

An Overview of Quality and Project Management Processes at AT&T

Alec Feiner
Katherine A. Edward

In AT&T, intensive attention to quality is becoming standard practice as the business units and research divisions institute procedures to improve their business and engineering processes. Our aim is to achieve total quality by satisfying customers and improving the functioning and efficiency of the processes we use to bring our products and services to market. How we adapt and improve these processes to serve and fulfill customer needs determines the company's capability to win in the marketplace. This issue of the *AT&T Technical Journal* presents a mosaic of some of the company-wide efforts to improve quality.

Quality Improvement Thrust

In the marketplace today, customers drive the basic definition of quality products and services. At AT&T, *quality* is meeting and exceeding customer needs and expectations. These needs and expectations are defined in the front-end process to the product life cycle as the prospectus and technical requirements for a product or service. [The term *front-end process* (FEP) refers to the concept and definition phases that precede the design of a product or service, which include analyses of customer needs and the market potential. *Life cycle* refers to the life of a product or service. It starts with the initial concept for the product or service, and ends with its extension or replacement by a newer product or service.]

A major goal of all successful businesses is to ensure that a product or service complies with the customer's needs and requirements while meeting the corporation's fiscal objectives and R&D capability.

Within AT&T, the most basic definition for quality is: *consistently meeting and exceeding customer expectations*.¹ This definition requires that employees work together—and with customers—actively improving the front-end and downstream processes in the most effective way, to deliver what is important to customers. (*Downstream processes* refers to all succeeding phases of design, development, manufacture, and support services.) By continuously improving how it manages development processes, AT&T strives to produce expanded products

and services that, when first introduced, are better than existing products or services. This constant improvement also enables AT&T to give its customers timely, high-quality products and services at competitive prices.

Just as AT&T's mission and markets have changed, so too has its focus on quality. The company's strategic emphasis for quality has shifted away from internal measures (i.e., number and types of defects)—which are inspection-intensive, reactive, quality-control methods that do not necessarily prevent defects from recurring. Today's approach measures the achievement of quality in terms of customer satisfiers—which include such attributes as price, performance, service, and timely delivery.

The company's expanded program—a direct result of the need to respond even more quickly to customer demands and market conditions—has a renewed emphasis on:

- Implementing a quality management system for every project to maximize customer satisfaction.
- Taking measurements to predict or determine the ability of a product, service, or process to fulfill customer expectations.
- Challenging ourselves to achieve important quality goals for corporate-wide improvement.
- Developing partnerships with internal and external customers and suppliers as a strategy for preventing quality problems in each phase of the life cycle of a product or service. The term *external customers* refers to

Panel 1. Acronyms and Terms

customer-supplier model — a work process that emphasizes relationships between the customer and supplier, process input and output, and requirements and feedback

external customer — a person or business that purchases the company's products and services

FEP — front-end process; the concept and planning phases for a product or service, which include translation of customers needs into a product definition

internal customer — a colleague who depends on an employee's output or results

ISO — International Organization for Standardization

life cycle — the life of a product or service; starts with the initial concept for the product or service, and ends with extension or replacement by a newer product or service

methodology — the processes, metrics, and documentation developed for a particular task or technique

metrics — standard measurements that are used to compare the results to the requirements

OATS — orthogonal array testing system

performance improvement — activities that improve the performance of a process or of a product or service

PQMI — process quality management improvement;

a seven-step methodology for process management and continuous improvement

process improvement — activities that introduce beneficial change to a process

process management — activities that establish responsibilities, define the process, manage customer-supplier relationships, evaluate process performance, and identify opportunities for improvement

product realization process — the design, development, and manufacturing stages required to take a product or service from its initial concept to its delivery to customers

quality management system — a system that uses the principles of process quality management improvement to manage quality in the design, development, and manufacture of a product or service

robust design — a design method for making a product or process less sensitive to manufacturing variation

root-cause analysis — a method for determining the underlying reason that a product, process, or service does not conform to requirements

statistical quality control — the use of statistical methods to analyze, study, and monitor the capability and performance of a process

the people or businesses who purchase the company's products and services. The term *internal customers* refers to our colleagues who depend on the output or results of our work.

- Accelerating product introduction; i.e., shortening the time required to bring new products or services to market.
- Controlling costs through process improvement, elimination of rework, and inventory reduction, and by providing more reliable products that require little or no maintenance so fewer repairs are needed at customer sites.
- Involving all employees in programs that enable them to do their jobs right the first time.
- Using industry- and world-wide standards and award criteria—especially the International Organization for Standardization (ISO) Series 9000 Quality Standards and the criteria for the Malcolm Baldrige National Quality Award—as self-assessment tools that help

measure the effect of the quality system. (The ISO quality standards are used for external certification. The United States government gives the Malcolm Baldrige award to U.S. companies to recognize their leadership in quality. The National Institute of Standards and Technology manages the award, which is based on a stringent application and examination process.)

