# Utility Service Quality—Telecommunications, Electricity, Water

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(March 2004)

**Abstract:** This survey of quality-of-service issues raised by regulation identifies twelve steps for promoting efficient sector performance. First, regulators must identify objectives and prioritize them. Inter-agency coordination is often required to establish targets. Regulators must also determine a process for selecting measures and an appropriate method for evaluating them. Finally, performance incentives must be established and outcomes periodically reviewed. Telecommunications, electricity, and water all have multiple dimensions of quality that warrant careful attention.
**Author Keywords:** quality, regulation, incentives

**Acknowledgment:** I appreciate the careful review of an earlier version of this paper and suggestions by Drs. Sanford Berg and David Sappington, Department of Economics, the University of Florida. Any mistakes and omissions should not be attributed to them.

## 1. Reasons for Quality-of-Service Regulation

In this paper, I examine the incentive mechanisms increasingly used by utility regulators to encourage telecommunications, electricity, and water companies to improve the quality of their services to customers. Specifically, regulators face the challenge of ensuring that service quality for core services does not deteriorate as companies under their jurisdiction transition from rate of return to price cap regulation and experience increasing competition for some of their non-core services.

Traditional price regulation is changing to allow utilities greater flexibility in making investments in operations and infrastructure. Without appropriate quality regulation, price regulation (rate of return, price cap, or variants) may give companies unintended and distorted incentives for infrastructure investments and service delivery. For example, a company may oversupply quality if rate-of-return regulation encourages excessive capital investments to improve service quality. Because rate-of-return regulation affects quality, the level of quality customers receive for services may be more than they are willing to pay (Baldwin and Cave, 1999). In other situations, companies may have a perverse incentive to reduce investments and outlays that promote higher service quality. For example, a company subject to price cap regulation may compromise its service quality by reducing costs to increase profits, particularly if its services are not subject to much competition (Baldwin and Cave, 1999).

### 1.1. Definition of service quality

A utility company's quality of service applies to the delivery of services to the end user. "Delivery" in this context includes activities preceding and following service delivery and the network components (hardware and software) through which those services (telephone signals, water, and voltage) are provided. Certain services are common to all three utility industries (telecommunications, electricity, and water), and the quality concerns are likewise similar, notably in regard to customer and technical services (e.g., timely installations or connections, prompt responses to customer

complaints, efficient billing practices, safeguarding of customer accounts, accuracy of customer information, and network reliability). Other concerns about non-price performance are industry-specific.

### 1.2. Twelve regulatory steps

A goal of regulation is to have service quality properly aligned with customer rates. Establishing a quality-of-service framework is a formidable task for regulators who try to integrate quality into incentive systems. Regulators should:

- Determine appropriate regulatory objectives,
- Balance those objectives to determine regulatory priorities,
- Coordinate oversight responsibilities for quality-of-service and quality-of-commodity programs,
- Define the appropriate quality standards desirable for each service,
- Develop quality-of-service measures,
- Identify a process for developing those measures,
- Select the number of measures for the framework,
- Select the types of measures for the framework,
- Evaluate the measures,
- Understand the biases in and contexts for the measures,
- Determine the appropriate incentives for incorporating those measures,
- Determine the most effective process for monitoring and reviewing the framework.

## 2. Quality-of-Service Measures

The development of meaningful measures is the foundation for all quality-of-service frameworks. However, there are certain preconditions for establishing measures. Regulators should determine their objectives, including the quality level required, in the context of competing objectives. Because collecting and processing information is a complicated undertaking that requires extensive planning, regulators must also consider the coordination needed to develop the parameters and incentives as well as the best means of obtaining information.

### 2.1. Determining regulatory objectives

The design of parameters and incentives depends on the regulatory objectives, which may include establishing conditions for increased competition, improving service reliability, and making companies more responsive to customer complaints. Other concerns might be energy conservation and employee safety.

### 2.2. Balancing regulatory objectives

Regulatory mechanisms can encourage utilities to provide too much quality (rate-of-return regulation) or too little (price-cap regulation) in relation to customers' assessed needs. Furthermore, mandates for utility efficiency (measured in terms of cost per unit), universal service obligations, and competitive access also may affect and even conflict with a regulator's quality-of-service objectives. In addition, regulators must weigh any externally imposed objectives, such as environmental standards, that potentially drive up costs and affect quality. For example, in England and Wales, water companies must invest in a wide range of capital improvements to meet standards of the European Union regarding levels of lead in drinking water and treatment of wastewater to be returned to the environment.

### 2.3. Coordinating oversight responsibilities

When responsibility for quality-of-service regulation is shared by different regulatory agencies, coordination of oversight is necessary. Performance standards and customer complaints may be managed by agencies other than the utility regulator. For example, in Victoria, Australia, the Regulator General monitors the quality and supply of electricity while safety is regulated by the Chief Electrical Inspector. The Australian Competition and Consumer Commission

regulates prices for telecommunications services, but quality and technical standards are regulated by the Australian Communications Authority (Arblaster, 1999).

