6

Service Quality

ROWLAND L. CURRY
JONATHAN M. KRAUSHAAR
ROBERT M. GRYB
JOHN R. AKE
THOMAS E. BUZAS,
STANFORD V. BERG,
AND JOHN G. LYNCH, JR.
LAWRENCE P. COLE

Rowland L. Curry

The divestiture of the telephone operating companies from the AT&T system had the potential to disrupt voice and data communications throughout the nation and significantly affect service quality. The industry began the implementation of equal access for all interexchange carriers in accordance with the Court's orders. Moreover, at the same time, the telephone companies were having to adapt to changes in equipment operations caused by the 1983 deregulation of CPE. The transition produced customer confusion and limited discontinuities in the operations of the system, but the network remained intact. In many instances, AT&T and the BOCs had to sort out deeply entangled facili-

ties; the companies even used tape on switching office floors to designate ownership and operating responsibility. It is a significant tribute to American planning and technology that the divestiture was accomplished with as few snags as actually occurred.

A characteristic of telephone service quality analysis is that success is measured in terms of the lack of attention paid to the quality of the service offered. There are exceptions, for example, when a customer notices the clarity of a transcontinental circuit or an exceptionally efficient installation. However, in today's technological society, we have grown to expect good performance, and poor performance has become the memorable exception. A "regulatory" perspective sometimes fails to give credit where it is due; the telephone companies in the United States created a reliable and advanced technical communications system through a century of hard work and dedication to the provision of good service.

An effective service quality evaluation process must consist of standards, measurement, and analysis. A standard can be defined as something established by authority as a rule for the measure of quantity, weight, extent, value, or quality. Standards set the criteria for judgment; measurement produces the data; and analysis uses these data to provide a judgment on whether the criteria were met. These three sequential elements must exist in a tight correspondence, and must be used in carefully controlled and monitored applications. Loose or weakly specified standards cannot produce reliable performance judgments, no matter how good the data and analysis. Without standards, the evaluator has no benchmarks or criteria with which to compare actual results. Accurate and consistent measurement is essential to ascertain the current status of any activity. And, to evaluate a program effectively, the evaluator must conduct feedback analysis of the measurement compared to the standard, in order to determine whether change should take place.

Regulators attempting to evaluate the quality of telephone service following the divestiture appear to be faced with a shortage of uniform nationwide standards, inconsistent measurements, and very little analysis. The fact is, however, there has been continual and extensive evaluation by utility analysts at the micro level, consisting of the level of engineering, installation, and maintenance of switches and facilities. Evaluation at the micro level has assured continuation of acceptable service quality despite a general lack of analysis at the macro level, the overall level of network performance.

It is important to recognize this micro/macro evaluation distinction when comparing the nature and operational level of service evaluation

among services, providers, and regulators. Significant differences can be seen in the evaluation perspectives of: (a) regulators and utilities, (b) federal and state regulators, and (c) local and interexchange services. Regulatory analysts, by necessity, cannot become steeped in the detailed analysis performed by the utilities. At the same time, regulatory analysis is often more objective than that done by the utilities. The same comparison of perspective can be found between state and federal regulatory agencies; the states often analyze issues in greater depth than the FCC, but in many instances, the FCC has a more "forest view" perspective.

For a variety of reasons, most regulatory analysis of telephone service quality has been oriented toward LECs, with very little service quality evaluation of interexchange carriers. State regulatory agencies have adopted service standards over the past fifty years or more, but only a few specifically applied to long-distance service. Most rules have been oriented toward customer connection with the local exchange. This is partly because it has only been since the emergence of interexchange competition and the divestiture that there has been the potential for separate standards for interexchange carriers. Further, most of the interexchange carriers are either nonregulated or are operating in a more competitive environment, and regulators have shown little interest in pursuing added standards for them. Finally, some state regulators who have attempted to measure service performance of interexchange carriers have encountered difficulty in determining the source of specific inadequacies. In order to maintain a comprehensive mechanism for the evaluation of telephone service quality, all three components of evaluation need to exist for all comparative segments—utility and regulatory, local and interexchange, and federal and state. The following sections will discuss the three components of evaluation—standards, measurement, and analysis—and their application to the question of divestiture's effect on service quality.

Utility regulatory agencies function as administrative law bodies which are given certain powers by constitutional or legislative mandate. In discussing standards, it may be helpful to examine the relationship among the levels of authority under which the rules are established: i.e., whose rules are they? Telephone service quality standards can be grouped into the following five categories for the purpose of this discussion:

Legislative	A specific standard is mandated by law.
Administrative	There is no specific legal requirement, but the appropriate regulatory agency adopts formal rules

	or orders which establish standards governing the provision of service for all utilities.
Tariff	There is no specific legal standard or formal administrative agency rule, but each individual utility's tariff contains criteria that control the provision of service in a contractual sense.
Industry Standard	None of the above authorities have approved standards, but a utility has its own internal or industry-accepted standards which control the provision of service.
Nonexistent	Folklore prevails; no legislative or regulatory agency standards exist, and the utility has no written documentation on standards for the service.

Standards may be established at any one of these levels of authority. In practice, all five of these categories exist for various services and regulatory agencies. Generally, the "higher" levels of authority set standards establishing broad requirements, while technical details are found in utility procedural documents.

State regulatory agencies are generally given authority by their respective state legislative bodies to assure that regulated carriers provide an adequate level of service. Currently, thirty-one state regulatory agencies have adopted formal telephone service quality standards which are applied to local exchange carriers. A smaller number of regulatory commissions have approved standards that apply to interexchange carriers. Performance standards in the state range from brief to voluminous. Typically, the formal state standards fall into two general categories; customer service and technical standards.

Performance standards related to customer service vary greatly from state to state, but usually include one or more of the following: location, retention of records, filing of periodic reports, tariff regulations, customer information, billing procedures, handling of complaints, disconnection practices, customer deposits, directory requirements, pay telephone provision. Technical network standards exist in many states, and may include the following: engineering and construction standards; party line provisioning; emergency operation (batteries, generators); maintenance requirements, reports; testing methods, test lines; service order completions, commitments; trouble reports (volume of reports, commitments for repair, clearing time); operator answer time;

dial tone speed; call completions (or blockages and failures); and transmission and noise quality.

Because state regulatory agencies function in an oversight capacity, the standards established by those agencies are generally less stringent than those set by the utilities themselves for a particular item of evaluation. As an example, telephone utilities might adopt a 98 percent standard for their own individual business offices in order to ensure compliance with the state PUC standard of a lesser 95 percent. Conversely, a state PUC might establish a lesser standard for a particular performance item knowing there is significant variation in the capabilities of the many LECs under its jurisdiction.

The NARUC has adopted Model Telecommunications Service Rules that contain suggested guidelines for both customer service and technical service quality standards. The model rules are basically patterned after existing rules in place in various states, and are offered as a guide for other states that desire to adopt standards. The NARUC model rules are modified as necessary to track industry issues and technology. Changes are developed by NARUC staff subcommittees, and must formally be adopted by the Committee on Communications and the Executive Committee of NARUC.

The FCC has not adopted any specific standards for service quality performance of telephone utilities. In order to assure adequate performance, the federal agency depends on the existence of state service standards, on utility industry standards, and on requirements contained in the approved tariffs of the utilities. The FCC has used various monitoring plans during past years to analyze the level of interstate service quality offered by local exchange and interexchange carriers.

As a result of the proposal to utilize price caps as an alternative form of regulation for telecommunications carriers, parties have recommended that the Commission adopt minimum service quality standards, and the FCC staff has begun analysis of that recommendation. NARUC and consumer advocacy groups have argued the FCC plan to replace rate-of-return regulation with a price cap plan will encourage reductions in network investment and maintenance expenses, thus degrading the level of service quality. The utilities have argued they must maintain high levels of service quality to be successful, and service quality is unlikely to decline as a result of the price cap approach. As of this writing, the FCC has expressed its intent to refrain from establishing standards for service quality, and instead to require periodic monitoring reports from the utilities.

Measurement, as used in this discussion, involves the use of various

instruments (e.g., test equipment or auditing techniques) to produce data that reveal the nature and level of service quality. Three groups generally "perform" measurements of telephone utility service quality; customers, regulators, and the utility itself.

Historically, surveys of the perception of service quality by utility customers were considered as a useful, but rather subjective and nontechnical measurement. In addition, few customers had the expertise to perform measurements using sophisticated test equipment. However, as interexchange carriers and complex premises equipment vendors have begun serving major customers, technical gauges from the "customer" group have gained credibility. Large customers often have staff with technical skills to perform reliable tests and measurements on the facilities connecting the customer to the utility.

Nontechnical customer opinion surveys have become an increasingly accepted form of measurement for service quality. Typically, a utility will engage a consulting firm to poll customers who have had a recent transaction (installation, repair, etc.) with the utility. That survey will show the customer's perception of service, and may be used to evaluate diverse practices ranging from operator staffing to worker neatness. While state regulatory agencies recognize the value in such polling, it is generally viewed as being too subjective to be used as a tool for regulatory analysis.

Understandably, the vast majority of performance measurements are conducted by the utilities themselves. With approximately 1,370 local exchange telephone companies operating in the United States, the amount of continual testing necessary to keep the network functioning properly is staggering. Telephone companies of all sizes must perform periodic measurement and analysis on network facilities. Tests range from individual component specifications to overall network performance testing. With newer analog and digital electronic technology, much of the testing is done at a centralized location, and repair forces are dispatched as needed. Some computerized systems are able to dial repeatedly into test terminations to determine the percentage of call completions, and others are able to test subscriber lines during off-peak periods at night. Such systems are not limited to the larger BOCs, but also are used by smaller telephone companies with modern systems. Some of the performance measurement data collected by the utilities are provided to regulatory agencies to assess service quality, either on a routine reporting basis or by special request. The data are generally limited to a small number of broad performance categories the agency believes best reflects the overall condition of the utility's service.

Service performance measurement for regulatory purposes must be

consistent, not only within one utility's operation but, ideally, across the operations of all utilities within the regulatory agency's jurisdiction. Measurement of performance must be oriented toward the ultimate analysis of the data and the standards to be applied. If various telecommunications utilities use similar but different methods of measurement for a particular performance category, analysis and comparison of the results with a published standard are difficult. As an example, one utility may report on service orders worked within five days, and another may use the measure of three days.

In addition to the difficulties caused by inconsistent measurements, regulatory analysts face a dilemma in determining the authenticity of utility data. Many performance measurements are based on large numbers of events (e.g., service orders, trouble tickets, or completed calls), to which only the utility itself has access. Such measurements cannot be duplicated by the regulatory agency; therefore, some level of assurance is required for the regulator to accept the data. In order to address this concern, evaluators occasionally conduct desk or field audits of the performance data provided by the utility, and data filings may be required to be accompanied by sworn statements of authenticity by utility representatives. In addition, there is an increased use of management audits of utilities for regulatory purposes, within which the data collection procedures are generally addressed.

Tests and measurements may be performed by the regulatory agencies themselves. State regulatory agencies which have reported having field testing programs in place are: Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Missouri, Nebraska, New York, North Carolina, Ohio, Oklahoma, Oregon, South Carolina, Tennessee, Texas, Virginia, West Virginia, and Wyoming. Those programs may include call completion, operator answer time, and facility testing elements. In addition, almost all regulatory agencies track the number of customer complaints received against telephone utilities. Those complaints are often categorized by issue, resulting in patterns of complaints such as noisy lines or calling failures. Patterns detected through customer contacts can lead to additional measurements and investigations by the utility or regulatory staff.

The third element of evaluation—analysis—refers to the comparison of measurements with approved standards. Without analysis, the establishment of standards and the compilation of measurement data are meaningless. To an engineer, this element represents the feedback of a measurement of the output of a device in order to establish control on the input.

In order to support a reasonable conclusion, an analyst must be

assured that the measurement data are consistent. Data gathered under inconsistent assumptions reduce the probability of an accurate conclusion. Inconsistent measurements pervade telephone service quality data collected by the various telephone utilities and reported to state and federal regulators. Within a given jurisdiction, a regulatory agency may adopt sufficiently detailed instructions to ensure that the utilities provide consistent measurements in a particular category. Among different jurisdictions, however, inconsistencies cause great problems for analysis.

As an example, one of the most useful measures in service analysis is the "Trouble Reports per One Hundred Lines" category. In-depth analysis of this index has shown that various utilities exclude certain types of reported calls from this measurement. Many of the exclusions are reasonable, such as a customer contact which is not truly a trouble report. However, some utilities have been found to exclude over twenty varieties of calls, while others exclude only a few. This difference in procedures has resulted in significant differences in results.

Inconsistencies in measurement are clearly found in other areas such as service order provisioning, where some utilities collect data based on the percentage of orders filled within three days, and others record the percentage of orders filled within five days. In most cases, the measurements can be translated to a common denominator if an approved standard is present.

Another difficulty for the utility analyst is the "masking" which occurs when data are aggregated into a statewide, companywide, or nationwide result. Individual companies, states, or exchanges can be experiencing significant service problems, yet aggregated measurements show no adverse indications. One operator service location in a large state may be experiencing substandard performance during particular periods of the month or year. However, after combining that operating unit with others in the state, and averaging the performance for all the days of the reporting period, the substandard performance will not be seen.

One solution for the masking problem is the technique of reviewing the percentage of entities meeting a particular standard. While this requires "an index of an index," it can improve the performance analysis caused by large data aggregation. As an example of this technique, assume that an approved standard requires the utility's switching offices to provide a dial tone within three seconds 95 percent of the time during busy hours. It is more meaningful for an analyst to know that only 80 percent of the offices met the standard, than it is to know that the dial tone speed percentage aggregated for all offices was 94.5 percent.

Telephone utilities often aggregate many individual performance measurements into a single composite index for comparison purposes. The composite figures invariably contain assumptions and weightings which may be disputed. For instance, one utility combines its "trouble report" index with its "service order installation" index and other performance data to produce an "exchange maintenance index." That index appears to be helpful to the utility in comparing exchanges or operating districts. However, it is not particularly helpful to a regulatory analyst who must compare the performance of that utility with regulatory performance standards.

