USING FINANCIAL, TECHNICAL AND MANAGERIAL CAPACITY MEASURES IN AN ASSISTANCE-ORIENTED APPROACH TO COMPARATIVE PERFORMANCE ASSESSMENT OF SMALL DRINKING WATER UTILITIES IN THE MIDWEST TECHNOLOGY ASSISTANCE CENTER (MTAC) REGION

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EXECUTIVE SUMMARY

Performance measurement has a long history in the evaluation of the quality and level of services provided by public and private utilities. The goal of this project is to provide a practical framework within which to develop and provide comparative performance measures that improve the financial, managerial, and technical capacity of small public and private drinking water utilities within the Midwest Technology Assistance Center Region. Our analysis includes data from small public and private drinking water utilities regulated by state commissions in Indiana, Illinois, Missouri, Ohio, and Wisconsin.

The emphasis of environmental regulators of water utilities has been, rightly so, on the evaluation of water quality. This project goes beyond the compliance information on water utilities maintained by the EPA in their publicly available databases. We implement the EPA's capacity planning and development framework that is organized around three primary goals of financial capacity, managerial capacity, and technical capacity. Developing capacity and enhancing performance is a long-term activity. The larger and highest performing utilities are expected to regularly assess their operations and engage in ongoing improvement. In contrast, small water utilities frequently are resource poor and unable to reliably provide service. The approach implemented here and as it is replicated and refined over time, should help state commissions foster better performance among small jurisdictional utilities. By identifying the best performing utilities and those approaching the best observed "performance frontier" the approach may facilitate improved performance.

The project implemented a highly compressed version of a complete performance evaluation that consisted of establishing a focus group of stakeholders with knowledge of and interest in water utilities. Water utilities are imbued with the public trust. That is why we deemed it essential to include economic and environmental regulators and representatives of water utility customers in this process. We engaged this expert group in order to obtain a comprehensive and face valid list of performance indicators. The process of developing indicators quickly highlighted the tensions and tradeoffs that exist in implementing performance evaluation systems. One of the primary tradeoffs that had to be addressed is between developing a comprehensive evaluation system and the data requirements burdens it imposes. The expert group workshop yielded, through vigorous debate on the value of each of the proposed indicators, a set of measures that could be used as a starting point for this evaluation exercise. We obtained data and analyzed them and finally constructed performance indices, thus completing a full cycle of performance evaluation. Our analysis focused on those systems with 1,000 service connections or fewer and considered them in two subsets: those with 500 or fewer customers and those with 500-1,000 service connections. This grouping reflects the recommendation of the expert group and a commonly held view that the smallest utilities are apt to have the most difficulty establishing and maintaining capacity.

Obtaining a set of indicators that have universal acceptance for water utility evaluation is not a straightforward exercise. One of the project's first useful products came out of the deliberations in the stakeholder workshop on developing performance indicators. Although it is an imperfect set and remains a work in progress, a lasting outcome of this workshop were indicators that capture some aspects of the financial, technical, and managerial performance.

Data collection for these indicators highlighted a primary threat common to valid and reliable performance measurement. There is tremendous variability in the availability and quality of data between and within the states involved in this exercise. A complicating factor in data quality is

that definitions of commonly used measures vary from one jurisdiction to another hence comparability of results becomes an issue.

It is a well-established fact that implementing an evaluation system that is acceptable to all stakeholders is a multi-phase, multi-year undertaking. With this project, we have begun this process for water utilities. At present, data quality is the primary obstacle to obtaining valid evaluations. As data quality improves through multiple implementations of the process we have followed in this project, we will be able to place greater confidence in the results. The first step in this confidence building exercise would be for the individual water utilities to establish that these measures do reflect their performance over time. Once the validity of these measures has been established, over time, for a specific water utility we can study the implication of the best practices analysis conducted here and begin to compare performance within and across regulatory jurisdictions.

In summary, using the capacity development requirements of the SDWA as our performance assessment framework, the project team implemented a multi-step process that:

1. constituted a panel of experts to identify suitable performance measures;
2. gathered data on these measures for a representative group of utilities (municipal. and investor-owned) regulated by state utilities commissions; and
3. analyzed data made available by commission staff in targeted states in an attempt to develop benchmarks based on identification of observed best practices.

The accompanying report illuminates our approach and presents our findings.

CHAPTER I

INTRODUCTION

The goal of this project is to develop and provide comparative performance measures that improve the financial, managerial and technical capacity of small public and private drinking water utilities in Ohio, Indiana, Illinois, Missouri and Wisconsin.[1] The project also provided an opportunity to utilize and validate an open, participatory stakeholder process for identifying performance indicators and factors that may explain performance. This is important. The Safe Drinking Water Act (SDWA) Amendments of 1996 not only established specific capacity development requirements to be carried out cooperatively by state commissions and state primacy agencies, they also mandated that water utilities provide an annual water quality report to their customers. These Consumer Confidence Reports (CCRs) are a tangible acknowledgement that public water utilities are imbued with the public trust and therefore must communicate and work with their customers and other "publics" to disclose problems and craft practicable solutions.[2]

In that vein, this project involved stakeholders from the utilities, environmental and economic regulators and consumers. The approach is forward-looking and constructive. It is assistance-oriented and builds upon all three goals of the capacity planning and development framework forwarded in the reauthorized SDWA. The results provide regulators and operators with an approach to the identification of the best level of overall system performance that is practicable.

Developing capacity and enhancing performance is a long-term activity. The larger and highest performing utilities in the country may reasonably be expected to regularly assess their operations and engage in an ongoing agenda for improvement. In contrast, small water utilities frequently have neither the skills nor the resources to reliably provide even basic quality water service. In

[1] Within the MTAC region, the Michigan and Minnesota public service commissions do not regulate drinking water utilities. Iowa, Kansas and Nebraska although they supported the project proposal declined to participate due to their small number of jurisdictional water utilities.

[2] Major elements of the CCR include the lake, river, aquifer, or other source of the drinking water; a brief summary of the susceptibility to contamination of the source, based on the source water assessments by states; how to get a copy of the water system's complete source water assessment; the level (or range of levels) of any contaminant found in local drinking water; EPA's health-based standard (maximum contaminant level) for comparison; likely source of that contaminant; potential health effects of any contaminant detected in violation of an EPA standard; an accounting of the system's actions to restore safe drinking water; the water system's compliance with other rules; statement for vulnerable populations about avoiding *Cryptosporidium*; information on nitrate, arsenic, or lead in areas where these contaminant may be a concern; and phone numbers of additional sources of information, including the system and EPA's Safe Drinking Water Hotline (800-426-4791). See: http://www.epa.gov/safewater/ccr/basicinformation.html

addition, as commission staff persons will attest, some of them are not motivated to improve. These operators may have gotten into the water business as a byproduct of developing a housing project or inherited the responsibility from a family member. In some cases, it is a job they did not seek, are not qualified to carry out, do not take seriously and simply wish would go away. As a result of the very real challenges small systems face and the indifference of some owner/operators, state commission staff persons sometimes become surrogate overseers of these operations. This project's approach to benchmarking is designed to help state commissions assist and encourage better performance among small jurisdictional utilities. By identifying the best performing utilities and those approaching the "performance frontier" the project could also facilitate beneficial acquisitions and mergers.

Using the capacity development requirements of the SDWA as our performance assessment framework, the project team implemented a multi-step process that:

1. constituted a panel of experts to identify suitable performance measures;
2. gathered data on these measures for a representative group of utilities (municipal and investor-owned) regulated by state utilities commissions; and
3. analyzed data made available by commission staff in targeted states in an attempt to develop benchmarks based on identification of observed best practices..

BACKGROUND

The 1996 Amendments to the SDWA extended the authority of the U.S. Environmental Protection Agency (EPA) beyond its traditional realm of environmental regulation into the financial, managerial, and technical "capacity" of drinking water utilities. The requirements of the amended SDWA subsequently created a new regulatory framework not only for state primacy agencies but for state public utility commissions as well. Capacity provisions of the 1996 Amendments were established to halt proliferation of water service provision by suppliers unable to demonstrate longer-term prospects for sustaining adequate service to customers and to improve the capabilities of existing systems. Geared to small utilities, the three-tiered capacity model established in the 1996 law also provides a suitable lens through which to view the operations of larger, more capable and better-financed systems. In fact, the financial, managerial or operational and technical "capacities" of performance in the 1996 Amendments parallel performance areas utilized by some water/wastewater quality improvement programs. For example, the American Water Works Association's (AWWA) QualServe™ or Quality Utility Service program launched in 1995, prior to passage of the SDWA Amendments, considers performance across the business systems shown in Table 1

Table 1: Business Systems

Organization Development • Leadership • Human Resources	Business Planning and Management • Water Resources • Capital Improvement • Financial Management • Strategic Planning • Information Management
Operations Management • Water Quality • Water Treatment • Operations and Maintenance • Plant and Real Property Management • Emergency Response	Customer Relations • Customer Service • Customer Accounts • Government/Public Relations

Source: QualServe™ Program Materials, Program Overview: Getting Started in QualServe™, AWWA, 1997

The initial activities of the nation's public utility commissions relative to capacity planning and development are documented in a report by the National Regulatory Research Institute (NRRI) titled *Water Capacity Development and Planning: A Benchmarking Guide for Regulatory Commissions*.[3] That study includes an analysis of state commission water rules, extant at that time, looking specifically for indicators of capacity planning and capacity development. It also discusses the extent to which capacity provisions in the federal law enable state commissions to serve as "control points" for ensuring certain elements of a new or proposed system's capacity for providing sustained water service.

The report makes the case that commissions have jurisdiction over many of the areas captured by the SDWA capacity indicators. The report also found that economic and environmental regulators in many states had begun working together on capacity planning and development for

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[3] John D. Wilhelm, [1999]*Water Capacity Development and Planning: A Benchmarking Guide for Regulatory Commissions* (Columbus: The National Regulatory Research Institute)

drinking water utilities in their jurisdictions and that communication and coordination between commissions and state primacy agencies responsible for capacity planning and development would be beneficial to those drinking water utilities that were regulated by both state agencies. A 2002 NRRI survey found that 13 of 15 states responding had collaborated with other entities in their states around water issues including, among others, system performance and viability.[4] Anecdotal evidence suggests such environmental and economic regulatory collaborations continue to be established or enhanced. For example, in 2005 on the wastewater side the Tennessee Regulatory Authority and the state primacy agency entered into a memorandum of understanding in order to educate one another on their roles and responsibilities, streamline, coordinate and clarify threshold requirements for new systems and work together to discipline errant wastewater systems. [5]

The federal legislation vested regulators with a set of potentially useful tools to analyze and promote the capabilities of proposed, new, and established suppliers of drinking water to meet customer needs. State environmental and economic regulators have authority to decide whether a prospective water supplier should be given approval to operate through licensing and permitting processes and by granting to the utility a Certificate of Public Convenience and Necessity. "Certificate" proceedings typically require information about and an assessment of a proposed utility's technical, managerial and financial capabilities and resources. Requirements vary among states. In some jurisdictions, requirements are being made more stringent or some form of surety is being mandated which would be forfeit if a utility fails to fulfill its obligation to serve. In addition, some states have regulatory provisions in place to assess and recertify existing systems.

The 1996 Amendments gave states considerable discretion in the establishment of their capacity programs. For this reason, it can be difficult to make comparisons among the capabilities of suppliers from different states. The approach to benchmarking small utilities described here can potentially overcome these variations by bringing relevant stakeholders together to reach consensus on key performance variables potentially applicable to all.