The regulator may consult with other agencies to assess the likely costs of a quality improvement program. For example, environmental standards, which affect service costs as well as service quality, may influence the prices set by utility regulators. Ofwat (the UK water regulator) works with the utility companies, the Department of the Environment, Transport and the Regions, and four other regulators concerned with drinking water quality and the environment to identify changes needed to companies' assets to meet quality improvement obligations (Ofwat, 2002b).

### 2.4. Defining appropriate quality levels

Before developing policies to promote service quality, regulators need to decide on the desired quality level for each service under consideration. To that end, regulators must weigh competing objectives, such as expanding basic service to geographic areas to meet universal service objectives versus improving services to customers already served. Therefore, the optimal level becomes a political decision since customers already served may resist both lower service quality and increased cost for existing quality to accommodate an expanding customer base.

The general concept of "optimal" quality of service is aptly captured by Baldwin and Cave (1999, p. 253):

> As quality increases it becomes more expensive to raise it further; hence the marginal cost of quality improvement rises as quality rises. In contrast, as quality rises, the extra benefit consumers get from a further increase in quality declines. These two factors determine an optimal level of quality, where marginal benefit (to the customer) and marginal cost (to the utility company) are equal.

Not all providers will incur the same marginal costs in improving quality. Companies in urban and rural areas will have different marginal costs for service quality. Typically, it costs more to provide the same degree of service quality to rural customers than to urban customers, even if both sets of customers have identical preferences and marginal willingness to pay (Meyrick and Associates, 2002).

With that observation, we begin to appreciate that the "optimal quality" for any given service is difficult to determine. Moreover, any quality standard is subject to change over time as customer needs and expectations change and as technological improvements change companies' costs in providing different levels of quality. Thus, regulators tend to establish optimal quality standards as a departure point for a specified period of years, recognizing that standards may need to be adjusted to accommodate new conditions.

As an alternative to a uniform quality standard, regulators might authorize companies to provide substandard quality service under specified conditions without penalty (Baker and Tremolet, 2000). This approach may be attractive if it furthers a particular regulatory goal, such as greater access to piped water service for low-income households. If overall benefits outweigh costs to both companies and customers, regulators might allow companies to offer differentiated levels of service quality that customers select according to their preferences. When quality differentiation for low-income households is permitted, the conditions for lower quality should be objectively identified in contracts whose provisions are enforced. At the other end of the demand spectrum, large industrial customers might be willing to pay for reliability that exceeds specified quality-of-service standards, and a utility might need to provide those customers with redundant systems. For example, electricity distribution companies might have to install switching devices that enable customers, at a higher cost, to switch between feeders at high voltage to avert power failures (Meyrick and Associates, 2002). In that case, companies and their customers could negotiate higher quality standards (excluded services) that are not subject to price control provisions.

Quality-of-service standards are expressed in terms of performance measures related to percentage of work to be done or persons to be assisted within a specified time period. For example, for telephone companies, such a standard could require that repairs be made within eight hours for 95 percent of reported faults. For electricity companies, a

requirement might be that service be restored following an outage for at least 80 percent of customers within three hours. For water companies, 95 percent of all meters might be required to be read over a two-year period (to limit estimated usage). To develop appropriate measures and standards, regulators generally try to get information from at least two sources – utility companies and their customers.

### 2.5. Obtaining information from utilities

Regulators rely on data furnished by utility companies to develop appropriate mechanisms for regulating quality of service. However, regulators may lack explicit legislative authority to easily access information about service quality from companies. Moreover, the contested nature of much of the regulatory process, at least in some countries, could prevent regulators from obtaining company information. In some cases, company managers may have only a limited understanding of the relationships between quality levels, costs, and prices (Small, 1999). Under price-cap regulation (some form of which is often used in conjunction with quality-of-service regulation), company managers also may have little incentive to disclose their investments for improving quality. Because price cap plans tend to span multiple years, companies may decide to provide substandard service and defer capital improvements until immediately before the next price review. Finally, compliance with quality-of-service requirements imposes costs on companies for data collection and analysis and increases exposure of their service strategies to potential competitors, consumer activists, and politicians.

### 2.6. Obtaining information from customers

To establish optimal quality standards, regulators attempt to gauge the value customers place on quality-of-service improvements, often expressed in terms of their marginal willingness to pay for those improvements. However, regulators may encounter problems in obtaining reliable information from customers and in quantifying their preferences. Customers' willingness to pay may be affected by changing technologies because increased automation in utility operations may lower their tolerance of substandard performance. For example, customers making telephone calls are now used to instant connections; therefore, they may be unwilling to tolerate telephone service relayed by satellite because of the inevitable delay in signal transmission. Customers' priorities also may change. With increased affluence, they may be willing to pay for greater service reliability, but that willingness may diminish as reliability improves.

