GUIDELINES TO ESTABLISH SERVICE OBJECTIVES FOR COMPUTER-BASED INFORMATION SYSTEMS

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1. GENERAL

1.01 The purpose of this section is to:

(a) Provide a set of guidelines for project managers on how to establish the Service Objectives used in the development and operation of computer-based systems

(b) Outline what is a Service Objective, how they are measured, and the types that should be defined

(c) Describe how to use the service characteristics of system objectives as aids in controlling the development process

(d) Describe the use of Service Objectives in an operational computer-based information system, their modifications to reflect local conditions in negotiating service agreements (Section 007-505-320), and their inclusion in any service measurement plan.

1.02 The reasons for reissuing this section are listed below. Revision arrows are used to emphasize the more significant changes.

(a) Further clarifies which projects are expected to establish Service Objectives as well as the organizations to be involved.

(b) Removes the description of the banding concept of measurement from this section and makes reference to Section 007-505-100*, User Service Reporting System (USERS) for Computer-Based Information Systems to which it has been added.

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(c) Eliminates Exhibit 6 (Sample Size Selection) and provides a rewrite of Exhibit 4 (Statistical Measures). This strengthens the coverage on statistical measures.

1.03 This section is a guideline. The procedures described are recommended for use by users, service providers and developers of both centrally developed systems (CDSs) and locally developed systems (LDSs). Also, this section does not pertain to the setting of Service Objectives for systems other than computer-based information systems as defined above.

1.04 This guideline has been developed by American Telephone and Telegraph Company (AT&T)—Information Systems Results group, with the assistance of a multicompany project team.

1.05 Service Objectives, as described in this section, are the basis for negotiating a local service agreement. This agreement defines acceptable levels of service, among all participants of an operational computer-based system. Guidance in measurement techniques (eg, sample design including which statistics to use) should be requested from the local Operating Telephone Company's (OTC) Business Research Organization. The designated Service Objectives agreed to in these local service agreements could form the basis for local or systemwide measurement plans.

1.06 The extent to which these guidelines are followed should depend on the size and scope of the project. If the project is a candidate for a service measurement plan, which requires negotiated service agreements, additional emphasis should be placed on following the procedures recommended by this guideline for the establishment of Service Objectives.

1.07 The information systems covered by this section are operated internally in the Bell System and the products and services are used by company employees. As such, the plan measures the service being provided to company employees rather than the generally recognized standards established over the years by the Company and by State and Federal Regulatory Agencies for the control and measurement of telephone service provided to the public.

2. DEFINITION OF SERVICE OBJECTIVES

2.01 Service Objectives identify those areas of system performance critical to operational user service requirements. Service Objectives are expressed in terms of timeliness and availability of the essential services to be delivered. For example, Service Objectives might specify response time for online transactions, delivery schedules for printouts, update and recovery times for data bases, etc. Service Objectives cover the criteria for provision of service to meet the user requirements in a cost-effective way for the total corporation. They also provide a vehicle for measurement of this service in an operational environment.

2.02 Service Objectives are a subset of system objectives as described in Section 007-227-310, Developmental Documentation Specifications—General Information. Service Objectives pertain only to the performance aspects of the system's products and services provided to the user, while ***system*** objectives cover such additional items as force or expense reductions, enhanced record keeping, etc.

2.03 Each Service Objective established for a computer-based information system consists of a specific performance goal to be measured (eg, the expected response time for transaction XYZ) and the manner and criteria which are used to decide the measurement (eg, response time for transaction XYZ will be 10 seconds or less 98 percent of the time).

2.04 Development of Service Objectives begins in the feasibility and definition phases of Total System Development (TSD) with the identification of the system objectives. (See Part 6.) As development progresses, the essential user services to be measured during system operation are specified in greater detail and the actual Service Objectives are developed.

2.05 The performance characteristics of system objectives should be identified early in the system development effort and be based on the systematic collection of user's requirements as indicated in this document. Thorough research and documentation on the services required will allow for selection of valid Service Objectives for measurement during system operation.

2.06 During the ***development*** process, Service Objectives provide the project manager and the developers with an important portion of the information needed to:

(a) Review progress and keep the user informed of any changes in design specifications

(b) Assist in deciding project resource requirements

(c) Determine the categories and levels of measurable performance of computer-based information systems which are to be subsequently tracked in the operational system to monitor compliance

(d) Obtain project approval at the end of each phase

(e) Evaluate alternative systems

(f) Determine what performance measurement facilities, capabilities, and tools need to be built into the system

(g) Determine what resources may be required for implementation and conversion.

2.07 The more precisely the Service Objectives are stated during feasibility, the more effective their implementation. Vague statements of these Service Objectives force the developer to make more assumptions of what is required. This can only lead to the development of a system that is less likely to meet the needs of the users.

2.08 During the conversion and initial installation of a system, the Service Objectives are used as the basis for the initial, locally negotiated service agreement.

2.09 During the ongoing life of the system, compliance with Service Objectives is tracked to ensure that the system continues to meet the level of service specified in the service agreement. The necessary control provisions such as logging instructions, supporting documentation requirements, verifications, authorizations, transmittals, etc, should be included in the design of an information system to ensure reporting accuracy, completeness, and security. See Section 007-209-201*, System Control Standards and Section 007-209-302*, System Control Guidelines.

2.10 User ***dissatisfaction*** with a system is usually ***cumulative*** and does not come to the attention of management until after the situation has markedly deteriorated. Service Objectives along with the related system objectives provide all parties involved in the development and use of a system with current and specific documented information on the intentions of the system. This benchmark knowledge allows for the early recognition of deviations from objectives and permits their resolution ***before*** the problems become critical.

2.11 The Service Objectives covered in this practice are intended to address only the performance of the services or products delivered to the users of a computer-based system. They are not intended to cover the use made of these products or services by the user which should be covered by another measurement plan. For example, response time to users employing terminals would be a Service Objective, but the further use of that information in dealing with the telephone customer would be part of a different system or measurement.