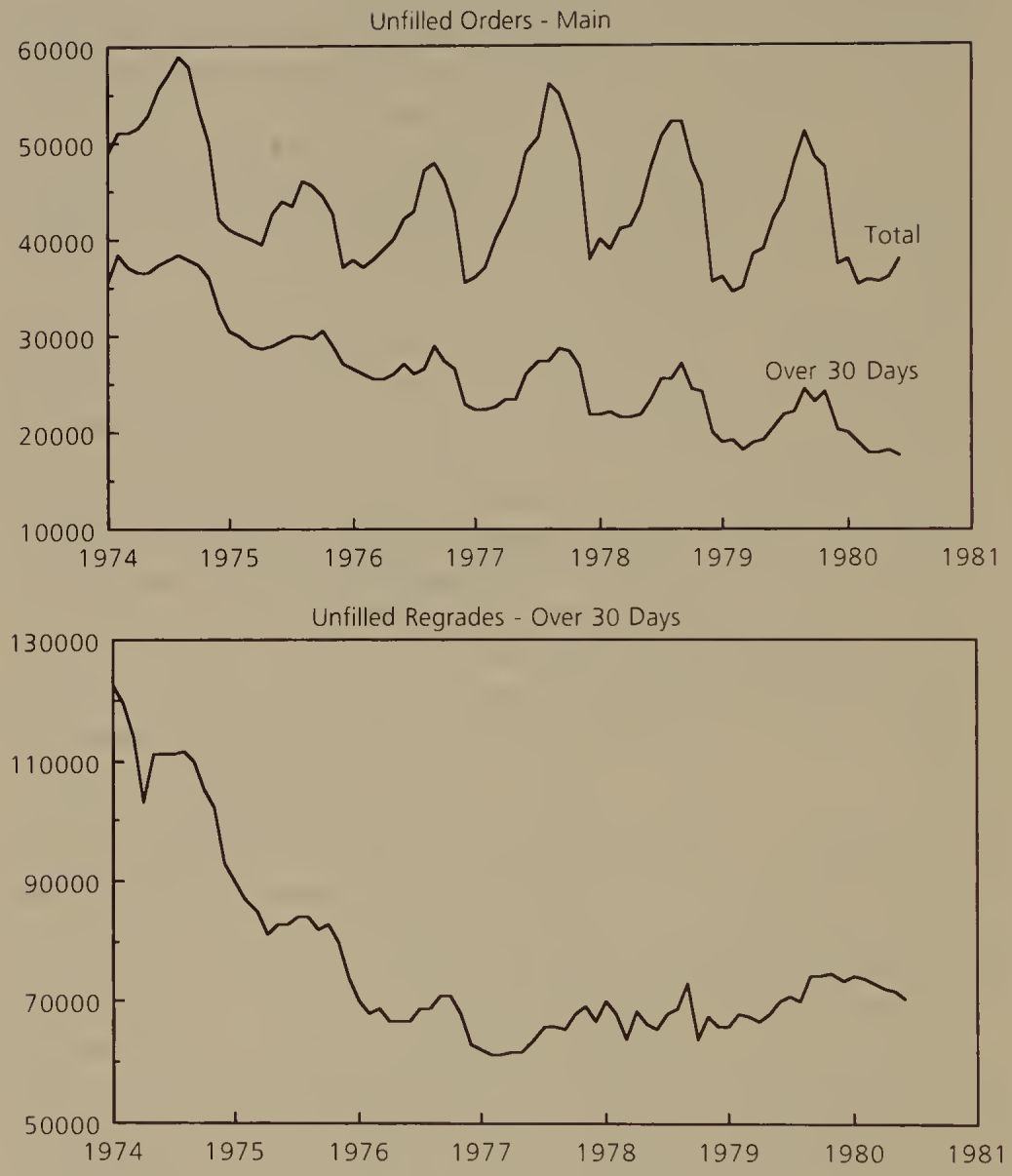
Unfortunately, regulatory analysts of telephone service quality are cursed with a void of knowledge when evaluating the impact of divestiture. In order to evaluate the effects of an event, it is critical to know what was happening before and what was happening after the event took place. Individual states possess performance data for their respective BOCs, and there are some studies which show bits and pieces of the pre-divestiture and post-divestiture service quality picture; however, there are very little meaningful measurement data that track clearly across the divestiture divide.

In 1976, the FCC Common Carrier Bureau's Special Studies Branch released its Quality of Telephone Service Survey, a study of nationwide telephone service quality offered by the Bell System. That special report included ten basic measurements that reflected significant indices of service quality. The study report compared the performance of each geographic operating area with benchmarks based on industry objectives in seven of the ten categories to determine areas of weakness, and a "weakspot" analysis was compiled. The 1976 study was updated on a semiannual basis until it was discontinued in 1981.

Figures 6.1a–6.1d contain summary graphs of nationwide data provided in the FCC Quality of Telephone Service Survey in overlapping periods from January 1974 to December 1980. Spanning the entire Bell System, these graphs show performance in ten categories: unfilled orders—main total; unfilled orders—main over thirty days old; unfilled regrades—over thirty days old; percent toll and assistance answers over ten seconds; percent DDD incoming trunk—equipment blockages and failures; percent dial tone over three seconds during busy hours; percent regular installations not completed within five days; percent regular installation appointments not met (for company reasons); customer trouble reports per one hundred stations; and percent repeated repair reports.

The FCC publication of these performance measurements was accompanied by a "weakspot" analysis, in which the performance in

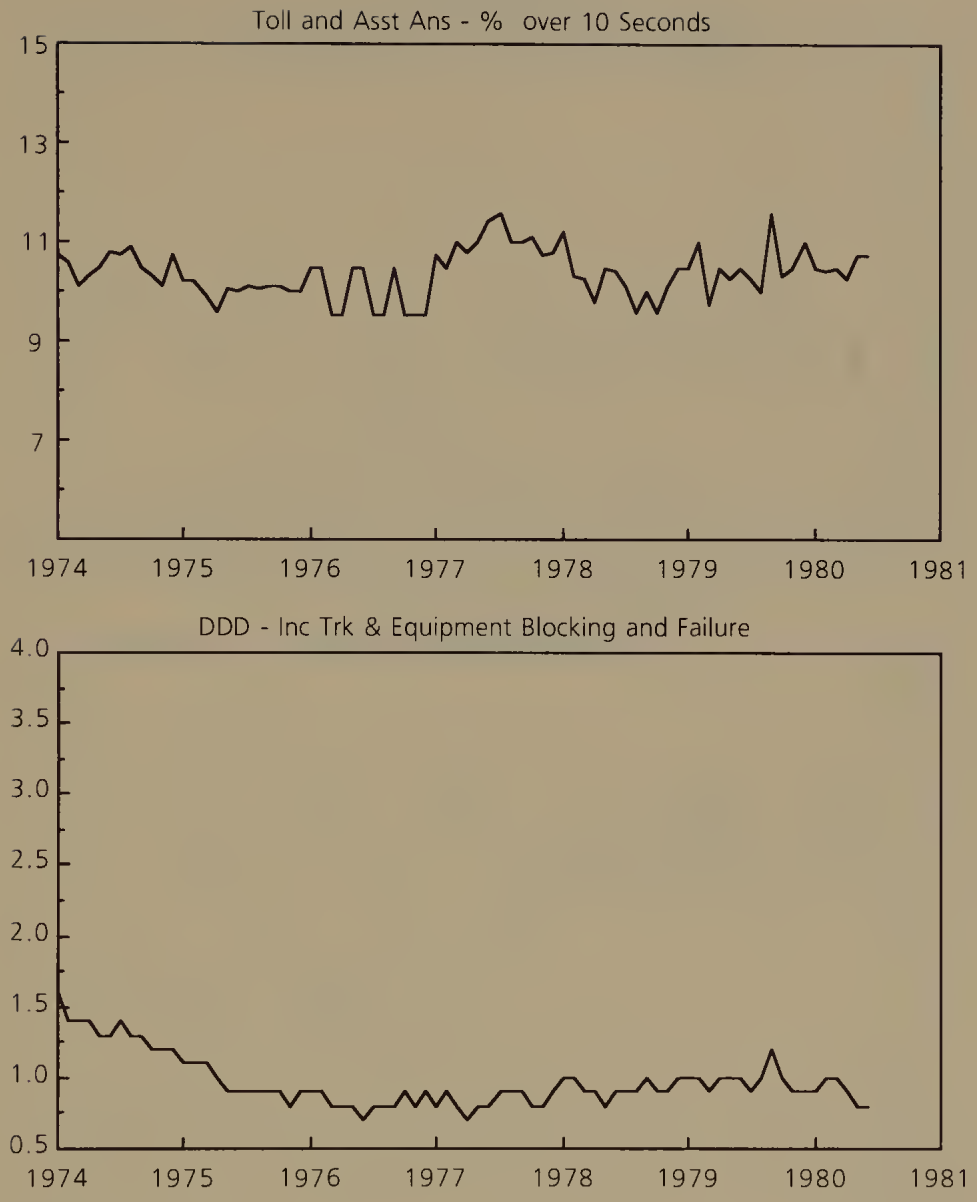
FIGURE 6.1a



Source: Bell System.

seven of the categories was compared to FCC "benchmarks." These benchmarks were not formally adopted FCC standards. The failure to achieve the benchmark level in a category resulted in a "weakspot" in the affected area for that time period.

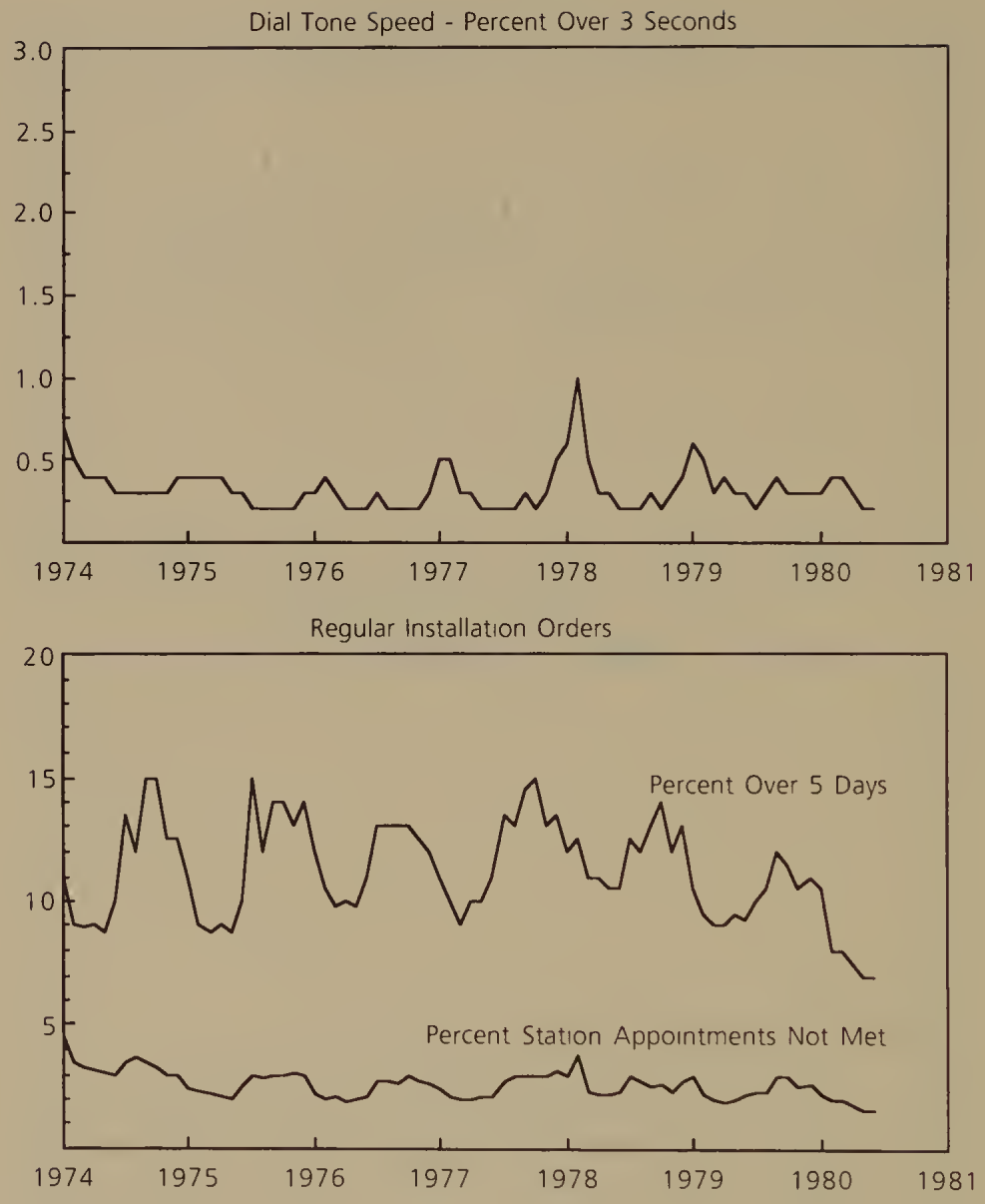
FIGURE 6.1b



Source: Bell System.