One way regulators can determine consumer benefit is to survey customers regarding their willingness to pay for higher quality of service or their willingness to accept reduced service quality at a lower price. However, customers' responses to surveys on valuations of changes in service quality may provide unreliable, incomplete, and inaccurate information for at least three reasons. First, customers lack the necessary technical expertise to evaluate quality dimensions. And, given the monopolistic nature of many utility services, they may not have been exposed to different quality options or have needed to choose among competing services (Berg and Lynch, 1992). Second, the company will always have more information about service quality than either the regulator or the customer. These circumstances can cause customers' attitudes to be inappropriately influenced by the company's selective presentation of information, absent regulatory intervention. Third, customers will have an incentive to understate their true preferences if they believe they might have to pay for service quality improvements that, in their view, will be made anyway. Conversely, they will have an incentive to overstate their true preferences if they believe that they will only have to pay for a marginal increase in costs associated with improvements. Under the latter scenario, customers would essentially "free ride" on the increased cost passed on to other customers.

### 2.7. Developing quality-of-service measures

Regulators often lack adequate information from utility companies and customers to determine the desired level of quality standards with precision, and they may not have access to detailed information about past company performance in providing services or the potential for service improvement over time (Davis, 2000). However, regulators recognize that companies are unlikely to make investments in a manner that approaches the targeted quality level absent a formal system of incentives, performance expectations, and customer feedback. A two-pronged approach is often used to resolve this dilemma, essentially by providing incentives for companies to align their investment strategies for capital improvements and internal operations more closely with customer preferences.

Regulators might first identify a set of targets for various dimensions of a company's performance. The identification process could involve many parties, including the affected companies and their customers. Regulators would then require companies to file data that enable regulators to measure performance, and data collection requirements should correspond to regulatory objectives. For example, if regulators receive customer complaints primarily on network congestion of the telephone system, excessive electric power interruptions, and sewerage leakages, they may require collection of data that address these industry-specific concerns while ignoring services whose quality is satisfactory and unlikely to improve. For example, in many developed countries, electronic switching in telecommunications has reduced dial tone delay to almost zero, eliminating any need to monitor dial tone delay (Bureau of Transport and Communications Economics 1992, p 63).

Second, regulators might provide customers with information that makes them aware of their company's performance. Such information affects customers' perceptions and expectations of service quality and, in turn, companies' responsiveness to those expectations. Ultimately, measurable responses from both companies (in terms of performance outcomes) and customers (in terms of performance evaluations) affect the determination of targeted quality levels that regulators will revisit periodically. Information on companies' performance that regulators relay to customers, like formal targets that regulators set for companies, is based on a well-conceived set of quality-of-service measures. Regulators may modify measures following informal exchanges among affected parties or as part of a formal procedure that links price regulation to quality-of-service improvements. In the discussion below, I focus on the scenario of a formal procedure.

Measuring quality of service is complicated by the multi-dimensional nature of quality attributes, which means that, depending on their specific needs and expectations, customers perceive certain attributes to be of greater value than others. For example, service reliability is likely to be valued more than the availability of payment options. Even so, all quality dimensions included in quality-of-service frameworks should be important to consumers, controllable by companies, and measurable by regulators (Council of European Energy Regulation, 2001).

Surveys of customer preferences and willingness to pay can help regulators determine the measures that matter most to customers, but measures selected should relate to services the company can directly affect. To the extent possible, regulators should focus on outputs that can be measured, such as response time to complaints or restoration of service within a specified period of time, rather than on inputs, such as technical solutions and company investment plans. Finally, measures should assess the distribution of service quality to ensure that a customer segment does not experience quality deterioration even as the average customer receives improved service (Meyrick and Associates, 2002).

### 2.8. Identifying a process for developing measures

The process for determining appropriate measures is frequently extensive and time-consuming. It often requires the formation of working groups consisting of regulators, affected utility companies, and consumer representatives. It also involves establishing a procedure for collecting information, modifying the measures, and reporting the measures. For example, the International Water Association recently published a collection of performance indicators that were subject to review and comment from interested parties in some 50 countries and that entailed active participation of a task force established in 1997. Another cooperative effort is the Council of European Energy Regulators Working Group on Quality of Electricity Supply formed January 2000. This working group prepared a benchmarking study that described and compared the indicators and standards used for assessing quality of electricity service. Participating countries included Italy, the Netherlands, Norway, Portugal, Spain, and the United Kingdom. A similar effort was undertaken by the Steering Committee on National Regulatory Reporting Requirements established by the Australian Utility Regulators' Forum. That Committee successfully gained consensus on the development of an electricity service quality reporting framework for distribution and retail services to be used in the six Australian states and two territories. This framework now forms the basis for performance reports by distribution and retail businesses to all Australian electricity regulators. For telecommunications, the European Commission (among other entities) has issued various reports on quality-of-service.