3. SERVICE OBJECTIVES SELECTION

3.01 Service Objectives are identified during the feasibility phase with the selection and analysis of user service requirements. The tasks to be performed by the project team studying the problem/opportunity (see paragraph 6.02) are as follows:

(a) Identify all users of the system products and services

(b) Conduct an analysis of user needs, based on user expectation research, task forces, user groups, etc

(c) Analyze the assumptions and constraints

(d) Clearly and concisely define the characteristics that constitute the basic parts of the service to be provided in nontechnical terms

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(e) Ensure that the various users communicate their service requirements fully and that the project team assists them in reaching agreement on the Service Objectives to be measured.

3.02 Once an initial list of Service Objectives has been agreed to, the project team should request technical representatives (eg, from information systems, network services, system analysis, etc) to assist the project team to:

(a) Priority rank each Service Objective (eg, vital, necessary, desirable, regulatory agency requirement, etc)

(b) Test the Service Objectives against the technical representative's experience and knowledge to ensure that the Service Objectives chosen are correct, achievable, and cost-justified

(c) Select those key elements that should be measured as indicative of the system's performance.

Classes of Objectives and Measurements

3.03 There are basically two classes of Service Objectives and measurements: delivered and internal diagnostic.

Delivered

3.04 Delivered Service Objectives are the essential components that reflect overall system performance expectations. They normally cover the principal system products and services provided for the end user. The response time provided to a terminal user of an on-line system is an example of this class of objective.

3.05 Only delivered Service Objectives should be employed in both local and Bell System measurement plans. They represent the key drivers that indicate ***overall*** system performance and user satisfaction. As such, they will be included in service agreements.

Internal Diagnostic

3.06 Internal diagnostic Service Objectives cover the intermediate processing steps required to produce the end service or product to the system user. As such, they contribute to and influence the specified delivered Service Objectives, which is the primary concern of the users. (In many cases, the performance of these intermediate steps is transparent to the users.) Examples of this class of Service Objectives are the communications facility and computer equipment transit times which contribute to the overall response time mentioned above.

3.07 Although not to be included in formal measurement plans, it is recommended that this class of Service Objective be identified and specified as to their impact on their related delivered Service Objective. For ongoing systems, these intermediate processes should be tracked to identify trends or causes of unsatisfactory performance. Internal diagnostic Service Objectives may be included in service agreements, primarily for administrative purposes, as well as the recording and reporting techniques. For example, the service agreement may specify that the internal diagnostic Service Objective will only be measured when its corresponding delivered Service Objective falls to a specified performance level and until it again attains its objective level.

4. TYPES OF SERVICE OBJECTIVES

4.01 As stated in paragraph 2.01, the Service Objectives (Exhibit 1) of a computer-based system are usually concerned with the timeliness and availability of the service to be provided.

(a) ***Timeliness:*** Is the specific service performed or delivered on time?

- This factor applies to both batch and on-line modes of processing (and hybrid systems) and is concerned that the services provided are performed, processed, delivered, etc, at a time commensurate with the needs of the business in a cost-effective manner.

- Examples of this type of Service Objective are (1) transaction response times at terminals used in on-line systems and (2) delivery of a printout report produced in a batch process.

(b) ***Reliability/Availability:*** Is the facility operational for processing when scheduled or required?

- In many cases, several handlings outside the computer room of an output may be required before the user receives the product. Networks, front-end computers, concentrators, and internal or external delivery services all may be part of a system. The user's concern is not how the output got to its destination, but is the service dependable.

- An example of this class for on-line systems is user terminal availability.

- Batch system availability tends to be invisible to the user. The processing and delivery of system products encompasses both timeliness and availability for batch systems. For example, a computer facility may be out of service for a period of time and still be capable of meeting its scheduled batch commitments.

5. SERVICE OBJECTIVE WORKSHEET

5.01 Service Objective selection allows the project team to select the critical performance requirements of a system from the broad range of all aspects of system performance. Exhibit 2, Example 1 contains a worksheet to aid in identifying Service Objectives. Exhibit 2, Example 2 is a sample of a completed Service Objective Worksheet. This worksheet would also be useful in defining the Service Objectives (components) used in service agreements. It should be noted that the information shown in Exhibit 2, Example 2 is for illustrative purposes only.

5.02 A separate worksheet should be filled out for each Service Objective contemplated for a system. The first time the worksheet should be used is during the feasibility phase of system development. The worksheet should act as a framework for a Service Objective, providing a central document to record what is known about the Service Objective and what needs to be determined. The discipline of adding to the worksheet as the development phase progresses should result in a clear statement of the performance goals of the system. The complete worksheet would fulfill the requirements for the system objective documentation which is reviewed during the development process.

6. SERVICE OBJECTIVES IN TOTAL SYSTEM DEVELOPMENT

6.01 This section describes the requisite steps in the evolution of Service Objectives which must be considered during the Total System Development process. It further expands on the description previously given in Part 2 of this section and relates the development of Service Objectives to the project management process (Section 007-208-310, Project Management). The careful review and refinement of Service Objectives during the entire development process promotes better understanding of the attainable and achievable services to be provided in the delivered system.

6.02 The first draft of the Service Objective is the responsibility of the project manager whose department sponsors the development of a computer-based information system assisted by representatives of the potential users of the system. For systems in one company, user representatives from the various departments and/or geographical areas would participate. Bell System projects would have representatives from the various OTC user departments. They would use their collective knowledge of the problem (or opportunity) and of the user environment to review alternative approaches and Service Objectives. It is this group's function to analyze the system objectives and to identify the realistic, achievable, measurable, and cost-effective Service Objectives required to meet the performance goals of the system.

6.03 The developer and the project manager each have a set of responsibilities to accomplish. For the system to achieve its Service Objectives, however, balance must exist between the people, money, time, equipment, and procedures required for project implementation. This reconciling of resources is done by the project manager and the developer throughout the development process by providing the organization and controls necessary.

6.04 A project team review should be conducted in each phase of the TSD process to determine if the original service-related objectives are still valid and achievable or require modification. Any changes agreed upon with the developer should be acknowledged in writing and included in the TSD end-of-phase documentation.

6.05 The project manager, with the assistance of the project team representatives, should select those Service Objectives that will actually be measured during system operation. These performance goals become the official Service Objectives. Every attempt should be made at this point to assure that adequate provisions have been included in the system design to allow for effective measurement of the Service Objectives.

6.06 Any Service Objective proposed should be evaluated, not only with regard to its primary purpose of service reporting, but also its ability to identify where improvements are needed and to analyze the effects of changes made to the system.

