DEVELOPMENT PROCESSES AND APPLICATIONS AT AT&T: AN OVERVIEW

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Market dynamics and shorter product-development life cycles are challenging AT&T to recast its project structures and establish well-defined processes and methodologies for developing new technology. AT&T's success in competitive markets, today, depends on how it determines the processes required to produce and deliver the "right" products and services to its customers, at a price they are willing to pay, when they want them. This issue of the *AT&T Technical Journal* focuses on current initiatives that are under way in the AT&T R&D community to define the processes and methodologies used in developing new technology. The papers document the activities of a variety of hardware and software development and manufacturing projects and showcase methodologies that affect the technology that AT&T offers commercially.

Rigorous Processes, Dynamic Structures

Several factors have influenced AT&T's adoption of more rigorous development processes. Foremost was the need to include the customer as a major source of new product and service requests. For this reason, activities that center on detailed market research and assessment receive more attention now than they have in the past. Our knowledge of gaps and deficiencies in how we bring products and services to market has caused us to reexamine the front-end process of our product-development cycle. (Panel 1 defines acronyms and terms used in this paper.)

Consequently, we have identified the need to speed up and shorten the entire cycle. But shortening and speeding up this cycle significantly reduces the amount of time a product can stay in development. As a result, more integrated or concurrent definition and planning processes are required to shorten the total cycle time and monitor or control the accelerated effort. This is especially true in periods of increased market competition for low-cost, high-quality products.

AT&T engineers are being pushed by this unprecedented

challenge to speed new-product development as they strive to satisfy customer needs and expectations. Therefore, they must define specific methodologies (i.e., procedures and the associated documentation) to monitor each phase of the development effort. Different phases of the life cycle require different managerial techniques. For instance, the solutions posed to problems in the concept and definition phases, which occur early in a product's life cycle, may be entirely inappropriate in the final production phases, when the technology has matured and is ready for release.

The need to improve the engineering, manufacturing, and quality interfaces is encouraging system analysts and designers to execute quality-control methods that ensure the viability of our products and services. Because engineering and production have interrelated needs, they must work together to plan, define, and manufacture quality products. Quality control is no longer assured through an inspection process performed on finished goods.

Besides, today's highly competitive markets are driving AT&T to integrate the manufacturing and production phases of its product-development life cycle concurrently with the chronologically earlier, engineering design and development phases. Errors identified in upfront processes are much less expensive to correct in terms of resources, effort, and time than errors discovered in the field. Initial fixes also are less costly to make and have the advantage of not compromising the customer's perception of quality in the company's products and services.

The significantly high risks associated with producing leading-edge technology amid stiff market competition generate great need for documented, project-interface procedures that span all organizational elements. Consequently, AT&T is replacing its traditional practices—which were originally established to control repetitive, standard tasks—with more-dynamic project structures. These new procedures and tools are helping AT&T to control resources and accommodate volatile market demands.

Motivation for This Issue

In this issue of the *AT&T Technical Journal*, we focus on several initiatives that are under way in the AT&T R&D community and have particular impact on a project's success:

- Early definition of customer needs and expectations.
- Specification of adequate project-management structures to provide effective interfaces to the management and development processes.
- An integrated-planning process and clarification of the project's goals, time, and resource requirements. To assure quality development, every project-team member must commit to these initiatives.
- Effective use of design reviews, audits, and other change-control techniques to assess and correct deviations from planned activities.

One objective of sharing the applications and knowledge presented in this theme issue is to accelerate the rate at which this information is adapted by a variety of projects across AT&T's business units. By increasing employees' awareness of the integrated whole of planning, scheduling, controlling, and evaluating our development and manufacturing projects in the pursuit of quality, we solve two pertinent business problems that face our industry: the high costs to develop new technology, and the rapid obsolescence of existing technology.

Organization of the Issue

The issue is divided into three sections:

- Processes that occur in the beginning phases of the product-development life cycle
- Project-planning processes and management initiatives that affect the quality of development projects
- Project cost, schedule, and quality-control procedures and tools that assess the effectiveness of the development processes.

Early Phases. The first group of papers describe the front-end processes of a development project. Specifically, these processes identify the need for the product or service and define the characteristics of its market.

Because there is no single customer in the mar-

Panel 1. Abbreviations and Terms

EVA — earned-value analysis
NCP — Network Control Point
product-development life cycle — the process of bringing a product into existence, from inception through deployment to customers
QFD — quality-function deployment
R&D — research and development
WBS — work-breakdown structure

ketplace, one goal of the marketing effort is to determine a generic list of customer needs for the specific technologies and services that AT&T develops. The purpose of this market-driven, front-end activity is to:

- Establish the feasibility for a new technology, product, or service based on commercial analysis. (Products and services must fit the overall strategy and financial objectives of the corporation.)
- Define the technology under investigation in terms of explicit customer specifications and requirements.
- Specify the initial design of the product.

The front-end processes of a development project have an impact on its later stages. Mistakes made here affect every phase of the project and are often the source of cost overruns and needless rework. Two articles included in this issue illustrate some of AT&T's current activity in this area.

The first of these articles—a paper by William Infosino, Sam Parker, and David Unger[1]—describes a systematic and quantitative process used by AT&T to assess the needs of large customers for telecommunications equipment. The methodology is specifically designed to support the planning and marketing of complex industrial products. This process includes:

- Identification of generic product attributes (e.g. reliability, compliance with standards, etc.)
- Design of questionnaires to assess the customer's willingness to pay for each attribute
- Market segmentation (i.e., separation or division of the market into homogeneous groups) of customers according to their attribute willingness to pay for features or options
- Development of multiattribute choice models to forecast customer preferences among alternative product and price proposals.