### 2.9. Selecting the number of measures

At least three factors govern the number of measures to be selected for quality-of-service regulation: They should matter to customers, be responsive to predetermined regulatory needs and concerns, and adequately reflect the conditions of a company's specific service area (customer population, topography, and other characteristics). Regulators' capacity to use performance measures effectively in the hearing process is reduced if there are too many measures to consider. Therefore, a smaller number may be preferable (Berg and Lynch, 1992). However, the number of measures should be able to encompass diverse conditions in a company's service areas. A limited number of measures for assessing service quality in fairly homogeneous, densely populated service areas (e.g., urban areas in the United States) may prove insufficient for large sparsely populated areas with very diverse conditions (e.g., rural Australia; see Meyrick and Associates, 2002). As a guideline, the appropriate number of indicators should be determined by the quality of data available for measurement. Because quality is more important than quantity, it may be prudent to start with fewer indicators and add to them as reliable data become available. Six to eight service quality measures might be a good objective for a mature framework, including measures to capture service reliability and responsiveness to customer complaints and inquiries.

### 2.10. Selecting the types of measure

If measures are not appropriate for increasingly competitive markets, companies will have little incentive to improve service quality. However, measures selected to realize regulatory objectives like competition may compete or perhaps even conflict with measures selected to promote a quality dimension like service reliability, which customers and regulators both value. For example, many regulatory commissions in the United States require vertically integrated electric utilities to comply with the customer average interruption duration index (CAIDI) or the customer average interruption frequency index (CAIFI), or both.1 Yet Ilic et al. (2001) note that these measures may not be optimal in a restructuring market; they are often implemented by reliance on deficient system-wide standards for the loss of load probability rather than by investment in technologies that ensure reliable power supply for individual customers.

### 2.11. Evaluating measures

Because technologies change rapidly, regulators need an ongoing process to evaluate the relevance of measures. For example, a recent quality-of-service report by Ofwat (2002a) states that the current measure of time taken to answer customer calls (within 30 seconds) presents problems, since the routing instructions for automated voice systems can exceed the mandated response time. Some companies exclude the time needed to negotiate automated response systems while others classify calls transferred by switchboards as having been answered even though the customer may not have had the opportunity to speak with a company representative. Because of data inconsistencies, Ofwat has decided to explore alternative measures.

### 2.12. Understanding biases in and contexts for measures

Inadvertent biases in the definitions selected for quality-of-service measures create inequities. For example, the Federal Communications Commission (FCC) includes several definitions for outages - average number of line-minutes per event, outages per thousand access lines, and number of outages per switch - since a company with a large number of smaller or remote switches with lower line counts would reap a comparative advantage from outages measuring the average number of lines per event. Alternatively, a company with larger switches benefits from measurement of average outage duration. Therefore, the FCC opted for multiple definitions of outage performance to neutralize any potential reporting biases (Kraushaar, 2001).

Context is also important, and regulators should not adopt measures from other countries automatically since a country's stage of infrastructure development should be reflected in its selection of measures (Tata Energy Research Institute, 2000). For example, telephone density and other development indicators are used in India, where infrastructure development has lagged and is a concern, but might not be appropriate quality-of-service measures in the United Kingdom, where indicators for keeping appointments, not used in India, would be more relevant.

## 3. Incorporating Measures into Incentives

Given imperfect and often deficient information from utility companies and customers, regulators are challenged to develop incentives schemes to improve quality of service, especially during periods between price control reviews. These intervals can last five or more years without significant rate adjustment, and companies may be inclined to enhance earnings by reducing operating costs and capital investments and thus service quality.

To discourage that behavior, regulators may simply publish a set of quality measures provided by the company, with no targets or specified parameters set for those measures. However, such reports (or yardstick comparisons) do not provide strong incentives, may have no direct connection to the most efficient means of providing quality, and may exclude relevant factors affecting a company's performance (Oodan et al., 1997). Regulatory tools linked to targeted quality levels include minimum standards and performance-based standards.

With respect to minimum standards, regulators may use some sort of benchmarking system to monitor compliance and impose penalties or sanctions for noncompliance. With respect to performance-based standards, regulators can link price or revenue cap adjustments to performance standards and benchmarking efforts to provide incentives for quality improvement and disincentives for deterioration of quality and reliability.

### 3.1. Minimum service standards

Quality of service applies to technical, commercial, and commodity standards. Utility regulators generally have more direct oversight with respect to technical and commercial standards. Technical standards apply to reliability issues, such as the number and duration of service interruptions. Commercial standards apply to the direct transactions between the company and the end user. Such standards are expressed in terms of measures and represent the minimum performance level that regulators expect from companies. These standards may be authorized through regulatory agency orders, licensing provisions, or legislation. Minimum standards should be set at appropriate levels before monitoring and enforcement occurs.

