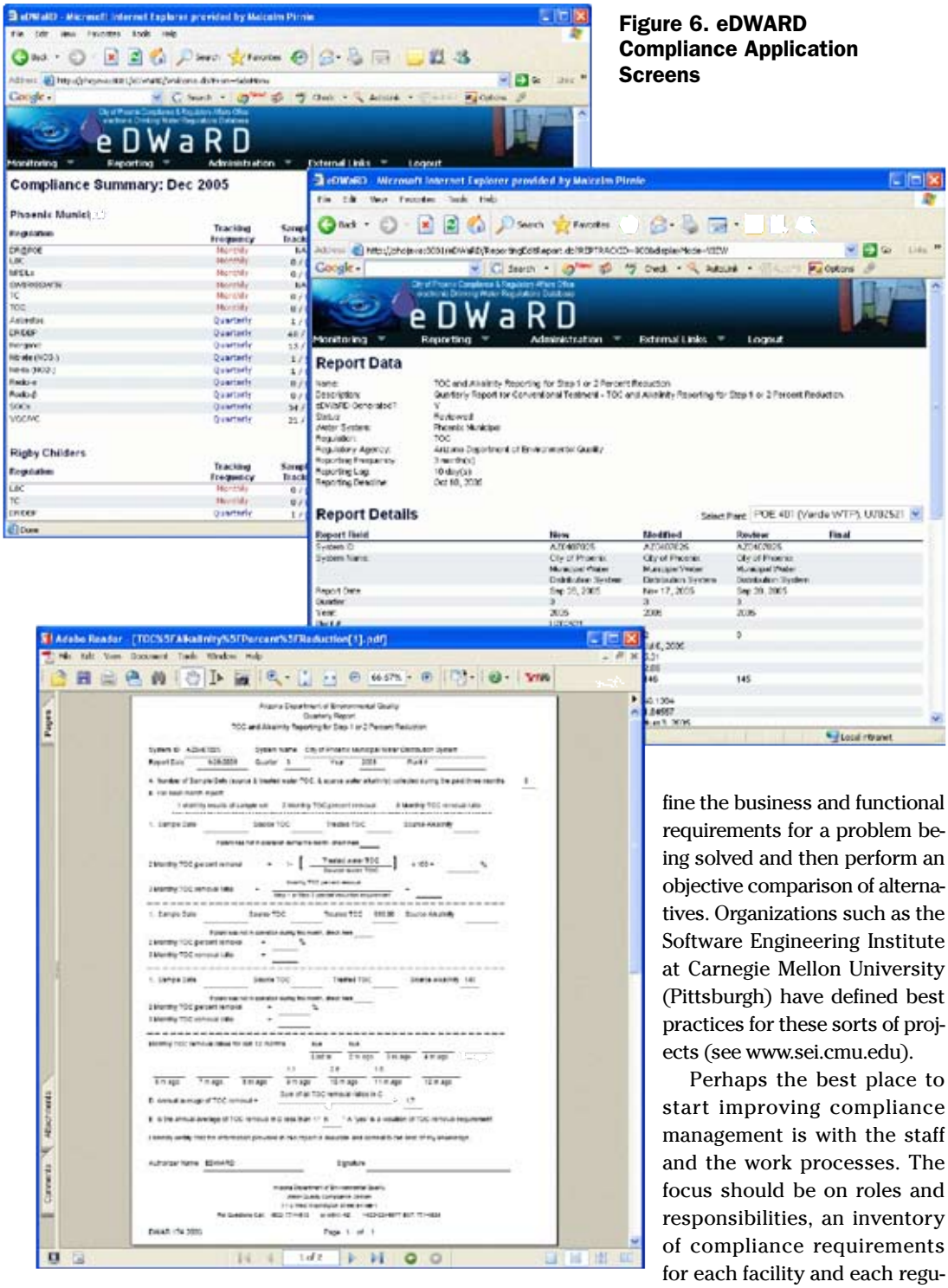

Figure 6. eDWARD Compliance Application Screens

and a data warehouse.

Having put in place reasonably up-to-date systems, utility managers should consider using EAI concepts and commercial or open-source software to automate data flow, which will speed up compliance processes and make them more reliable. (*Open source* refers to a software development and licensing arrangement in which a community of volunteers develop and license the software, and users agree that they will offer any improvements back to the development team.) Before managers can evaluate custom or Internet-based options, they must define the business and functional requirements for a problem being solved and then perform an objective comparison of alternatives. Organizations such as the Software Engineering Institute at Carnegie Mellon University (Pittsburgh) have defined best practices for these sorts of projects (see www.sei.cmu.edu).

Perhaps the best place to start improving compliance management is with the staff and the work processes. The focus should be on roles and responsibilities, an inventory of compliance requirements for each facility and each regulation, and engineering simple work processes for major compliance activities. These first steps will create a greater understanding of the technology needed to reduce compliance risks.

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