6.07 The benefits and costs of the system to the corporation and not for any one department should be the emphasis of the economic study (see Feasibility Report Guidelines, Part 10, References) that is done at this time. The balancing of corporate goals, human factor considerations, hardware capabilities, the time value of money, sensitivity testing, and risk analysis should also be included in the economic analysis called for in the development of any computer-based information system.

6.08 With the satisfactory conclusion of the system trial or individual certification test, the system is capable of producing results that satisfy the stated system objectives, including the Service Objectives, ***if it is operated in a specific environment as noted in the System Description (described in Section 007-230-210).*** Variations from the stated results should be expected if the environment is different.

6.09 Major releases of the system should include an update of the deliverable documentation that specifies what effect, if any, there will be on the Service Objectives. This may require renegotiation of certain aspects of local service agreements.

7. SERVICE OBJECTIVES IN OPERATIONAL SYSTEMS

7.01 Service Objectives provide the performance measurement input to local service agreements. The Service Objectives supplied by the developer may be modified to reflect local conditions as part of the development of a local service agreement. Additional objectives that are considered important at a particular site are added to a service agreement. These service agreements are negotiated between the users and processors of computer-based information systems and set out in writing what each party expects of the system. The System Administration Guide will provide additional details on the uses of a service agreement in managing a system (see Section 007-230-210). Negotiating and signing the service agreement cause the various parties to acknowledge their own system responsibilities as well as those of the other signatories.

7.02 Service Objectives in operational systems at local sites allow management to:

(a) Measure and evaluate conformance to the stated system goals

(b) Control the performance of the system

(c) Determine if the system needs modification

(d) Ascertain if the participants in the system are fulfilling their responsibilities

(e) Determine if new objectives and, therefore, new system modifications are needed

(f) Ensure that users receive the agreed upon service.

7.03 The measurement of Service Objectives called for in the service agreements should become part of a regular reporting procedure to monitor the performance of the system. The AT&T Information Systems Results group is available to assist in the development of prototype service agreements for information systems, particularly the CDSs. Subsequent AT&T project manager consultation with each OTC in drafting their individual agreements will provide an effective interchange of ideas among companies and will help prevent duplication of efforts.

7.04 Regular reporting of Service Objective performance should be helpful in identifying problem areas in the Service Objectives, the system, or the organization failing to meet the required Service Objectives.

7.05 Summarization of the performance data forms the basis for both local and systemwide measurement plans. A formal record of all problems should be maintained and reported on an annual basis.

7.06 It is recommended that Service Objectives be reviewed periodically and updated for systems that are in operation (see Section 007-505-320, Guidelines to Produce a Service Agreement for Computer-Based Information Systems). They should also be negotiated for systems already in operation that do not have a service agreement. They should be stated in a form suitable for inclusion in such an agreement.

8. MEASUREMENT CONSIDERATIONS

Measurement Techniques and Tools

8.01 In establishing Service Objectives, consideration must be given to the tools and methods required to measure the stated Service Objectives in an operational system. In many cases conventional and commercially available devices, packages, methods, etc, may be available. One example is the use of the computer vendor's software facilities to provide throughput data, job completion times, etc. Where Service Objectives are established for which these are not applicable, consideration should be given by the developers to incorporating the data collection features within the system itself. For example, the capability to capture the required performance data might be imbedded within the system code. Another alternative is the stopwatch (see Exhibit 3). In those cases where it is extremely difficult or impossible to measure the Service Objective, consideration should be given to using a less desirable measure of the Service Objective until appropriate monitoring tools can be developed.

Boundaries of Measurement

8.02 When stating a Service Objective, the measurement boundaries must be made clear. For each Service Objective the interface points where the measurement will be taken, ie, the delivery point location(s) for a batch report, should be clearly stated. It is important to ensure that the boundaries of measurement are sufficient to cover the points where actual user service is provided. For example, it would not be appropriate to use the time a report is printed as a measure of its availability to the user. The report is only available when the user can begin to work from the report; therefore, a measure at the point of delivery would be far more accurate.

Measurement Procedures

8.03 The following items relating to measurement should be defined for each Service Objective:

- The source of the measurement information, eg, vendor logs, stopwatch, manual log, etc
- The measurement formula or other method including sampling, continuous measurement, etc
- Time period of measurement
- Points at which measurement is to be taken, ie, user terminal
- Performance level, eg, 5 seconds response time 90 percent of the time
- What tools are required to measure performance, ie, software, hardware, or manual
- The organization responsible for recording and/or processing of the performance data
- The personnel responsible for taking action when objective service is not achieved
- The actual course of action required when objective service is not achieved.

Clarity of Measurements

8.04 The performance level of each Service Objective should be described with a proper and appropriate statistical measure (see Exhibit 4). These statistics should be easy to understand, use, and interfere as little as possible with the process being measured. Early selection of the measurement technique can ensure that it meets these criteria and continues to be statistically valid. Avoid statistical pitfalls such as trying to average percentiles. Exhibit 4 contains material to assist in developing performance measures for batch processing products such as reports.

Measurement During Overload Conditions

8.05 By definition, a system cannot perform all its functions within the criteria when the systems are overloaded. Unless specific precautions are taken, some systems may simply stop or have service

degraded beyond usability. A common strategy for overload performance is for the system to make some lower priority services unavailable and to provide a limited amount of high priority services with impaired but adequate timeliness. The system service criteria should include specification of services which will be provided during overload, how much of each service will be provided, and how timely the service provided will be.

Measurement Statistic

8.06 After the appropriate statistic for a Service Objective has been selected, it is necessary to develop a range of allowable values in order to complete the process. For example, selecting a statistic for measuring on-line system response time requires specifying the time units and the numerical value (eg, 8 seconds or less 90 percent of the time for a prescribed period). The process used to determine the proper response time objectives should include a human factors study. (See Response Time, Operator Productivity, and Job Satisfaction; Part 10, References.) The emphasis should be on job function requirements rather than the capabilities or limitations of the equipment. This study results in the proper measurement of Service Objectives that balance customer needs with end user productivity and satisfaction in an efficient and cost-effective manner.

