

# Oracle9i Database Manageability

*An Oracle White Paper*  
*May 2002*

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## EXECUTIVE OVERVIEW

A well-managed data center is critical to the success of every organization. A profitable business must maximize *quality-of-service* – specifically application performance and availability – while minimizing *cost*. This can create a problem, as these three goals are frequently at odds with each other.

Recognizing these demands, Oracle has made enhanced manageability one of the primary design goals of Oracle9i. Three major changes have resulted:

- Packaging and deployment options for both Oracle9i Application Server and Oracle9i Database Server have been dramatically simplified, streamlining installation and configuration.
- Oracle9i Database server has been significantly enhanced to simplify database administration and provide a high degree of self-management.
- Oracle has added to the Oracle Enterprise Manager tool set to provide coverage of the entire computing platform.

The net benefit to customers is improved quality-of-service and reduced IT staff costs.

**A profitable business must maximize quality-of-service – specifically application performance and availability – while minimizing cost. Reducing management costs - the largest component of IT spending - is key.**

## **1. SYSTEMS MANAGEMENT – THE PRODUCTIVITY PAYOFF**

The purpose of using information technology is to increase employee productivity and organizational efficiency. As the cost of hardware and software continues to drop, the relatively fixed costs of human administrators loom proportionately larger. The only method of addressing those costs is through more effective systems management.

Today, over 50% of data center budgets are attributable to staff costs. Efforts to reduce these expenditures have been thwarted by a dramatic increase in the demands placed on IT organizations. These constraints apply to most every application, but become particularly acute when deploying over the Internet. Coupled with the frequent shortage of IT skills, these challenges are the reason management costs are so resistant to easy reduction. According to Hurwitz Group,

"Acquisition costs are a small percentage of TCO when compared with the overall costs and specifically, ongoing support and management costs: Over a three-year life cycle, ongoing support and management together represent more than 62% of total TCO."<sup>1</sup>

### **1.1 Measuring Manageability**

Overall cost is only one dimension of manageability. As web-based applications become increasingly popular, quality-of-service metrics around performance and availability become the critical measures of return-on-investment. If the application is meeting these targets, its users and administrators will consider it successful. Manageability, done correctly and efficiently, lets companies realize the full potential of their computing platform.

On the other hand, poor manageability leads to slow response to changes in the environment, causing diminished capacity and eventually even an availability crisis. Gradually the system becomes unresponsive to its administrators, and this can only end in the disappointment of its users and owners. According to AMR Research,

"Levels of availability are now arguably the most important factor in determining total cost of ownership since the cost of downtime to the business in a B2B or B2C e-commerce environment far outweighs any IT cost components."<sup>2</sup>

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<sup>1</sup> *Achieving Faster Time-to-Benefit and Reduced TCO with Oracle Certified Configurations*, Hurwitz Group, March 2002

<sup>2</sup> *E-Commerce and Technology Spending Report 2000 – 2002*  
AMR Research

## 2. ORACLE MANAGEABILITY FEATURES

The solution to today's manageability challenges lies in intelligent products capable of automating routine tasks and, where possible, making real-time recommendations to their administrators. These two facets are key to reducing management costs through increased administrator productivity.

In Oracle9i, Oracle has delivered an integrated product suite built from an intelligent server out to value-added management tools. The two halves of this integration are the:

Manageability Features
<a href="#">Intelligent Database Server</a>
<a href="#">Comprehensive Management Framework</a>

### 2.1 Intelligent Database Server

As average database size and user population has increased over time, customers have made it clear that ease-of-use is highly desirable to ease the burden on busy IT staffs.

#### 2.1.1 Magnifying Administrator Efficiency

Configuring a database for optimal performance and availability is a critical administrative goal. While often approached as a one-time process at configuration time, maximizing quality-of-service through system tuning is a dynamic process. An administrator must balance the current load against system resources, seek to maximize throughput on the platform, all while meeting minimum response-time requirements. To perform this task, an administrator has just three classes of resource to allocate: disk space, memory and CPU time.

In tackling this challenge, Oracle delivers several key self-management capabilities in Oracle9i Database. These features enable the database itself to handle much of the configuration and tuning of the disk space, memory and CPU subsystems, without any action required of the administrator.

Off-loading work from an individual to an intelligent server effectively "scales the administrator" – freeing them to handle larger data sets, more users, and even additional databases. This efficiency increase can postpone or eliminate the need to hire additional IT staff. Several large Oracle customers report DBA-to-database ratios of between 10 and 45, indicating that Oracle's management offerings are meeting with real-world success.