Table 6.1 contains a sample of the Summary of Total Weakspots for the entire Bell System for the period from January through June, 1978. Each Bell System operating area was evaluated separately. For that period, there were a total of nineteen weakspots, four of which were

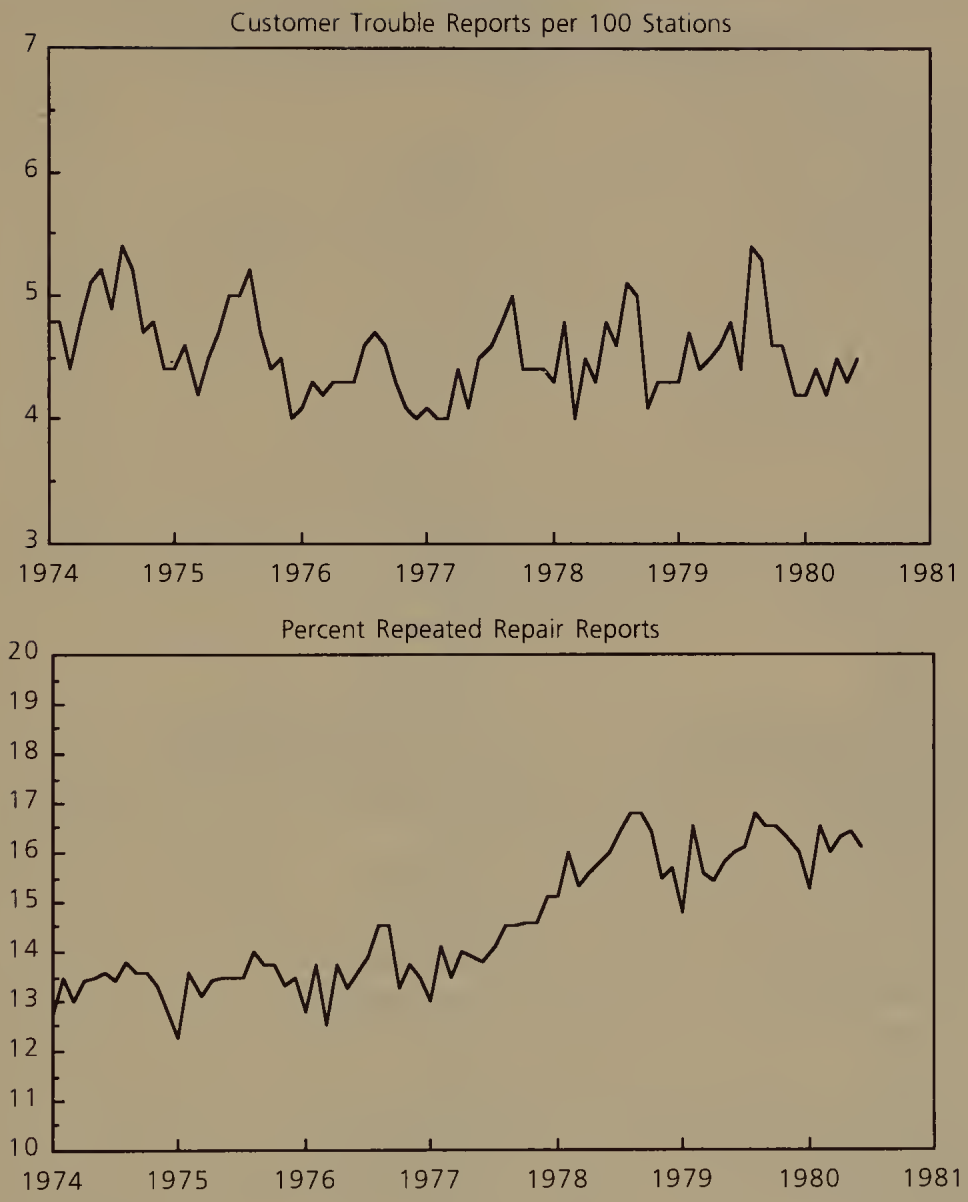
FIGURE 6.1c



Source: Bell System.

shown for South Central Bell in Kentucky, and three each in New England Telephone (Rhode Island) and Pacific Bell (Los Angeles). The strength of the FCC's pre-divestiture report was not in its aggregated, nationwide data, but in the specific analysis of weaknesses in regions of the country.

FIGURE 6.1d



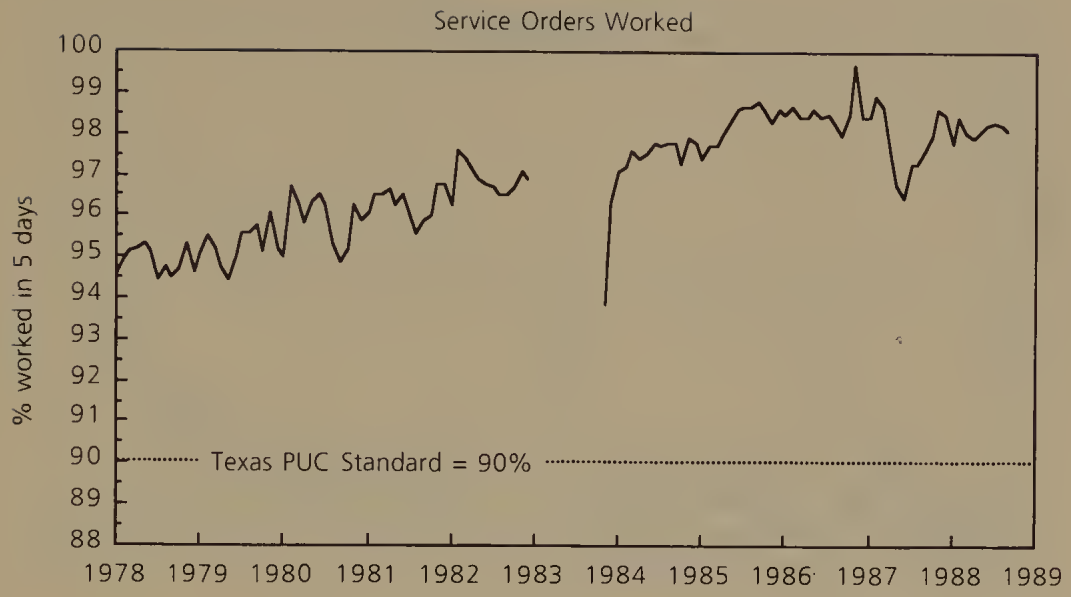
Source: Bell System.

The FCC's Memorandum Opinion and Order, released on December 23, 1983, approving the transfer of facilities associated with the divestiture, required the divested BOCs to provide service quality data on a semiannual basis. A 1989 FCC paper by Jonathan Kraushaar, entitled "Report on the Quality of Service for the Bell Operating Companies"

TABLE 6.1
Total Weakspots Quality of Service Area Report

New England		Illinois	
Maine	0	Chicago	0
New Hampshire	0	Suburban	0
Rhode Island	3	State	0
Vermont	0	Northwestern	
Massachusetts	0	Iowa	0
New York		Minnesota	0
New York City East	0	Nebraska	0
New York City West	0	North Dakota	0
Suburban	1	South Dakota	0
Upstate	0	Southwestern	
New Jersey	0	Arkansas	0
Pennsylvania		Kansas	0
Philadelphia	0	Missouri	0
Eastern	0	St. Louis	1
Central	0	Oklahoma	0
Western	0	N.E. Texas (inc. Dallas)	0
Chesapeake and Potomac		S.E. Texas (inc. Houston)	2
Washington, D.C.	0	W. Cent. Texas (inc. San Antonio)	0
Maryland	0	Mountain	
Virginia	0	Arizona	0
West Virginia	0	Colorado	0
Southern		Idaho	0
North Florida	0	Montana	0
South Florida	0	New Mexico	0
Southeast Florida	0	El Paso (Texas)	0
Atlanta	0	Utah	0
Georgia (excl. Atlanta)	2	Wyoming	1
North Carolina	0	Pacific Northwest	
South Carolina	0	Washington–Idaho	0
South Central		Oregon	0
Alabama	0	Pacific	
Kentucky	4	Bay	0
Louisiana	1	Northern	0
Mississippi	0	Los Angeles	3
Tennessee	0	Southern counties	0
Ohio	0	Nevada	0
Michigan		Southern New England	0
Outside	0	Cincinnati	0
Detroit	0		
Indiana	1	Total	19
Wisconsin	0		

FIGURE 6.2



Source: Southwestern Bell.

has been released by the Common Carrier Bureau's Industry Analysis Division. Later in this chapter, Kraushaar provides a summary and analysis of that study.

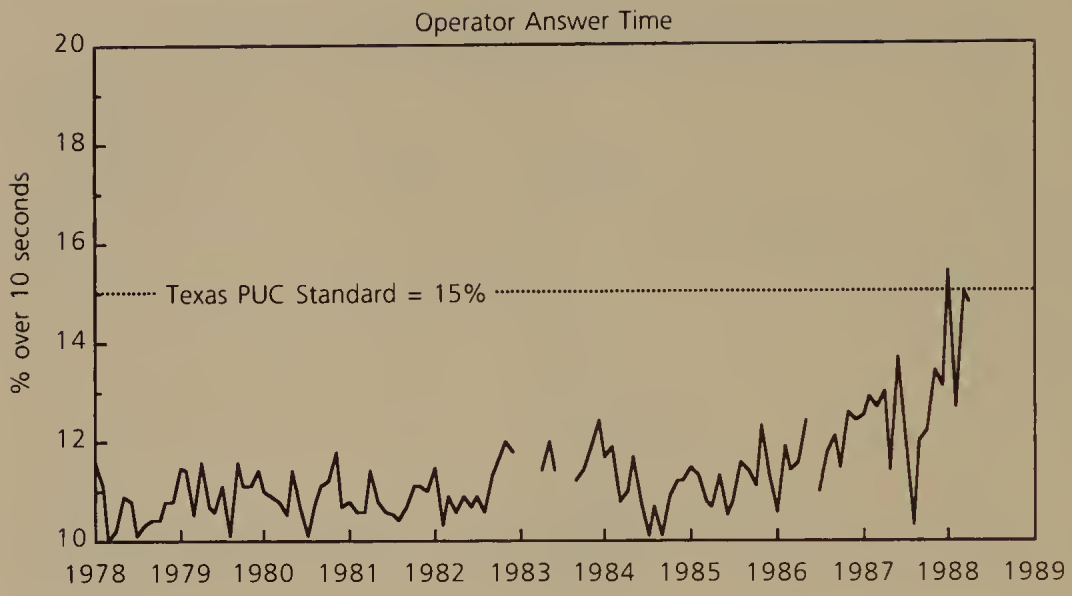
Many state regulatory agencies have collected service quality data that reflect various performance indices related to the Bell operating divisions prior to 1984, and continuing through 1988. For example, performance results in four key categories for Southwestern Bell's Texas operations are shown in figures 6.2 through 6.5.

Most of the performance measures show general improvements over time. Southwestern Bell has generally met most of the Texas PUC service quality standards during the past ten years. The analysis of Southwestern Bell's Texas performance data shows several trends and events of interest as described in the following paragraphs. However, no significant impact of divestiture is evidenced.

Figure 6.2 tracks Southwestern Bell's provisioning of customer service orders, with the index showing the percentage of "regular" service orders filled within five days. The only remarkable trend of these data during the past ten years is the general, gradual improvement in the percentage of service orders completed within the specified period. No negative trends were visible about the time of divestiture.

Figure 6.3 shows the trend of operator answer time, measured as the percentage of instances over ten seconds. The Texas PUC standard for

FIGURE 6.3



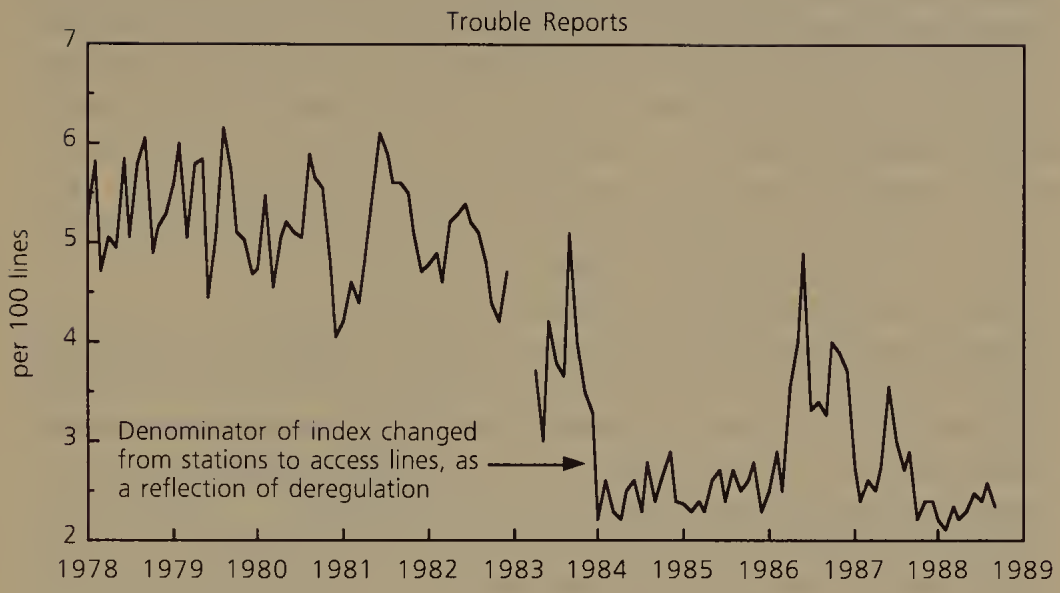
Source: Southwestern Bell.

this service measure is 15 percent, and until 1988, Southwestern Bell operated well within this objective. There is no noticeable trend in the 1983–1985 time period, across divestiture.

Figure 6.4 shows Southwestern Bell's Texas performance in the category of Trouble Reports per one hundred Stations/Lines. Prior to the deregulation of customer premises equipment, the performance measure "Trouble Reports per 100 Mainstations" was one of the most often used indices. The deregulation of CPE resulted in the elimination of many of the trouble reports for the regulated utility. This reduced the number of trouble reports per line. At about the same time, however, the base or denominator of the measure was drastically reduced through the change to "Trouble Reports per 100 Access Lines." The end result of the combined changes was that the BOC's performance index improved significantly in that area during 1984. This change was not due to an improvement in service, but rather a change in reporting methods, and was not directly related to divestiture.