8.07 The techniques employed should allow the capability of adequately expressing the delivered service in meaningful and understandable terms. Using units of measure in Service Objectives which are natural to the user (eg, bills, transactions, checks, etc) will encourage forecasts by the users that are more accurate and make the performance reports understandable to all the participants in the system. It should also minimize any misinterpretation of the reported results, by either the users or providers of service.

On-Line Measurement

8.08 The user's perception of the service provided by on-line systems sometimes differs from what is actually provided. In general, users are bothered most by variability and extremes, particularly in areas of response time and availability. (See Exhibit 4 for more detail on statistical measures.) There should be a complete understanding between the user-requested service and that actually provided and reported.

Batch Measurement

8.09 Batch systems are usually measured in terms of whether or not a report gets to a specific place on or before a certain time. A simple percentage recording of the success ratio can be a confusing way to record such an event. Care must be exercised to ensure that the measurement associated with a Service Objective is meaningful. For example, when five reports are due in 1 month, and one arrives late, the resulting service level is 80 percent; a Service Objective of 90 percent would not be meaningful. Recording how many times an objective is missed can be a more meaningful way to record performance. Alternative batch measurements are discussed in Exhibit 5.

Cost

8.10 Another important consideration in the measurement selection process is the cost and overhead required to acquire, store, summarize, and present the performance statistics. This is especially important when considering the design or selection of a monitoring tool as it impacts any system's logic, storage, and processing requirements.

9. OTHER CONSIDERATIONS

9.01 There are other factors that should be considered in developing Service Objectives. Some of these are listed below and may not be all inclusive or address the unique requirements of particular applications.

- General assumptions and constraints
- Resource consumption and utilization rate
- Scheduling
- Data base
- Backup, recovery, and reorganization
- Subjective evaluation
- Minimization of self-reported data
- Caveats.

General Assumptions and Constraints Associated With Operational Service Objective Development

9.02 Any underlying assumptions upon which the Service Objectives were predicated should be ***documented*** in the developmental material and the service agreement. These might pertain to factors such as:

(a) The skill level of the individual receiving or providing the service

(b) Specific hardware modules, operating systems, and network facilities that may be employed and their interconnection

(c) Input/Output requirements—to/from other systems

(d) Availability of new or proposed systems, hardware, network facilities, etc.

9.03 Any constraints placed upon the system or under which it must operate should also be documented in the developmental material and the service agreement. Examples of this type of restriction are:

- Company policy
- Regulatory restrictions
- Contract restrictions
- Existing organization
- Legal restrictions
- Corporate objectives
- Security
- Technological considerations
- Environmental restrictions
- Economic restrictions
- Safety.

Resource Consumption and Utilization Rate

9.04 The direct association of a resource consumption, such as Central Processing Unit (CPU) utilization, to a Service Objective should be the result of a Service Objective being successfully met within a cost target. Thus, resource consumption data should not normally be considered as a Service Objective. It is, however, very useful to planners and implementors of systems to adequately configure and size the installation to meet stated Service Objectives.

Scheduling Considerations

9.05 Total system input schedules and system output schedules are items frequently covered, as attachments, in service agreements. The following paragraphs describe some of the aspects of scheduling which may affect the associated Service Objectives.

9.06 A schedule for all system inputs and outputs should be documented on a locally developed form. Included in the schedule should be allowances for system outages and other unusual occurrences. A management review of these schedules may reveal if certain Service Objectives are mutually exclusive and may need to be changed.

9.07 Batch product schedules should reflect the production cycles of the system, dependent system cycles, the informational needs of the user, and the resource (including data base) requirements of the system.

9.08 On-line systems require a schedule of system availability. This schedule should contain provisions for:

- Examination
- Test time
- File/data base reorganization
- Backup/recovery
- File retention procedures
- Conversion
- Preventive maintenance.

9.09 The effect of the loss of availability of any interface to an on-line system, including what alternatives are available, should be documented.

Data Base Backup, Recovery, and Reorganization

9.10 Another area for which Service Objectives should be considered is data base backup, recovery, and reorganization.

9.11 The effect of the recovery procedures (Section 007-590-304, Computer Center Physical Security and Disaster Recovery—Contingency Planning and Disaster Recovery) on the Service Objectives should be documented. Time (clock hours) estimates of data base recovery or reorganization activity and which Service Objectives will be affected should be included in the detail design end-of-phase documentation.

Subjective Evaluation

9.12 Service Objectives must minimize the potential for subjective evaluations or misinterpretation. Such measures as quality of output should only be considered as a Service Objective if they can be specifically identified and a measurement method defined.

Minimization of Self-Reported Data

9.13 Recording of performance data should be done by the receiver of service rather than the provider, so long as it is economically feasible. One viable way of doing this is to design into the system automatic recording of performance data to minimize self-reporting. If the recording of performance data is done by the provider of the service, the receiver should agree to the recording method.

Caveats

9.14 Most Service Objectives are modified and refined throughout the development process. Considerable effort will be saved during the development process by maintaining a history of which Service Objectives are modified and the reasons for each change. A complete record of those Service Objectives not in the system, including the reasons for exclusion, would be helpful. Early and full documentation of Service Objectives leads to better design and fuller understanding by all parties of what will be delivered.

10. ASSOCIATED INSTRUCTIONS AND REFERENCES

10.01 Bell System Practices to be used for reference are:

SECTION	TITLE
007-208-310	Project Management
007-209-201*	System Control Standards
007-209-302*	System Control Guidelines
007-227-310	Developmental Documentation Specifications—General Information
007-230-210	Systems Deliverable Documentation
007-505-100*	User Service Reporting System (USERS) for Computer-Based Information Systems
007-505-320	Guidelines to Produce a Service Agreement for Computer-Based Information Systems
007-590-304	Computer Center Physical Security and Disaster Recovery—Contingency Planning and Disaster Recovery

10.02 Books to be used for reference are:

EDP Performance Management Handbook, Applied Computer Research, Phoenix, Arizona, 1978.

Engineering and Operations in the Bell System, Bell Telephone Laboratories, 1977.

Total System Development for Information Systems, Frank G. Kirk, John Wiley and Sons, New York, 1973.

Engineered Work Measurements, Delmar W. Karger, 1977.

Motion and Time Study (Improving Productivity), Marvin E. Mandel, 1978.

*Check Divisional Index 007 for availability.

Data Processing Systems: Performance Evaluation, Saul Stimler, 1974.