- Studying our competitors and leading companies in the industry to learn more about product realization processes as a way to compare our performance against theirs.
- Establishing our own award and recognition systems for the achievement of quality.

Critical Areas of Emphasis

The key motivation for AT&T is to improve the quality of its products and services. To achieve this improvement, the company is emphasizing methods to influence quality in the following critical areas:

- A total quality approach
- Customer and supplier relationships
- Management processes.

Foremost is AT&T's broad focus on an integrated or *total quality approach* that emphasizes early planning and building quality into every market offering. When projects measure activities against market-driven objectives that are defined before the development effort begins, it is easier to satisfy customer expectations.

The second area of emphasis is the *relationships between customers and suppliers*. AT&T's customer-supplier model² was derived from the implementation of Joseph Juran's quality theories at the Florida Power and Light Company. This model draws attention to the fact that everyone is both a customer and a supplier and must fill both roles during all phases of the product life cycle. It stresses that all employees must communicate and obtain feedback about how their work satisfies, not only the needs of external customers, but also internal customers.

AT&T's new emphasis encompasses both the information and the physical processes that the company uses to develop, manufacture, and deploy products and services to the marketplace. To ensure quality, management processes must provide the internal structure for the information and physical processes the company uses to fulfill customer needs. (The July/August issue of the *AT&T Technical Journal* will be devoted to these quality-driven processes.)

Another area of focus is the *management processes* that determine the direction AT&T's business units will take. Management's responsibility is to relate the business strategy (e.g., general market strategy, profit and loss strategy) of the company and business units to individual processes. In their role as stakeholders, managers ensure that quality management principles are applied; supply the necessary resources; verify the integrity of information; and manage the interfaces between processes, organizations, and groups.

Managers must also champion the way and lead by example. This requires that all managers spearhead the drive for quality by setting organizational goals and objectives and, then, sponsoring internal education and training programs that promote on-going improvement.

Methodologies for Improving Quality

This issue of the *AT&T Technical Journal* seeks to increase awareness within the R&D community of

successful applications of methods for process improvement and project management. Papers are presented along three themes and describe the improvements experienced at AT&T during different phases of the process of bringing a product or service to market:

- Processes that occur during the early FEP stages when customer needs and expectations are analyzed before the financing is established for development or production of a product or service
- Managing the components of a quality-driven project through integrated quality methods and project management techniques
- Quality and process management of the total project.

Customer-Needs Analysis. A major focus of AT&T's quality methods is on renewing the processes used to build quality into the design and production of any new product or service. This reengineering, or rebuilding of the processes that are used to bring products or services to market, starts early in the FEP phases of the life cycle, where product or service concepts are formally evaluated for marketability. Here, dedicated teams of systems engineers, marketers, and product managers are charged with:

- Obtaining market information
- Identifying customer needs and expectations
- Assessing the competition
- Distilling the findings into engineering and design requirements.

What the cross-functional teams of experts document is a customer's needs and willingness to pay for a product or service that satisfies those needs. That information translates directly into product or service features that are provided at costs that meet the quality and profitability criteria of each business unit and the corporation.

Typically, the players include a champion who identifies and owns the process of analyzing a product or service need. This individual has the authority to commit resources and effect change. Other participants include representatives from the appropriate product marketing and management organizations, account teams, finance, systems engineering, development, manufacturing, warehousing and distribution, field support, and other services.

It also is imperative to involve the customer through market analysis or by contractual obligation. Market analyses identify what customers want or value—the tradeoffs they would be willing to make in exchange for desirable or needed features. Similarly,

contracts may—and should—explicitly define those aspects of a product's design that require the customer's input before decisions are to be made. The customer's *go* or *no go* decision about several alternative cost, feature, and quality descriptions determines the number of iterations needed before we offer a particular product or service. If we fail to include the customer in this decision-making phase, we compromise AT&T's ability to achieve its quality goals and fiscal objectives.

By increasing our interaction with potential customers, we improve our success rate with new products, services, and feature enhancements.

Products and services are more *fit for use* because they conform to technical requirements, do not have physical defects, and satisfy customer needs. What is important is that the product or service with the right attributes be available at the right time.