As noted, regulators may enforce company compliance with standards through both non-financial tools (benchmarking reports) and financial sanctions. Regulatory requirements that companies file quality-of-service data at specified intervals may be sufficient. The regulator uses the raw data to develop benchmarks that communicate to the public the company's performance on selected services. Public scrutiny and external pressures generated from benchmarking requirements, coupled with the threat of penalties, license revocation, or price control, may prevent reduced service quality. Oversight of this sort is particularly important if there is a multi-year period between rate reviews.

Penalties can take the form of fines, compensation to customers, reduced earnings, and no retention of earnings, and they may vary according to the nature of the standards. For example, commercial standards can be classified as "overall" and "guaranteed." Overall standards cover service areas where individual guarantees to consumers may not be possible but where companies are expected to deliver predetermined levels of service. Such standards are usually defined in terms of a percentage of performance (e.g., new connections) to be achieved over a specified period of time. In contrast, guaranteed standards apply to individual service delivery and require compensation to customers in cases of noncompliance. The level of performance pertaining to guaranteed services is usually expressed in terms of response time (Council of European Energy Regulators, 2001).

Regulators have several options in applying sanctions: written warnings, monetary fines, and loss of concession. Monetary fines can be paid directly to customers or into a special fund with a clearly specified purpose.2 Performance bonds may be collected to prevent non-payment of fines. The level of the fine should reflect the disutility of quality shortfall and costs of attaining quality standards (Foster, 2002). Establishing the appropriate amount for a fine is important because companies may be willing to risk fines if the costs of improving a given service are much higher than the potential aggregate amount in penalties. Compensation could result from court action or from alternative councils for

dispute resolution. For addressing quality-of-service complaints, consumer councils or ombudsmen might be a less costly venue for small customers and companies.

With the minimum service approach, regulators generally impose penalties for company performance below a targeted level (pass/fail strategy) but do not reward superior performance, thus establishing an asymmetric incentive system and giving companies little incentive to surpass the established minimum benchmarks. Also, if standards are initially set to equate marginal costs and benefits, technological change in the industry can subsequently change this equilibrium and make it disadvantageous for companies to make investments and surpass the standards. As Berg and Lynch (1992) show, companies are unlikely to take the initiative unless they are rewarded for doing so.

Because minimum standards are not weighted to reflect the importance customers attach to each quality dimension, the asymmetric nature of the incentive scheme becomes further pronounced. For example, the Florida Public Service Commission determines target performance indicators for measures of telecommunications service in Florida. These benchmarks pertain to answer times, availability of service, repair service, safety adequate grounding, Intra-LATA timing and billing accuracy, and 9-1-1 Emergency Service. A company's performance is compared to the thresholds for each measure, and performance that falls short for each quality dimension is penalized. This pass/fail approach encourages the commission to focus on a company's areas of poor performance instead of on its overall performance. Because companies have substandard performance on different quality dimensions, inter-company comparisons will be inconsistent unless explicit weights (reflecting priorities) are assigned to the measures (Berg and Lynch, 1992).

### 3.2. Benchmark reports of quality performance

Regulators often monitor performance by requiring utility companies to submit data expressed in agreed-upon measures on specified quality dimensions, then use inter-company comparisons to test for compliance with standards and reward or punish companies for good or poor quality service, respectively. Such reporting may take the form of comparing the same quality dimensions for several utility companies or comparing a company's performance against company-specific baselines (known as the "yardstick" approach). With the yardstick approach, baselines could relate to the company's historical performance or to a hypothetical yardstick (service quality attributes of "best practice" companies). Regardless of the design for reporting, regulators need information on a regular basis from companies that are using comparable measures.

Publication of comparative quantitative measures can encourage managers to strive for greater efficiency and quality in service delivery; indeed, it can simulate competition even when little or none exists (Foster, 2002). Pressure from public scrutiny of benchmarking reports motivates managers to address substandard company performance. However, if regulators lack express legislative authority to make benchmarking information public, the potential benefits of public scrutiny may not be realized.

Benchmarking and inter-company comparisons have met with some criticism, particularly when financial rewards are used to promote performance, since conditions beyond companies' control, such as weather, geography, customer composition, and access to technology, may skew comparisons. Williamson (2001) provides three reasons for avoiding such comparisons: (1) "low-cost, low-quality" providers may be offering superior value for money compared to other providers, and simple indicators may fail to account for customers' willingness to pay for a given level of quality, (2) statistical techniques are complex and cannot control for variations in quality performance, and 3) perverse incentives may be introduced and cause a company to surpass another's quality levels even though the costs of those quality improvements exceed benefits to the customer.

Another criticism of inter-company benchmarking is that it may cause customers to have unrealistic expectations about service quality improvements. Customers might not appreciate the differential costs for the same level of service reliability in rural and urban areas (Meyrick and Associates, 2002). Therefore, benchmarking should be used to promote customer awareness of comparative company performances and to alert regulators to further investigate

certain aspects of a company's performance when service quality is particularly costly or substandard. Benchmarking is generally most effective when combined with other regulatory measures or the threat of such measures.

