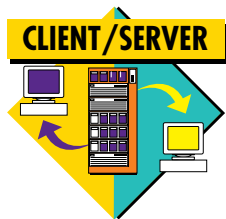


---

# PDM Implementation Framework



By Eddie Ho, Peter Stoll, and Eric Dunn

---

The IBM Austin Product Data Management (PDM) implementation framework comprises several hardware and software components. Key emphasis has been placed on performance, high availability, automated backup and recovery, connection-based load balancing, system monitoring, worldwide network connectivity, shared filesystems, secured access, and development and manufacturing tool integration. The implementation framework has provided the foundation to support mission-critical Engineering Change and worldwide Release processes at IBM Austin, Texas.

For the past 20 years, the IBM Corporation has been using mainframe-based legacy Product Data Management (PDM) systems to support its mission-critical Engineering Change and worldwide Release processes. These processes facilitate and control the communication of information from development to worldwide manufacturing locations. The implementation of ProductManager/6000, PDM business software, has created a significant opportunity for the IBM Engineering Change and Release team in Austin, Texas to redefine the implementation framework using the latest in client/server technology.

To support the corporate re-engineering initiatives as well as to follow the principle of "use what we sell," IBM chose ProductManager/6000 and the RISC System/6000 (RS/6000™) platform. In addition, we had to define several hardware and software components, which focus on the following functions:

- ◆ High availability
- ◆ Automated backup and recovery
- ◆ Connection-based load balancing
- ◆ System monitoring
- ◆ Network connectivity
- ◆ Shared filesystem access
- ◆ High performance
- ◆ Secured access
- ◆ Seamless integration between development and manufacturing systems

A well-planned implementation can keep the Product Data Management installation from becoming a potential bottleneck for the Engineering Change and worldwide Release processes. Because of the diverse types of end-user workstations, various response time requirements, and multiple product integrations, a three-tiered client/server data model was chosen to support the PDM framework. Figure 1 shows this model.

## Austin RS/6000 Development Environment

Both local and remote manufacturing locations require access to the PDM system to implement engineering changes. The Austin Engineering PDM implementation will support the RISC System/6000 Division, IBM Microelectronics Division, and the PC Company. It will also support the following remote manufacturing locations: Raleigh, North Carolina; Wangaratta, Australia; Vimercate, Italy; Yamato, Japan; and Sumare, Brazil.

## Requirements

We identified implementation requirements before developing any formal specifications or making a capital investment. These requirements were based upon the re-engineered development process as well as current commitments to development and manufacturing customers:

- ◆ Performance equivalent to the mainframe-based legacy system
- ◆ 100 concurrent, 300+ casual users
- ◆ Scalable implementation
- ◆ Consolidated technical data repository
- ◆ Automated backup and recovery
- ◆ High availability with 7x24x365 operations
- ◆ Worldwide network connectivity
- ◆ IBM Local Area Network security compliant
- ◆ Seamless integration to CAD/CAM, part selection, and downstream Material, Requirements, and Planning (MRP) systems

## Three-Tiered Architecture

IBM's ProductManager/6000 supports a flexible three-tiered client/server architecture using the Distributed Computing Environment (DCE) framework.

These tiers are client, compute, and database layers, as shown in Figure 2. The client layer executes the ProductManager/6000 Graphical User Interface (GUI) with either AIX, OS/2, or Windows workstations. The compute layer is responsible for running the ProductManager/6000 ObjectManager, which creates and submits the database transactions to the database layer. The database layer receives the database transactions and makes the necessary inserts, updates, deletes, and retrievals to the database. It is also responsible for data storage (backup and recovery).

## Software Components

The software component is key to achieving the predefined requirements. Application Services Manager, Product Structure Manager, Product Change Manager, and Document Control Manager, which comprise the ProductManager/6000 solution are major components. However, other software and support infrastructure, as shown in Figure 3, is also required.

Figure 4 lists the key software support packages for Product Data Management.