Process and Project Management. If AT&T is to continue to bring to market the products and services that fulfill customer expectations for price, performance, features, and timeliness, then we must integrate quality methods with project management techniques.

By definition, the process management methodology directs our efforts to establish process management responsibilities, manage the relationships between customers and suppliers, and evaluate process performance and improvement opportunities.

On the other hand, project management focuses on activities that produce specific outputs over the life of the project. Because the management functions of organizing, planning, directing, and controlling recur in each project phase, the project activities that support these functions are clearly processes.³ Therefore, when AT&T applies process management principles to improve the efficiency and effectiveness of its project management processes, it increases the value of the processes to the business and its customers.

Project management techniques provide the procedures and tools to ensure on-time delivery of quality products and services to customers. The work breakdown structure and project schedule provide mechanisms for smooth execution of a project plan. These tools also enable project managers to reduce cycle times. With these tools, managers can forecast the advantages of adding personnel and expending resources when the estimated project duration extends beyond the due date set by customers or the opening in the market window.⁴

PQMI. A powerful method for dealing with process quality management and improvement exists at AT&T in a formalized methodology known as PQMI. It is a seven-step method that gives AT&T managers the means for establishing process management responsibilities by organizing a team of accountable individuals to define process tasks. When implemented, the PQMI process is frequently coupled with project management techniques.

A responsible individual is designated the *process owner*. He or she must coordinate all team activity that is directed at:

- Defining the process; i.e., describing its boundaries, inputs, outputs, suppliers, and subprocesses
- Identifying the needs of internal and external customers
- Ensuring the requirements can be measured.

By establishing measures to assess conformance to customer requirements, the team identifies opportunities for improvement.

Analyses, Metrics, and Robust Design. Before AT&T scientists and engineers undertake steps to improve their product realization processes, they must first investigate the sources of problems and inefficiencies. They do this through systematic analysis of probable causes, errors, and defects. The quality method known as *root-cause analysis* helps project and process improvement teams to identify error sources. By first determining the underlying cause of nonconformance, the teams are able to make the corrections needed to prevent future defects.

Traditional statistical-quality-control methods have long been applied in AT&T to monitor process capability and performance. For more than a decade, AT&T has also established standard measurements, or metrics, to report on the results of software development projects. At the corporate level, metrics provide management with information about the quantity of faults in a software release. The fault counts are normalized so that the results from projects of differing size can be compared. Regular reports:

- Evaluate trends on the number of faults found during the software's useful life.
- Assess how the correction of errors in the "field" affects customers.
- Measure responsiveness in resolving customers' complaints.

At the project level, metrics give software developers a way to track and, thereby, prevent errors from propagating across process boundaries when the product that contains the code goes into production.

To comply with the demands of its customers for high-quality, low-cost products and services, AT&T has also built new tools for experimental and process engineering that follow the methodology known as *robust design*.⁵ This engineering method for process or product design controls variables, so the process or product is less susceptible to manufacturing variations. AT&T is applying the robust design method to a wide variety of quality initiatives.

In the product development process, large amounts of time are expended on experiments and simulations. For example, our development staff may vary such design parameters as temperature, pressure, and load conditions in controlled experiments to measure the effects of these parameters on a product's performance. Robust design provides a systematic way to measure these factors and predict their effects, helping us produce designs that are less affected by them. Thus, robust design helps minimize the effects of these factors in the customer's environment and, thereby, helps extend the total life of the product or process.

In This Issue

The remaining papers in this issue present some company-wide quality initiatives that have improved the functioning of each component phase of a product or service realization.

Front-End Process Improvement. The first group of papers addresses process improvement activities that occur in the market assessment or FEP phases in a development project.

Daryl Lynn Farley describes⁶ five interrelated processes of the FEP discipline used for the AT&T 5ESS[®] switch for the U.S. market. This approach provides company management with information about new product and service opportunities.

In AT&T Bell Laboratories, the Telecommunications Service Planning Organization has established a quality method and support environment, known as the *Fast Decision Process*. This approach, which Catherine D'Abadie et al. describe in their paper,⁷ is helping to reduce the time needed to take new telecommunications services from concept to development. The authors tell

how their approach integrates principles and tools from the quality discipline into a set of procedures that technical planners can use to produce quality FEP documents (i.e., high-quality documents that are clear, concise, on-time, technically correct, etc.) The payoff from the process comes in terms of higher quality technical designs and shorter design cycles.