### 3.3. Performance-based standards

Performance-based standards may be used with price- or revenue-cap mechanisms. Such designs include a set of targeted performance standards that trigger financial incentives for performance. These standards generally apply to reliability, customer satisfaction, customer service, and, in some cases, employee safety. Benchmarking is often a component of schemes to motivate companies to adopt "best practices." If the incentive scheme is carefully crafted, it will reward or penalize performance in a manner that makes companies and customers aware of the cost to them of improved or degraded quality. If the incentive design fails to reward better-performing companies, however, these companies may be inclined to lower their quality output.

Regulators have been slow to adopt integrated approaches to promote quality. NRRI's (2001) reliability survey for electric utility regulation reports that only seven of forty responding state commissions used penalties and rewards for meeting performance standards and only six state commissions included service quality as part of their performance-based or incentive rate-making mechanisms. (Also see Davis 2000, p. 15.)

In developing a performance-based standard scheme, regulators should: determine the intended use of the incentive scheme, specify incentive attributes, decide whether superior or inferior performance should be subject to rewards or penalties, decide how incentives should be triggered, and determine whether quality attributes are assessed most effectively on an individual basis or through an index that aggregates them. These steps are examined in more detail below.

**3.3.1. Purpose of incentive scheme.** In devising an incentive scheme, regulators should determine the purpose for the scheme and make changes as circumstances demand. The incentive scheme needs to be predictable because company investments are often long-term. Yet, regulators must be able to reassess their design and make needed adjustments because quality may deteriorate significantly in certain services or for certain customer classes. For example, the New York Public Service Commission decided to use benchmarking reports combined with guaranteed performance standards to analyze quality-of-service trends of the telephone company Verizon New York. Beginning in 1995, the commission set service performance thresholds for the company. Although specific indicators have been modified in recent revisions to the incentive plan, the concepts are essentially the same. The commission uses the report to analyze company performance trends over time. If performance deteriorates, the commission requires explanations and exacts corrective action for substandard performance. Moreover, the commission requires the company to pay customer rebates for failure to meet certain target levels. From September 2001 through February 2002, the company had to pay nearly $2 million in rebates for failure to meet 43 monthly targets for repair appointments and out-of-service complaints. Reports on Verizon's performance are disclosed on the commission website.

**2.2.2. Incentive attributes.** Regulators should determine a set of measures to be subject to benchmarking. The appropriate benchmark for such comparisons, at least initially, is often based on the utility company's recent performance. However, when recent performance continues to be the base line for quality improvement assessments, distortions can appear over time. For example, recent periods of good performance may be attributable to an unusual series of favorable conditions, such as the weather or other exogenous factors, yet cause regulators to set an unreasonable standard. One approach is to use the average of a specified number of years to correct for possible anomalies (Meyrick and Associates, 2002). Regulators then apply incentives for company performance that slips below or surpasses given benchmarked levels for the selected quantitative or qualitative measures.

One method of doing this is by using a price- or revenue-cap formula that incorporates a factor for quality: CPI-X+Q (or S), where CPI = Consumer Price Index, X= a productivity or efficiency factor, and Q or S = a quality factor. The Q (or S) factor could be determined through customer satisfaction indices or employee health and safety indicators (Council of European Energy Regulators, 2001). Price cap or revenue cap formulas with the Q (or S) factor allow

companies to increase rates or retain more revenue when quality surpasses a targeted benchmark level. If quality is substandard, the cap would be reduced, resulting in a revenue loss to the company.3

This scheme often provides for penalties to be assessed against a company if targeted performance standards are not met. For example, in Norway, a calculation is made annually for each electric company on the expected costs to customers for interruption in power supply (Langset, 2001).4 This calculation represents the optimal quality level against which actual interruption costs will be measured. At the end of each year, the regulator determines the difference between actual and expected interruption costs. If the quality of supply is better than expected, the difference is added to the company's revenue cap. If worse, it is subtracted from the cap. Companies can also enter into direct (guaranteed) compensation agreements with large customers consuming over 400 MWh per year if those customers' interrupted costs can be estimated.

Regulators may apply "dead-bands" to measures in the incentive scheme. A "dead-band" is a statistical deviation permitted for performance above or below the benchmark level at which the utility would neither be rewarded nor penalized. The intent is to reduce revenue variability if the utility's quality-of-service performance deviates from the benchmark to a specified (usually small) degree. Dead-bands also allow for regulators' limited knowledge about utility costs and customer preferences or valuations since information from utility companies and customers is often deficient. (See Meyrick and Associates (2002) for an analysis of the advantages and limitations of dead-bands.)