## Three-tiered Client/Server Data Model

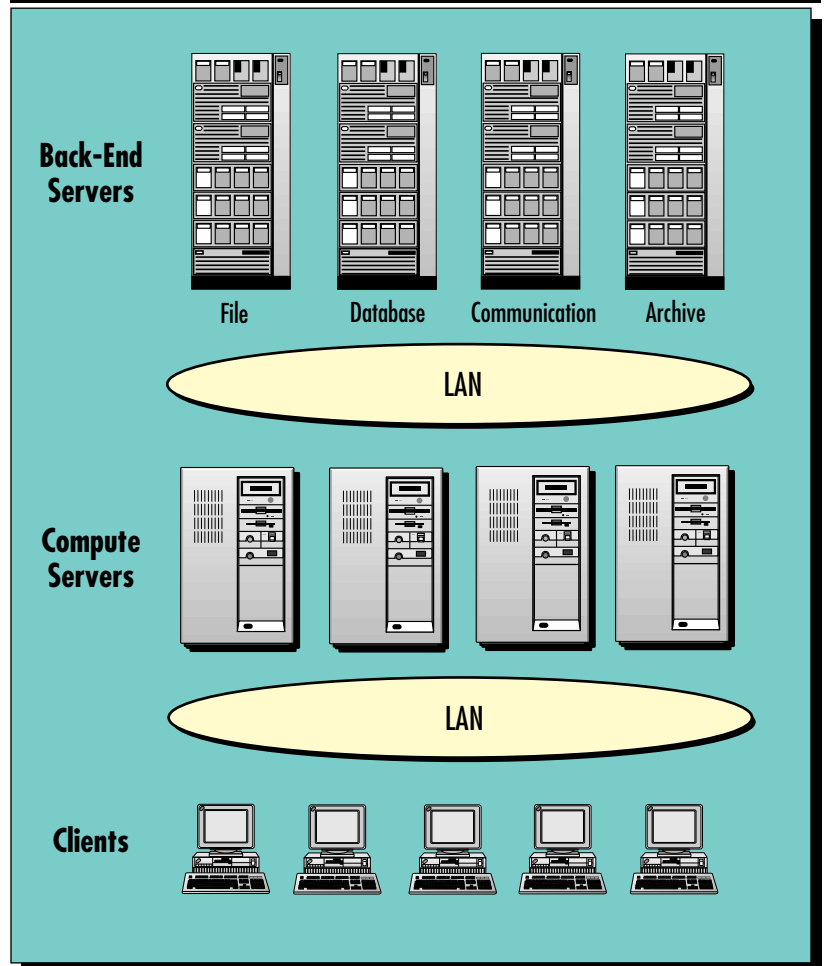


Figure 1. Three-tiered client/server data model

## Performance/Capacity Planning

Performance simulation and capacity planning is an ongoing activity that supports the rollout of the implementation. The objective of the prototype environment, which initially supports this activity, is to define resource utilization and potential implementation bottlenecks. To support the performance simulations, we used preVue/X to initially define and script user workloads.

## Workload

Initial workloads consisted of the following:

- ◆ Users creating and distributing folders to local and remote users
- ◆ Users reviewing and approving folders
- ◆ Multiple users creating Engineering Changes (ECs) and part numbers

- ◆ Multiple users requesting background reports
- ◆ Users browsing existing ECs and part numbers

The workload is executed using preVue/X and locally developed scripts.

### Capacity Planning

BEST/1® for UNIX monitors the resource utilization during the simulation; it also reports CPU, memory, network, paging, and disk utilization. This process identifies resource utilization as well as potential performance bottlenecks. In addition, “what if” scenarios can be

created using various hardware and software configurations to determine the most efficient implementation. For example, you can model and evaluate specific hardware and software configurations prior to implementation. The model analysis can be used to evaluate a specific configuration.

### Network Connectivity

Network connectivity is an important consideration when implementing an enterprise PDM client/server solution, particularly if 1,000 local and remote users will be accessing the system.