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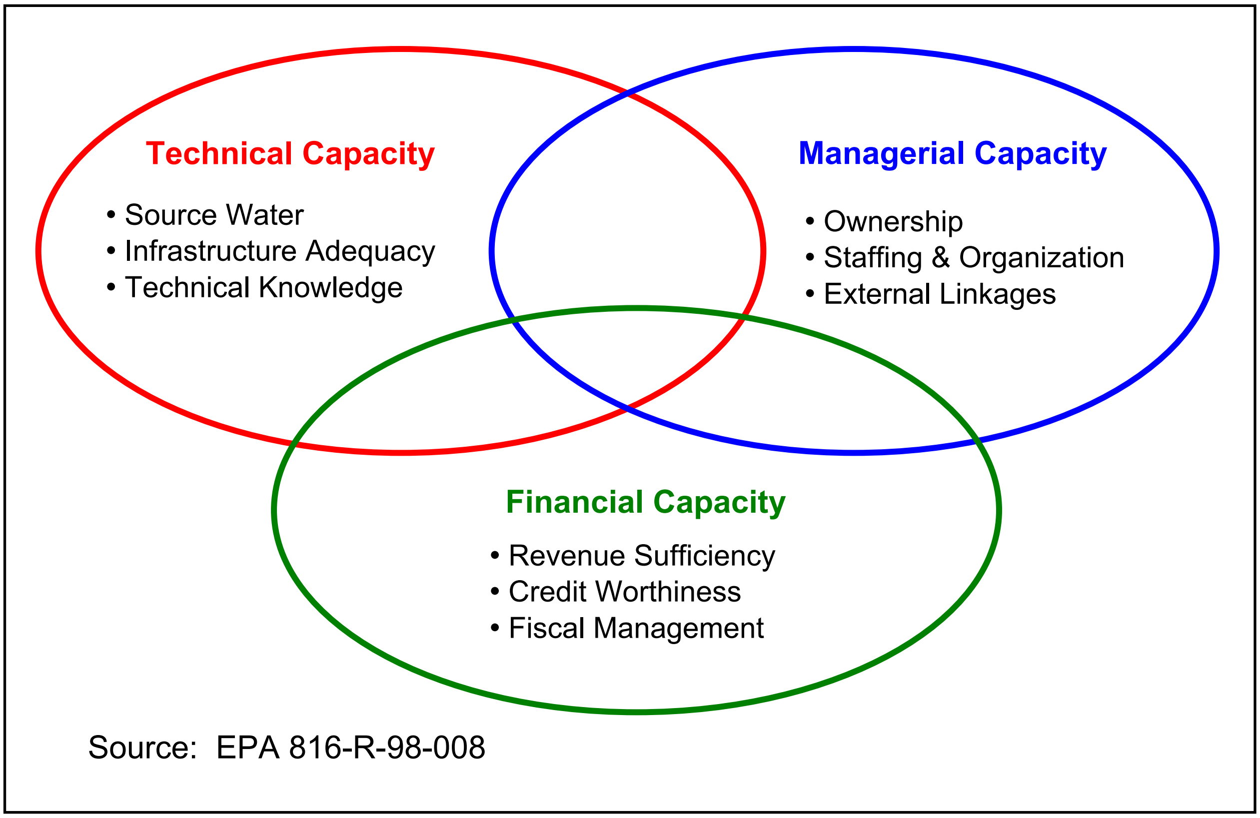
[4] Melissa J. Stanford, [2002] *Water Supply Assurance and Drought Mitigation Options for State Regulatory Commissions and Key Stakeholders* (Columbus, Ohio: The National Regulatory Research Institute)

[5] Melissa J. Stanford, [2005] *Briefing Paper: State Commission Regulation of Wastewater* (Columbus, Ohio: The National Regulatory Research Institute)

The concept of capacity invokes a systems orientation. This approach acknowledges the significant components of the system and stresses the importance of their interaction and contribution to the success of the system as a whole.

Figure 1: Capacity Planning and Development Framework



The three-part conceptual framework for water system capacity, as depicted in Figure 1, is organized around three primary goals (and suggested parameters) of financial capacity, managerial capacity and technical capacity. Successful systems are those that are able to satisfy each capacity goal singularly and all of the capacity goals in combination. Our work builds upon the benchmarking report[6] to Midwest Technology Assistance Center (MTAC) that focused on economic indicators. This project goes beyond that work by addressing technical and managerial capacity in addition to financial capacity and by developing a process that these water systems can implement to enhance their capacity and performance.

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[6] "Benchmark Investigation of Small Public Water Systems Economics" Department of Geography, Southern Illinois University, Carbondale, IL 62901, 2000.

An important comparative advantage of our approach is that it incorporates, by design, all three goals of capacity planning to produce a holistic measure of overall system performance. A water utility in compliance with environmental standards whose rates do not cover the cost of providing service or that does not collect bills from customers risks financial ruin. A utility that collects revenues from customers but fails to invest those dollars in necessary distribution or water treatment plant will also eventually fail. Like a three-legged stool with one leg missing, a water utility cannot "stand" (and remain "standing" into the future) if one or more performance "legs" are damaged or missing. The comprehensive approach employed in this study is, in our view, superior to approaches that focus only on individual parameters of capacity, such as economic efficiency or environmental compliance.

Another feature offered by this project is the ability to compare performance across public and private ownership. There are numerous studies focused on municipal drinking water systems. AWWA's QualServe™ program, for example, has mostly included publicly-owned and operated municipal systems. Studies that include privately owned systems often simply attempt to compare the economic efficiency between different ownership types. However, there is a paucity of work that specifically targets overall system performance in both segments of the drinking water industry. Our approach helps to address this gap by including both publicly owned and operated and investor-owned utilities subject to the jurisdiction of state utilities commissions. Outcomes should prove useful for those state commissions that routinely bear responsibility for regulating municipal systems as well as those that regulate municipal systems on appeal, by request or under other special circumstances. Moreover, some form of restructuring: acquisitions, mergers, long-term contract management arrangements, purchased water interconnection and other forms of water service delivery are slowly but surely complicating a once bright line between public and investor-owned systems. Recent takeover attempts of publics by privates and investor-owned by public systems illustrate how the two sectors may both compete for control of a water system and/or merge in an effort to grow and gain economies of scale. The critical common denominator for this project is that it includes only those water utilities regulated by state utilities commissions.

CHAPTER II

PROJECT IMPLEMENTATION

This project focused on providing comparative performance assessment and evaluation for very small drinking water utilities in the MTAC region. Our work was conducted for five of eight MTAC states in which public utility commissions have jurisdiction for ratemaking purposes over investor owned water utilities. These are Ohio, Indiana, Illinois, Missouri and Wisconsin[7]. Building on previous efforts, the National Regulatory Research Institute (NRRI) and Ohio State University (OSU) team conducted the work in four major phases.

1. Expert Group Session: an intensive two-day stakeholder workshop to identify, debate and develop appropriate measures and validate the analytical method
2. Data Collection: gathering the technical, managerial, and financial data from state commission staff
3. Data Analysis: provide a framework for identifying best practices[8], performance benchmarks[9], and prescriptions for improvement
4. Presentation of Findings: report the findings to applicable stakeholders and parties.

The NRRI/OSU team has had success developing this type of support and cooperation for conducting comparative performance assessments of small drinking water utilities.[10] Our previous success was based on three primary factors. The first was involving key stakeholders in the project at the onset and seeking their input into the design and conduct of the work. The second important lesson we learned was that the choice of methods and tools used for conducting the analysis is very important. These methods were presented to the project stakeholders during the expert group workshop. The third important feature of both the past and instant successful

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[7] The Wisconsin Public Service Commission regulates more than 500 municipal water utilities in addition to seven investor-owned systems.

[8] A. Desai [1999] "Program Evaluation, Best Practices and Data Envelopment Analysis" in *Policy Analysis Methods*, Stuart S. Nagel (Ed.),pp. 183-203, Commack, NY: Nova Science Publishers.

[9] The literature on benchmarking is vast, see for instance Sharif, Amir M.[2002] Benchmarking performance management systems. *Benchmarking: An International Journal*. Volume 9 No. 1; Yasin. Mahmoud M. [2002] The theory and practice of benchmarking: then and now. *Benchmarking: An International Journal*. Vol. 9, No. 3; Jarrar, Yasar F. and Mohamed Zairi. [2002] Internal transfer of best practice for performance excellence: a global survey. *Benchmarking: An International Journal*. Volume 7, No. 4. The benchmarking report to MTAC also provides a list of citations to benchmarking studies.

[10] John D. Wilhelm, [2003] *Evaluating and Assisting Medium and Small Water Companies in California*. Global Developments in Water Industry Performance Benchmarking Conference. (Perth, Australia).

program, involving regulators, utilities and consumer representatives, is that the results will have face validity for all parties. At the outset, the method affords all parties a common understanding about the intended uses of the results.

EXPERT GROUP WORKSHOP

The first major activity of this project was identifying potential members of a stakeholder expert advisory panel, securing their agreement to participate, and briefing them on the objectives and plans for the project. This important and time-intensive effort took place over several weeks and included multiple conversations with potential expert group participants and their colleagues, information dissemination about the project and benchmarking in general, and formal official requests and approvals from participating agencies and organizations. The second activity was a two-day, facilitated expert group workshop. From the regulatory community, representatives participated from state public utility commissions and the U.S. EPA. From the utility community, a representative of the National Association of Water Companies (NAWC) small systems committee (himself the owner of a small water utility) participated. A representative of the water committee of the National Association of State Utility Consumer Advocates from the Ohio Consumers' Counsel was also included among the stakeholders deemed essential for this project. Limited travel stipends were provided to these invitees.[11]

The session was held at the School of Public Policy and Management of the Ohio State University in Columbus, Ohio. The workshop was facilitated by John Wilhelm, former NRRI member of this project team. Mr. Wilhelm also led NRRI's prior, similar benchmarking initiative in cooperation with the California Public Utilities Commission and their jurisdictional water utilities.

Objectives for the workshop participants were to:

1. Become familiar with the scope and goals for the project
2. Review the proposed performance analysis method
3. Select the level of analysis
4. Identify appropriate performance measures and explanatory factors for small drinking water utilities in the MTAC region
5. Define the data requirements and potential limitations

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[11] Ms. Bielanski's travel was supported and her expenses were provided by U.S. EPA.

6. Select the study participants
7. Assist in the data collection effort (state commission staff)
8. Review the results and provide feedback (projected to occur at the conclusion of the project and not as part of the two-day session).

There is an extensive literature in the field of performance benchmarks. Drawing from this literature, we examined a robust range of measures and indicators. Indicators selected were those deemed most appropriate for benchmarking the small public and private drinking water utilities in the MTAC region based upon the collective experience of stakeholder group members. Details of the workshop and ensuing communications with expert panelists follow.

Workshop participants included: Professor Anand Desai, Interim Director, School of Public Policy and Management, Dr. Vivian Witkind Davis, Interim Director, National Regulatory Research Institute, Mr. Jerry Webb, Indiana Utility Regulatory Commission, Mr. Steve Hines, Ohio Office of the Consumers' Counsel, Ms. Jenny Bielanski, United States Environmental Protection Agency, Mr. Bruce Schmidt, Wisconsin Public Service Commission, Mr. David Monie, National Association of Water Companies and the owner and operator of a small water utility, Ms. Sue Daly, Public Utilities Commission of Ohio, Mr. Joe McGarvey, Ms. Melissa Stanford, Mr. John Wilhelm, NRRI

Working Group Members, Mr. Jim Merciel, Missouri Public Service Commission, Mr. Ray Pilapil, Illinois Commerce Commission, were unable to attend the workshop. However, they actively participated in subsequent dialogues and data collection for their jurisdictional small utilities.

SELECTION OF PERFORMANCE INDICATORS

The goal of the MTAC Project was to develop and provide comparative performance measures in order to improve the technical, managerial and financial capacity of small public and private drinking water utilities in Illinois, Indiana, Missouri, Ohio and Wisconsin. The goal of the focus group meeting was to familiarize participants with the goals and scope of the project, review the analytical techniques and the level of analysis to be used and most important, utilize their collective expertise and various perspectives to identify and debate appropriate performance measures and explanatory factors for small drinking water utilities in the MTAC region. Many of these performance indicators could also be useful for small utilities elsewhere.

Choosing the right things to measure is important. Choosing the right organizations to benchmark with or against is also essential. The situation, opportunities and constraints typical of small systems are not typical of utilities with larger numbers of ratepayers, sizable rate bases and easier access to capital. It is appropriate to compare organizations with others in their same “league” that face similar difficulties and therefore with whom valid performance comparisons and practicable prescriptions for improvement can be derived. This comparison is in keeping with variance provisions contained in the 1996 SDWA Amendments that permitted small water utilities to use alternative technologies for compliance.

The expert group also went about the critical task of defining data requirements and identifying small systems under their jurisdiction to be benchmarked.

Performance measures were identified for three categories: financial, technical or operational and managerial to correspond with the capacity development framework contained in the Safe Drinking Water Act Amendments of 1996. Through discussion and debate an array of potential measures was established with which all could nominally agree.

Each expert was then given index cards and asked to rank each indicator by order of importance with number 1 ranking being the most important. The rankings are listed in parentheses. Using the method of summing the rankings for each indicator, those receiving the 3 lowest scores overall would comprise the most important 3 indicators for each category. These are denoted with an asterisk.