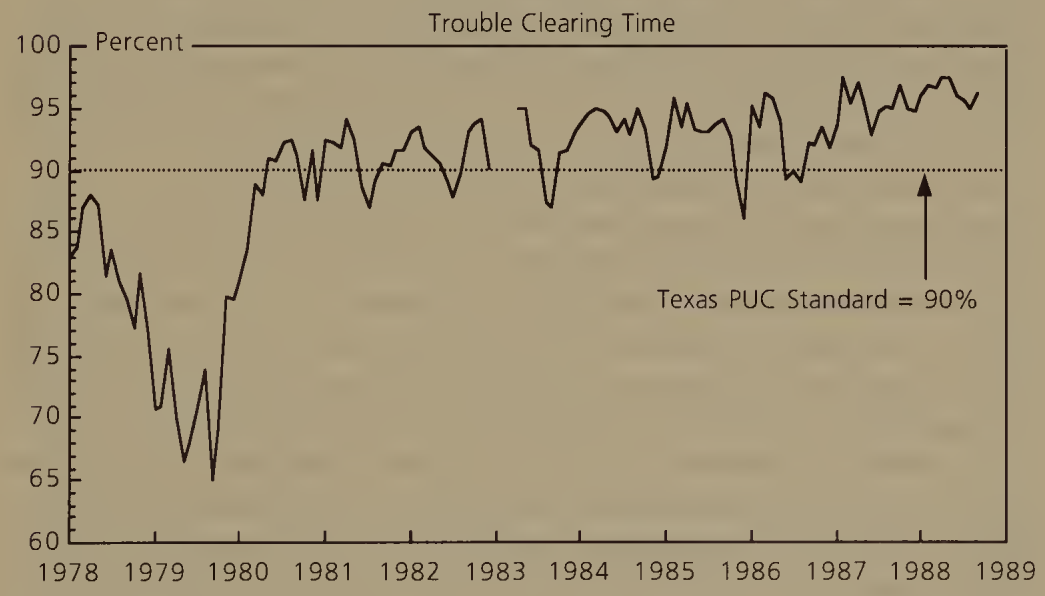
Figure 6.5 illustrates the utility's performance in the category of "Out-of-Service Troubles Cleared Within Eight Working Hours." In 1979, the utility was having a difficult time with this measure, due in large part to the existence of buried air-core plastic cable throughout the state. The utility embarked on an aggressive plant replacement program, and there has been a gradual improvement in the category

FIGURE 6.4



Source: Southwestern Bell.

FIGURE 6.5



Source: Southwestern Bell.

since that time. No significant variation was seen as a result of divestiture.

The most significant impact of the divestiture on service quality would be expected in the interLATA toll network. After all, little was

changed in the realm of local exchange operations. The most abrupt change took place in the splitting of the toll network into inter and intraLATA. Prior to divestiture, the LATA concept did not exist; there is no pre-divestiture interLATA network performance for comparison. In addition, many of the pre-divestiture service standards applied to the overall telephone system are meaningless when used to evaluate AT&T or any other interexchange carrier. Traditional standards related to service orders and trouble reports per one hundred lines have no relevance in evaluating the divested AT&T.

AT&T has placed added emphasis on network quality, and the company is moving toward digitalization of the network, with features such as Dynamic Non-Hierarchical Routing (DNHR) and Common Channel Signaling (CCS) as major improvements. AT&T continues to employ an aggressive service monitoring program, which consists of automatic measurements and customer surveys.

The competitive nature of the interexchange marketplace has certainly provided incentives for the continuation of satisfactory, if not improving service quality. Competitors such as US Sprint have based massive customer marketing campaigns on the technical excellence of their network, and that has clearly made an impression on AT&T.

Very little data is available from AT&T regarding service quality, and it does not report semiannual information to the FCC in the same manner as the BOCs. AT&T does report some measurements to state regulatory agencies. However, it has not provided data that would track meaningful measures across the threshold of divestiture.

It is clear that the divestiture of the BOCs from AT&T has had no catastrophic effect on nationwide service quality. However, lack of consistent data from the pre-divestiture era to the post-divestiture era makes it difficult, if not impossible, to quantify precisely the effects on a nationwide basis. And much more data are available to analyze the BOCs than AT&T. It is important to also recognize the forces of CPE deregulation during the same time period further complicate any analysis.

Critics argue that the AT&T divestiture should never have taken place, that the result of the consent decree was to dismantle the most reliable telephone system in the world. It is a tribute to the technical planning and talent of the telecommunications industry that the massive task was accomplished with no apparent long-term setbacks in service quality or network performance.

The preservation of adequate national telephone service quality depends on the ability and willingness of federal and state regulatory agencies, the courts, and the Congress to work in harmony to establish

policies which encourage telephone utilities to continue improvements in their operations. In an era of increasing regulatory flexibility, regulators must maintain service evaluation standards, measurement, and analysis to ensure the public interest is protected.

Jonathan M. Kraushaar

Rowland Curry aptly points out some of the problems in collecting quality of service data, focusing in particular on the problem of specifying uniform standards. The present FCC quality of service monitoring program was established to respond to the general concern about service quality following divestiture, and relies on a technique for analysis which was designed to address precisely the problem of dealing with data in which the imposition of detailed uniform standards was not feasible. It illustrates the obvious limitations and constraints in rapidly setting up a monitoring program after divestiture.

In the December 1983 authorization for transfer of ownership associated with divestiture, conditions were specified that the Commission would collect quality of service data, among other things, to determine divestiture's impact. The 1983 order gave the Common Carrier Bureau the opportunity to work with the companies to determine what data would be filed.

There were, of course, a number of constraints on requiring service quality data collection. These included the deregulatory environment, and the fact the companies were undergoing a tremendous amount of upheaval just to get their operations in order. Moreover, many of the state PUCs already monitored quality of service. Because it was infeasible to ask for new data not already being prepared, the companies were asked to provide information on the general categories of data they collected for internal use and for the state commissions. Material to be used in the monitoring program was limited to those data categories which were provided by all the Bell companies.

Despite the uniformity in data categories, it was recognized that there were various differences among the companies in how data was prepared and assembled. Imposition of detailed standards at all levels would have prevented the timely availability of baseline data. As a result, efforts focused on new ways to evaluate the existing data in a meaningful manner. It is hoped the analysis technique I will describe

will be helpful to others in examining data from different companies, with possible variations in measurement standards.

The FCC monitoring program focused on local operating company data in particular for two reasons. First, all interexchange service is limited by access into the local networks. Second, the greatest concerns voiced at the time of divestiture were about how the local carriers were going to perform.

The quality of service items currently being monitored are broadly organized into five main categories: (1) customer satisfaction levels; (2) percent of switching machines performing at or above dial tone speed objectives; (3) percent of offices meeting all transmission objectives; (4) percent of calls encountering equipment failure or blocking; and (5) percent of on-time service orders.

Customer satisfaction levels are determined by company surveys, which are an outgrowth of pre-divestiture methods developed by Bell Laboratories. Percent satisfaction levels for residence, and small and large business subcategories are requested. Some companies also provide data for a medium business subcategory. Data has been summarized in two FCC reports in March 1989 and June 1990. Several minor changes were made to data presented in the June 1990 report. For example, Pacific Bell's general business subcategory was classified in the March 1989 report as medium business and reclassified in the June 1990 report as small business.

Due to their subjective nature, these surveys generally are not expected to provide conclusive results when changes in the quality of service are slight or gradual. Nonetheless, the companies place a high reliance on these surveys. In accordance with the Commission's general policy not to place new burdens on the carriers, and to use existing measures whenever possible, the survey results have been incorporated into the monitoring requirements along with the following other more objective gauges.

The length of time it takes for a customer to obtain dial tone, sometimes referred to as dial tone delay, is historically one of the most obvious and immediate causes for customer dissatisfaction. All companies monitor it with fairly consistent objective standards. Severe dial tone delay in a number of central offices during the late 1960s was one of the factors leading the Commission's Docket 19129 investigation of AT&T. Eventually a pre-divestiture general standard of a three-second dial tone delay became well established, and the companies now provide the FCC with data on the percentages of central offices failing to meet it.

The primary variation noted among companies relates to the way they measure and calculate standard compliance. Although such variations may be expected between companies, each company is required to document any changes in its standards when it files any new data. Dial tone delay is becoming less significant in an environment of electronic switching machines, in which the failure mode may be loss of an entire office, rather than increased dial tone delay. Nonetheless, it continues to provide historical perspective and illustrates the impact of new technology and investment on service quality.

The four major components of transmission quality are noise, balance, loss, and distortion. Perceptible noise or inadequate signal amplitude are obviously objectionable. Balance and distortion measurements are also needed, although problems in these areas may be harder for customers to identify. Information on the percentage of offices meeting all company established transmission level standards associated with these four criteria, as well as the standards themselves, have been requested by the FCC.

Although the measured transmission characteristics and the techniques for collecting and processing the data are similar for all reporting companies, it is not clear that all companies are basing their transmission quality measurements provided to the Commission on all four components. Some companies may be reporting the percentage of measured central offices that meet only one or two of the key criteria. In addition, Pacific Bell did not provide transmission quality data for a number of reporting periods I will be reviewing. Furthermore, there is some concern about subtle problems relating to other companies' understanding of the requirements for this category of data. And finally, there may be variation in the objective criteria which companies use to determine whether an entity is categorized as passing or failing transmission tests.

The FCC also monitors the percentage of on-time service orders. This measurement reflects the date promised to the customer, and is not a uniform standard time interval for all companies. As with many of the other data elements, the underlying reports from the BOCs do not always use the same formats, definitions, and reporting categories. For the purpose of summarizing the data, however, the reported results for on-time service orders will be shown in three overall categories: residence, access, and a "catch-all" labeled "Special/Business."

The final category of service quality being reported to the FCC is the percentage of calls which cannot be completed due to equipment problems or lack of adequate facilities. Historically, the toll network has

been designed so that typically less than one percent of all calls encounter such problems. For local networks this percentage may be slightly higher, but should not exceed 5 percent. End-to-end blocking is difficult to evaluate since more than one trunk connected in tandem may be used in completing calls. A relatively new system called Service Evaluation System II (SES II) is used by some of the operating companies. This system monitors a sampling of calls traversing the network and evaluates the status of each call just prior to completion. Since not all companies use this system, it is not possible to assure complete consistency for this data category in the FCC's monitoring program.

Companies not using SES II employ another equipment-based measurement parameter, which indicates the percentage of offices not meeting company-established performance levels. Although these data also deal with calls not finding their way through the network, they have a different meaning than the SES II results, are numerically somewhat higher, and are not provided separately for interLATA and intraLATA calls. They are included in place of the SES II results for interLATA calls. The data in this category are based on a sampling process that may differ from company to company, but which the FCC has not evaluated. Despite the above imperfections, data for this category may provide a broad indication of trends in call completion rates.

All RBOCs have provided data to the Commission, although a number of companies do not provide certain data subcategories. The data first were compiled in 1985, and continue to be submitted to the FCC semiannually. Although the quality of existing service measurements are too aggregated to pinpoint localized problems, one would expect significant service quality problems to be more global in scope and to probably occur over an extended time period. Rather than evaluating absolute levels for the five measurements, adverse changes can be detected by examining changes in each of the data.

In addition to simple data trending, a technique of indexing has been used by the Commission to help standardize results and determine the presence of general trends in company results. The approach is based on the premise that the magnitude of a change in service quality from one reporting period to the next, which may be influenced by many extraneous factors (including subjective perceptions) is less significant than what kind of a change occurred. This technique should help to deal with variations in individual company procedures in preparing the data submitted. The validity of results only depends on individual company consistency in its own procedures.

The indexed results reflect changes from 1985 baseline data. Each

subcategory is assigned a "+1" if the current data element reflects improved performance relative to the corresponding item in the baseline period. Similarly, if the current data reflects poorer performance, the index is assigned a "−1." If there is no change, the respective index is assigned a zero. Data elements not provided by the carriers in the FCC's March 1989 report discussed here, but which were provided previously, automatically result in a "−1" index. A second result not penalizing the carriers for missing data was also calculated. Data not provided in 1985, but provided subsequently, results in a zero in the baseline index. This reduces the maximum attainable score and should encourage all required data to be filed.

All the subcategories under each main category are then averaged. A "+1" is assigned to the main category if the subcategory average is greater than zero, and a "−1" is assigned if the average is less than zero. A zero results if the subcategory average equals zero. The results of the process, assuming no penalty for missing data, is shown in table 6.2. All resulting main category indices could be added to provide a single overall index.

The quality of service data presented is intended to be viewed in the context of the Commission's original concerns about broad future service deterioration trends associated with the divestiture. The individual reports provided by the companies tend to make interpretation of short-term variation difficult, since the indices almost always register over 90 percent. Nonetheless, a key concern of the commission is to compare current and baseline results and to identify any adverse long-term trends.

In table(s) 6.2 (and 6.3), the individual quality of service indicators are grouped into five summary indices for all companies up to and including the reporting period, January–June 1988. (Table 6.3 includes a penalty for missing data.) In order to better evaluate the data provided to date, the data for each of the individual measured items associated with the seven regional holding companies were averaged. These results, based on revisions in the source data, have been trended and are displayed in figures 6.6 to 6.9.