Quantitative Methods in On-Line Systems, J. A. T. Pritchard, 1976.

Design of Man-Computer Dialogues, James Martin, 1973.

10.03 Other references to be used are:

AT&T's "Terminal Response Measurement Tools" IL 80-10-202, Information Systems Data Base/Data Communication, Piscataway, New Jersey, 1980.

AT&T's "Service Measurement Standards," IL 79-08-380, Staff Measurements Section, Basking Ridge, New Jersey, 1979.

"Feasibility Report Guidelines," Information Systems Planning Section, Piscataway, New Jersey, 1979.

"Response Time, Operator Productivity and Job Satisfaction," AT&T Long Lines—Headquarters Engineering, Bedminster, New Jersey, 1978 (Attn. B. B. Tiernan).

Dr. G. Carlson, "Measuring Response Time of Interactive Terminals," EDP Performance Review, August, 1975.

11. GLOSSARY

11.01 The following terms and definitions are used in this section.

Developer

The person or group that specifies system requirements and design and is responsible for the construction and installation of a computer-based information system.

Information Services

The organizational entity that supervises computer center functions, negotiates computer center media schedules, monitors production work, and provides hardware support, software support, and maintenance.

Performance Review

The phase of Total System Development that documents how well the operational system is meeting the system objectives for performance which were established in feasibility and refined through the design phases.

Service Provider (Supplier)

The group or entity that is responsible for the computer subsystem or other facilities (mail, network, etc) required to get the system products or services to the user of a computer-based information system.

Project Manager

The person who plans, controls, and organizes the system ***development*** process from an administrative standpoint. There is usually a project manager at AT&T and in each OTC that has this responsibility for the project.

Service Objectives

The service goals of a computer-based system that satisfy the needs of the business in a cost-effective manner. Specifically, it identifies those performance characteristics of the system which impact these goals in terms of timeliness and availability.

System Objectives

A statement of intent to design for a particular purpose. It states what a system must accomplish in order to provide a solution for a recognized corporate problem and/or take advantage of an opportunity.

System Users

The individuals or organizations who receive the defined output from and/or provide input to a computer-based information system.

SAMPLE SERVICE OBJECTIVES

1. **On-Line Systems**

   A. Ninety percent of all user transactions will be processed in 10 seconds or less within the reporting period.

   B. The ABC terminals will have access to the host 98 percent of the scheduled uptime.

   C. During the peak period (2—3 p.m.) response time will be 15 seconds or less 90 percent of the time.

   D. The data base shall be current by 8 a.m. each day.

2. **Batch Systems**

   A. Ninety-eight percent of the scheduled reports for job X will be delivered by 7 a.m.

   B. Ninety-eight percent of orders received by 5 p.m. will be completed by 5 p.m. the following day.

3. **Other Service Objectives**

   A. Ninety-five percent of the data base updates will be done by 11 p.m.

   B. Rejects shall not exceed 3 percent of daily input.

Exhibit 1—Sample Service Objectives

SERVICE OBJECTIVE WORKSHEET

This exhibit presents a worksheet (Example 1) for use in developing Service Objectives. The worksheet can be a convenient checklist for use whenever it is necessary to validate that a particular Service Objective has the desired characteristics. This worksheet should be validated at the end of each phase of system development starting with feasibility and whenever Service Objectives are converted into local system components. While this checklist is extensive, it may miss some characteristics that are relevant to particular systems. These items should be added to that system's worksheet as soon as they are identified. Alternatively, not all of the items on the worksheet will apply to every Service Objective. It is suggested, however, that each item either have a positive entry or a not applicable (N/A) notation. The following information is keyed to the exhibit:

A. Prepared By—person responsible for preparing this worksheet.

B. System—name of the computer-based system.

C. Title of Objective—a brief descriptive phrase, ie, User Terminal Response Time.

D. Measurement Purpose—a brief explanation of why attaining this objective is important (eg, timeliness, reliability) to maintain acceptable user response time. (Refer to Part 2, Definition of Service Objectives.)

E. Statement of Measure—for example, 90 percent of all user transactions will be processed in 10 seconds or less.

F. Boundaries of Measurement—start and/or stop points (limits) of the Service Objectives. (Refer to paragraph 8.02 for more detail.)

G. Source of Measurement Information—the specific package or device, software routine, or manual method that will provide the necessary raw performance data. (See paragraph 8.01.)

H. Measurement Formula—the specific parameters involved, eg,

$$\frac{\text{Total Number of Transactions Processed in 5 Seconds or Less}}{\text{Total Number of Transactions Processed}} \times 100 = \text{Response Time \% (5 Seconds or Less)}$$

In addition, it should be stated how the data is to be collected (sampling or continuous measurement).

I. Time Period of Measurements—time span included in report, month, quarter, etc.

J. Priority—relative ranking of this Service Objective—1, 2, 3, etc. (Ties should be discouraged; each objective should have a different priority number.)

K. Organizational Commitment(s)—what functional group(s) is responsible for attaining this objective? This should be the same group that has the authority to remedy any problem in meeting the objective.

L. Output Report Users—list the groups that require the output this Service Objective measures.

Exhibit 2—Service Objective Worksheet (Sheet 1 of 6)

SERVICE OBJECTIVE WORKSHEET

M. Measurement Statistic—the statistical method of measurement—percentage, total count, etc. (Refer to paragraph 8.06, Measurement Statistics.)

N. Group(s) Responsible for Measurement—Recording—the group(s) that will collect and/or record the measurement data and the frequency of recording.

O. Group(s) Responsible for Measurement—Processing—the group(s) that will process the data into report format.

P. Group(s) Responsible for Measurement—Distribution—the group(s) that will ensure that the measurement reports are circulated to all the interested parties. This should be the same group that monitors compliance to the performance goals.

Q. Assumptions—the basic factors that are needed for this Service Objective to be achieved, eg, software and hardware skills. (Refer to paragraph 9.02.)

R. Constraints—restrictions which must be accounted for in meeting this objective, eg, company policy, regulations, etc. (Refer to paragraph 9.03.)

S. Internal System Dependencies—any internal system characteristics or priorities that could affect attaining this Service Objective including programs that must supply data.

T. External System Dependencies—any known external inputs and/or systems that are required in order to meet this Service Objective.