Financial Indicators

A.	Equity Ratio	(5,2,2,5,3,1) = 18*
B.	Net Operating Income / Loss	(1,1,1,4,1,2) = 10*
C.	Internally generated funds	(4,4,5,2,4,5) = 24
D.	Rate Base / Connections	(2,5,3,1,5,4) = 20
E.	Operating Ratio: Total Revenues / Total Operating Expenses	(3,3,4,3,2,3) = 18*

Where 1 denotes “Most important” and 5, “Least important.”

Operational or Technical Indicators

A.	Water Loss	(7,2,7,1,1,3) = 21*
B.	Compliance (EPA, SDWIS / Fed)	(2,4,1,3,6,1) = 17*
C.	Operator Certification (right cert for plant)	(1,7,5,6,4,2) = 25
D.	System Map	(6,3,4,7,5,4) = 29
E.	Customer Complaints	(5,6,6,4,2,7) = 30
F.	Compliance (state commission data?)	(4,5,2,2,7,6) = 26
G.	Adequacy of Facilities – sanitary surveys	(3,1,3,5,3,5) = 20*

Where 1 denotes "Most important" and 7, "Least important."

Managerial Indicators

A.	Budget / Business Plan	(1,1,2,5,3,1) = 13*
B.	Current CCR	(4,2,3,4,2,2) = 17*
C.	Accurate Financial Statements	(2,3,1,1,4,3) = 14*
D.	Working Phone Number	(3,5,4,2,1,4) = 19
E.	Liability Insurance	(5,4,5,3,5,5) = 27

Where 1 denotes "Most important" and 5, "Least important."

Explanatory Factors

- Number of months since last rate case
- Percent of customers metered
- Production Meters (Station Meters)
- Fire Protection
- State
- Ownership type: Investor owned utility (IOU) or municipal owned utility
- Grant Money + Contributions in Aid of Construction (CIAC)

The project team decided to attempt to collect data for all chosen indicators and explanatory factors, if possible, or at a minimum, collect information for the top three indicators for each area.

DISCUSSION ON INDICATORS

Water Loss

With regard to the water loss indicator, a lengthy discussion took place on the different ways in which utilities calculate actual water losses or determine their level of unaccounted-for water. Based on the discussion, we did not anticipate having a uniform measure for this indicator. However, due to its perceived importance as an indicator of utility performance, we decided to collect the data despite this constraint. Although water utilities have frequently utilized measures of unaccounted-for water to gauge the leakiness of their distribution systems, the measure's use has been called into question in recent years. The American Water Works Association (AWWA) suggests that unaccounted-for water should be no greater than 10 percent of input volume (and some state commissions utilize similar standards). As explained in a 2002 AWWA report, "In 1996, AWWA's Leak Detection and Accountability Committee recommended 10 percent as a benchmark for unaccounted-for water supplanting a 15 percent standard that apparently was based more on folklore than empirical analysis. But even this 10 percent recommendation is considered arbitrary in nature and the use of any percentage indicator is now viewed as suspect; particularly in light of emerging approaches that rest on more accurate water accounting."[12]

The unaccounted-for water indicator is influenced by a system's operating pressure and amounts of rainfall or snowmelt. In a dry period when higher volumes of water are being pumped, the unaccounted-for water percentage decreases and may make it appear that water losses are also decreasing. In addition, measures of unaccounted-for water do not take into account other key influences on "real losses":

- Number of service connections
- Location of the customer meter on the service connection
- Length of mains
- Infrastructure condition, materials, frequency of leaks and bursts
- Types of soil and ground conditions, insofar as they influence the proportion of leaks and bursts which show quickly on the ground surface.

[12] Janice A. Beecher, *Survey of State Agency Water Loss Reporting Practices, Final Report to the American Water Works Association, January 2002.*

The International Water Association's distribution division established a task force in 1996 to review existing methodologies and recommend a basic standard terminology for calculating real and apparent water losses that could be used for benchmarking.[13]

Utility Size

During the focus group we discussed what size small utility was the right size for purposes of this project. Some argued for using utilities with 500 connections or fewer. Others felt that we should include utilities with 1,000 connections or fewer. We decided to organize the data into two groups: those with no more than 500 connections and those with between 501 – 1,000 connections. This reflects the perceived significant differences between utilities in each size category and a commonly held view that the smallest utilities experience increasingly more serious technical, managerial and financial problems. It is also consistent with the notion touched upon previously that choosing the appropriate benchmarking "partners" is key to making meaningful comparisons and identifying practicable prescriptions for improving performance.

Subsequent Dialogue and Consultation with Expert Panel

A draft data collection instrument was created and reviewed by the expert panel. Discussions ensued in an effort to clarify the proposed questions and further define terms, performance indicators and explanatory factors. In subsequent discussions, the expert panel provided feedback on appropriate proxies to represent general performance indicator categories.

Adequacy of Facilities

For the "Adequacy of Facilities" indicator, there was concurrence on two proxies:

- Is the system metered?
- Are the meters tested?

Age of the distribution and age of the treatment systems were also considered and supported as potential proxies for the "Adequacy of Facilities" performance indicator. However, the group decided not to use age as a proxy. Data were not readily available from Wisconsin's utilities.

[13] IWA Blue Pages, "Losses from Water Supply Systems: Standard Terminology and Recommended Performance Measures", IWA, October 2000.

And anecdotal information further suggested that neither utilities nor commissions in other states would find the information easy to obtain. In fact, even the largest utilities regulated by state commissions have found it challenging to determine the age and condition of distribution systems components. In addition, age alone can not reliably represent the adequacy or inadequacy of a utility's treatment and distribution systems. Old pipes that remain useful beyond their projected useful life do exist. Similarly, newer plant equipment can deteriorate sooner than expected due to the quality of the materials, soil conditions, manufacturing defects, lack of maintenance and repair or other factors.

Results of sanitary surveys were also considered as a potential source of information on the adequacy of a system's facilities. Constraints to utilization included the fact that methods used to conduct sanitary surveys and findings of deficiencies or inadequacies in a system are not necessarily comparable across states. States use different questions and may gauge responses differently.[14] Despite this limitation, the group ultimately agreed to keep the results of sanitary surveys in the study and to rely on the informed judgment of each participating state commission staff person to rank the results of those surveys using an ordinal coding system of:

- Excellent
- Good
- Fair
- Poor

Ability to Generate Funds Internally

Potential proxy measures for the "Ability to Generate Funds Internally" performance indicator were also a subject of discussion among the expert panelists. Proxy measures considered included ratios of liquidity, existence of special funds, temporary cash investment area, amount of paid in capital or equity, retained earnings, unappropriated earned surplus, level of company debt, credit ratings, if any, and results of viability screenings, if any.

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[14] An American Water Works Association representative echoed these views of sanitary surveys in a June 20, 2006 Washington Report concerning the Groundwater Treatment Rule which said it is likely that USEPA will include a provision that will effectively make deficiencies in sanitary surveys — if they go uncorrected for 90 days — a violation of a treatment technique. USEPA or states could then require utilities to make capital or operational changes based on the findings of the sanitary survey. Alan Roberson states in the report, "Sanitary surveys are a valuable tool, but they are highly variable within and among states and depend a lot upon the judgment or abilities of an individual inspector for them to become the basis for being declared out of compliance."

Results of viability screenings were of interest to the panel and received considerable support. However, considerable constraints to using them were also noted. Constraints included the complexity involved in extracting financial viability related questions from a viability screening assessment tool, some of which might duplicate performance indicators chosen for this project. Another concern was that we would be using a viability screening device as an input to our project's benchmarking approach to measuring the viability or financial health for that utility. For example, viability screenings include components such as net operating income/loss, rate of return, debt/equity ratio etc. Another critical constraint to their use was data availability. Our experts thought viability screenings would likely not be available for all systems included in our study. For all of these reasons, the group decided to not use viability screening results for this project.

The panel decided to use some type of liquidity ratio. Group members recommended and the group considered several alternatives:

- Current Ratio = Current Liabilities/Current Assets
- Equity as a percentage of rate base where equity = paid-in capital + retained earnings + unappropriated earned surplus + capital stock, and,
- Net income + non-cash expenses (depreciation, rate case and debt amortizations) = Internally Generated Funds.

The coding rule for the survey was determined to be: If there are any funds, respond "Yes" and include the amount and if none, respond "No."

DATA COLLECTION

Once the appropriate performance measures and proxies were selected and validated by the project team and expert group, the data collection phase of the project began. The data collection instrument was specifically designed for the purposes of the project. It provided the project team the option to collect data electronically.

We expected two primary sources of financial data: the state public utility commission and the utilities. Public utility commissions maintain annual reports from jurisdictional utilities as well as a considerable amount of information used for general ratemaking and policy purposes. In some instances, the utility's technical compliance data came from the EPA's Safe Drinking Water Information System (SDWIS) database or directly from state primacy agency. Ideally, one would expect explanatory information and system characteristics (connections, source water, metering, etc.) to come from the state primacy agency, the state public utility commission, the EPA SDWIS database, or the utilities themselves.

In summary, the financial, technical and managerial data for this project came from a variety of sources. Chief among these are state primacy agencies, state public utility commissions, the EPA SDWIS database and the utilities themselves. However, the major conduit for all of the data were the public utility commission members of the expert panel without whom the team could not have completed this project.

CHAPTER III

METHODOLOGICAL BACKGROUND

Benchmarking, best practices, and performance measurement studies are important activities that are conducted in both the public and private sectors and in all of the nation's utility sectors, including drinking water. The work is being done by numerous parties, including regulators, consumer groups, academics, consultants, and the utilities themselves. However, conducting performance assessment in an open, cooperative environment, with broad-based stakeholder support and involvement has often been the exception rather than the rule.

In the public sector, performance assessment comes under a number of guises.[15] As demand for accountability from the public sector has grown in recent years, there has been a tremendous growth in the literature on measurement of performance. Underlying such assessments and measurement are concepts of best practices and benchmarking. . Best practices are obtained by taking a snapshot of observed practices and identifying those that are judged to be the best. Benchmarking, as it is most commonly understood, is a continuous process of monitoring and comparing one's performance with one's past performance or with what has been identified to be best practices among one's peers. These approaches to performance evaluation have their basis in the traditional notions of efficiency and effectiveness, but go beyond these basic concepts by incorporating additional criteria in judging good performance.

Both relative and absolute measures of performance are of interest to stakeholders. They would like to know how a specific utility is performing as well as obtain a sense of how this performance compares with that of its peers.

Although the literature on measuring performance of water utilities is limited, we draw upon the considerable literature on public sector performance to gain some insights into the general principles underlying such evaluations.

[15] Harry P. Hatry, [1999] *Performance Measurement: Getting Results*. Washington, DC: The Urban Institute.

LITERATURE ON BENCHMARKING

One of the chief lessons to be drawn from the literature is that performance measurement entails a long-term commitment. Establishing monitoring systems can be time consuming and gathering data for these systems can be expensive. Large organizations have the capacity and resources to implement monitoring systems, but similar efforts for small organizations can become an inordinate burden. For instance, many small utility companies do not meter their water use, hence, for them, the initial cost of installing meters and maintaining the relevant data can be prohibitive.

However, performance measurement helps managers specify service goals, expectations and strategies, and identify daily management problems and solutions.[16] It is most useful for internal management purposes where there is a full commitment to continuous improvement, to learn from others and to implement improvements.[17]

Performance measurement and subsequent improvement requires a culture in which learning from mistakes and sharing experiences is valued and rewarded. Hence, while one can develop a number of systems to monitor and assess performance, finally performance evaluation is only as effective as the people who implement it.[18] The creation of networks to facilitate sharing of individual experiences and to develop a shared understanding of the issues is an important aspect of developing an environment that promotes a sustained interest in performance assessment.[19]

Performance is context dependent. Local conditions vary, hence considerable attention must be paid to local differences if evaluations as to been seen as relevant.[20] The focus of the benchmarking exercise plays a vital role in determining whether it will have lasting benefits. A great deal of benchmarking activity can be described as "results" benchmarking as opposed to "process" benchmarking. An emphasis on results can yield quick improvements, perhaps to the

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[16] Xiaohu Wang [2002] Assessing performance measurement impact: a study of U.S. local governments, *Public performance & management review,* Volume 26, No. 1.