**3.1.3. Symmetric/asymmetric reward schemes.** The "asymmetric" reward scheme commonly used with minimum standards may also be used with performance-based standards, and often produces the same perverse results. In contrast, a "symmetric" incentive scheme has the Q or S factor of the price or revenue cap (or other form of penalty or reward) set to reward quality provided above the benchmark level and penalize failure to provide quality at the benchmark level. Although customers may view this reward scheme as requiring them to pay the company twice - both for the incentive and for the improvement costs (Office of the Regulator General, 2001) - symmetric reward schemes are generally considered the better approach. Because costs of quality may change over time, regulatory penalty schemes that lack rewards could provide companies with inadequate investment incentives. Moreover, a symmetric approach is less likely to reopen debates about the amount of revenues companies are allowed to lose or gain under the incentive scheme (Williamson, 2001). An example of the symmetric approach is the incentive scheme used in Victoria, Australia, for electric utility customers. The incentive rate was set at the estimated marginal cost for improved reliability but below the presumed value customers placed on improved reliability. Distribution companies are allowed to retain revenue "benefits" if they exceed the benchmark for a specified period of time, which is an incentive to improve service (Meyrick and Associates 2002).

**3.1.4. Indices of overall service quality.** Rewards and penalties may be applied to each measure used to assess a utility company's service quality or they may be applied to measures aggregated into an index of overall service quality. If incentives are applied to each measure, there may be greater transparency concerning a utility company's performance along each quality dimension, but regulators and customers may have more difficulty understanding the implications of a utility's overall performance.

Overall service quality indices enable regulators to measure a utility company's progress toward achieving specified quality-of-service goals and to compare its overall performance to that of similarly situated companies. If designed carefully, such indices may be simpler for regulators to use and customers to understand. Also, if designed carefully, such indices can include performance measures that are not inadvertently included in or combined with other measures. These indices provide the measures to be weighted (taking in account customer valuations). Then weights can be aggregated, with the total score subject to the regulator's threshold for performance reward or penalty.

The importance of deliberative design cannot be over-emphasized. An unstated objective can put a company at risk and result in inappropriate incentives. Therefore, all dimensions of quality covered by the index must be carefully defined. Moreover, companies and consumer advocates must perceive the weighting used for each measure as fair and

non-punitive; otherwise, they will oppose adoption of the index. As Berg (1995) observes, weights appropriate for residential customers may not be appropriate for commercial and industrial customers.

An example of a service quality index is the Overall Performance Assessment used by Ofwat to compare 23 water and water and sewerage companies. That index includes eight measures, one of which is not currently used for comparative purposes. Ofwat assigns a score falling in the range of good, acceptable, or needs improvement for five quality dimensions related to water supply and customer service. Two dimensions are used to compare a company's performance to the industry mean. The overall score is reflected in adjustments to the companies' price limits (+0.5 percent for the best performing companies to -1.0 percent for the worst.) Ofwat uses the index to determine where company performance is below an acceptable level or where performance has significantly deteriorated. If companies receive scores reflecting substandard performance, they must take corrective action. Poor performance captured in the overall performance index is also linked to penalties authorized under a guaranteed standard scheme.

Ofwat's service quality index, in conjunction with other regulatory tools, appears to provide utilities with incentives to improve performance, and the index has the virtue of using only eight indicators to assess quality of service. This makes it easier for regulators to focus on a few key factors and make modifications as needed to reflect changing technologies. It also helps utilities improve the reliability of their data-gathering procedures. As Berg and Lynch (1992) note, regulators may encounter problems with single-service quality indices if the standards are unweighted, the weights are not aggregated, or there are so many measurements that company performance becomes difficult to evaluate and compare. The Ofwat approach appears to address those concerns.

## 4. Monitoring and Reviewing the Quality-of-Service Framework

Effective regulation of service quality requires an iterative process that is predictable. Measures, incentives, and the actual process for reviewing performance are subject to change, but if changes occur too frequently, companies will be reluctant to make long-term investments in capital-intensive infrastructure. Although changes can occur between price reviews or rate hearings, countries like the United Kingdom and Australia formalize the procedure to maximize input from as many affected parties as possible. For example, Ofwat incorporates its quality-of-service regulation into its five-year price control regime. The timetable for setting new prices began in October 2002 and the new price limits are expected to take effect in April 2005. During that period, Ofwat's review will cover four phases and actively involve consumers, other ministries engaged in water quality regulation, and regulated companies. As put forth in Ofwat (2002b, p 4), Phase 1 involves consultation on Ofwat's approach to setting prices and on the information requirements of business plans. In Phase 2, companies submit a draft business plan, and then a final plan in Phase 3. Following all considerations regarding proposed price limits and water quality, implementation begins in Phase 4

Central to revising the quality-of-service framework is the process regulators adopt to gather input from consumers, utility companies, and other agencies. Regulators can open dockets or investigations and hold public hearings or roundtable discussions involving affected stakeholders. Alternatively, they can issue consultation papers that set out the main issues regulators want to cover in a quality-of-service review, soliciting opinions from affected parties on critical or controversial aspects and supplying research findings that inform their price-setting decisions.