These aggregated data show improvements in the areas of customer perception, transmission quality, dial tone speed, and blocking since the data were first collected in 1985. In the area of on-time service performance, there is a noticeable, although small, decline in the on-time service provisionary category for residential customers. Customer perception results appear somewhat less variable than when they were first provided: however, business perceptions appear to have improved

TABLE 6.2
Quality of Service Data Analysis

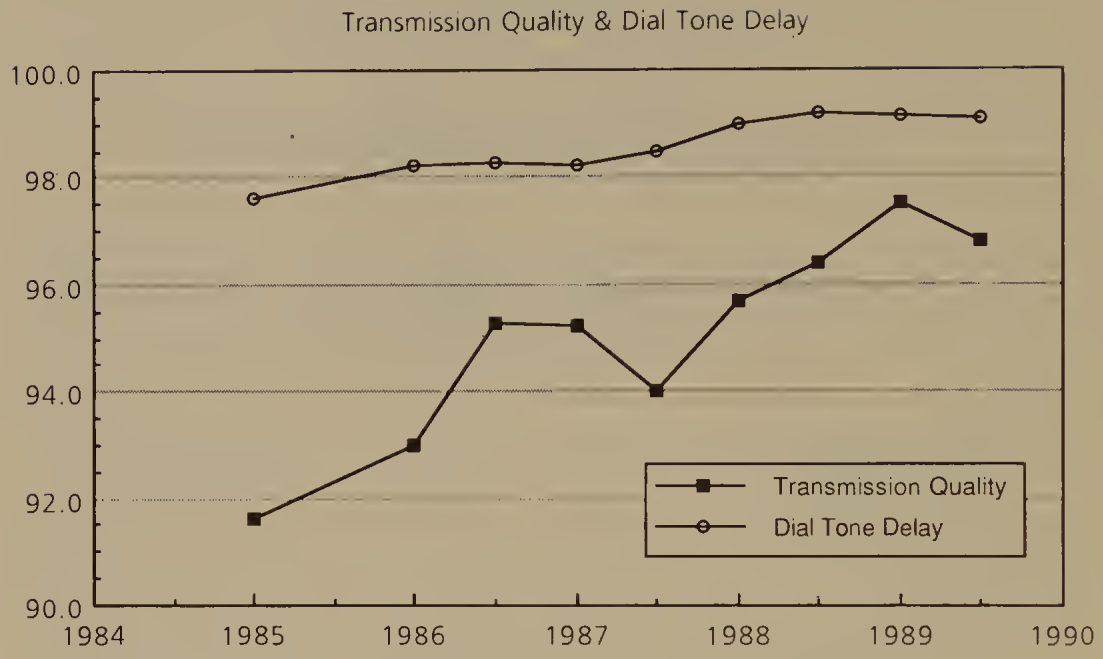
Trends Composite Index[a]
First Half 1988 Data – End of Year 1985 Data

	Customers Satisfied	*Dial Tone Speed Objective*	*Trans-mission Quality*	*On Time Service Orders*	*Call Com-pletion*
US West					
Northwestern Bell	0	1	−1	0	0
Pacific NW Bell	1	1	1	−1	1
Mountain Bell	1	1	−1	1	0
SW Bell	−1	1	1	1	−1
Bell South					
Southern Bell	1	1	−1	−1	1
South Central Bell	1	−1	1	1	1
NYNEX					
New York Telephone	1	1	1	1	1
New England Telephone	1	1	1	1	1
Pacific Telesis					
Pacific Bell	1	0	0	−1	0
Bell of Nevada	1	−1	1	−1	0
Bell Atlantic					
C & P Cos.	1	1	1	1	1
Bell of Pennsylvania	1	1	−1	1	1
New Jersey Bell	1	1	1	1	1
Ameritech					
Illinois Bell	1	−1	−1	0	0
Indiana Bell	1	1	1	1	0
Michigan Bell	1	1	1	1	0
Ohio Bell	1	1	1	1	0
Wisconsin Bell	1	−1	0	1	0

Note: +1 indicates index has improved.
−1 indicates index has deteriorated.
0 indicates no change from baseline or data missing.
[a]No penalty for missing data.

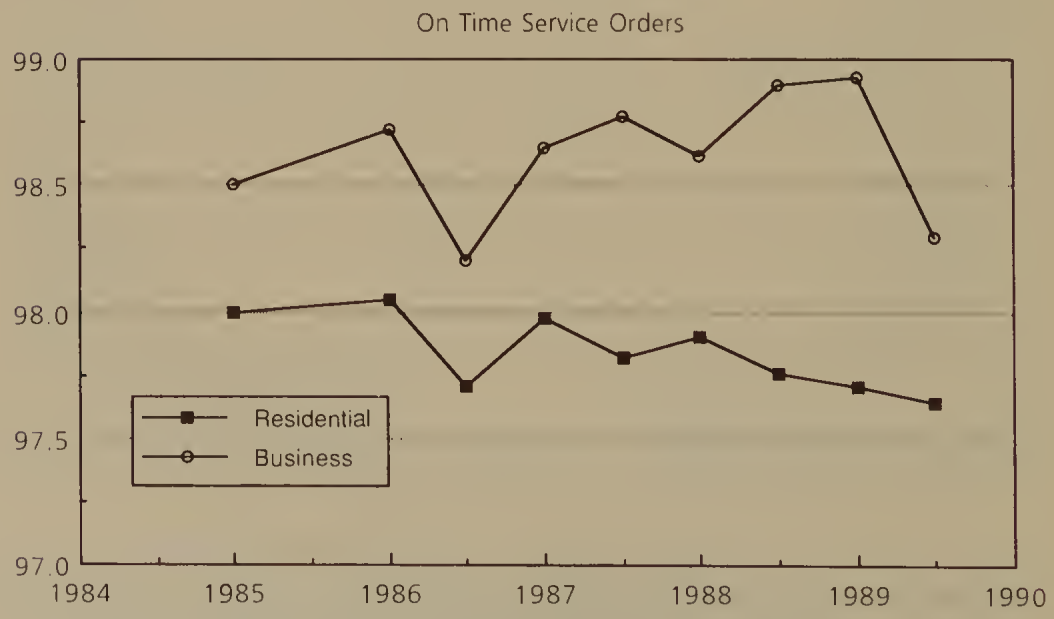
more than residential perceptions. A noticeable decline in data for the second half of 1989 is apparent in a number of categories. This may be attributable to the telephone strike in late 1989; however, more subsequent data would be needed to confirm this fact.

FIGURE 6.6



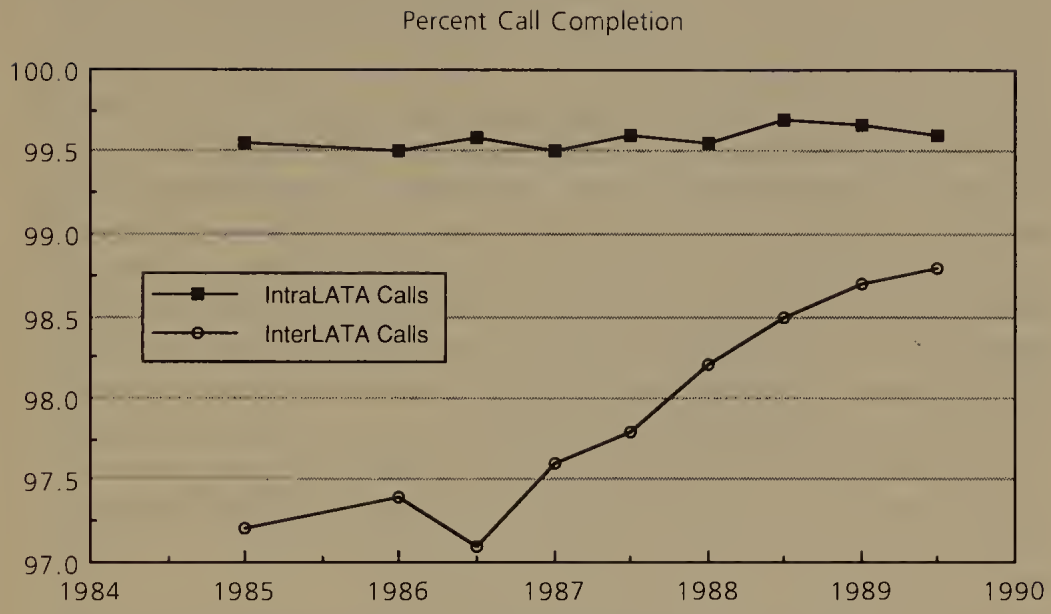
Source: FCC "Update on Quality of Service for the Bell Operating Companies" Common Carrier Bureau, June 1990.

FIGURE 6.7



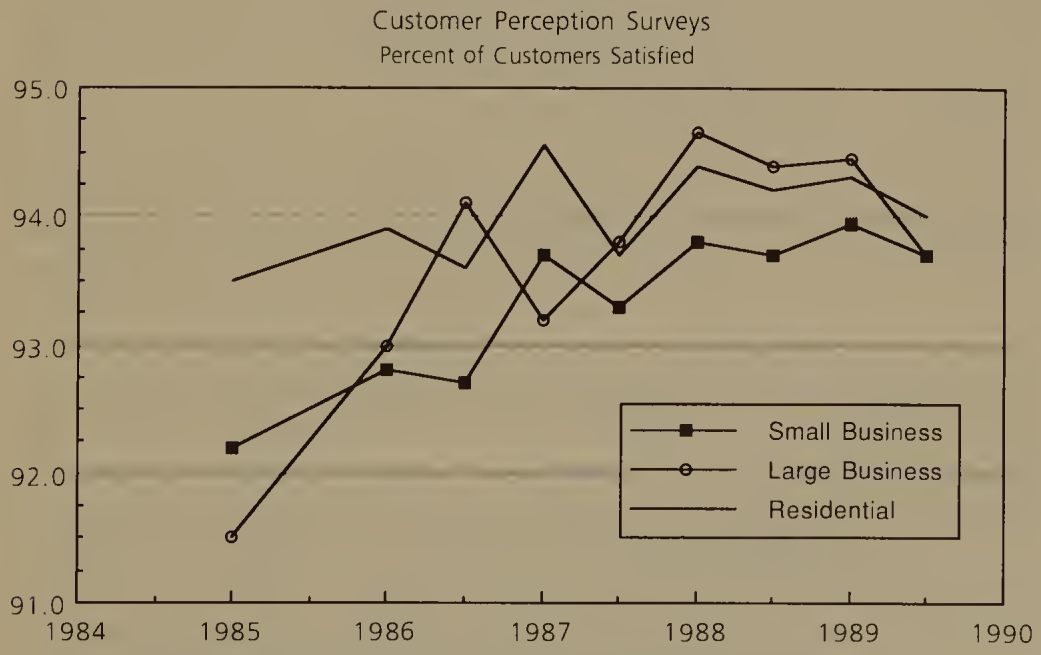
Source: FCC "Update on Quality of Service for the Bell Operating Companies" Common Carrier Bureau, June 1990.

FIGURE 6.8



Source: FCC "Update on Quality of Service for the Bell Operating Companies" Common Carrier Bureau, June 1990.

FIGURE 6.9



Source: FCC "Update on Quality of Service for the Bell Operating Companies" Common Carrier Bureau, June 1990.

the significance of these measures when taken alone should be viewed carefully, since they tend to be less objective and may be influenced by many extraneous factors, such as a customer's past experiences with service and his general expectations. In addition, customers may not be able to identify problems and service perceptions of local carriers separately from problems and perceptions of interexchange carriers.

Another concern relates to the robustness of the data and significance of small changes in the results. It appears that the companies are currently operating in a range of performance well above that which would elicit a significant amount of customer complaint. Therefore, small fluctuations in this range may not have any clear significance, but continuing small declines could serve as an alert to adverse trends. In addition, individual adverse elements may easily be masked. The results from, and responsiveness in, restoring service in the case of a natural disaster or fire is generally not reflected in this kind of data. Finally, the extent of any trend may be more difficult to assess than the presence of a trend.

Although a technique has been presented to deal with the problem of variations in standards alluded to by Curry, and objective standards of each company are supposed to remain fixed, it is possible they may change. The companies reporting data have generally indicated that their procedures and standards for preparation of the quality of service have not changed; however, in some cases the character of the underlying data appears to suggest otherwise. Because the indexing process for each company relates to performance in a limited number of distinct categories relative to 1985 baseline results, comparison between companies should be made with caution.

It is true that the present monitoring system contains some reporting inconsistencies, and is subject to both limitations in our state of knowledge and practical limitations in observing large complex real world systems. However, the observed trends in service quality appear to be supported by the companies' significant investment in fiber facilities and the significant amount of new switching equipment deployment associated with equal access requirements following divestiture. Also evident in the data are differences in trends for large business and residential customers. It is interesting to note, for example, there is a slight decline in the on-time service order category for residence subscribers. To the extent that Curry's observation of lengthening operator service response time, and the slightly poorer response to residential customer service orders mentioned above involves a greater reliance on people resources, this may also reflect changes in the way people and

capital resources are being managed. Of course, further study would be required to confirm this possibility.

Given the limited data series and the level of aggregation, it is difficult to predict to what degree and how quickly the data now being collected will respond to changes in future quality of service. The FCC data presented here and any results derived therefrom, should thus be used with caution and should not be a substitute for more detailed data that may be collected elsewhere (e.g., by the state PUCs). It should also be clearly understood the data being received are not appropriate to address the existence of localized problems. And while it is not the intent of the data collection to compare the performance of individual companies, analysis suggests there are differences in performance patterns of the companies since the measurement process was begun.

Robert M. Gryb

From its very inception, the telephone industry has been undoubtedly the most measured business in the world. From the earliest days of Theodore Vail, telephone company employees were held accountable for the quality of service rendered to their customers.

In the Bell System, prior to divestiture, every district manager in every telephone company in the system received (on a monthly basis) reports on the level of customer satisfaction in his district for the various services for which he was responsible. This included satisfaction with installation, repairs, operator services, directory services, local calls, toll switch calls, and many other important types of service. Prior to divestiture, six million customer interviews were done per year to provide input to those managers to help them better manage their business and serve the customer.

The spirit of competitiveness between districts, divisions, regions, and companies in the telephone business in achieving the highest possible levels of service, while simultaneously achieving high scores on productivity measurements, was an incredible driving force. Accomplishing the "balanced job" was no myth—it was the most prevalent basis for employee merit ratings, and the most important motivator for operations managers throughout the telephone industry.

Over the years, the number and types of service measurements grew with the complexity of the business. Most were born from necessity—to balance loads, allocate resources, engineer additions, or train or

assign personnel, for example. The goals and objectives of what might be called "standards" came about by two self-propelling forces. First, customers' levels of expectations kept changing, based on their past experiences. If customers became used to experiencing every call going through in ten seconds, they expected it, and became annoyed if it took longer. Couple this with the fact every good manager was staking his or her career and salary on getting better results than their peers, and you have the reason why telephone service in the United States has been the best in the world.

Without in any way denigrating the importance of the regulatory process, there is no question in my mind that when it comes to levels of service, the forces I described are 99 percent of the reason for the excellent levels of telephone service that still exist. Rowland Curry has said, "We have grown to expect good performance, and poor performance has become the memorable exception."