[17] Hesham Magd, and A. Curry, [2003] Benchmarking: achieving best value in public-sector organizations, *Benchmarking: An International Journal,* Volume: 10, No. 1

[18] Jacky Holloway, et al, [1999] A vehicle for change? A case study of performance improvement in the new public sector, *The international journal of public sector management,* Volume 12, No.4.

[19] Mohamed Zairi and John Whymark [2000] The transfer of best practices: how to build a culture of benchmarking and continuous learning – part1- 2**,** *Benchmarking An International Journal*, Volume: 7, Issue: 2.

[20] Theodore Poister and Gregory Streib, [1999] Performance measurement in municipal government: assessing the state of the practice, *Public Administration Review*, Volume 59, Issue 4.

detriment of sustained long-term performance at a high level. An emphasis on process, on the other hand implies the examination of causal processes, the creation of organizational cultures sympathetic to the ethos of benchmarking, training and communication during the benchmarking process and reliance on people with experience in benchmarking.[21]

Another concern mentioned in the literature is that an emphasis on outcomes might detract from the primary objective of the public sector, which is to provide equitable service to the public.[22] Constant monitoring, particularly if accompanied by penalties for failure, can make organizations risk averse. A culture in which the main emphasis is on accountability could lead to the suppression of experimentation that could potentially lead to improvements.[23]

In the final analysis, the purpose of improved performance is not good management but the delivery of good service. The implementation of the results of performance measurement has implications for resource allocation. When the understanding of the relationship between resource allocation and performance is not clear and the general emphasis is on the latter, there is the potential for a misapplication of the results.

CHOICE OF METHODS

The choice of an appropriate method or analytical approach is important to the utilities, as is the intended use of any resulting findings. Table 1 highlights the advantages and disadvantages of the most common performance comparison techniques.

It is important to bear in mind that the purpose of performance measurement is to improve performance. The chief criterion, therefore, in the selection of the procedure for measuring performance must be that it yield information that can be used for enhanced performance rather than a single number that provides some measure of the level of performance.

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[21] Matthew Hinton, Graham Francis,and Jacky Holloway, [2000]. Best practice benchmarking in the UK, *Benchmarking An International Journal,* Volume: 7, Issue: 1

[22] Amanda Ball, Bowerman, Mary; Hawksworth, Shirley [2000] Benchmarking in local government under a central government agenda, *Benchmarking: An International Journal,* Volume: 7, Issue: 1

[23] Mary Bowerman, et al. [2001] Benchmarking as a tool for the modernization of local government, *Financial Accountability and Management*, Volume 19, issue 4.

Table 2: Analytical Techniques Used in Performance Comparisons

Techniques	Advantages	Disadvantages
Anecdotal Information	▪ Easy to collect information	▪ Highly subjective ▪ Not rigorous
Standards	▪ Predefined ▪ Easy to understand	▪ Pass/fail only ▪ No overall assessment ▪ Multiple bests, no differentiation
Simple Ratios	▪ Simple to perform ▪ Easy to understand	▪ Effect of extreme values ▪ No overall assessment ▪ Multiple bests, no differentiation ▪ No explanatory factors
Regression Analysis	▪ Uses explanatory factors ▪ Limits effect of outliers	▪ Needs formal model ▪ Best "average" performance ▪ Limited to one outcome ▪ Complexity
Data Envelopment Analysis (DEA)	▪ Non-parametric ▪ Accommodates multiple performance measures, outcomes ▪ Generates a best practices "frontier" ▪ Generates holistic, scalar measure of best overall performance ▪ Uses explanatory factors ▪ Offers "prescriptions" for improvement	▪ Complexity ▪ Low awareness of method

We conducted the assistance-oriented, comparative performance assessment of the small drinking water utilities in the MTAC region using a two-stage approach. The first stage of the analysis employed data envelopment analysis (DEA)[24] to generate performance results that identify best practices observed in the data. This method uncovers, quantitatively, how well all of the utilities in the analysis are performing relative to each other. It has the potential to generate prescriptions for improvements for those utilities that are not performing as well as their peers. And it identifies likely "mentors" from that select sub-set of high performing utilities whose policies,

[24] See for instance: A. Desai "Program Evaluation, Best Practices and Data Envelopment Analysis" in *Policy Analysis Methods*, Stuart S. Nagel (Ed.) 1999, pp. 183-203, Commack, NY: Nova Science Publishers; A. Desai. "Data Envelopment Analysis: A Clarification." *Evaluation and Research in Education*, **6**, 1, 39-41, 1992. A. Desai and J.E. Storbeck. "A data envelopment analysis for spatial efficiency," *Computers, Environment and Urban Systems*, **14**, 145-156, 1990.

practices and personnel others may reasonably hope to emulate. The second stage of our approach helps us understand the importance of chosen explanatory factors associated with the utilities in the study.

It is especially important to note that the DEA approach was utilized because it can accommodate more than one performance measure or indicator. As our goal was to conduct a holistic assessment of small drinking water utilities using the capacity framework (e.g., to jointly account for the technical, managerial and financial performance of the utilities), DEA was seen as the most attractive analytical tool.[25]

DATA ENVELOPMENT ANALYSIS

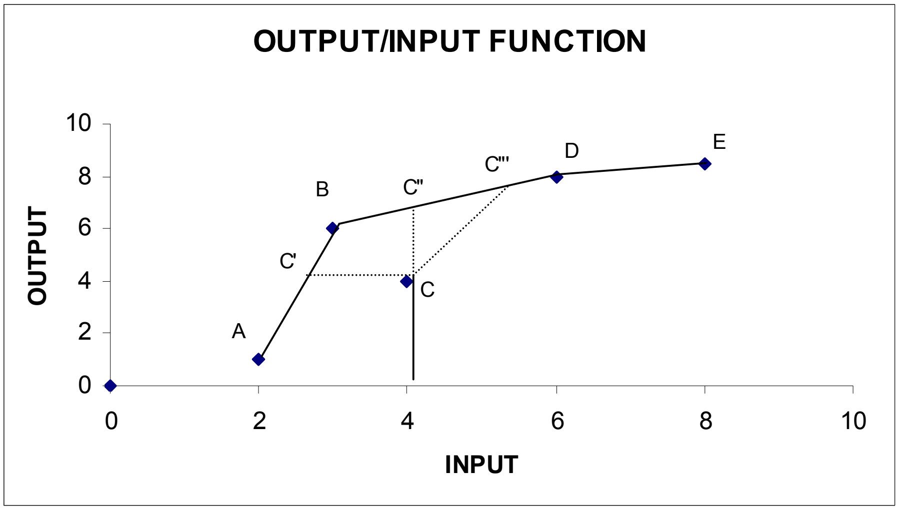
We digress here to provide a conceptual and, later on, a formal introduction to the data envelopment analysis. Simply put, DEA uses data on inputs and outputs to develop multidimensional performance indices based on the concept of efficiency as defined in the economics literature. The unit of analysis is a water utility that uses inputs (resources) to produce outputs.

Consider water utilities A, B, C, D and E that have a single input and a single output. We can plot these input (horizontal axis) and output (vertical axis) combinations as shown in Figure 2.

In this context, a utility is said to be "efficient" if it uses minimal inputs to produce maximal output. Hence, in this simple example, we connect the utilities that have the optimal combination of minimum input and maximum output in a piecewise linear fashion, at points A, B, D and E, to obtain the best observed practice frontier. Any utility that lies on this frontier is deemed efficient. A utility that lies "inside" or "below" this frontier is deemed "inefficient." The utility, C, lies inside this "best practice frontier" defined by ABDE. Hence, for C to be efficient it has to lie on the frontier. It can do so by decreasing its input to C' or increase the output to C" or some combination as shown by C"'.

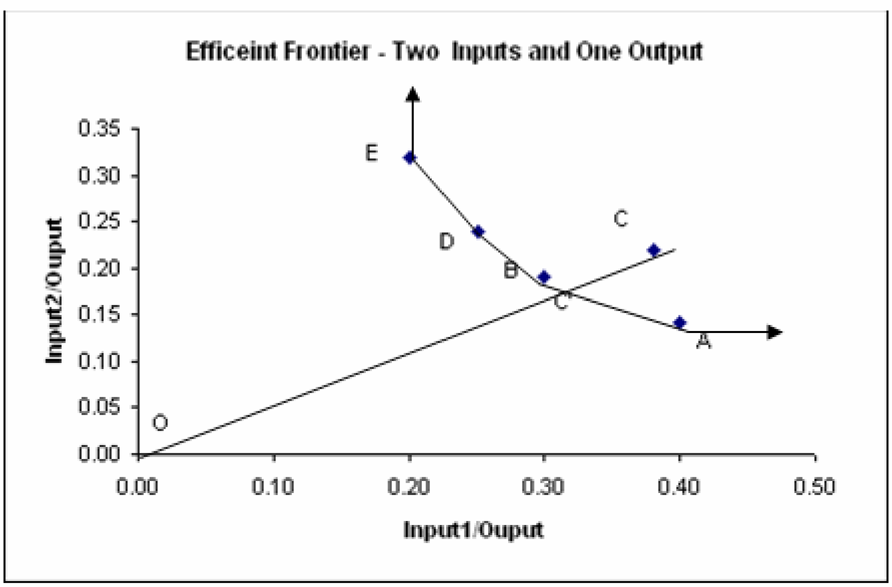
[25] A presentation demonstrating the usefulness of the DEA methodology for water utility benchmarking was given to the NARUC Water Committees by Dr. Sanford Berg in February 2006.

Figure 2: Input-Output Combinations



In reality, utilities will not have a single input or single output. So, if we consider two inputs and one output we obtain a slightly different picture. For ease of illustration, we divide the output into the inputs so that we can show the ratio of inputs to output on the two-dimensional surface of a piece of paper.

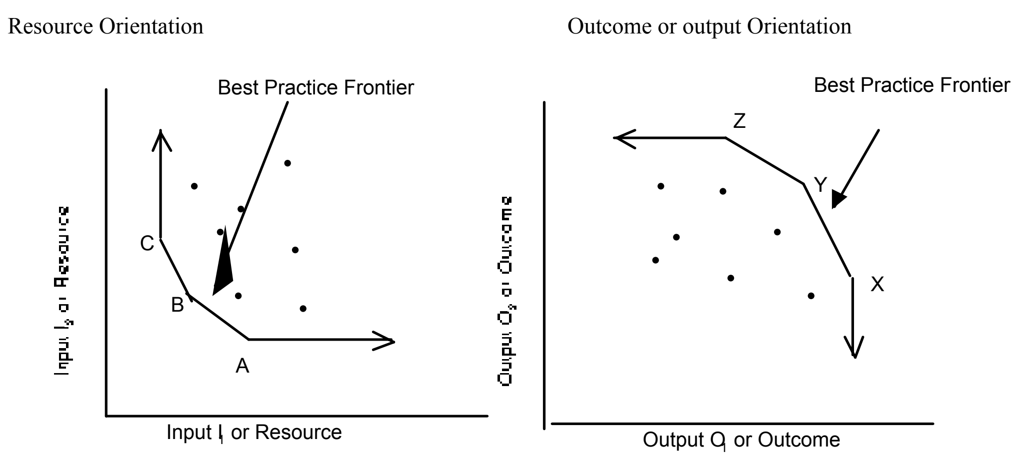
Figure 3: Best Practice Frontier



We can once again obtain the best practice frontier by connecting the extreme utilities (points) A, B, D and E as shown in Figure 3. Efficiency here is measured as the distance of the utility from the frontier. We can measure performance in terms of distance from the frontier. If the utility is on the frontier then it is judged to exhibit a best practice and is given a score of 1.0 or 100%. Any utility not on this frontier is deemed "inefficient" and its performance measure is based on its distance from the frontier. Hence for utility C which is not on the frontier, we can draw a line from the origin to C, intersecting the frontier at C'. The ratio OC' to OC represents the measure of relative performance of C with respect to the other utilities that make up the frontier.

Note that the same logic can be used for outputs normalized across inputs. The orientation of the best practice frontier will be different. Since the frontier is obtained by connecting efficient utilities in a piecewise linear fashion, removal or addition of efficient utilities will alter the shape of the frontier. Changes in output or input values may also change the curve.

Figure 4: Orientations



In general, as shown in Figure 4, DEA frontiers can be classified as *input models* also known as *resource orientations* or *output models* known as *outcome orientations*. The boundary for the input model is shown as ABC and is of a "southwest" orientation. Any inefficient utility will appear to the right of the frontier. To make the utility more efficient it will need to contract its inputs into the frontier along what may be called the contraction path. Similarly, the outcome orientation yields a northeast boundary as shown in XYZ and inefficient utilities will have to expand towards the boundary along the expansion path.