U. Unusual Resource Requirements—specialized equipment or skills needed to attain this Service Objective, eg, microfilm.

V. Data Base Recovery/Update—the probable effect of improper data including time to modify. (Refer to paragraph 9.10.)

W. Scheduling Priorities—mutually exclusive criteria, ie, fast response time and high message volume. (Refer to paragraph 9.05.)

X. Caveats/Comments—special cautions or conditions that could affect attaining this Service Objective that have not been previously listed.

Exhibit 2—Service Objective Worksheet (Sheet 2 of 6)

SERVICE OBJECTIVE WORKSHEET

PREPARED BY: (A)

SYSTEM: (B) TITLE OF OBJECTIVE: (C)

MEASUREMENT PURPOSE: (D)

STATEMENT OF MEASURE: (E)

BOUNDARIES OF MEASUREMENT: (F)

SOURCE OF MEASUREMENT INFORMATION: (G)

MEASUREMENT FORMULA: (H)

TIME PERIOD OF MEASUREMENT: (I)

PRIORITY: (J)

ORGANIZATIONAL COMMITMENT(S) (K)

OUTPUT REPORT USERS: (L)

MEASUREMENT STATISTIC: (M)

Example 1

Exhibit 2—Service Objective Worksheet (Sheet 3 of 6)

SERVICE OBJECTIVE WORKSHEET

GROUP(S) RESPONSIBLE FOR MEASUREMENT:
RECORDING: (N)
PROCESSING: (O)
DISTRIBUTION: (P)

ASSUMPTIONS: (Q)

CONSTRAINTS: (R)

INTERNAL SYSTEM DEPENDENCIES: (S)

EXTERNAL SYSTEM DEPENDENCIES: (T)

UNUSUAL RESOURCE REQUIREMENTS: (U)

DATA BASE RECOVERY/UPDATE: (V)

SCHEDULING PRIORITIES: (W)

CAVEATS/COMMENTS: (X)

Example 1 (Contd)

Exhibit 2—Service Objective Worksheet (Sheet 4 of 6)

SERVICE OBJECTIVE WORKSHEET

PREPARED BY: James A. Dunn

SYSTEM: FAST TITLE OF OBJECTIVE: On-Line Response Time

MEASUREMENT PURPOSE: To ensure that the computer facility provides the terminal operators with the requested information in a cost-effective interval.

STATEMENT OF MEASURE: 90 pecent of all responses will be within 7 seconds or less.

BOUNDARIES OF MEASUREMENT: The time interval between the terminal transmit key being depressed and the first character displayed on the screen.

SOURCE OF MEASUREMENT INFORMATION: Response Measurement Controller

MEASUREMENT FORMULA:

$$\frac{\text{number of transactions within 7 seconds}}{\text{all transactions}} \times 100 = \text{Response Time \%}$$

Measurement period: 9 a.m. — 5 p.m. daily

TIME PERIOD OF MEASUREMENT: Work Month

PRIORITY: ONE (1) — If response time cannot be maintained, additional operators will be required which will jeopardize the economics of system mechanization.

ORGANIZATIONAL COMMITMENT(S): Data Center XYZ — Provision of computer facilities necessary to keep Special Measurements System (SMS) operational.

OUTPUT REPORT USERS: Operator Services Locations 1-27
System Manager, Fast
Data Center XYZ

Example 2

Exhibit 2—Service Objective Worksheet (Sheet 5 of 6)

SERVICE OBJECTIVE WORKSHEET

MEASUREMENT STATISTIC: The number of days per month that the system did not provide 90 percent of the responses in 7 seconds or less.

GROUP(S) RESPONSIBLE FOR MEASUREMENT:
RECORDING: Data Center XYZ
DISTRIBUTION: Project Manager-Fast
PROCESSING: Data Center XYZ

ASSUMPTIONS: FAST requires the Standard Operating Environment—VENDOR "X" (Section 007-203-NNN).

CPU	— Vendor "X"
TAPE (6250 BPI)	— 5
Memory	— 8 MEG
Dedicated Channels	— 2
Disks (317 MEGA BYTES)	— 12

CONSTRAINTS: State regulatory agencies have specified that under certain charged rates for service, the response time must be 10 seconds or less 95 percent of the time.

INTERNAL SYSTEM DEPENDENCIES: Daily file update to be done by 6:00 a.m. the following day.

EXTERNAL SYSTEM DEPENDENCIES: File ABC01 must be received by 11 p.m. daily.

UNUSUAL RESOURCE REQUIREMENTS: Voice answer back VV01 required on lines A001, B001, and D002.

DATA BASE RECOVERY/UPDATE: Loss of "key" file requires 30 minutes to recreate; total system downtime of 60 minutes is estimated.

SCHEDULING PRIORITIES: "Key" update requires static data base, on-line system must be turned off. Estimate two occurrences per year.

CAVEATS/COMMENTS: Any system outage of more than 5 minutes must be reported to the Project Manager within 10 minutes. Estimated time to recover and actions to be taken must also be given at this time.

Example 2 (Contd)

Exhibit 2—Service Objective Worksheet (Sheet 6 of 6)

STOPWATCH TIMING

Stopwatch timing is an adequate tool to measure response times of 3 seconds or more, especially when a mechanized means of gathering performance data is unavailable. Stopwatch measurement equipment is inexpensive; the procedures needed are easy to learn and simple to do. In addition, anyone can use the same method to gain confidence in the results. The validity of the results can be verified by use of such statistical measures as the percentage method.

Statistical measures, especially those which are the most suited to on-line systems, are discussed in Exhibit 4. How to select the sample, the appropriate sample size, and the estimation procedures should be determined in consultation with local Business Research Organization.

Exhibit 3—Stopwatch Timing

STATISTICAL MEASURES

There are a number of descriptive statistics which are used to represent various characteristics of a collection of data. The selection of a statistic for use in a particular instance should be made only after considering:

- Its suitability as a measure of the characteristic of interest;
- The relative difficulty of collecting and operating on the required underlying data;
- The relative ease with which it can be understood and interpreted;
- Its sensitivity to extreme, possibly extraneous, conditions.

For on-line systems, the characteristic of interest is likely to be consistency of response time; that is, the extent to which a user can rely on the system to produce a response within the expected interval. The discussion which follows assumes that this aspect of consistency is the characteristic to be measured.