In its review process, Ofwat uses a two-pronged approach with respect to consultations on customers' priorities for services and prices. The regulator, in conjunction with other ministries, agencies, and consumer representative groups in the United Kingdom and Wales, coordinated research efforts for the 2005-2010 price review. During the summer of 2002, they conducted focus group discussions and conducted a quantitative survey. Survey results were shared with companies to assist them in formulating their draft business plans. The consultation covered: customers' views and needs with respect to the water industry, how customers' views fit within a wider social and economic context, customers' priorities for improvements to the environment, water quality, and service, and customers' willingness to pay for program delivery. Companies can also conduct their own customer surveys provided these surveys meet certain criteria prescribed by Ofwat.

The Office of the Regulator-General (ORG) in Melbourne, Australia, used a similar process to review its quality-of-service framework. ORG outlined base-case levels of service quality for electric distribution companies for 2001-2005. These benchmarks represented the status quo of services delivered by each distribution company licensee from 1997 through 1999. In developing the benchmarks, ORG consulted with a working group established to consider quality issues. Companies were allowed to propose alternative benchmarks to the base-case benchmarks if they: specified the expenditure required to achieve the alternative targets, provided evidence that their proposal reflected the needs of most of their customers, and articulated clearly the potential trade-off between price and service quality. In deciding on appropriate benchmarks, ORG (2001, Appendix A) took into account views expressed by customers throughout the consultation process.

## 5. Concluding Observations

Development of quality-of-service frameworks requires that regulators implement a methodical process for determining regulatory objectives, coordinating with other oversight agencies involved in quality regulation, defining appropriate quality standards, and obtaining information from utility companies and their customers to establish those standards. Regulators can then develop quality-of-service measures and identify the most effective incentive plan for their initiatives. Minimum standards using pass-fail criteria are often used to assess a company's efforts in achieving quality-of-service targets. However, minimum standards are fairly crude methods of evaluating company performance because they fail to make distinctions for various levels of substandard and superior service. Regulators will more effectively align incentives with service improvements if they use performance-based regulation composed of benchmarking, a symmetric reward scheme, and price-cap or revenue-cap formulas that incorporate service quality. If designed properly, overall service quality indices may be the most effective way to compare similarly situated companies along a set of quality dimensions.

Quality has several dimensions and is valued differently by customer classes. For example, manufacturers are more likely to place a higher value on service reliability from an electric utility than are its residential customers. In addition, certain attributes of quality cannot be assessed objectively; therefore, quantitative measures cannot be applied to them. In developing appropriate benchmarks to compare companies' service quality, regulators need to determine which type of measure (quantitative or qualitative) will most aptly capture the service to be evaluated. In addition, regulators should appreciate that inter-company comparisons will be complicated by exogenous factors affecting companies' service areas, such as population density, topography, and weather.

The process for developing the quality-of-service framework is iterative in that measures and incentives are subject to ongoing scrutiny and revision. Prompting those revisions are technological changes, changes in customer demands and willingness to pay, and changes in the competitive nature of the regulated services. Like measures, incentives cannot be "cast in concrete." In developing countries, the regulatory objective of extending basic services to unconnected households must be balanced against improving service for households already connected. Regulators should consider the costs and benefits of both objectives. If benefits of service expansion outweigh costs, regulators might permit companies to provide differentiated services without penalty to connecting households in order to prevent quality degradation of services to already connected households.

Because quality-of-service frameworks are often linked in some manner to price reviews or investigations, regulators should begin to collect and verify quality measures early in the process. It is especially important for regulators to solicit suggestions from stakeholders throughout the process, particularly regarding the validity of the performance measures, given ongoing technological improvements. Because regulators will always have limited access to data on utility companies' core operations, the most effective way to offset that disadvantage is to invite diverse views. Thus, stakeholder participation is crucial to the development of an effective quality-of-service regime.

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**(Footnotes)**

1 See the State Public Service Commission Reliability Survey compiled by the National Regulatory Research Institute in February 2001.

2 As an alternative to monetary fines, regulators could require utility companies to make infrastructure investments in specified areas. For example, the New Mexico Public Regulation Commission issued an order in March 2001 that required the telecommunications company Qwest to invest $788 million over a five-year period to improve its network and deploy advanced services following the company's failure to meet previously mandated quality-of-service standards.

3 See Davis (2000) for a thoughtful overview of how price caps and revenue caps operate and the associated advantages and disadvantages of caps. Also see Sappington and Weisman (1996) for a good explanation of the factors that regulators might consider in establishing benchmarks.

4 The regulator makes these calculations as part of an incentive plan to encourage electric utilities to move toward a socioeconomic optimum. This optimum can actually allow a company to decrease quality but only if its internal costs decrease more than the interruption costs to customers increase. Estimates of the amount of energy that would have been supplied to customers if the interruption had not occurred (energy not supplied) and average specific costs for each customer category determine interruption costs. A regression model is used to calculate the expected level of unsupplied energy for each company and, in turn, the expected interruption costs. The methodology is explained in Langset (2001).