**Off-loading work from a person to an intelligent server effectively "scales the administrator" – freeing them to handle larger data sets, more users, and even additional databases.**

**Assumption of management duties by the server often results in increased performance and decreased resource use.**

### 2.1.2 Self-management Yields Better Performance

An interesting side-effect of this assumption of management duties by the server is that performance has, in many cases, *increased*, at the same time as resource consumption has *decreased*. This is because the server micro-manages resources as requests are made of the system, doing a much better job overseeing the ever-changing workload than a slower human administrator.

Administrators are often forced to make educated guesses in advance, or at best, react slowly to emerging events, whereas the database server has precise real-time information and the ability to make sophisticated calculations to optimize its actions. As additional resources become available within the server, the database can quickly calculate where they can do the most good, and assign them accordingly, around-the-clock.

### 2.1.3 Self-management Features

In Oracle9i Database, the manageability feature changes are far too numerous to discuss in detail here. However, in the following section, we will discuss key changes in each management area.

- [Space Management](#)
- [Memory Management](#)
- [Processor Management](#)
- [Operations](#)

For further information on these features, please see the *Oracle9i Database Manageability Technical White Paper*.<sup>3</sup>

### 2.1.4 Space Management

Space management refers to the server's use of disk storage. As databases have increased in size and complexity, space management has been the Achilles heel of many production databases. A single business application may have several thousand tables, any one of which could run out of space and halt operations.

Over time, as data trickles or floods into a database, additional disk space will periodically be required. This routine operation by itself may not affect availability, but adjusting the placement of individual tables to take advantage of new space has traditionally been more challenging.

Oracle9i Database contains functionality to address these requirements and more via features such as:

- Data Partitioning
- Automatic Undo Management
- Automatic Free Space Management

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<sup>3</sup> <http://otn.oracle.com/products/manageability/content.html>

- Oracle Managed Files
- Resumable Space Allocation

These capabilities allow the administrator to configure the database to assume responsibility for what were formerly tasks for the DBA.

### 2.1.5 Memory Management

For high performance, good memory tuning is critical. Yet most modern databases have numerous memory structures, and each must be managed separately. Oracle9i Database makes this job simple by automating memory management tasks via features such as:

- Dynamic Memory Reconfiguration
- Self-Tuning SQL Execution Memory
- Memory Size Advisors

### 2.1.6 Processor Management

Processor time is a perishable commodity within the database. But simply letting every request freely contend for attention from the CPU is only an option on lightly used systems. As servers become more heavily loaded, it is important to allocate CPU cycles according to business priorities, so important work gets done with dispatch. Oracle9i Database simplifies this aspect of administration with features such as:

- Dynamic Resource Management
- Database Resource Manager

### 2.1.7 Operations

A significant portion of an administrator's time is spent performing routine operational tasks such as Backup & Recovery. Oracle9i Database improves productivity with features such as:

- Clustered Databases (Real Application Clusters)
- Standby Databases (Oracle Data Guard)
- Simplified Backup and Recovery (Recovery Manager)
- Predictable Recovery Time

## 2.2 Comprehensive Management Framework

A self-managing database is a tremendous asset, but business applications rely on many other components as well. The application front-end may run on a client machine or in a browser. It may communicate with a middle-tier server, which in turn accesses one or more back-end servers. All these components run on host machines and communicate via a network. In the past, these components were

**Oracle Enterprise Manager is Oracle's bundled, comprehensive management framework. It exposes and enhances the manageability features in the Oracle database.**

often managed separately, with database, system and network administrators usually using different and incompatible tools to perform their tasks.

Oracle provides a comprehensive management framework in Oracle Enterprise Manager. Enterprise Manager is included with every Oracle database at no additional charge, and various optional Management Packs are also available. The base product includes:

- A centralized, lightweight console that is the primary interface for performing all management tasks.
- A powerful middle tier Management Server that provides all management framework services.
- Distributed, non-intrusive Agents that execute tasks, monitor conditions and collect statistical data on each managed system.
- An additional set of integrated applications and tools for administration of the entire Oracle stack.

For further information on these features, please see the *Oracle9i Enterprise Manager Technical White Paper*.<sup>4</sup>

### 2.2.1 Monitoring from the User Perspective

**Monitoring is critical to availability; any latency in detecting an emerging problem increases the length of any interruption in service.**

Often the first people to realize a system problem exists are its users. Because application performance and availability are crucial to the success of an application, administrators must focus on the application users' experience, rather than simply managing individual system components in isolation. Administrators must continuously monitor application performance. Should degradation occur, they then need to quickly investigate the application stack and pinpoint the problem.