The first measure which usually comes to mind as a statistic to describe a collection of data is the arithmetic mean or "average." It has a number of advantages. The mean is widely understood, easy to calculate, and relatively simple to estimate from a sample. It does not, by itself, however, provide any information about consistency of performance. By way of illustration, Fig. 1, in this exhibit, shows a distribution which might meet an average response time objective, but in which half of the users would find their response times unacceptably long. It also demonstrates that virtually no users actually received "average" service. Figures 2 and 3 illustrates two cases with identical average response time. Figure 2, however, shows a more consistent grade of service than that depicted in Fig. 3.

A standard deviation can be reported with the average as an indication of variability, but not without some drawbacks. Standard deviation is a somewhat unfamiliar measure to many users and, unless the distribution from which it is derived is fairly symmetrical, it is not particularly informative. Further, estimates of the standard deviation from small samples, at least, tend to be unreliable.

The median, which is the middle measure in an ordered set of measures, overcomes some of the difficulties associated with the mean as a measure of central tendency. It is unaffected by extreme values, and is most like all of the measures in the distribution in that the absolute differences, in aggregate, between it and the other members of the distribution are minimum. Like the mean, however, the median conveys no information about variability. While sample estimates of the median are usually only slightly less precise than estimates of the mean, it is difficult to determine the precision exactly unless certain restrictive assumptions are made about the population from which the sample was drawn.

A statistic which avoids most, if not all, of the problems cited above is the proportion (or percent) of transactions in which the objective response time is exceeded. It relates directly to the aspect of consistency which is of greatest interest, namely, how confident a user may be that a response will be received within the objective interval. Proportions, especially those 90 percent and greater, can be estimated accurately from fairly small samples. They do not, however, provide information about the aggregation of all responses as does the mean, beyond an indication that X percent of them are received within the objective interval. Proportions are also insensitive to the magnitude of response times beyond the objective interval; that is, no distinction is made between responses 5 seconds over the objective and those delayed 5 minutes. This is not seen as a disadvantage, however, since a user's primary interest is in the bulk (say 90 to 95 percent) of the responses which are received within the objective interval.

Exhibit 4 — Statistical Measures (Sheet 1 of 2)

STATISTICAL MEASURES

The conclusion to be reached from the foregoing is that, unless there are compelling reasons to the contrary, the most useful criterion of system performance is the proportion of responses received within the objective interval. For brevity, this criterion has been referred to elsewhere as the "percentage method."

Whatever statistic is chosen to be the measure of system performance, it may be desirable to estimate the statistic using sampling. In order to be valid and reliable, such estimates must be based on samples specifically designed for the particular system and measure. For this reason, system designers are urged to consult their local Business Research Organization for guidance and assistance in sample design.

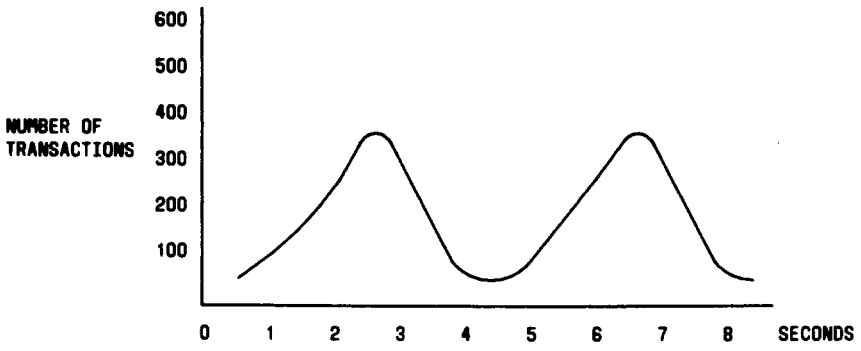

Fig. 1 — Response Time

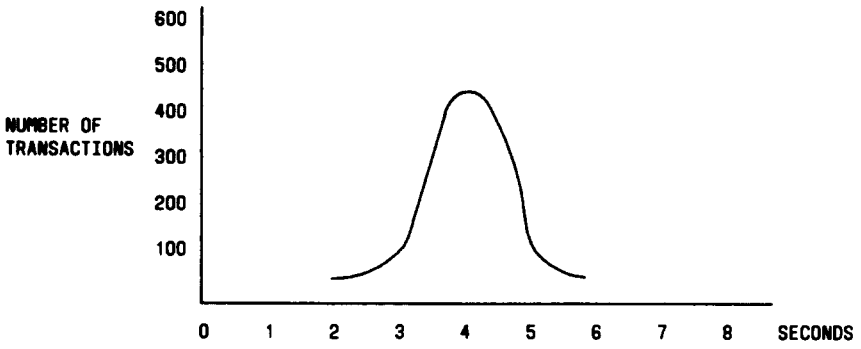

Fig. 2 — Response Time

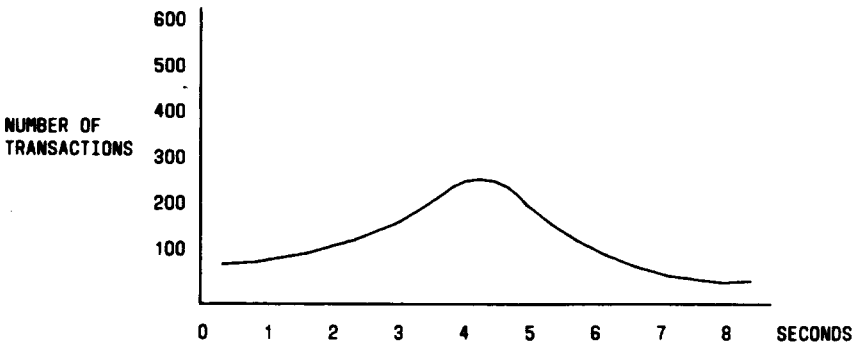

Fig. 3 — Response Time

◆Exhibit 4 — Statistical Measures◆ (Sheet 2 of 2)

BATCH MEASUREMENT ALTERNATIVES

The core of the Service Objective/Service Agreement/Service Measurement Plan process is the face-to-face negotiations which produce a useful Service Agreement. The role of the negotiation process is to set each Service Objective at a mutually agreed upon time beyond which the user will be greatly inconvenienced to such an extent that the workload is disrupted, people are idle, costs increase, commitments are missed, etc.