There were periods of time, especially the late 1960s, when growth in some major cities so far exceeded the planners' expectations that service took a turn downward, rather than its usual continuing upward trend. This triggered the FCC's twenty-city report on ten service indicators with "weakspot" levels. These levels were the equivalent of a ninety index, which fell far below the ninety-six level that was needed to meet the internal objectives of the Bell System. As the service in these cities improved, the report grew to cover seventy-five areas, rather than just twenty cities, but most of the twenty cities were included in the areas. Finally, weakspot failures became so rare that the seventy-five-area report was dropped in favor of exception reporting, if and when necessary.

What has divestiture really changed? It has not changed the concepts of ever-improving service, because of the continued existence of two factors mentioned earlier. First, higher levels of expectation due to new technologies such as faster electronic switching, better transmission on fiber optics, and more customized features, to name just a few. And, second, the persistent attitude on the part of the telephone companies that achieving higher levels of service is still the paramount motivator. However, the kinds of customers and their needs and expectations keep changing and getting more complex. Now the question is, "Who determines what are the right levels of service?" Curry asks, "What is good?" When a benchmark for a service measurement is set, it is always based on what is achievable, as shown by the distribution of a great many management units. It is essentially what customers have grown to expect.

Measurements are very, very expensive. Just think about the process.

If you measure (1) every time a phone goes off hook and a dial tone is given, (2) every time a trunk is seized and terminating lines get rings, (3) every time repeat attempts are made, (4) every time a call is made to repair and why, (5) every time a call is made to a business office and why, it is not difficult to imagine the costs involved in such a measurement process. Prior to divestiture, AT&T and the BOCs collected 130 service measurements every month. Some were simple, such as dial tone speed which was done by machine. Others involved human service observing of operators, business offices, repair bureaus, and even switched calls during set-up time. The costs for doing this were difficult to identify, because the measurement process was so woven into the operations comprising the business. However, we believed it could have been as high as several hundred million dollars per year. Even if it was half that amount, it was still an enormous expense.

There was (and is) much to be said for reducing these costs by eliminating expensive processes such as human service observing, and focusing on those factors which are really the most important—to manage the business efficiently, and to provide service which meets customers' expectations. Great strides have been made, and I am sure great savings have been achieved, by reducing the number of measurements and the manner of collecting data. Instead of deciding or telling customers what they should want or what is "good" for them, the telephone industry has moved toward the process of asking the customers, "How did we do?" and if it was not good enough, "Why?" and "What could we have done better?" Load balancing and speed of connection measurements may still be needed for efficient design and administration, but when it comes to judging quality of service and making sure in every location customers get service the way they want it, why not let the customer be the judge?

The kind of service measurements included in the FCC and NARUC service standards of the past in no way touch upon the real concerns of customers today. Problems of getting service installed and repaired, public phones, billing procedures, all have changed. If customers do not have the option to switch to another supplier, then they should have a voice in what they expect, and how well they are being served. Experience has shown this can be done accurately, and in a manner the customers appreciate. Of course, if they do have options, then the regulatory need for such data is moot, although well managed businesses will still need and use the data effectively.

I believe that monitoring service quality means gaining an understanding of the customer's point of view, and recognizing the fact that each customer, whether a residence, a small business with some data

and FAX, or a large corporation with a vast network, should have the ability to express how well his expectations are being met. If federal and state regulatory agencies still feel a need for a service monitoring process, they should be wary of the costs as well as the frailties of some of the historic internal methods. It would seriously be better to consider a new way of keeping pace with changing customer expectations and what is really happening to them.

AT&T's divestiture of the BOCs was achieved remarkably smoothly, and I think service quality measurements played an important part in achieving the changes gracefully (i.e., with relatively few problems in the day-to-day operations of the business). There are few, if any, businesses in the world which have better measurements of the service they provide than has the telecommunications industry.

John R. Ake

Rowland Curry's treatment of the service quality issue framed the problem as a transaction between two groups—the regulator and the regulated. Of course, that reflects a monopoly perception of the telecommunications business. Today, and not necessarily as a result of divestiture, one of the most significant changes that telephone companies face is the growing power of the customers, who now have the opportunity to "vote with their feet." There are several examples, such as the Hinsdale, Illinois disaster, where telephone companies have permanently lost business as a result of temporary service disruption. A new term has been floating around: "vendor diversity." In plain English, it means, "don't put all your eggs in one basket." That is a major problem if you arc an exchange carrier in a region where there are growing numbers of alternative local service arrangements.

At Illinois Bell, the two largest customers by an order of magnitude are MCI and AT&T. This is significant when you consider that the Ameritech region includes the likes of General Motors and Ford. The MCI and AT&T accounts dwarf the automobile accounts by many multiples. These accounts are so important that we hold regular meetings with Joe Reed of AT&T and Ron Spears of MCI, and when they call we pay attention. In fact, Ron has his own index which he uses to remind us of how we are doing, and I will assure you the "Spears" index is more important than any number of individual measurements.

The telecommunications industry has become very internally fo-

cused, often overlooking lessons we can learn from trends in other industries. For example, one of our other neighbors and customers in Illinois is McDonalds, the hamburger people. They devised a system called QSC that made them unique in the fast food business. "Quality, Service, and Cleanliness" became the corporate credo which McDonalds drove back into the supplier chains—into the beef business, the potato business, and the dairy business. This seemingly simple phrase produced tremendous changes in quality levels and in the way those businesses developed and delivered their products. Similar changes are occurring today in the telecommunications business as a result of pressure from companies such as AT&T, MCI, and GM. These customers can and do impact our perception of our service, and the quality level we provide.

I have no empirical evidence for residence and small business customers, but I can relate the trends I sense in the industry. At the time immediately after divestiture, these smaller customers were concerned because they had to make decisions about issues they could previously ignore. Some people do not like to make decisions; some just do not like change. I believe, however, that we have weathered that storm, and the service quality delivered by local exchange carriers is as good or better than it was prior to divestiture.

Where does all this lead us? Away, I believe, from the need for service quality levels and toward a growing faith that the competitive nature of our markets will successfully motivate market participants to provide what customers demand.

There has been a great deal of recent discussion, within and about the local exchange carrier industry, as to the industry's motivations under various alternative forms of regulation. Specifically, the fear arises that increased earnings flexibility will encourage carriers to deliberately degrade service quality and thereby convert expense dollars, otherwise destined for network maintenance, into net income. The argument goes further to conclude that the monopoly environment makes the carriers immune from customer reaction.

If you think about it, this concern is illogical in today's increasingly competitive environment. First, customers do have choices, and the number of those options is increasing constantly. Second, carriers, of whatever type, are, for the most part, switching over to a "pay for what you use" pricing format. Under such arrangements, the call has to be completed quickly and with no "quality" problems in order for the serving carrier to, first, get paid for the service and, second, not experience inordinate "reorder" levels which serve only to drive up cost of

operation. The structure does not really exist, on a widespread basis anymore, under which a carrier can sit back and collect revenues, indifferent to the network quality provided.

Thomas E. Buzas, Sanford V. Berg, and John G. Lynch, Jr.

Our fellow contributors to this chapter thus far have made a number of important points about the quality of local telephone service. Six can be summarized as follows:

1. Companies and regulators take numerous technical measures related to service quality (Rowland Curry, Jonathan Kraushaar, Robert Gryb).
2. Measures are taken with respect to at least three classes of customers: residential, small business, and large business (Kraushaar).
3. There are, however, problems with a lack of consistency in the measures of service quality across regulatory body, company, and time (Curry, Kraushaar).
4. Companies also use consumer inputs, such as surveys, which regulators find too subjective for purposes of regulation (Curry, Kraushaar, John Ake).
5. Analysts need to be concerned about whether the standards are defined appropriately and whether the right things are being measured (Curry, Gryb).
6. Researchers and regulators must pay close attention to how the measures being taken should be combined into an overall index of quality (Curry, Kraushaar).

We shall discuss points 6, 2, and 4. In the present context, the question is whether service quality has improved or deteriorated since divestiture. In the broader context, we are interested in customer and regulator evaluation of company performance.

The answer to the post-divestiture service quality question would be clear if all indicators were improving over time for all classes of customers. Unfortunately, they are not. Curry plots Southwestern Bell's performance in several dimensions of service quality. Post-divestiture

performance appears superior on several criteria, but performance seems to deteriorate for operator answer time. According to Kraushaar, customer perceptions, dial tone performance, transmission quality, and on-time service orders for business customers either improved or remained the same following divestiture, but on-time service orders for residential customers decreased.

Since the indicators are mixed, we need some method of combining performance on the separate dimensions into a summary index. We agree with Curry that the process for determining appropriate weights for the different criteria is difficult and subjective. These difficulties have driven regulators to seek simple solutions that finesse complex measurement issues. An illustration is the index used by Kraushaar to ascertain whether quality declined or increased following the AT&T breakup. He rewards a company with a plus if performance has improved in comparison with the previous period, and penalizes with a minus if performance has declined. He then averages the pluses and minuses. The beauty of this approach is that it gets around the problem of different methods used by the various companies in preparing the data submitted. However, this approach has two important drawbacks.

First, Kraushaar's method treats all dimensions as equally important, in that the same "+1" and "−1" scores are used for changes on all five dimensions. Conceivably, these five dimensions *are* all equally important in the eyes of regulators. It is likely, however, that they are not.

Second, Kraushaar's procedure treats the magnitude of any change from the previous period as irrelevant—all that matters is whether the change reflects an increase or a decrease. For the sake of argument though, consider Kraushaar's table 6.2, where call completions dropped for Southwestern Bell, while dial tone delay, transmission quality and on-time service orders improved. Arguably, a large drop in call completions might outweigh small increases in the others. The plus/minus procedure would not reflect this information.

The question then is how to develop a rule for integrating different levels of performance on several criteria. One approach is to avoid the assignment of an explicit formula. That is, leave evaluation to the best judgment of regulators. In this case, the weights will be implicit, yet just as subjective as any explicit weights might be. Moreover, a wealth of behavioral research shows decisionmakers are inconsistent in the application of their own implicit weights.[1] Inconsistent evaluations will send confusing signals to companies. In particular, effort may be spent improving performance in the wrong areas for which rewards

may not materialize. In addition, undeserving companies may be rewarded and others unfairly penalized for changes in performance indicators.

Thus we agree with Curry that the determination of the weights for different criteria is a crucial issue. There are, basically, three approaches to determining the weights. First, in a competitive market, one could directly relate performance on the different criteria to marketplace choice in the form of a revealed preference analysis or by hedonic pricing analysis.[2] But with regulated monopolies like local telephone service, residential customers have no option to patronize alternative vendors, so this form of analysis is unavailable for this class of customers. To the extent commercial customers have telecommunications options and exercise these options, this form of modeling is available.

Second, one could ask customers about their preferences. It seems beneficial to ask some large commercial customers about their evaluations. As Ake suggests, they likely have investigated the possibility of telecommunications alternatives, and are quite knowledgeable about the importance they attach to different criteria. On the other hand, we are less sanguine about the value of asking residential customers about their preferences regarding the various dimensions of telephone service quality. First of all, they have no incentive to think about these matters, since they do not have the option of choosing different local telecommunications suppliers, nor can they realistically contemplate doing without service altogether. Thus it is unlikely that they have given much thought to the relative importance of the different dimensions of telephone service quality. Even if they had, consumers are ill-equipped to relate performance levels to end benefits. Of course, if we ask consumers to make tradeoffs they will. But, research on behavioral decision theory over the past decade has shown that when prior opinions about the tradeoffs do not exist, the revealed weights are highly unstable and susceptible to minor changes in the elicitation procedures, including question, wording, order, format, and context.[3] In contrast, recent research has shown that respondents who have high levels of expertise or prior knowledge in the value domain being measured are *not* susceptible to these same distorting effects of momentary salience, question wording, format, etc.[4]

Thus, for residential customers, the third available alternative to determine weights, modeling telecommunication experts' views of consumers' tradeoffs among different levels of performance on various technical demensions of quality seems the best (albeit not perfect) approach.[5] There are several ways to do this.[6] Modeling can use meth-

ods of conjoint analysis, information integration theory, and policy capturing. We have used one variant, hierarchical conjoint analysis,[7] to model the preferences of thirty-nine employees at six organizations: the Florida Public Service Commission (FPSC) and five local telephone companies operating in the state of Florida.[8] The thirty-eight rules covered in the study are listed in exhibit 6.1. In brief, we found: (1) a linear function provided a good fit, within the ranges of performance considered, to the experts' tradeoffs; (2) the thirty-eight criteria differed in importance with a one-percentage point improvement for the most important dimension receiving a weight 130 times greater than the least important (table 6.4); and (3) there were no significant differences among the weights based on employer.

Although the incremental weights are subjective, there was substantial agreement about them among experts at the FPSC and at the five telcos, so it appears to be a subjectivity we can tolerate. Partly based on our results, the New York and Florida PSCs are examining the possibility of including our model as part of the normal regulatory process.

If comparable weights were available to Curry and Kraushaar, it might be possible to say whether overall quality has improved or declined. At present, the most that can be said is that performance goes up on some and down on others, but probably has not deteriorated since divestiture.

Let us now turn to consumer surveys about service quality. From the standpoint of behavioral theory, the fact that residential customers have no occasion to make choices among competing local telephone companies renders residential ratings of quality and satisfaction far less meaningful than similar measures in competitive markets. Residential evaluations might be relevant in areas that involve individual, highly salient events for which responsibility can be unambiguously attributed to the regulated company. For example, consumer evaluations of installation and repair services and of operator assistance may be very useful. However, there is no competition among local telephone companies and thus the basis for comparison is unclear. Would consumers rate the telephone company relative to its past performance, as Gryb believes, or to the electric company or even to Sears?

Kraushaar and Gryb have noted that differences between companies or change over time may reflect shifts in perspective, such as changes in expectations, rather than differences in quality. Note that, depending upon one's purpose, one might *want* consumers to rate, for example, telephone installation relative to electricity installation or to appliance installation. Furthermore, the perspective appropriate to regulators may not be the perspective managers find most useful. The point is not that

EXHIBIT 6.1
38 FPSC Rules with Published Standards of Performance

Rule Cluster 1: Dial Tone Delay

1. Dial Tone Delay: 95% of all calls shall receive a dial tone within 3 seconds.

Rule Cluster 2: Call Completions

2. Intraoffice: 95% of all calls to numbers with the same first 3 digits as your own shall be completed.
3. Interoffice: 95% of all calls to numbers with different 3-digit codes but within your home exchange shall be completed.
4. EAS: 95% of all calls to different home exchanges must be completed.
5. Intracompany DDD: 95% of all toll calls within your local company's service area shall be completed.