DEA models can thus be constructed using multiple inputs and outputs. The essential mathematical problem that DEA solves is

> *How do we obtain a measure of relative performance and a corresponding set of weights for a utility so that this measure is maximized relative to that of other utilities producing at least the same level of outputs with the same or fewer resources (inputs)?*

In creating DEA, Charnes, Cooper and Rhodes[26] proposed a mathematical programming formulation of for the problem of estimating the relative efficiency of production units which produce multiple outputs from a given set of multiple inputs. Hence, for n production units producing k outputs, y, from m inputs, x, they propose solving the following fractional program to obtain the relative efficiency e of the production unit indexed by o.

Thus, the mathematical expression for the problem stated above is:

$$\text{Maximize} \qquad e_j = \frac{\sum_h u_{hj} P_{hj}}{\sum w_{qj} I_{qj}} \tag{1}$$

such that

$$\frac{\sum_h u_{ho} P_{hj}}{\sum_q w_{qo} I_{qj}} \leq 1 \qquad \forall\, j =< 1, 2, \cdots, n \tag{2}$$

$$w_{qj} \ \text{and}\ u_{hj} \geq 0 \qquad \forall\, j. \tag{3}$$

In (1), the numerator denotes a *virtual* output, being the combination of actual outputs, and the denominator denotes a *virtual* input, being the combination of actual inputs. The solution to the program finds weights u_{ho} and w_{qo} such that the ratio of virtual outputs to virtual inputs is maximized subject to the constraint that no ratio exceeds unity. Charnes and Cooper[27] developed

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[26] A. Charnes, WW Cooper and E. Rhodes [1979], "Measuring Efficiency of Decision Making Units," *European Journal of Operational Research*, Volume 3, No. 4,

[27] A. Charnes and W.W. Cooper, "Chance Constrained Programming," *Management Science*, Volume 6.

a transformation which yields a linear equivalent for the fractional program (1)-(3), thereby considerably simplifying the computation of $e_{0.}$ The fractional program yields an infinite number of solutions, for example, if (***u, w***) is an optimal solution then (δ***u***,δ***w***) is also optimal for δ>0. Transforming the variables (***u, w***) into (μ, ν), CCR offered the following equivalent linear programming formulation which is representative of one of the potential solutions of (1)-(3):

$$\max_{\mu,\nu} z = \mu^T y_o \qquad (4)$$

$$s.t. \quad \nu^T x_o = 1 \qquad (5)$$

$$\mu^T y - \nu^T x \leq 0 \qquad (6)$$

$$\mu^T, \nu^T \geq 0. \qquad (7)$$

The corresponding dual of (4)-(7) is as follows, where λ is a vector of weights and θ is the measure of efficiency.

$$\min_{\theta,\lambda} \theta, \qquad (8)$$

$$s.t. \quad y\lambda \geq y_o \qquad (9)$$

$$\theta x_o - x\lambda \geq 0, \qquad (10)$$

$$\theta \ free, \ \lambda \geq 0. \qquad (11)$$

Since Charnes, Cooper and Rhodes' original work, a number of variations of these linear programs have been developed and implemented in a variety of contexts. For instance, the ratio (1) can be maximized either by maximizing the numerator for a given value of the denominator or the denominator can be minimized for a given value of the numerator. Each of these options yields a different linear program. Similarly, different assumptions about the weights yield different sets of constraints and restrictions on the values of the weights thereby modifying (4)-(7) and (8)-(11). These different assumptions affect not only the membership of the set of production units that define the frontier but also how differences in the size of the production units and their activity levels affect their performance scores. For a more detailed discussion of these models and the underlying assumptions, see Seiford and Thrall.[28]

[28] L. Seiford and R. Thrall. [1990] Recent developments in DEA: The mathematical programming approach to frontier analysis. *Journal of Econometrics.* Volume 46, 7-38.

CHAPTER IV

DATA ANALYSIS

As already mentioned, all the MTAC states did not participate in this study. We obtained data from Illinois, Indiana, Missouri, Ohio and Wisconsin. Table 3 shows the number of small water utilities in our database from each of the participating states.

Table 3: Data Source

	Number of Utilities	Percent
Illinois	35	7.4
Indiana	31	6.5
Missouri	29	6.1
Ohio	21	4.4
Wisconsin	359	75.6
Total	475	100.0

We had usable data on 475 utilities from these five states. The majority of the data, almost 75 percent, is from Wisconsin. The quality of the data across these states was not uniform. In many cases, information submitted to state commissions by utilities had missing variables and errors in the reports. Data were either not available or not provided for all jurisdictional utilities meeting the criteria (up to 1000 service connections) for this project. State commission staff members were constrained by their ongoing, extensive workloads and by the time constraints on the project. The timeline could not be adjusted to reflect the actual start date and, for unanticipated administrative reasons, could not be sufficiently lengthened to accommodate additional data collection and verification attempts. The information from Wisconsin was consistently superior in terms of completeness and the number of errors. This likely reflects the ongoing priority given to data collection and management there. State commission water programs vary in size, methods, opportunities and constraints. As might be expected during the start up phase of a comprehensive performance evaluation effort, all the data necessary for the assessment are not readily available. These exists significant variation in data collection and reliability across the states. Procedures for ensuring high and uniform data quality will have to be implemented for a comprehensive and reliable benchmarking effort to be accomplished. The current state of the data does not support performance assessment that can serve as the basis for management action to improve utility performance.

That said, we begin our discussion of the data analysis by first providing some general information about the utilities included in this analysis. The majority of the utilities are municipal, with a little over twenty percent being investor-owned (IOU). This is an anomaly when one considers that the vast majority of state commissions regulate only investor-owned utilities. Table 4 lists the breakdown of the utilities into different ownership categories.

Table 4: Ownership Type

	Frequency	Percent
Conservancy District	1	.2
IOU	100	21.1
Municipal	365	76.8
Not For Profit (NFP)	9	1.9
Total	475	100.0

However, they are not evenly distributed across the states (Table 5). Most of the utilities in Wisconsin are municipal and Indiana has a mix of Not-for-profits (NFP), investor-owned and municipal-owned utilities. The other three states have data only from investor owned utilities.

Table 5: Ownership Type by State

	State				
Ownership Type	Illinois	Indiana	Missouri	Ohio	Wisconsin
Conservancy District	0	1	0	0	0
IOU	35	10	29	21	5
Municipal	0	11	0	0	354
NFP	0	9	0	0	0
Total	35	31	29	21	359

In the workshop discussion the participants suggested the use of operator certification as an indicator of managerial performance. However, it did not serve as a useful indicator since there is very little variability in our dataset with regard to certification. All except twelve owners in our dataset had certification (Table 6). Ten of these twelve are in Indiana, but there are not sufficient utilities in Indiana to compare their performance and conclude whether owner certification influences performance.

Table 6: Operator Certification

Operators are Certified	State					Total
	Illinois	Indiana	Missouri	Ohio	Wisconsin	
No	0	10	2	0	0	12
Yes	35	21	27	21	359	463
Total	35	31	29	21	359	475

Similarly, most of the utilities (448 of 475) are metered. However, of those that are not metered, most of them are in either Indiana or Ohio (Table 7).

Table 7: System is Metered

System is Metered	State					Total
	Illinois	Indiana	Missouri	Ohio	Wisconsin	
No	1	11	2	10	3	27
Yes	34	20	27	11	356	448
Total	35	31	29	21	359	475

All but four utilities in Wisconsin have fire protection (Table 8). In contrast, none of those in Illinois have it, about a third of the utilities in Indiana have fire protection and there are no data about it for those in Ohio.

Table 8: Fire Protection

Has Fire Protection	State					Total
	Illinois	Indiana	Missouri	Ohio	Wisconsin	
No data	0	0	0	21	0	30
No	35	21	18	0	4	69
Yes	0	10	11	0	355	376
Total	35	31	29	21	359	475

A number of proxy indicators of managerial performance were obtained to determine the level of managerial oversight. These indicators of managerial performance varied from something as mundane as having a telephone to something considerably more substantial as the accuracy of financial statements or the availability of annual water quality or consumer confidence reports. This information is provided in Appendix A for the purposes of completeness. However, these data tables in the Appendix contain little new information. The pattern apparent in the above tables continues with respect to these managerial factors. For instance, Wisconsin generally has utility companies that keep good financial records, has consumer confidence reports and working telephones. Except for Missouri and Indiana, which each have 18 utility companies with liability insurance, none of the other states seem to monitor that information.

Before we begin reporting on our analysis of the data, it is important to reiterate that with the exception of the Wisconsin data, the number of utilities in our data from the other states is small and therefore we do not have the full confidence that they are representative of the water utilities in these states. Further, there is variation in the definition of some of these variables across the states, hence comparisons across the states would be best avoided. In brief, we would recommend that the analysis discussed here be treated as illustrative of an inclusive and practicable process that might be followed in identifying best practices and performance benchmarks rather than a definitive analysis of the performance of these utilities.

PERFORMANCE MEASURES

A product of the workshop we conducted on identifying indicators of financial, technical and managerial performance was a set of variables. The selection of these variables was, as already mentioned, a product of intense discussion regarding the meaning, availability and quality of the data. Many of these utilities are small operations for whom data collection and information monitoring is not a high priority. However, the fact that data in some states are available across different operation sizes does suggest that it is possible to gather valid information on the operation of these utilities.

The data collection exercise yielded data on financial and technical indicators that would lend themselves to the development of quantitative performance measures. The information on managerial factors is limited primarily to water utilities in Wisconsin. Further, there is very little variation in these non-financial data hence, it difficult to compare financial or technical performance and to attribute differences in that performance to differences in managerial styles. As already mentioned, we constructed two DEA measures of performance, one financial and the other technical.

Financial Performance

As discussed in Chapter III the conceptual basis of this performance measure is in the economic theory of production where productive efficiency is measured in terms of being able to produce the maximum output for a given set of inputs. We use that basic concept to develop the performance index using information on revenues, expenditures, the rate base and the size of the utility as measured by the number of connections. Of these, variables, consistent data were available on the number of connections, and the revenues and expenditures for the utility.

Thus, the financial performance index was constructed by using expenditures as inputs and revenues and the number of connections as outputs. There was a consensus among the workshop participants that utilities with fewer than 500 connections were different from the relatively larger utilities which had up to 1,000 connections, therefore we constructed separate indices for utilities with fewer than and more than 500 connections.

Figure 2 shows the histogram of financial performance scores for 284 water utilities, with fewer than 500 connections. This score ranges from a minimum of 0 to a maximum of 100, where a score of 100 denotes best practice. The mean score was approximately 33. There are 128 large (between 500 and 1000 connections) utilities and the distribution of their financial performance score is illustrated in Figure 3. The mean in this case is approximately 37.

Since the majority of the utilities are from Wisconsin, this average predominantly reflects the score obtained by the Wisconsin utilities. When we consider the expenditure-revenues ratio, there is very little variation in the Wisconsin data, hence the peak in the histogram in Figures 2 and 3.