## The Implementation Framework

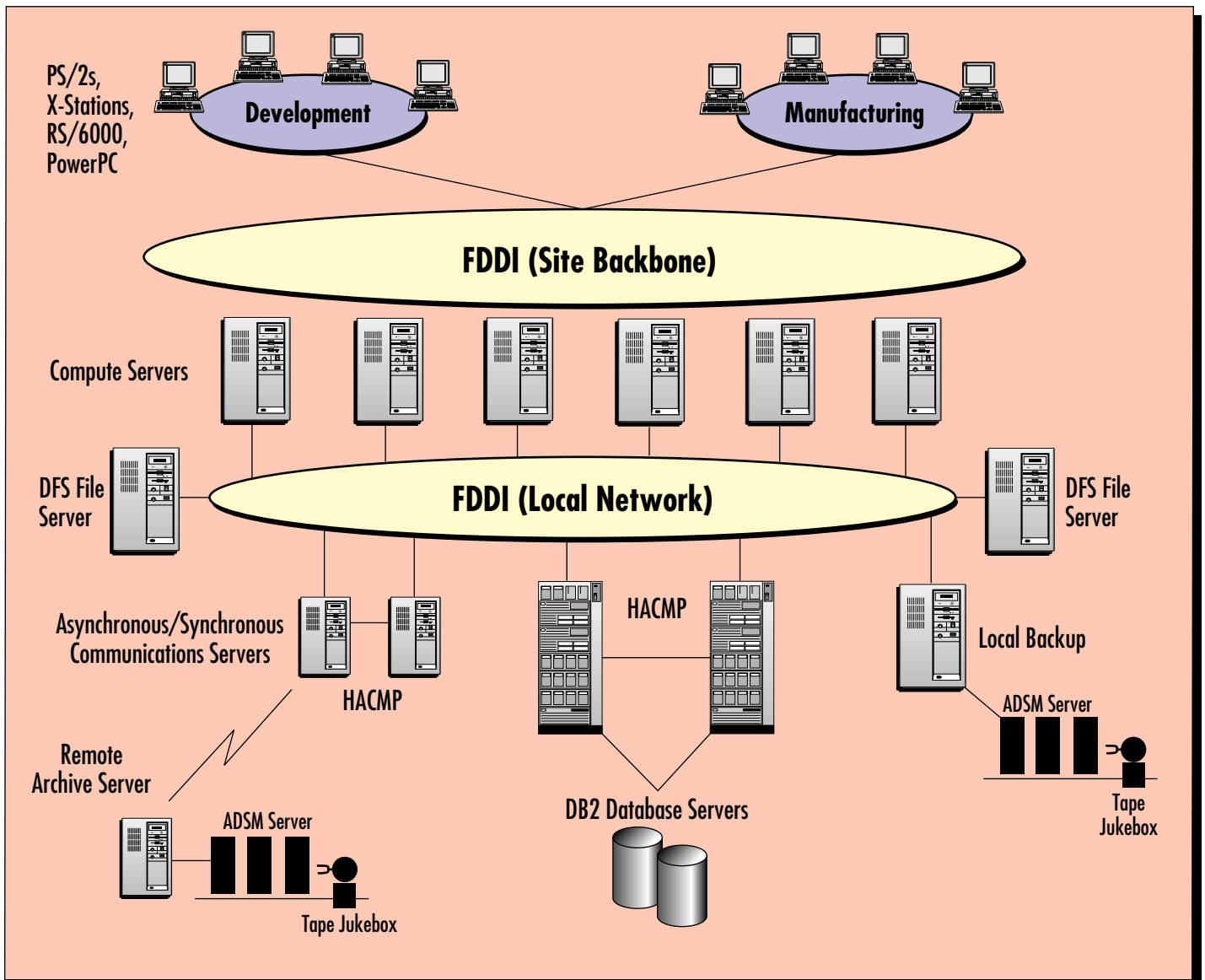


Figure 2. Implementation framework

Real-time access is required by all end users of the system. Consequently, key focus is placed on all aspects of networking.

### Local Area Network

The database servers, compute servers, system backup server, and asynchronous and synchronous communication servers are connected by Fiber-optic Distributed Data Interface (FDDI) via an intelligent IBM 8250 Multi-Access Unit. This unit is connected to a router that is directly attached to the Austin site FDDI backbone.