The performance of a computer-based system in providing batch products, such as reports, is based on the on-time delivery of these products. There are a number of ways in which the performance of this timeliness aspect of service may be measured. The following material presents three methods for consideration in establishing Service Objectives for batch products. They are: (A) Agreed Time, (B) Cumulative, and (C) a Combination of Both.

Any method employed should ***not*** consider giving credit for providing service before the agreed upon time. This negative incentive could result in providing products before they are necessary and at an ineffective cost.

Project managers are urged to consult their local Business Research Organization for guidance and assistance in selecting the proper statistics for batch measurement.

The selection of any one of these methods of measuring batch performance would depend on the conditions present in most of the OTCs using the system being measured. Whichever method is chosen, all OTCs participating in a Bell System measurement plan for that system would be expected to use that method in their reports to AT&T, or one approved by their local Business Research Organization.

A. Agreed Time

The agreed time method of setting a Service Objective is applicable when the participants in a batch system negotiate a specific due time (8:00 a.m.). The assumption is that receipt of the batch products beyond this time will result in missed commitments, delayed billing, work disruption, increased costs, difficult rescheduling, etc.

An example of an agreed time Service Objective would be:

"Report A will be delivered to point B by 08:00 a.m."

The advantages of this style of Service Objective are that they are easy to:

- Negotiate
- Measure and track
- Understand
- Administer.

Exhibit 5—Batch Measurement Alternatives (Sheet 1 of 6)

BATCH MEASUREMENT ALTERNATIVES

The disadvantages are:

- A small miss (1 minute) is the same as a large one (hours)
- There is no additional penalty for a long delay
- There is no incentive to provide the product in a timely fashion once the commitment time is missed.

The following chart illustrates tracking a report:

Component: Report "A" Delivery by 08:00 a.m.

Site: Point B

Month of: March, Year 1982

DATE	MET OBJECTIVE		COMMENTS REGARDING MISSED OBJECTIVE
	YES	NO	
3/03	X		
3/04		X	
3/05	X		
3/06		X	
3/07	X		
3/10	X		
3/11		X	Power Failure
•			
•			
•			
3/31	X		
TOTALS	18	3	

Exhibit 5—Batch Measurement Alternatives (Sheet 2 of 6)

BATCH MEASUREMENT ALTERNATIVES

B. Cumulative

The cumulative method recognizes that being a few minutes late on several occasions could be less important than being hours late once or twice per report period. The cumulative style Service Objective could be stated as follows:

> "Report A will be at point B by 08:00 a.m. each business day, but the cumulative number of allowable minutes late for objective service will not exceed 199 minutes per month."

The advantages of this style of objective are:

- Small delays are not counted the same as long delays
- Long delays receive increasingly heavy emphasis
- There is incentive to get the products to their destination as close to the designated time as possible
- May more truly reflect the impact of any delays in delivery of the batch reports.

The disadvantages are:

- Number of times late is not considered
- More time may be required to determine the performance level expected
- The objective may be more difficult to state and understand
- The tracking and administration of the data collection may require more effort than method A
- One long outage could incur a large penalty with no chance to achieve the objective for the remainder of the month.

Exhibit 5—Batch Measurement Alternatives (Sheet 3 of 6)

BATCH MEASUREMENT ALTERNATIVES

The following chart illustrates tracking the same information as in Report A but for a cumulative report:

Component: Report "A" Delivery by 08:00 a.m.

Site: Point B

Month of: March, Year 1982

DATE	TIME RECEIVED	MINUTES LATE	COMMENTS REGARDING MISSED OBJECTIVE
3/03	08:00	—	
3/04	08:30	30	
3/05	07:50	—	
3/06	09:00	60	
3/07	07:59	—	
3/10	07:50	—	
3/11	15:00	420	Power Failure
•			
•			
•			
3/31	05:40	—	
TOTALS		510	

C. Combination (Agreed Time/Cumulative)

The combination method combines the features of both agreed time and cumulative styles of performance measurement. For each cycle that the agreed time is not met, a miss would be recorded. In addition, the total minutes late would be accumulated and factored together with the number of misses to arrive at a level of performance. An example of this style of Service Objective would be:

> "Report A will be delivered to point B by 08:00 a.m. each business day and the cumulative allowable number of minutes late for objective service will not exceed 199 minutes."

The advantages of this style of Service Objective are:

- It combines the advantages of methods A and B while minimizing some of their disadvantages.
- It contains the incentive to meet a specific and negotiated time.

Exhibit 5—Batch Measurement Alternatives (Sheet 4 of 6)

The disadvantages are:

- Negotiating this method of objective may be more time consuming than methods A or B.
- The tracking, administration, and calculation of the results may be more complex.
- The meaning of the results may be unclear as to the cause of subpar performance.

The following chart illustrates tracking the same information as in "A" and "B" but for combination report:

Component: Report "A" Delivery by 08:00 a.m.

Site: Point B

Month of: March, Year 1982

DATE	RECEIVED	MET OBJECTIVE		MINUTES LATE	COMMENTS REGARDING MISSED OBJECTIVE
		YES	NO		
3/03	08:00	X		—	
3/04	08:30		X	30	
3/05	07:50	X		—	
3/06	09:00		X	60	
3/07	07:59	X		—	
3/10	07:50	X		—	
3/11	15:00		X	420	Power Failure
•					
•					
•					
3/31	05:40	X		—	
TOTALS		18	3	510	

Using this method requires that a formula be developed to weigh both the number of misses and the total cumulative minutes late to arrive at a combined service performance level. Any number of schemes may be employed and the one selected should best reflect the requirements of that particular application and its impact on user expectations.

Exhibit 5—Batch Measurement Alternatives (Sheet 5 of 6)

BATCH MEASUREMENT ALTERNATIVES

Using the data from the chart on Page 26, an example is provided below as a possible method:

Assume that each cumulative 100 minute delay equals one specific time miss.

Total Minutes Late		Cumulative Factor		Relative Misses
510	÷	100	=	5.1

Fixed Time Misses	=	3.0
Combination Misses	=	8.1

Exhibit 5—Measurement Alternatives (Sheet 6 of 6)