Figure 5: Distribution of Financial Performance Score for Small Utilities

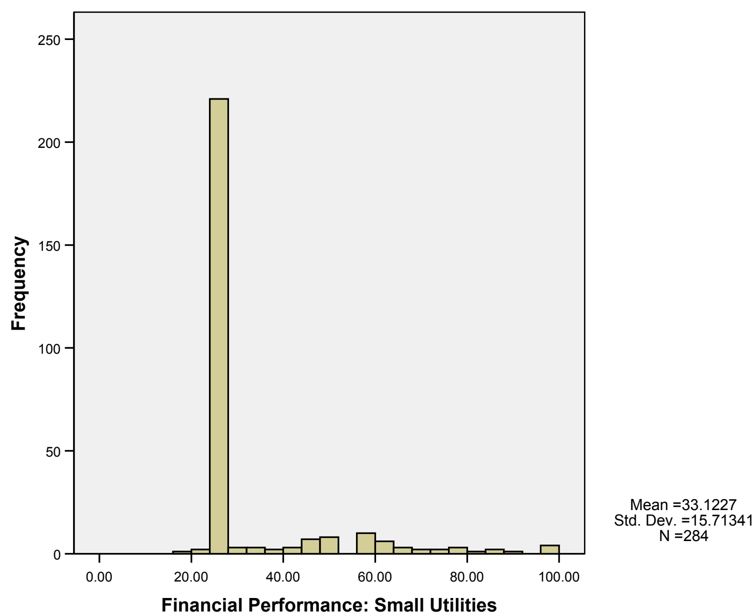
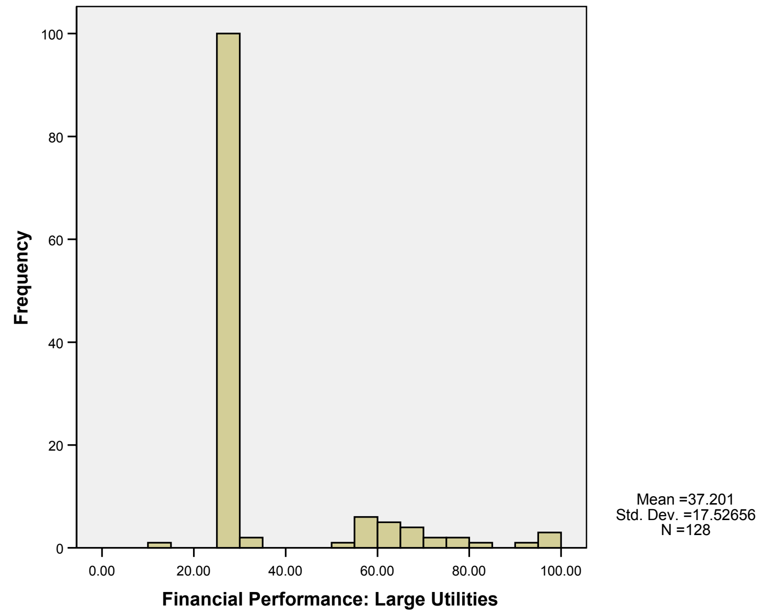
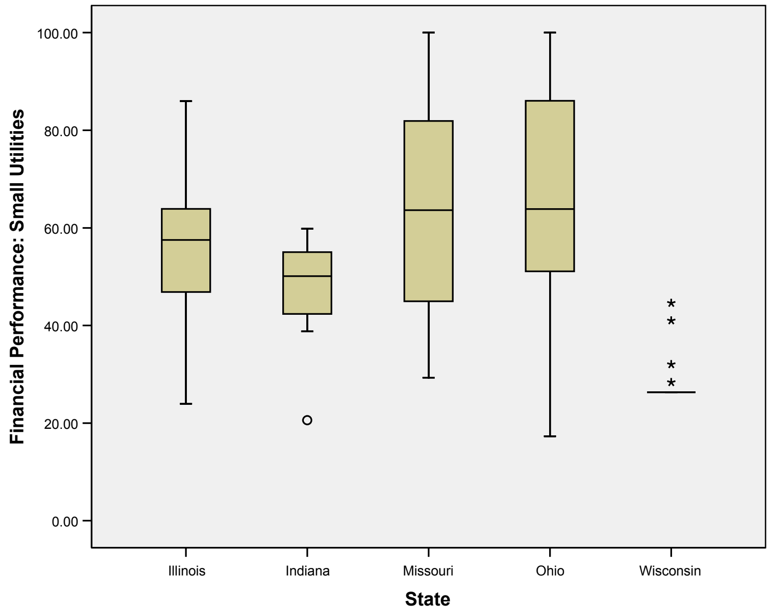


Figure 6: Distribution of Financial Performance Score for Large Utilities



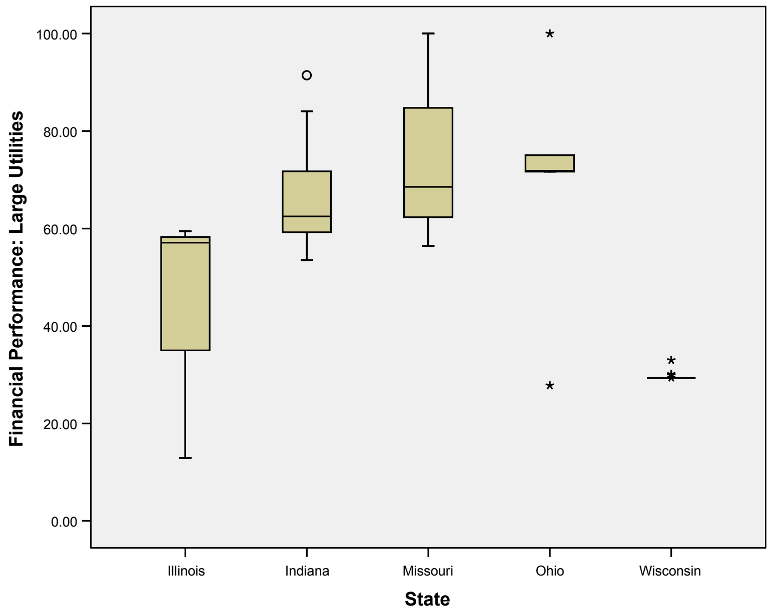
The distribution of these scores is skewed in that there is a long tail on the right. The bulk of the utilities have fairly low scores, the mean score being approximately 33 for the smaller utilities and slightly higher (37) for the larger utilities. The standard deviations for these two distributions are fairly close. With the exception of Wisconsin, this distribution suggests that there is considerable variety in the performance of these utilities, with a few of them doing relatively well, but the majority of them perform relatively poorly on this measure. To show how the financial scores vary within a state, this overall distribution of the scores is separated by state. The "side-by-side" box plots show the distribution of these scores in each state (Figures 4 and 5). The box represents to middle fifty percent of the data. The bars that extend from the box represent the remaining 25% of the data on either side of the middle 50%.

Figure 7: Distribution of Financial Performance Score for Small Utilities by State



The bars for Ohio and Missouri extend up to 100 indicating that the utilities that make up the best practice frontier are from these two states. In spite of the large number utilities from Wisconsin in this analysis, the box denoting these utilities is very small because there is very little variability in the Wisconsin data in the ratio of revenues to expenditures.

Figure 8: Distribution of Financial Performance Scores for Large Utilities by State

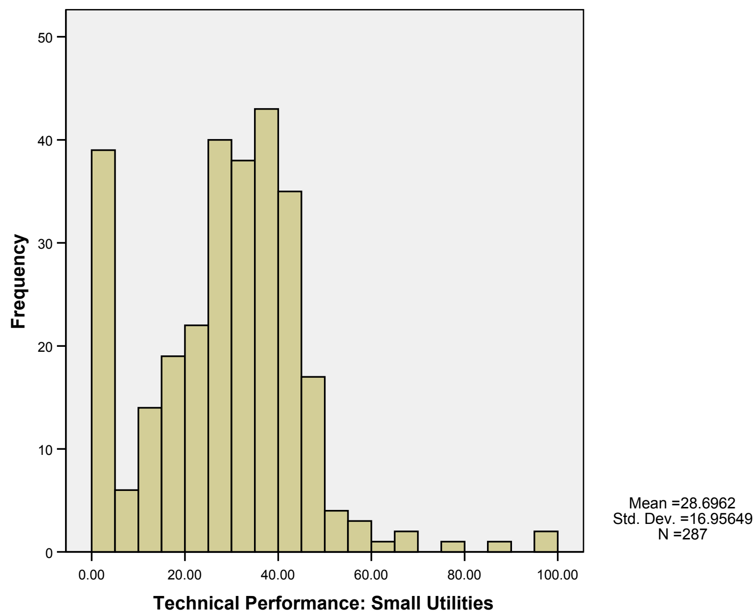


One must be careful in interpreting the relative positions of the boxes in these figures. If one had more confidence in the quality of these data, one could begin to draw inferences about the relative performance of the utilities across the states. For instance, an obvious interpretation would be that the Ohio and Missouri utilities on the frontier exhibit best practice and they should be studied further so as to learn about their finances and how that contributes to their superior performance. Although the boxes for each of the other states are above those for Wisconsin, it is not obviously true that the overall performance in the other states is superior to that of the utilities in Wisconsin. The scores are relative measures obtained by comparing them with their peers and therefore, the utilities are compared with different benchmarks, which yield scores that are specific to a given comparison or peer group.

Technical Performance

We constructed a second index to measure the technical performance of these utilities. This index is based on the total volume of water pumped, the number of gallons billed and the number of customers. Figure 6 shows the distribution of the scores for 287 small utilities with fewer than 500 connections.

Figure 9: Distribution of Technical Performance Score for Small Utilities



This distribution is different from that of the financial performance score for the smaller utilities. Here there spread is much more even across the full range of scores, however there appear to be many more utilities with very low scores. There are some utilities that demonstrate superior performance. However, the majority of the utilities do not score high on technical performance. The average score of approximately 29 suggests a big gap between the utilities on the frontier and the others, particularly those with scores below 10.

One of the variables for which we obtained data but did not use in this analysis is a measure of water loss. Ideally, this variable would have provided a good measure of technical performance of the utility, however, its definition varies from state to state and there were far too many utilities for which this information was missing so we could not use it in the analysis.

Figure 10: Distribution of Technical Performance Score for Large Utilities

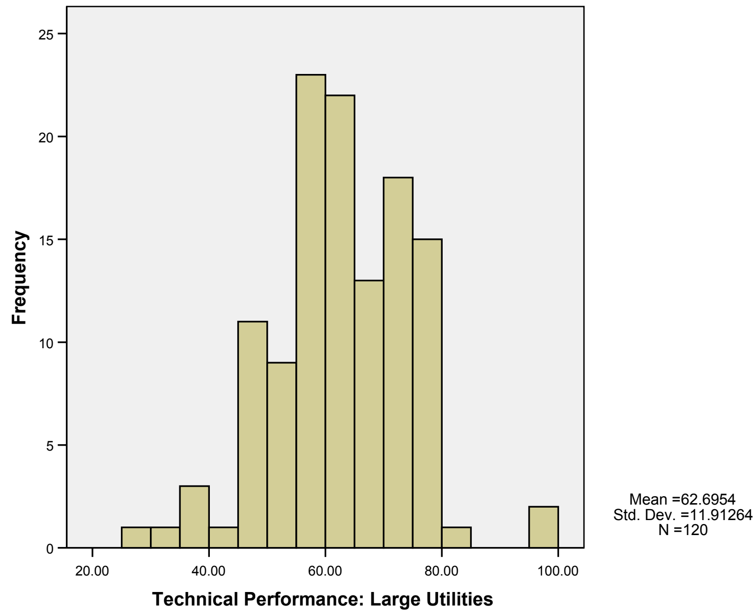
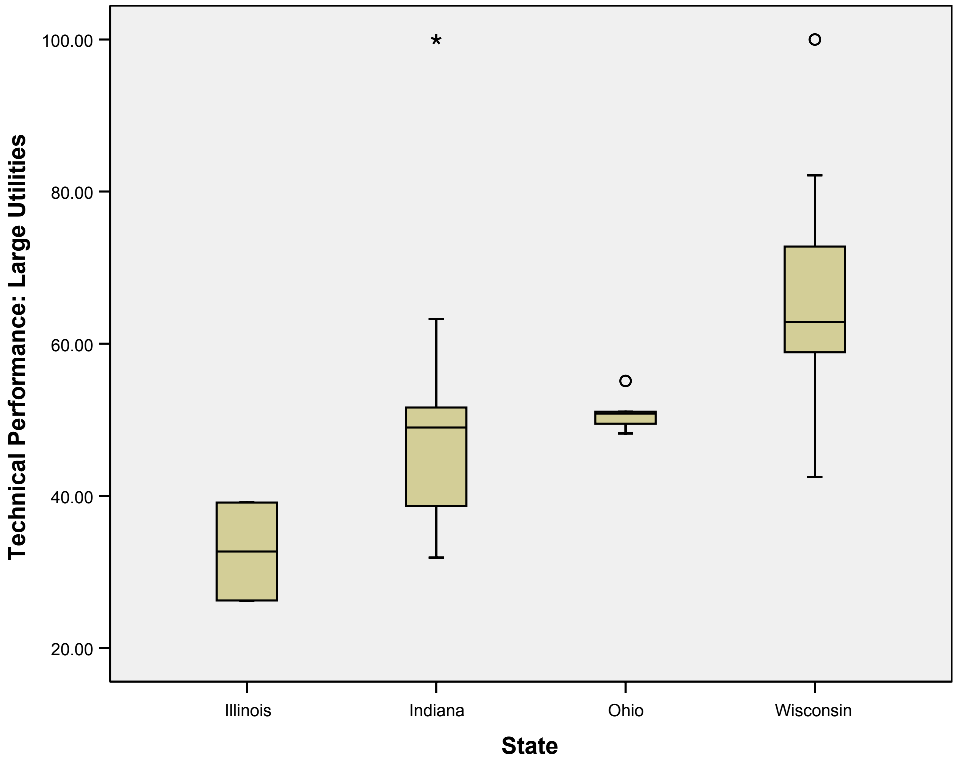


Figure 7, which depicts the distribution of the technical performance score of the 120 larger utilities shows many more utilities with higher scores. However, here too there seems to be a gap between those utilities on the frontier and the rest. The mean score of approximately 63 is the highest among the four sets of performance scores computed in this analysis.