Clients are connected to local area networks via 4/16 Mbits Token Ring. These LANs are connected to building routers, which are then directly connected to the site backbone. The standardized network protocol is the Transmission Control Protocol/Internet Protocol (TCP/IP).

### Wide Area Network

With global manufacturing locations in Raleigh, Sumare, Vimercate, and Wangaratta, the PDM database must be accessible 7 days a week, 24 hours each day (7x24). Multiple routers are required to support remote connectivity. The data transfer media consists of a worldwide multiprotocol network. Connection to the PDM implementation is supported either by executing the GUI remotely or via the AIX remote login facility.

### High Availability

To support a 7x24 mission-critical PDM implementation, we have placed significant emphasis on limiting any single point of hardware failure. To limit downtime, we added additional hardware such as a standby system, dual communication adapters, and shared DASD.

In addition, we installed IBM HACMP/6000™ and LoadLeveler™ to support high availability. HACMP/6000 facilitates the takeover of all resources by eliminating a single point of failure. LoadLeveler monitors and manages work loads. Together, they extend the overall system availability of the implementation.

### Communication Monitors

The ProductManager/6000 asynchronous and synchronous communication monitors are required to support real-time and batch communications to the database layer. These interfaces support CAD, MRP integration, batch reports, and Product Data Interface (PDI) communications.

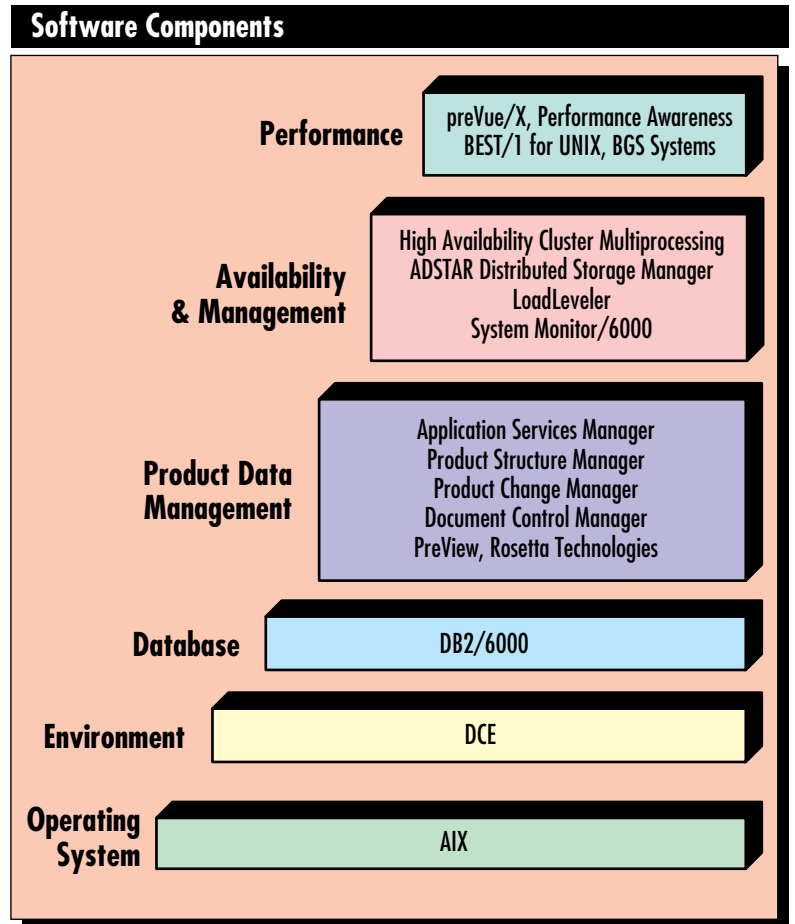


Figure 3. Software components

Software Support Packages for PDM	
Software	Function
preVue/X	Application simulation in a user environment
BEST/1® for UNIX	Capacity planning and management
High Availability Cluster Multiprocessing (HACMP)	24-hour availability support
ADSTAR™ Distributed Storage Management (ADSM)	Backup and recovery
LoadLeveler	Load balancing
System Monitor/6000	Resource monitoring
DB2/6000™	Mission-critical database support
DCE	Distributed Computing Environment infrastructure support
AIX	Operating system

Figure 4. Software support packages for PDM

---

Each communication monitor has a dedicated server.