Rule Cluster 3: Answer Time

6. Operator Answer Time: 90% of all toll calls to a toll office shall be answered within 10 seconds after the start of an audible ring.
7. Directory Assistance: 90% of all calls to Directory Assistance shall be answered within 20 seconds after the start of an audible ring.
8. Repair Service: 90% of all calls to Repair Service shall be answered within 20 seconds after the start of an audible ring.
9. Business Office: 80% of all calls to Business Offices shall be answered within 20 seconds after the start of an audible ring.

Rule Cluster 4: Adequacy of Directory and Directory Assistance

10. Directory Service: A directory conforming to FPSC rule 25–4.040 shall be published within 12–15 months since the last published directory.
11. New Numbers: 100% of all new or changed listings shall be provided to directory assistance operators within 48 hours after connection of service, excluding Saturdays, Sundays, and holidays.

Rule Cluster 5: Adequacy of Intercept Services

12. Changed Numbers: 90% of all calls to numbers that have been changed shall be answercd automatically within 20 seconds.
13. Disconnected Service: 100% of all calls to numbers to disconnected numbers shall be answered within 20 seconds by a recording informing the caller that the number reached is not in service.
14. Vacation Disconnects: 80% of all calls to numbers temporarily disconnected at the customer's request shall be answered within 20 seconds.
15. Vacant Numbers: 100% of all calls to vacant numbers shall be answered

EXHIBIT 6.1
(continued)

within 20 seconds by a recording informing the caller that the number reached is not in service.

16. Disconnects Non-Pay: 100% of all calls to numbers disconnected due to nonpayment shall be answered within 20 seconds by a recording informing the caller that the number is not in service.

Rule Cluster 6: Installation Service

17. 3-Day Primary Service: 90% of requests for Primary Service in any Calendar month shall normally be satisfied within an interval of 3 working days after the receipt of application.
18. Appointments: 95% of appointments kept that are set within time frames of 7–12 A.M., 12–5 P.M., or 5–9 P.M., or for a specific hour of the day.

Rule Cluster 7: 911 Service

19. 911 Service: 95% of all calls to 911 Service answered within 10 seconds.

Rule Cluster 8: Repair Service

20. 24-Hours Restoral: 95% of all customers shall have service restored within 24 hours of reporting trouble.
21. Appointments: 95% of Repair Service appointments kept that are set within time frames of 7–12 A.M., 12–5 P.M., or 5–9 P.M., or for a specific hour of the day.
22. Rebates—Over 24 Hours: 100% of customers whose service is interrupted for more than 24 hours shall be given prorated rebates.

Rule Cluster 9: Public Telephone Service

Sub-Cluster 9a: Functioning of Public Telephones

23. Serviceability: 100% of public telephones must meet all service standards applicable to service to other customers.
24. Telephone Numbers: 100% of all public coin phones must have identified station telephone numbers.
25. Receive Calls: 100% of all pay phones—except in prisons, schools, and hospitals—must be able to receive incoming calls.
26. Dial Instructions: 100% of all public telephone stations should have legible and clear dialing instructions, including notice of the lack of availability of local or toll service.

Sub-Cluster 9b: Enclosure of Public Telephones

EXHIBIT 6.1
(continued)

27. Accessibility to Handicapped: 100% of all stations installed since January 1, 1987, must be accessible to the handicapped.
28. Cleanliness: Normal maintenance shall include inspection and reasonable effort shall be taken to insure cleanliness and freedom from obstructions of 95% of all coin stations.
29. Lights: 100% of all public telephones must be lighted during hours of darkness when light from other sources is inadequate to read instructions and to use the instrument.

Sub-Cluster 9c: Coin Operations of Public Telephones

30. Pre-Pay: 100% of all coin-operated public telephones allow Pre-Pay. They provide a dial tone, require coin deposit prior to dialing (except for calls to operator or 911 as discussed in 32 and 33 below), and automatically return any deposited amount for calls not completed.
31. Coin Return: 100% of all coin stations shall return any deposited amount if a call is not completed, except messages to a Feature Group A access number.
32. Coin Free Access-Operator: 100% of all public telephones shall have coin free access to the Operator.
33. Coin Free Access-911: 100% of all public telephones shall have coin free access to 911 Service.
34. Coin Free Access-Directory Assistance: 100% of all coin stations shall allow coin free access or coin return access to Local Directory Assistance.
35. Coin Free Access-Repair Service: 100% of all coin stations shall allow coin free access or coin return access to Repair Service.
36. Coin Free Access-Business Office: 100% of all coin stations shall allow coin free access or coin return access to the Business Office.

Sub-Cluster 9d: Directory Security of Public Telephones

37. Directory Security: 100% of all coin stations have directories available. When there are three or more coin stations in one area, there must be a directory for the local calling area for every two stations. Otherwise, there must be a directory for every station.

Sub-Cluster 9e: Address/Location of Public Telephones

38. Address/Location: 100% of all public telephones have their locations posted, and the identifications of locations coordinated with the appropriate 911 or emergency center.

TABLE 6.4
1985—Generic

Cluster	*Rule*	*Results*	*Difference*	*Weight*	*Score*
1. Dial tone delay	95%	99.8	4.8	.1172	.56256
2. Call completion					
Interoffice	95%	100.0	5.0	.0786	.393
Intraoffice	95%	99.5	4.5	.0813	.36585
EAS	95%	99.5	4.5	.0600	.27
DDD-company	92%	98.8	6.8	.0372	.25296
3. Answer time					
Operator	90%	98.0	8.0	.0114	.112
Directory assistance	90%	96.2	6.2	.0078	.04836
Repair service	90%	97.8	7.8	.0082	.06396
Business office	80%	98.8	18.8	.0070	.1316
4. Directory					
Directory service	100%	100.0		.0298	
New numbers	100%	100.0		.0105	
5. Intercept services					
Changed numbers	90%	100.0	10.0	.0114	.144
Disconnected	100%	100.0		.0188	
Vacation	80%	80.0		.0037	
Vacant	100%	100.0		.0186	
Non-pay	100%	97.4	−2.6	.0304	−.07904
6. Availability of service					
3–day primary	90%	97.1	7.1	.0342	.24282
Appointments	90%	95.7	5.7	.0470	.2679
7. 911 Service	95%	95.0		.0885	
8. Repair service					
24–hour restoral	95%	96.9	1.9	.0170	.0323
Appointments	95%	96.9	1.9	.0213	.04047
Rebates	100%	100.0		.0024	
9A. Functioning of public telephones					
Serviceability	100%	97.3	−2.7	.0234	−.06318
Telephone numbers	100%	98.2	−1.8	.0163	−.02934
Receives calls	100%	100.0		.0092	
Dial instructions	100%	100.0		.0241	

TABLE 6.4 (continued)
1985—Generic

Cluster	*Rule*	*Results*	*Difference*	*Weight*	*Score*
9B. Enclosure					
Handicapped	100%	100.0		.0057	
Cleanliness	95%	100.0	5.0	.0037	.0185
Lights	100%	100.0		.0050	
9C. Coin operations					
Pre-pay	100%	100.0		.0114	
Coin return	100%	98.2	−1.8	.0063	−.01134
Operator	100%	100.0		.0021	
Directory assistance	100%	100.0		.0046	
911 Service	100%	100.0		.0015	
Repair service	100%	100.0		.0011	
Business office	100%	100.0		.0013	
9D. Directory	100%	94.4	−5.6	.0009	−.00504
9E. Address/location	100%	99.4	−.6	.0198	−.01188
Total weighted score:					2.71646
Rating (wt. score + 5.9244)					8.64086

consumer input is meaningless, but that asking the questions in a manner that is meaningful to regulators is not an easy task.

Earlier comments in this chapter represent an important attempt to examine the impact of divestiture on local telephone service quality. Although the bottom line is somewhat mixed, service quality has probably not deteriorated since divestiture. But the comments also underscore the importance of developing better indicators of industry performance. We have described one such effort where the weights for one-percentage point improvements were derived from telecommunications experts. We look forward to seeing future analyses of the value of service quality. Of course, the costs of achieving different levels of performance must be factored into the analysis as well.

Lawrence P. Cole

Rowland Curry has presented figure 6.2., "Service Orders Worked," which indicates that on the eve of divestiture the bottom fell out of a

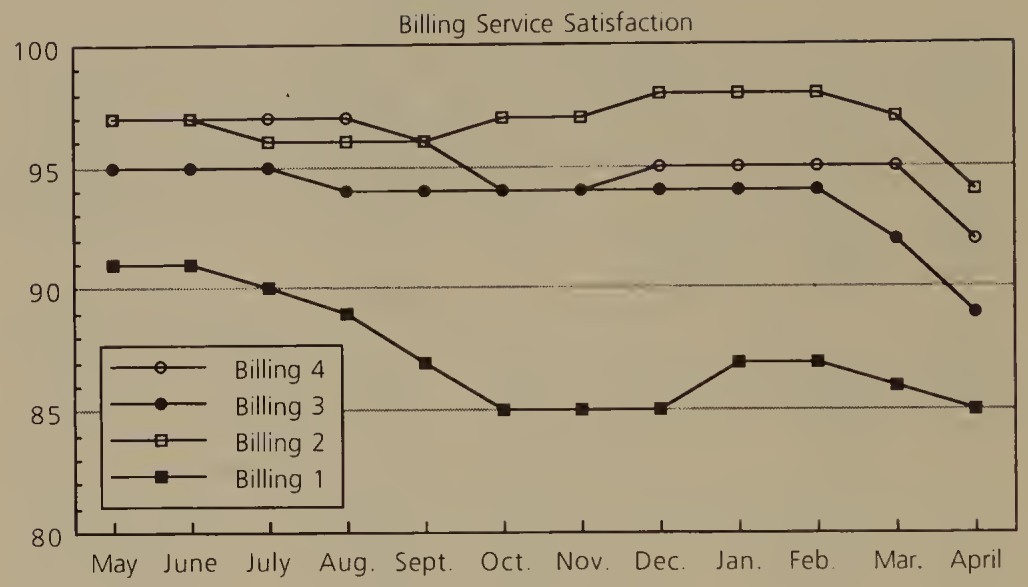
series reported by Southwestern Bell to the Texas PUC, but it later recovered and resumed its pre-divestiture trend. This, of course, is an example of the type of evidence used to determine whether divestiture affected any aspect of service quality. An economist or statistician will examine a data series more extensively where something appears to happen coincident with the event of interest, in order to determine what actually happened. When Curry did that, he satisfied himself that whatever happened with respect to telecommunications service quality was not related to divestiture.

Figure 6.3, entitled "Operator Answer Time," also depicts an index Southwestern Bell reports to the Texas Commission. Again, Curry finds nothing that needs investigation. I look at that series and see a slope coefficient that is horizontal from 1978 until mid-1984, and then I see what may be a sharp upturn in that slope. Although there may not be enough information here yet, there are techniques for testing whether the slope coefficient has, in fact, changed. Then it is a question of whether the trend is attributable to divestiture, or one of the other events, noted by various authors in this volume, that occurred in this period, including CPE deregulation and equal access activity.

Trends in customer satisfaction measures, such as those we at GTE found starting to show up in the monthly surveys we take throughout our serving territories, can be at least partially attributed to divestiture. We ask a variety of questions on these surveys: some are about very specific aspects of services, and some address an overall quality rating. Those numbers, cited in the press and elsewhere, show about 85 or 90 percent of the customers giving the telcos a "good" or "excellent" rating on a subjective scale of "excellent," "good," "fair," "poor," and "bad."

As indicated in figure 6.10, these studies began to show a decline in customer satisfaction with their bills during mid-1985 to mid-1986 for four GTE telcos; but this growing dissatisfaction was purely an issue of confusion. Divestiture meant the local exchange carrier portion of the bill had to become distinct from the interexchange carrier portion, even if the customer did not change long-distance companies. Certainly, other events contributed to confusion on the bills: CPE and inside wire deregulation, the imposition of customer access line charges, and equal access balloting, with the whole timetable of the latter having been tailored to the divestiture. So it would be very difficult to disentangle the effects due to divestiture per se. In any case, we did a great deal of focus-group type research to find out what would help customers better understand their bills. When the findings were implemented, the problem disappeared.

FIGURE 6.10



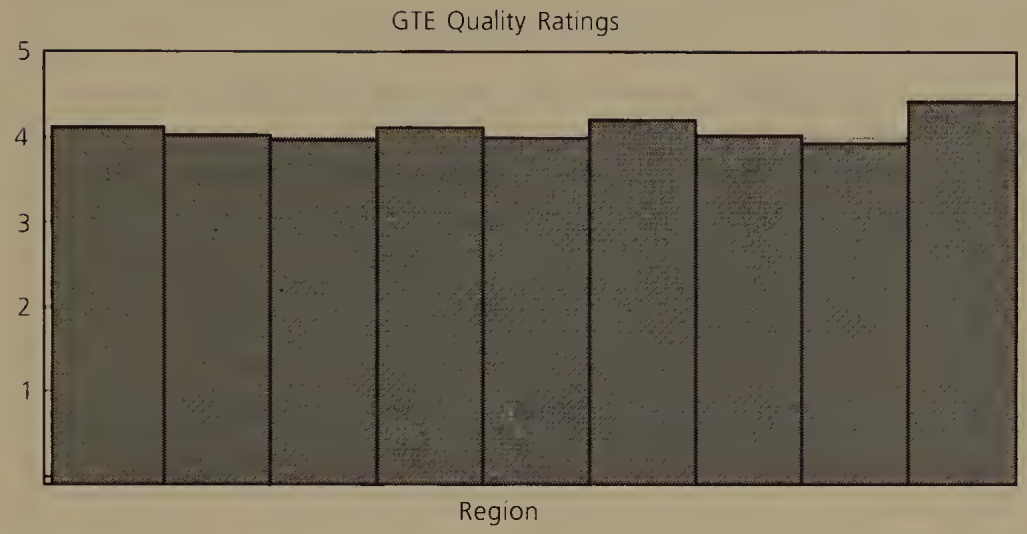
Source: GTE.