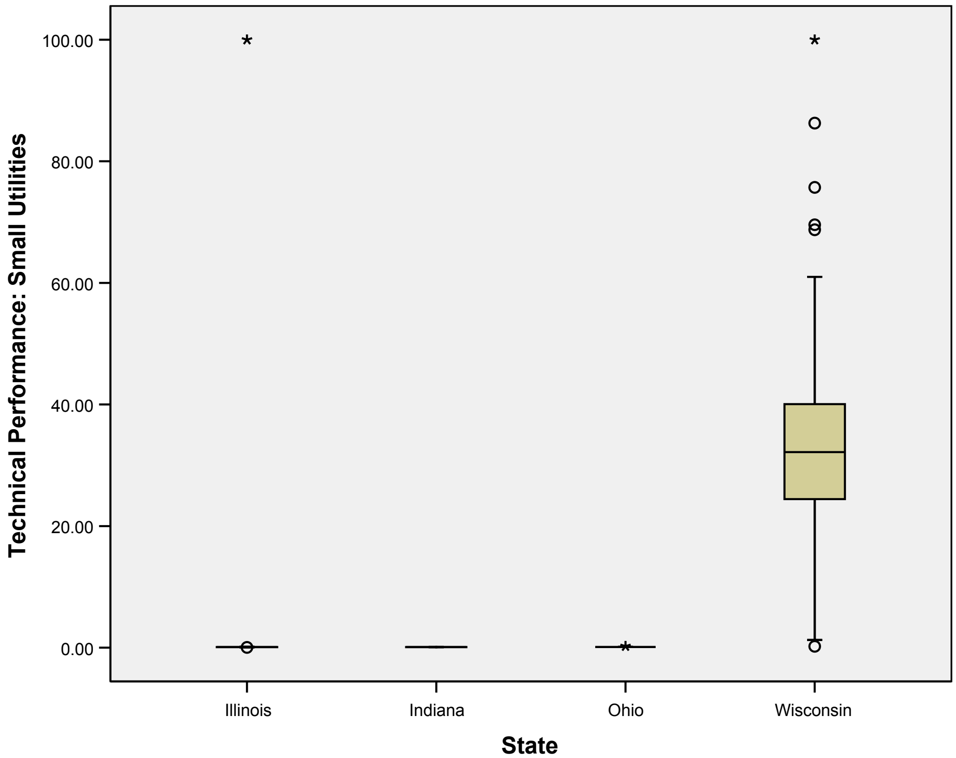
Figures 8 and 9 illustrate the distributions of the technical performance scores for the larger and small utilities, respectively.

Figure 11: Distribution of Technical Performance Score for Large Utilities by State



There are no discernable patterns in these performance scores. Among the larger utilities, the frontier is made up of utilities in Wisconsin and Indiana (Figure 8). Among the smaller utilities, the frontier includes utilities from Illinois and Wisconsin (Figure 9). We did not have sufficient data from Missouri to compute the technical performance measure.

Figure 12: Distribution of Technical Performance Scores for Small Utilities by State



Except for the utility on the best practice frontier in Illinois, there is minimal variation in the performance of utilities in Illinois, Indiana and Ohio. Although we have focused much of the attention on the best practice frontier, the utilities that lag behind and are far from the frontier are also worth studying in greater detail in that they provide information about why some utilities do not seem to manage to do well while others, operating under similar conditions do manage to provide their services efficiently and effectively. Hence studying performance of utilities at both extremes – those that are lagging behind and the leaders – would yield valuable information for performance improvement.

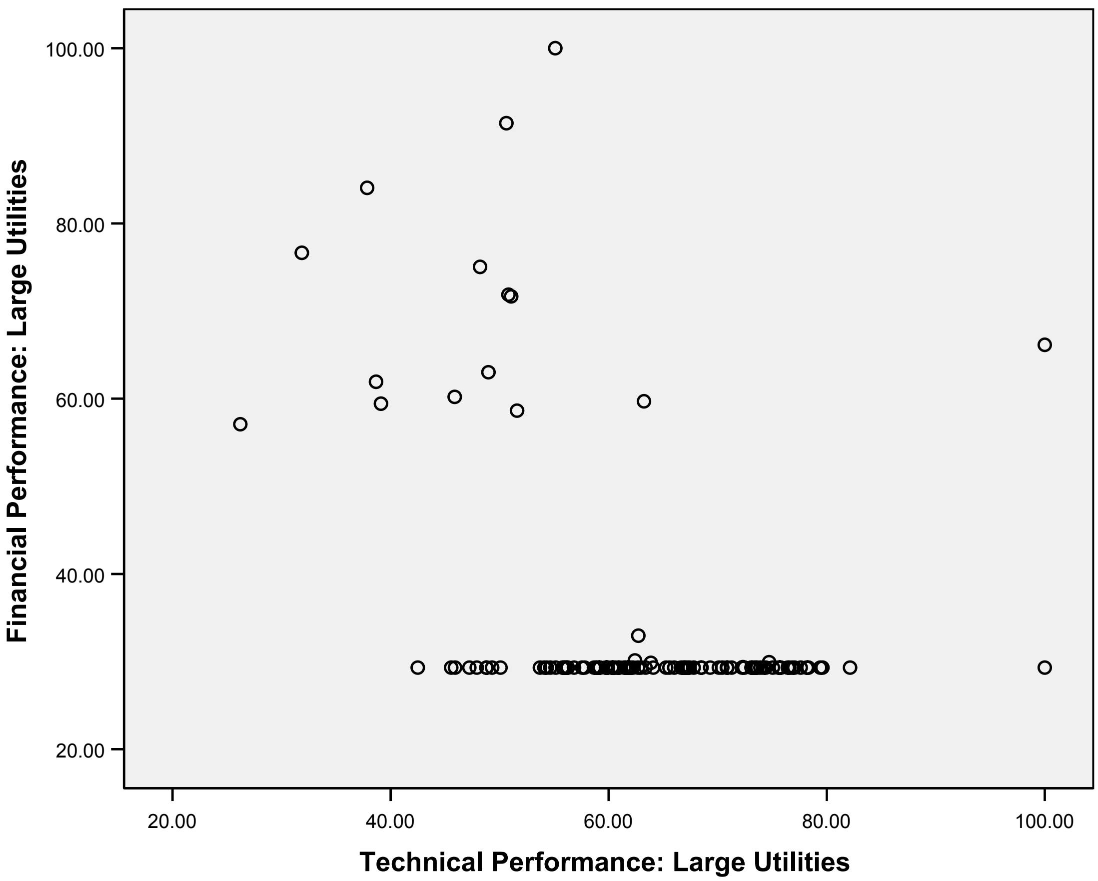
Table 9 provides summary statistics on the data distributions shown in Figures 2 – 9. It is clear from this table that even with high quality data, with the possible exception of Wisconsin, there are too few utilities to ensure a robust performance assessment.

Table 9: Summary Statistics for Performance Scores, by State

State		Financial Performance: Small Utilities	Financial Performance: Large Utilities	Technical Performance: Small Utilities	Technical Performance: Large Utilities
Illinois	Mean	54.92	43.13	4.44	32.66
	N	28	3	23	2
	Std. Deviation	15.01	26.23	20.83	9.11
Indiana	Mean	46.47	66.73	.09	52.08
	N	7	12	6	9
	Std. Deviation	13.51	11.46	.017	20.19
Missouri	Mean	64.27	74.17		
	N	17	7		
	Std. Deviation	22.51	18.19		
Ohio	Mean	64.91	69.27	.12	50.93
	N	8	5	7	5
	Std. Deviation	26.72	26.03	.05	2.59
Wisconsin	Mean	26.48	29.37	32.40	64.76
	N	224	101	251	104
	Std. Deviation	1.61	.38	13.43	9.64
Total	Mean	33.12	37.20	28.69	62.69
	N	284	128	287	120
	Std. Deviation	15.71	17.53	16.96	11.91

It is perhaps worth repeating that these scores are provided primarily for illustrative purposes since the data are of insufficient quality to warrant any conclusions about the financial or technical performance of these utilities. However, to demonstrate how this analysis would proceed with adequate data, we continue the exploration of the performance scores along both the financial and technical dimensions. Figure 10 shows a scatter plot of these scores. For illustrative purposes we show only the plot of the larger utilities along the two performance measures.

Figure 13: Plot of Technical and Financial Performance Scores



The shape of the data cloud shows that those utilities that perform well along one dimension do not do so along the other. Note that there are no data points in the "north-east" (top right hand) corner of the plot, suggesting that there are no utilities that score above 75 on both dimensions simultaneously. While some of this can be attributed to poor quality of the data, it is surprising that the top right hand quadrant of Figure 10 is devoid of any observations. Speculation regarding why this might be so would be premature in the absence of a proper understanding of what these data imply and how their measurements differ from one state to another.

Managerial Performance

The managerial performance data do not lend themselves to the creation of performance indices. We can, however, explore the effects of managerial characteristics on technical or financial performance. Once again, because of the paucity of the data, we can only show illustrative analysis. Interpretation of these analyses or drawing conclusions about the performance of these utilities based on these data would be premature.

Ideally one would like to be able to compare financial and technical performance in terms of indicators of managerial practice such as the existence of the budget / business plan, consumer confidence reports, or accurate financial statements. One aspect of management that seemed to be of considerable interest to the stakeholders who attended the workshop was whether ownership made a difference in performance. Ownership type, primarily whether the utility was investor owned or operated by a municipality was particular interest. The underlying hypothesis was that performance would be systematically linked to the nature of the ownership.

Table 10: Distribution of Ownership Type by State

	Ownership type				Total
	Conservancy District	IOU	Municipal	NFP	
Illinois	0	35	0	0	35
Indiana	1	10	11	9	31
Missouri	0	29	0	0	29
Ohio	0	21	0	0	21
Wisconsin	0	5	354	0	359
Total	1	100	365	9	475

Table 10 shows that except for Indiana, there is not much variability in terms of ownership of these utilities. The only other state where there is variability in ownership is Wisconsin, but of the 359 utilities in this data set, only five are investor owned. Continuing with this analysis, Table 11 shows the summary statistics for the performance scores by ownership type.