To support a 7x24 availability of these processes, we defined a highly available cluster. In the event of a single point of failure, the failed process is initiated on the standby node. The migrated processes will be reinitiated on the primary node when it is activated. This highly available configuration is called *shared*.

### Database Servers

The implementation requires high availability of the database. The database must be available 24 hours a day to support both real-time and batch communication.

To support this requirement, we defined a highly available cluster using the hot-standby configuration. If a single point of failure occurs, DB2® is accessed on the standby system. The data is readily accessible since it has been mirrored to the backup node.

### Connection-Based Load Balancing

To provide end users with the best performance on the compute servers, we defined and implemented connection-based load leveling to support an enterprise ProductManager/6000 implementation. A common front end was developed to support centralized access to the PDM system and its associated products. When you access the PDM system using the customized front end, IBM's LoadLeveler software component that executes on the asynchronous communication server assumes control. LoadLeveler's interactive session support identifies which compute server has the least load based upon customized metrics. Once the least-loaded compute server has been identified, a remote procedure call is executed to pass the user resources to the specified compute server.

### Backup and Recovery

We initially defined backup and recovery objectives to support the enterprise implementation. Since IBM's disaster-recovery program requires up to two years of data to be supported, the objectives established for the Austin Engineering Release backup and recovery consist of the following:

- ◆ To provide both local and remote (archive) backups
- ◆ To recover all data that has been backed up within two hours

- ◆ To recover the database from any point in time over two years

Automated backup is necessary to support a mission-critical implementation. Nightly, the database and data residing on the compute server are incrementally backed up to an 8mm Exabyte® 60 tape library. Weekly, the database is automatically archived off-site using the DB2 backup facility. The data is backed up over the Wide Area Network to an Exabyte 120 8mm tape library that resides off-site.

Both local and remote backups are automated via the ADSTAR Distributed Storage Management (ADSM) software. ADSM can support automated backup based upon a set of pre-defined parameters that are created between the ADSM client and server processes. Specific parameters consist of establishing the policy domain, policy set, management class, and copy groups. Recovery is a manual process invoked through the ADSM client interface.

### Distributed Computing Environment

DCE software is a major component of the Enterprise ProductManager/6000 implementation. DCE provides the client/server infrastructure that allows distributed applications to interact in a heterogeneous environment. Several components make up DCE:

- ◆ Distributed Time Service (DTS)
- ◆ Cell Directory Service (CDS)
- ◆ Security Service
- ◆ Distributed File System (DFS)
- ◆ Global Directory Agent (GDA)

High availability of the DCE implementation consists of three DTS processes, two CDS processes, two security processes, two DFS processes, and two GDA processes. The entire DCE cell comprises five servers with one or more active DCE processes per server.

DCE's DFS is used extensively in the ProductManager/6000 implementation. DFS, a distributed filesystem, enables cooperating hosts (clients and servers) to efficiently share filesystem resources across both LANs and WANs. Within ProductManager/6000, DFS supports the centralized access of ProductManager/6000 and associated binary files, as well as electrical and mechanical pre-release technical data. The DFS repository is accessible via the PDM compute servers and

DCE provides the client/server infrastructure that allows distributed applications to interact in a heterogeneous environment.