Improved Project Management. The second group of papers illustrates how AT&T is applying the organizational function of project management and quality-specific methods to:

- Manage the development of a private-branch exchange subsystem.⁸
- Design the A-I-Net[™] service creation environment.⁹
- Test an electronic mail system that is designed to work with AT&T's StarGROUP[®] software for local-area networks.¹⁰

In these papers, the authors explain how their innovative approaches yielded better results—based on established metrics—than more traditional system design, management, and testing techniques.

Process Management Initiatives. The third, and final, set of papers highlights¹¹⁻¹³ successful initiatives for process management and improvement across a wide array of AT&T market offerings:

- Software and hardware for large central-office switching systems
- Data communications networks
- Consumer telecommunications products.

These papers tell how AT&T can fall short of fulfilling customer expectations for price, performance, and on-time delivery if it implements only the traditional project management approaches.

Also, for many of our projects, "speed" (i.e., time to market) has become a competitive weapon.¹¹ Worldwide efforts to improve processes that directly influence how long a product or service stays in product development is today's key to market success.¹² Implementing a quality management system also ensures that the objectives of each phase of a project have been successfully met before we proceed to the next phase.¹³

Conclusion

As the papers in this issue illustrate, process improvement is a continuing effort. AT&T can already claim numerous successes in quality improvement. Over time, the process improvement approach will enable

AT&T to make substantial gains in productivity as it fulfills customer needs for timely, high-quality products and services.

References

1. B. M. Leary, *Quality Manager's Handbook, Issue 1*, Select Code 500-442, AT&T Customer Information Center, Indianapolis, Indiana, 1990.
2. R. B. Ackerman, R. J. Coleman, E. Leger, and J. C. MacDorman, *Process Quality Management and Improvement Guidelines: Issue 1*, Select Code 500-028, AT&T Customer Information Center, Indianapolis, Indiana, 1987.
3. E. M. Sieli, "Managing a Project as a Process," *AT&T Technical Journal*, Vol. 70, No. 2, March/April 1991, pp. 33-39.
4. D. S. Kezsbom, D. L. Schilling, and K. A. Edward, *Dynamic Project Management: A Practical Guide for Managers and Engineers*, John Wiley & Sons, New York, 1989.
5. M. S. Phadke, *Quality Engineering Using Robust Design*, Prentice Hall, Englewood Cliffs, New Jersey, 1989.
6. D. L. Farley, "The 5ESS® Switch U.S. Market Front-End Process," *AT&T Technical Journal*, Vol. 70, No. 3, May/June 1992, pp. 8-14.
7. C. A. D'Abadie, M. W. Funk, F. S. Litofsky, and D. E. Nelsen, "The Fast Decision Process," *AT&T Technical Journal*, Vol. 70, No. 3, May/June 1992, pp. 15-21.
8. K. K. Glass and L. M. Sanders, "Managing Organizational Handoffs with Empowered Teams," *AT&T Technical Journal*, Vol. 70, No. 3, May/June 1992, pp. 22-30.
9. S. L. Greenspan, J. J. Wisowaty, and R. E. Bright, Jr., "Product Definition Through the Design-by-Use Process," *AT&T Technical Journal*, Vol. 70, No. 3, May/June 1992, pp. 31-40.
10. R. Brownlie, J. Prowse, and M. S. Phadke, "Robust Testing of AT&T PMX/StarMAIL Using OATS," *AT&T Technical Journal*, Vol. 70, No. 3, May/June 1992, pp. 41-47.
11. F. P. Sansone and H. M. Singer, "Improving Time to Market in Consumer Products," *AT&T Technical Journal*, Vol. 70, No. 3, May/June 1992, pp. 66-72.
12. J. S. Colson, Jr., and E. M. Prell, "Total Quality Management for a Large Software Project," *AT&T Technical Journal*, Vol. 70, No. 3, May/June 1992, pp. 48-56.
13. D. C. Elmendorf, "Managing Quality and Quality Improvement," *AT&T Technical Journal*, Vol. 70, No. 3, May/June 1992, pp. 57-65.

(Manuscript received October 1, 1991)

Katherine A. Edward is a member of technical staff in the Systems and Network Training Department with AT&T Bell Laboratories in Middletown, New Jersey. She develops and markets instructional systems and courses on telecommunications and switching engineering. Ms. Edward joined the company in 1980. She has an M.S. in instructional technology from Syracuse University (Syracuse, New York).

Alec Feiner is chief scientist for AT&T Business Communications Systems and is based in Middletown, New Jersey. He oversees the forward-looking development activities and architectures for that business unit, particularly the evolution of the AT&T DEFINITY® Communications System. Mr. Feiner joined the company in 1953 with an M.S. in electrical engineering from Columbia University (New York, New York).