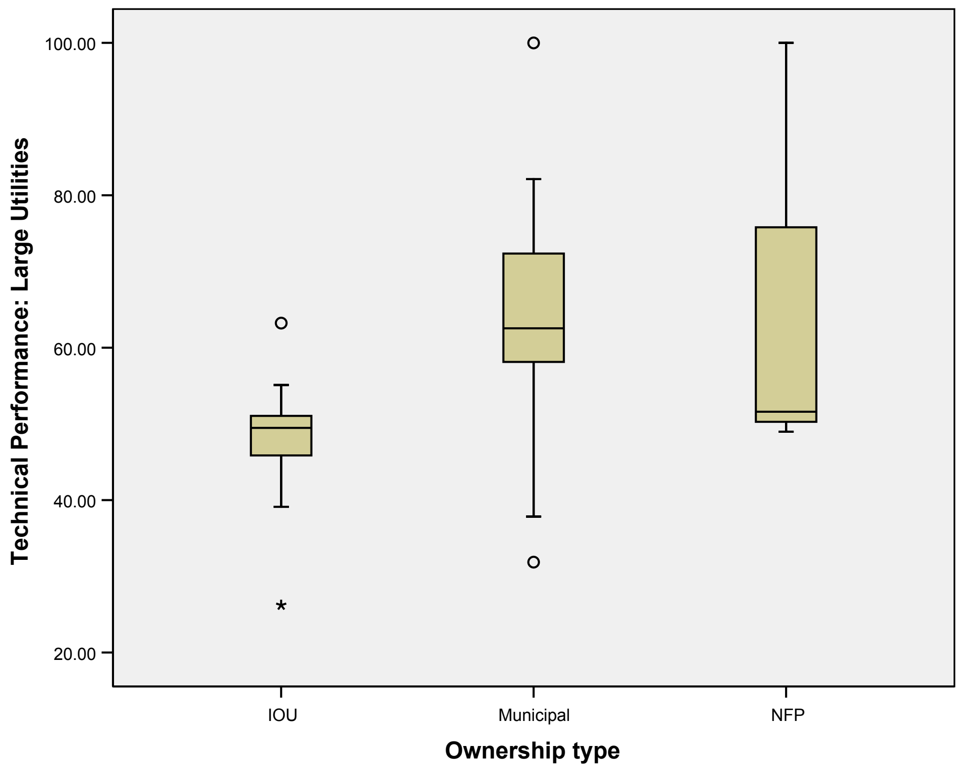
Table 11: Summary Statistics on Performance Scores by Ownership Type

Ownership type		Financial Performance: Small Utilities	Financial Performance: Large Utilities	Technical Performance: Small Utilities	Technical Performance: Large Utilities
Investor owned (IOU)	Mean	56.49	65.58	7.36	47.68
	N	62	17	39	9
	Std. Deviation	20.39	22.68	20.23	10.36
Municipal	Mean	26.48	31.44	32.18	63.83
	N	221	106	247	108
	Std. Deviation	1.62	9.89	13.54	10.66
Not-for-Profit (NFP)	Mean	51.29	62.66	.10	66.86
	N	1	5	1	3
	Std. Deviation	.	3.90	.	28.73
Total	Mean	33.12	37.20	28.69	62.69
	N	284	128	287	120
	Std. Deviation	15.71	17.53	16.96	11.91

These numbers in Table 11 are illustrative of the type of information that would be available for comparison across ownership types. A table such as this one in which the financial performance scores for investor owned utilities are approximately twice those of municipal utilities would be sufficient evidence to warrant additional exploration of the claim that ownership type does affect performance. However, the same table also suggests that the claim that one type of ownership is obviously superior is not clearly established. For instance, the distribution of the technical performance score shown in Figure 11 tells a different story.

In this instance however, such analyses would be potentially misleading on a number of counts. For example, the box plots do not represent comparable numbers of utilities and the majority of the utilities are municipal and most of them are in Wisconsin.

Figure 14: Comparison of Technical Performance Scores based on Ownership Type



Explanatory Factors

Similarly, factors such as regular monitoring of meters, whether the utility has fire protection or type of ownership were all identified as factors that could potentially account for the variations in performance. Unfortunately, as the tables in the appendix and above indicate, there is not sufficient explanatory power among these factors to provide actionable recommendations.

BEST PRACTICES

The purpose of this analysis is to develop performance measures and to obtain benchmarks that could be used to help utilities identify best practices and potentially emulate them in the hope of improving individual and overall performance. The first task in monitoring performance entails data collection. The mere fact that data are being collected raises awareness of the different aspects of the operation regarding which the information is being obtained.

The workshop we held in Columbus brought together various stakeholder groups in an effort to agree upon performance indicators for water utilities. Getting together regulators, industry representatives, consumer representatives and researchers to discuss how one might go about monitoring and improving the industry performance is a non-trivial task. Data collection, particularly one that focuses on performance can be perceived as a threat to the autonomy of the operator and is generally viewed with suspicion. Hence, we see that workshop as an important initial step towards developing a culture of assessment and reflection on industry and individual practices.

The proposed indicators for which data were collected were a compromise between what is desirable for the purposes of a meaningful performance audit and feasibility in terms of data availability and the potential burden on state commission staff. We learned from this workshop that there is general agreement on a number of indicators, particularly financial and technical measures.

Although rate base is a commonly used indicator for studying utilities, its use in this context seems problematic. A small or negative net rate base is among the challenges many small systems face. Perhaps a simpler measure based on expenditures and revenues might be more indicative of the financial state of the company. State commissions sometimes employ such measures or operating ratios when the small size of the rate base makes it ineffective as a basis for determining a utility's revenue requirement. However, although revenues and expenditures seem to be simple and commonly used concepts, their measurement is not straight forward. What should and should not be included in computing expenditures is not always obvious. And although state commissions usually rely on NARUC's Uniform System of Accounts, they may or may not rely on the most recent version. When the service is not metered, the link between revenues and level of consumption and, therefore, service level is not direct. The number of connections is another measure of the size of the operation, but that does not always provide a good sense of service volume.

Similarly, the use of the amount of water lost as an indicator of technical performance is not straightforward. The definition of water loss and the manner in which it is calculated varies across states. Commission prescribed target levels of unaccounted-for water also vary. Agreement on how it is to be measured might be a useful step in developing comparable measures.

While definitional and computational issues can be resolved in the development of financial and technical indicators, there seem to be few measures of managerial performance that can be used to develop numerical indices. Most of the information we gathered to obtain a sense of managerial performance focused on whether the utility followed various practices or maintained different types of documentation that might suggest or be a reasonably proxy for good managerial oversight. For instance, we gathered information on whether the utilities had a business plan and maintained a budget. While these are a good start towards monitoring good managerial practices, they do not lend themselves to analytical measures of utility performance. Of course as state commission economic and environmental regulators will readily confirm, some small utilities lack even these basic business tools and practices. It appears intuitive that many could improve their performance to at least some extent simply by treating the operation like a business.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

There are a number of hopeful signs regarding the performance of water utilities that have come out of this project. The first is that it is possible to bring together multiple stakeholders from divergent and sometimes adversarial perspectives to a discussion of performance indicators and to have them agree on what might be a start on developing a uniform data set that could serve as the basis for monitoring and ultimately improving the performance of water utilities.

We have also learned an important lesson, which unfortunately is not new. That is, data collection is an onerous activity that requires substantial amounts of time dedicated solely to that activity. As we discovered from this exercise, data, even those that are regularly collected by utility commissions and the EPA, are not always easy to come by. Even when they exist, their formats vary as does their quality and accessibility. Many of these water utilities are small. They are operated by a small staff, often family members who operate not only the physical plant but also have multiple responsibilities associated with operating a vital utility. Hence, until performance monitoring and reporting can be shown to be of benefit to the utilities, it is going to be difficult to obtain reliable information on a timely basis.

There is also another factor or organizational constraint deserving illumination. Whether a special project concerns small systems benchmarking and associated data collection or some other out-of-the ordinary activity, it is not, by definition, the basic, essential kind of activity that state utilities commissions are required – by law – to accomplish. The very detailed analyses and review of costs and revenue required in rate increase cases along with other mandated administrative processes, hearings and proceedings consume available time. As a California regulatory practitioner recently said, "What is not considered is the opportunity cost. The granular focus on individual cost items in the GRC (general rate case) often overwhelms other issues."[29]

[29] Kevin P. Coughlin, [2006] *Water Regulation: Reforming the Back-Water of Regulation*

However, the progress we have made in bringing together different stakeholders suggests that although there is tremendous variety across the states and within each state, it is possible to develop indicators of water utility performance along the lines envisioned in the capacity planning and development framework forwarded in the reauthorized Safe Drinking Water Act. In bringing multiple stakeholders to a common table to discuss water utility performance we have begun to operationalize the conceptual framework depicted in Figure 1.

In particular, in this project we have laid the foundation for developing a set of performance indicators based on financial, technical and managerial aspects of the utility's activities. While these indicators do not capture the complete set of activities they do capture important aspects of the utility's performance. They are however, are a compromise between conceptual necessity and practical feasibility.

We knew at the outset that the quality of the results we would obtain would depend crucially on the quality of the data. Through the stakeholder workshop and subsequent discussion we organized a data collection process that would impose as little hardship as possible for such an effort. And the stakeholder group endeavored to select indicators that "fit" the operational realities of small systems. However, data availability and accessibility became an issue. The data quality is uneven. Except for Wisconsin, the states seem to collect limited information on a regular basis.

The financial score is the most robust. However, there remains some ambiguity regarding what are the best measures of financial health of these utilities. Unlike the large electric and gas utilities, where the rate base is a reliable measure of the utility's income, in the case of small water utilities it is not as robust a measure. Operating costs, revenues and expenditures provide valuable insights into financial viability and welfare, but they too vary in definition and can be problematic indicators of financial well being.

The technical and financial indexes we have proposed in this analysis are robust measures, provided reliable data exist and are available. As our measures indicate, there is clearly substantial variation in the performance, both technical and financial, across the utilities.

In spite of the fact that the Wisconsin data were the most comprehensive, their financial information is suspect. Our analysis suggests that utilities that perform well on the financial index do not appear to do as well on the technical aspects of the utility's performance. If that result is not an artifact of the data then it is worth further scrutiny.

An effort to explain financial and technical performance in terms of managerial and explanatory factors would be premature. There is not sufficient data on these factors to warrant reliable conclusions. Where we do have sufficient data, for example, regarding whether or not a utility is metered, there does not appear to be much variety across the utilities that could account for variations in performance. This may be noteworthy as it hints that the collective lens through which our stakeholders view small water utilities may be clouded or overly influenced by outliers. In fact, only a scant few systems in our study are not metered. Perhaps the enduring sad rhetoric surrounding small systems and the "horror" stories shared among water professionals about some very troubled small systems have led to an overall opinion that is – or is becoming - out-of-date. That is, capacity provisions in the SDWA Amendments of 1996 may have worked sufficiently well so far that most systems that were not metered have taken this essential basic step toward better service in the last ten years. Similarly, the requirement that utilities become more visible to their customers in the form of an annual water quality report may have caused even the smallest, most neglected systems to put basic tools in place, such as a working phone number where customers can reach them.

Those wishing to employ the stakeholder process modeled in this project may wish to identify first and second choice indicators for each performance area. If the first indicator – or set of indicators -- selected to assess technical performance proves to be of limited use due to a lack of variability or lack of data, the project team can try the already identified alternative indicators. It may also suggest that a larger number of indicators, proxies and explanatory factors be used whenever data are available and resources will permit.

That said, we were unable to arrive at definitive conclusions about the performance of these utilities at this time because of data paucity and quality.

This project has identified the actual data elements that informed stakeholders determined would constitute a thorough assessment of water utility performance. We have laid out a process, shown how the analysis might be done and hinted at some of the results that can be obtained. However, a major data collection effort has to be undertaken if we are to make such analyses credible and trustworthy enough for people to take them seriously enough to acknowledge that we have identified best practices that are worth emulating. As one of our experts suggests, "…to get to the promise land of consistent data would require either some federal agency to mandate utilities to report a defined set of data or some multi-state agreement that required utilities to report a defined set of data."[30]

For state commissions and other stakeholders to actively engage in benchmarking efforts overtime, legally mandated regulatory processes may need to be adjusted or organizational priorities reconsidered to allow and facilitate the dedication of time and resources to alternative regulatory approaches. Statutory or administrative changes may also be needed for the results of performance benchmarking evaluations to be made public and officially considered in regulatory decisions.

[30] Bruce Schmidt, Wisconsin PSC, e-mail communication, July 2006

APPENDIX A

Table A1: Working Phone Number

Has Working Phone Number	State					Total
	Illinois	Indiana	Missouri	Ohio	Wisconsin	
No data	0	10	0	0	0	10
No	0	1	0	0	0	1
Yes	35	20	29	21	359	464
Total	35	31	29	21	359	475

Table A2: Liability Insurance

Has Liability Insurance	State					Total
	Illinois	Indiana	Missouri	Ohio	Wisconsin	
No data	31	13	0	21	359	424
No	0	0	11	0	0	11
Yes	4	18	18	0	0	40
Total	35	31	29	21	359	475

Table A3: Accurate Financial Statements

Financial Statements are Accurate	State					Total
	Illinois	Indiana	Missouri	Ohio	Wisconsin	
No data	0	10	0	0	0	10
No	0	3	3	0	0	6
Not Verified	35	0	0	0	0	35
Yes	0	18	26	21	359	424
Total	35	31	29	21	359	475

Table A4: Existence of Current Consumer Confidence Report

Existence of Current Consumer Confidence Report	State					Total
	Illinois	Indiana	Missouri	Ohio	Wisconsin	
No data	0	10	0	9	0	19
No	1	0	2	0	0	3
Yes	34	18	27	12	359	450
Yes - but poor	0	3	0	0	0	3
Total	35	31	29	21	359	475

Table A5: Utility Has Liability Insurance

Has Liability Insurance	State					Total
	Illinois	Indiana	Missouri	Ohio	Wisconsin	
No data	31	13	0	21	359	424
No	0	0	11	0	0	11
Yes	4	18	18	0	0	40
Total	35	31	29	21	359	475