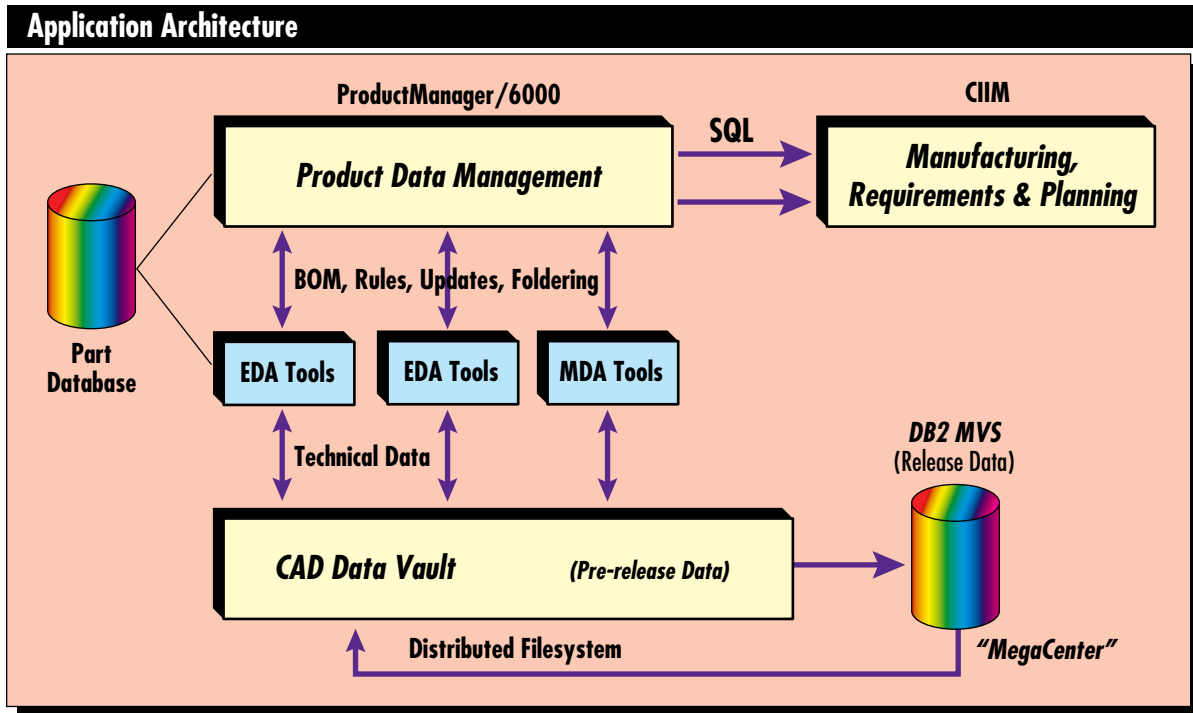


Figure 5. PDM product integrations and interfaces

local clients. Once data is updated on the DFS server, the local client caches are refreshed.

### System Monitoring

IBM System Monitor/6000 monitors each server that comprises the PDM implementation. This software provides online notification of predetermined resource conditions. If a condition is triggered, notification is sent to PDM Information System support via E-mail or digital pager, depending on the resource and severity of the condition. In addition, a World Wide Web page will be updated to reflect the status of each server and resource every 15 minutes.

### Seamless Integration

The Product Data Management system eases the flow of product information from development to manufacturing. Consequently, the PDM implementation framework must support several key product integrations and interfaces, shown in Figure 5.

The Austin Product Data Management implementation framework supports both batch interfaces and seamless integrations between ProductManager/6000, MDA/EDA design applications, CAD data vault, parts database, and the Material, Requirements, and Planning system.

The batch interface is based upon using the ProductManager/6000 product data interface. This interface supports remote data communications via the Asynchronous Communication Monitor (ACM). Seamless integration is supported via the ProductManager/6000 Synchronous Communication Monitor (SCM). The SCM provides a real-time interface to the electrical and mechanical design applications as well as the MRP system.



**Eddie Ho**, IBM Corporation, 11400 Burnet Road, Austin, TX 78758. Mr. Ho is a senior programmer in the AIX Executive Briefing Center. He has a BS in Computer Science from the University of Wisconsin and an MS in Computer Science from North Dakota State University.

**Peter Stoll**, IBM Corporation, 11400 Burnet Road, Austin, TX 78758. Mr. Stoll is a senior manufacturing analyst in the RS/6000 Manufacturing area. He has a BA from the University of California at Los Angeles.

**Eric Dunn**, IBM Corporation, 11400 Burnet Road, Austin, TX 78758. Mr. Dunn is an advisory development programmer in the RS/6000 Technical Services area. He has a BS in Management Information Systems and an MBA from Old Dominion University in Norfolk, Virginia.