The second, a paper by Pat Brown,[2] is a tutorial on the product-realization approach known as *quality-function deployment* (QFD). Brown's paper illustrates how AT&T is applying this technique to a variety of projects. He cites examples of how the process has been used to influence the definition, design, implementation, and deployment of the software and hardware features that AT&T offers its customers.

The QFD process encourages product-definition teams to analyze and rank the "voice of the customer" to produce the best, most-competitive products or services.[2-4] Efforts are focused on meeting carefully defined customer requirements, rather than on simply manufacturing or supplying services according to predefined specifications.

Project Definition and Planning. Decisions to develop a leading-edge product or service that is profitable and satisfies established, technical requirements are made more readily when a reasonable analysis of the work precedes preparation of the project plan. Planning is an iterative process. It establishes the day-to-day operations, resource allotments, schedules, and budgets necessary to realize our customers' product and service requests.[5]

In the second group of papers, we address the issues associated with project definition and planning processes, i.e.,

- Definition of major work procedures, activities, and tasks
- Establishment of organizational structures that delineate the duties of all project personnel
- Strategies for accomplishing project objectives; i.e., meeting predetermined specifications in the least time and at the least cost.

The paper by Eileen Sieli defines[6] process management and describes the functions required to promote continuous improvement and innovation in the project-management environment. Sieli describes the advantages of applying the principles of process management and its customer-versus-supplier philosophy rather than applying the current modes of managing projects as distinct, one-at-a-time occurrences.

In AT&T's *customer-supplier philosophy*, customer requirements guide day-to-day business decisions.

This philosophy, which is constructed on the premise that everyone—inside and outside the corporation—is both a customer of and a supplier to the other, promotes the satisfaction of customer needs. Communicating with customers to determine their most important needs and to get back information on how requirements were satisfied is an important aspect of the process.

Gerry Rexing's paper[7] traces an eight-year history of the development projects at AT&T's Network Control Point (NCP) and how these projects were driven toward more-structured planning. Rexing illustrates how the use of two, proven, project-planning techniques—a work breakdown structure (WBS) and a responsibility matrix—have helped to improve software performance (i.e., on-time delivery to customers) and quality assurance (i.e., performance as promised.) The WBS breaks down the work activities of a project plan into definite units or packages. These units are then assigned specific job numbers and estimated costs, personnel, and times (e.g., weeks, months) to complete the unit. A responsibility-matrix documents project assignments and task relationships.[5]

In their paper, Ed Marion and Eric Riddleberger describe[8] a model that is currently used by the managers of AT&T's government projects whenever simultaneous development efforts are planned. The model establishes a project-management process based on:

1. Project size
2. Project complexity
3. The customer's requirement that we report contract cost and schedule-performance measures that are based on the concept of earned-value analysis (EVA)
4. Risk.

EVA is a cost-accounting technique whereby project-cost estimates or budgets are compared with actual project expenses. To assess progress, we measure in dollars the amount of "work" performed (i.e., effort expended) in a reporting interval.[9]

Initiatives for Quality. The third group of papers addresses the development processes that occur throughout the project's life to maximize quality, cost-effectiveness, innovation, and productivity.

In their paper, Lynn Brunsen et al. illustrate[10] how a common process for governing the development of hardware designs ensures the production of a quality product. The elements of the methodology for new-hardware development provide a process-quality framework that ensures:

- Communication and teamwork among members of cross-functional teams
- Adherence to design requirements
- Manufacturability of the switching product
- Continual improvement of the hardware-development methodology.

Next, John Joyce, Marc Ayers, and Robert Cruickshank explain[11] how the process of control is an iterative process that is synonymous with the management of change. The authors list methodologies and processes for managing design changes for Generic 1 and Generic 2 of the DEFINITY® Telecommunications System product line. They describe how the newly implemented, change-management procedures contributed to overall product quality. In particular, the procedures emphasize customer requirements, coordination of change-procedure documentation, testing of modifications, and facilitation of the control-team process.

Computer-information systems and other statistical techniques that are used to schedule, track, and monitor the performance of development projects are illustrated in a paper by Bob Vehse, Steve Nygren, and Duane Butherus.[12] The authors make specific recommendations for commercial-sector projects that emphasize quality and productivity initiatives, product realization, and fiscal accountability.

Finally, Hosein Fallah et al. describe[13] several tools used throughout AT&T's development community to assess how effectively our products and services meet customer expectations. This final paper defines current standards for implementing project-management audits, software-process assessments, and technical and post-mortem reviews. In addition, the authors share practical experiences from projects that use the techniques.

Benefits to AT&T

If other AT&T projects implement the initiatives described here, these benefits will result:

- Faster commercialization of new technology
- Fewer product defects
- Enhanced customer satisfaction
- Increased employee productivity.

The processes and applications described in this issue illustrate some tangible reasons for sustaining the efforts throughout the corporation. As more projects adopt these techniques, the benefits will become even clearer.

To start, the thorough analysis of customer needs is equipping AT&T's marketing personnel, product managers, systems engineers, and software and hardware developers with the knowledge they need to execute the right product for the marketplace. By first defining the project, management is then able to establish the appropriate structures to expedite project work.

Deployment of more rigorous processes also helps identify the dependencies among complex project tasks. When the scope, order, and time frame of the work to be done are documented in the planning phase, the initiative establishes the baselines for project control. Communication channels are also opened among the different specialists who must work together as members of cross-functional project teams.

Auditing the management structures that are put in place to develop new products and services minimizes errors, improves quality, and shortens the product's or service's time to market.

Ultimately, the marketplace will measure the true benefits that lie ahead for AT&T as we seize the opportunity to reduce development costs, deploy more timely technology, and increase profits.

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