We carry on extensive customer perception measurement. Figure 6.11 shows the overall quality ratings for nine GTE companies on a scale of one to five for a typical month. Suppose these were available for the RBOCs over the whole post-divestiture period, so that one could do some analysis of them (figure 6.12). One interesting undertaking would be to examine of the relationship, if any, between the behavior of the RBOCs' quality ratings over the five-year period, and their earnings performance as reported in the national business press (figure 6.13).

There are some obvious hypotheses to test in this area. Quite apart from any possible functional relationships between earnings and quality, there is also a question of how the RBOCs' quality ratings relative to one another have varied over time. Presumably a pre-divestiture view would have found them to be fairly tightly bunched due to the central administration of the Bell System. Would we now expect to find more dispersion between the highest ranked and the lowest ranked RBOC? And would that be a direct consequence of divestiture?

Also as a result of divestiture, long-distance customers may deal with as many as three carriers in order to complete a single call. In that connection, I call your attention to a series of articles in the *IEEE Communications Magazine* for October 1988, an issue entirely devoted to quality and other aspects of standards and measurement of service quality in a very informative way. In one of those articles, "National

FIGURE 6.11



Source: GTE.

FIGURE 6.12

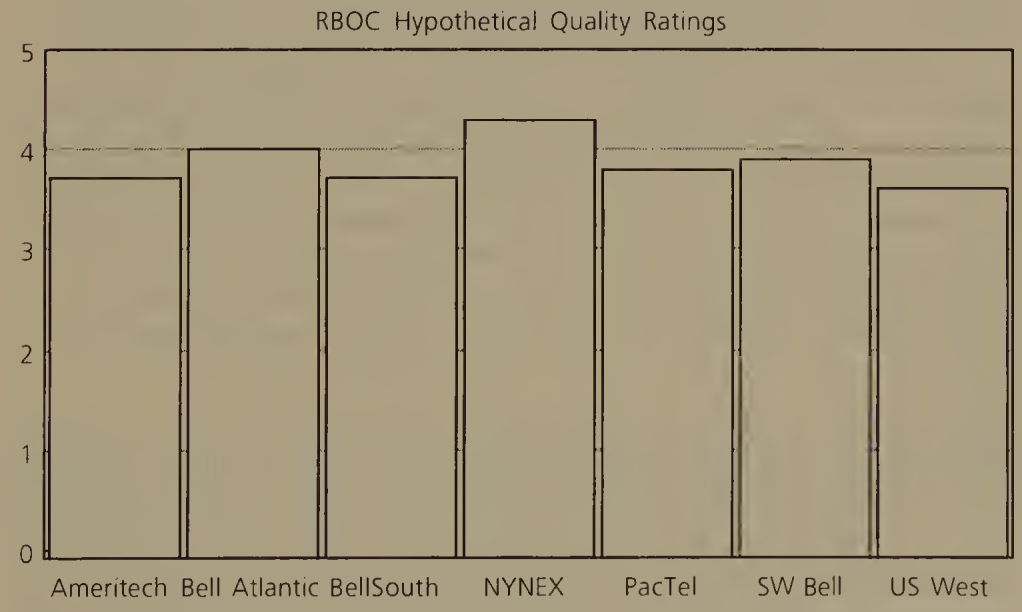
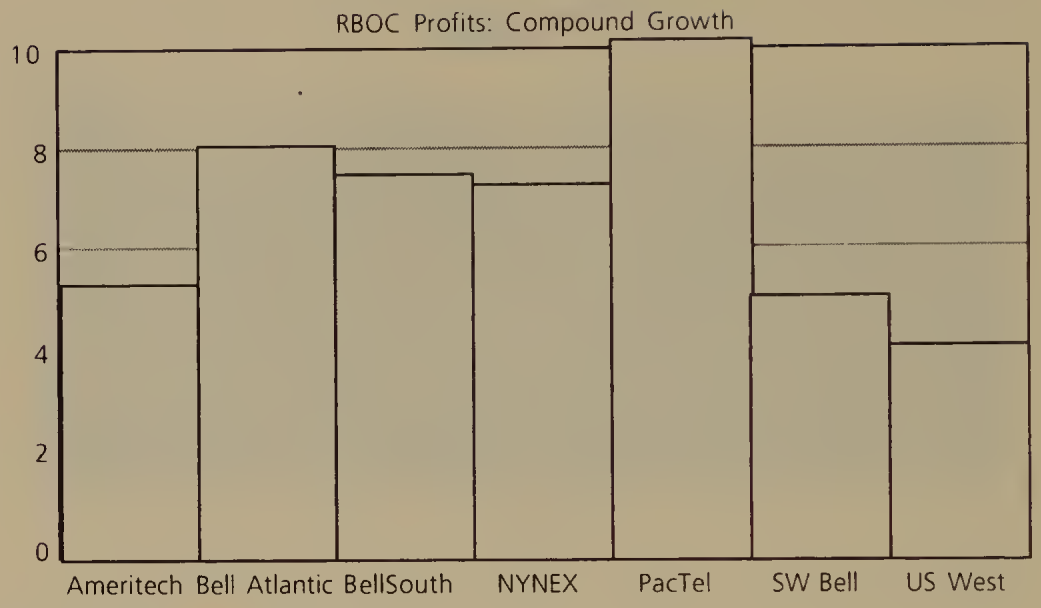


FIGURE 6.13



Source: *Fortune*, January 2, 1989.

Performance Standards for Telecommunications Services," Melvin N. Woinsky states:

> The multicarrier, multivendor structure for providing telecommunications services clearly calls for national standards to support compatibility and interoperability. The pieces must 'plug together' in order for service to be provided. A need for performance standards, however, is not as evident. Long-distance end-to-end services are competitive and it can be argued that the performance level is a characteristic of the service to be determined by customer needs and willingness to pay in a free market environment. Standards should not impede competition based on service performance level nor unnecessarily restrict the price/quality options available to customers, nor should standards impede the introduction of beneficial new technology.

I think this view echoes Robert Gryb's remarks about the customer perception measures being more important than some of the traditional quality measures. And it is the customer's determination of quality that ought to count. There may be needs for various standards for technical reasons, but those standards should not limit the range of quality options that can be offered.

From the point of view of those who work in the area of the statistical validation of the service quality measures, the questions that natu-

rally arise are, "Why this particular set? Why four versus five measures? What is the research basis for these particular items? Also, what is the connection between these measures and what truly concerns customers?"

We have studied some aspects of what constitutes a quality contact between a customer and a customer service order center (CSOC). Some PUCs have standards that require 80 percent of the calls coming into a CSOC to be answered in 20 seconds. This may be a perfectly valid standard, but how important is it to customers? No one wants to be put on hold for a long period of time, either to get a sales pitch or to have music played at him, but it is clear that other things may be more important to customers than the specified twenty seconds. Thus, if, as suggested, increased FCC service quality monitoring is one of the results of price caps, there should be a discussion devoted to which measures are used, how many, and why.

Thomas Buzas, Sanford Berg, and John Lynch usefully remind us of the fact that service quality is multidimensional. They then assert, "Since the indicators are mixed, we need some method of combining performance on the separate dimensions into a summary index." This is not at all obvious. Why do we need an index? And, if we do need something that somehow incorporates the many dimensions of quality, why should it be anything other than the overall quality rating perceived by customers, as measured as best we can with state-of-the-art survey methods?

Consider the thirty-eight dimensions of service quality used in the Florida study reported by Buzas, Berg, and Lynch. How would the threatened "possibility of including our model as part of the normal regulatory process" work in Florida? If quality falls below the standard set by the PUC along one or more of those dimensions, must those dimensions be directly and individually addressed by the company, or must the index be improved? Suppose the index fell, but no standard was violated, except maybe a standard for the index value itself. Could the company then get the index back up to snuff without improving service quality along the dimensions whose decline led to the fall of the index in the first place? Could it raise quality along dimensions that were relatively easy and inexpensive to improve, or could it shore things up along those dimensions it knew mattered most to its customers? (These two sets are not necessarily mutually exclusive.)

Note these questions are analogous to the many questions asked about the proposed use of price indices in implementing price cap regulation plans. That suggests the imposition of the Buzas, Berg, and Lynch quality monitoring scheme could be accompanied by upper and

lower bands on service quality changes and baskets of quality dimensions.

Implicit in the last question above is the presumption, among others, that some of the items in the Florida list do not matter much to customers. In general, our research indicates that customers do not give half a hoot, much less two, for some of the commonly imposed regulatory standards of service quality. Now, maybe the Florida list is based on careful study of what Florida residence and business customers really care about, and those thirty-eight items are all significant. But one gets the impression from the analysis that the list consists of items that the regulators think consumers should regard as important, and furthermore, that consumers are not even considered competent to determine their relative importance.

I have a difficulty understanding why asking residential customers about their preferences regarding the various dimensions of telephone service quality is not the best of the three alternatives offered by Buzas, Berg, and Lynch. Note that I refer to *preferences,* not *judgments* about technical matters. It seems to me to be definitional in a market economy, especially in market segments where customers have no choice of service providers, that it is totally inappropriate to ask anybody else. Whose interest is regulation supposed to be protecting where competition is lacking? And since when have customers been required to have any particular competence in order to have a preference? (Many of us who do not know much about art, know what we like when we see it.)

In fact many customers have dealt with other providers in other locations where they have resided, or they may work in areas served by a different company than the one that serves their residence. They also may have dealt with more than one interexchange provider. Furthermore, doing business with a phone company is not unlike doing business with several other service industries. Therefore, I think customers have an adequate experiential basis for evaluating service quality. As for consumers being ill-equipped to relate performance levels to end benefits, they are not alone. Nor will they be, until studies establish relationships between objective performance levels based on measures that engineers and regulators are fond of and customer ratings of service quality. Presumably the latter are the end benefits that count: customer satisfaction with what they get, relative to what they pay.

ENDNOTES

1. For example, see C. Camerer, "General Conditions for the Success of Bootstrapping Models," *Organizational Behavior and Human Performance* (1981), 27:411–22.

2. Sherwin Rosen, "Hedonic Prices and Implicit Market Product Differentiation in Pure Competition," *Journal of Political Economy* (1974), 82:34–55.

3. Logically equivalent ways of asking about preferences yield different preference orderings, and dimensions that are made momentarily salient or that can be easily articulated receive disproportionate weight. James R., Mita, and Sujan Bettman, "Effects of Framing on Evaluation of Comparable and Noncomparable Alternatives by Expert and Novice Consumers," *Journal of Consumer Research* (1987), p. 14. Baruch Fischhoff, Paul Slovic, and Sarah Lichtenstein, "Knowing What You Want: Measuring Labile Values," in T. Wallsten, ed., *Cognitive Processes in Choice and Decision Behavior* (Hillsdale, N.J.: Erlbaum, 1980), pp. 117–42. Timothy D. Wilson, Dana Dunn, Dolores Kraft, and Douglas J. Lisle, "Introspection, Attitude Change, and Attitude-Behavior Consistency: The Disruptive Effects of Explaining Why We Feel the Way We Do," in L. Berkowitz, ed., *Advances in Experimental Social Psychology* (Orlando, Fla.: Academic Press, 1989), 22:287–343.

4. James R., Mita, and Sujan Bettman, "Effects of Framing on Evaluation of Comparable and Noncomparable Alternatives by Expert and Novice Consumers," (1987), p. 14. Feldman and Lynch, 1988. J. Wesley Hutchinson, "On the Locus of Range Effects in Judgment and Choice," in R. Bagozzi and A. Tybout, eds., *Advances in Consumer Research* (Ann Arbor, Mich.: Association for Consumer Research, 1983), vol. 10. John G. Lynch, Jr., Dipankar Chakravarti, and Anusree Mitra, "Distinguishing Contrast Effects Caused by Changes in Mental Representation from Those Caused by Changes in Response Language," Working Paper, University of Florida, 1989. Timothy D. Wilson, Dolores Kraft, and Dana Dunn, "The Disruptive Effects of Explaining Attitudes: The Moderating Effect of Knowledge about the Attitude Object," *Journal of Experimental Social Psychology* (1989), p. 25. These distorting effects all operate in the process of constructing tradeoffs at the time of measurement, but those with high levels of expertise need only retrieve tradeoffs that existed prior to measurement and that are accessible in memory.

5. Ideally, these experts' judgments would be informed by various measures of customer satisfaction with service, but would not treat these measures as defining quality. Technical knowledge allows such experts: (1) to have some understanding of how levels on measured technical dimensions relate to end benefits; (2) to factor in externalities, as for example, when certain customer groups would not choose to pay for certain dimensions of quality, and this decision affects others who call them (Eli Noam, "Questions by Commissioner Noam Concerning the Establishment of Economic Incentives to Quality Performance by New York Telephone as Part of the General Treatment of its Rates," NYPSC Report to Hon. J. Michael Harrison, Administrative Law Judge, 1989); (3) to respond to questions about tradeoffs without undue distortions due to normatively irrelevant details of the questioning procedure.

6. For a well-written nontechnical explanation of the basic approach, see Paul Green and Yoram Wind, "New Way to Measure Consumers' Judgments," *Harvard Business Review* (July–August 1975), 53:108.

7. Jordan Louviere, "Hierarchical Information Integration: A New Method

for the Design and the Analysis of Complex Multiattribute Judgment Problems," in Thomas Kinnear, ed., *Advances in Consumer Research* (Provo, Utah: Association for Consumer Research, 1984), 11:148–55.

8. Thomas E. Buzas and John G. Lynch, "A Formula for the Comprehensive Evaluation of Local Telephone Companies: Report to the Florida Public Service Commission," University of Florida, Public Utilities Research Center, Working Paper, 1989. Thomas E. Buzas, John G. Lynch, and Sanford V. Berg, "Regulatory Measurement and Evaluation of Telephone Service Quality," University of Florida, Public Utilities Research Center, Working Paper, 1989.