Enterprise Manager incorporates the user perspective by providing a set of tools to diagnose problems throughout the technology stack:

- Application
- Application Server
- Database
- Operating System
- Storage System
- Network

### 2.2.2 Defining and Meeting Service Levels

Many of today's companies use Service Level Agreements to quantify their quality-of-service objectives. According to Donna Scott of Gartner Group,

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<sup>4</sup> <http://otn.oracle.com/products/manageability/content.html>

"Due to increased dependency on IT, more and more business process and IT infrastructure owners are seeking contracts and agreements specifying required service levels from both in-house and outsourced service providers. As a result, although less than 15 percent of large enterprises measure the end-to-end availability and performance of critical applications today, we believe 75 percent will be doing so and measuring against pre-defined service level agreements by year-end 2004 (0.8 probability)."<sup>5</sup>

Failure to meet these requirements, in addition to the clear inconvenience to the user community, may result in financial penalties imposed on the provider. Thus maintaining appropriate service levels in these environments is a critical priority for IT departments.

Enterprise Manager is particularly valuable in this situation because it documents performance details such as application response time and system availability. With these in hand, administrators quickly identify potential performance problems as they are developing. They also provide a record of a system's behavior over time.

### **2.2.3 Determining Business Impact**

Enterprise Manager's system health assessments track the performance of particular components, as well as the system as a whole. Enterprise Manager keeps both current and historical performance information, so administrators can easily see how the system is performing in real-time. Drawing on the saved information, administrators can perform capacity planning by extending the trend out into the future. These assessments allow administrators to easily monitor resource use and avoid looming performance problems.

For environments where continuity of business applications is critical, it is important to ensure that changes made to the system do not impair quality-of-service. Enterprise Manager's administrative impact reports show administrators the effects of changes before they are applied to the production system.

### **2.2.4 Effectively Responding to Events**

An important feature any management system is automated monitoring and task scheduling. System problems may develop at any time of the day or night, so a facility is needed to monitor critical systems and instantly alert administrators to developing problems.

Enterprise Manager includes an advanced event system where administrators set up traps to monitor any component of interest. Administrator may choose to be emailed or paged as part of the response to a triggered event. Typical examples include paging or emailing an administrator when overall application response time exceeds a set threshold, or when resource use is too high on a specific host. Oracle

**Events allow a programmed response to anticipated problems, reducing the burden on human administrators and allowing for "lights out management".**

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<sup>5</sup> Donna Scott, VP & Research Director, Gartner, Inc. March 2002

Enterprise Manager includes hundreds of pre-defined events for all managed components of the application stack. It also supports customized events in any scripting language.

### 3. MANAGEMENT IN ACTION

Features in isolation are only one part of the manageability picture. Oracle has organized the many management features and tools to form a complete solution to address real business problems, thus contributing to a more positive bottom-line. Here are Oracle's solutions to specific management challenges arising over the full application lifecycle.

Management Challenges
<a href="#">Installation &amp; configuration of products</a>
<a href="#">Maintaining user authentication</a>
<a href="#">Maintaining availability</a>
<a href="#">Maintaining performance</a>
<a href="#">Maintaining packaged applications</a>
<a href="#">Backup &amp; recovery of database</a>
<a href="#">Change management</a>

#### 3.1 Installation and Configuration of Products

System installation and configuration is an unavoidable expense for every new installation. Oracle reduces these costs by simplifying packaging and streamlining installation.

##### 3.1.1 Simplified packaging

Oracle9i consists of two main products: Oracle9i Database and Oracle9i Application Server. Components previously available separately have been collected into just these two products, resulting in a streamlined installation process and fewer physical CDs to order and install. For example, all of Oracle's core middle-tier services have been integrated into Oracle9i Application Server.

**Oracle9i consists of just two main products: Oracle9i Database and Oracle9i Application Server.**

##### 3.1.2 Oracle Universal Installer streamlines installation

Oracle provides a common installation utility – the *Oracle Universal Installer* – on all supported platforms. This provides administrators with a familiar installation environment, whatever the platform or product. The install experience itself is much streamlined compared with previous versions, with few questions asked; installations are now standardized to install the full contents of the product suite, reducing variability.

By reducing the complexity of installations, administrators save time, and Oracle is able to provide a higher-quality product, as testing can be concentrated on fewer configurations for each product. Support is much improved as well, since support analysts now have a much better idea of what is in the customer's environment. So problems, where not entirely avoided by this new arrangement, are now more quickly identified and fixed.

**User authentication is a universal security requirement, made more complex by the numerous separate systems typically in use.**

### **3.2 Maintaining user authentication**

According to Gartner, password management is one of the most labor-intensive and risk-prone IT functions, costing \$200 - \$300 per user each year.<sup>6</sup> Centralized management of security reduces complexity and cost, and provides greater control.

Users can be defined traditionally, as database users, or more flexibly, as enterprise users. The difference comes from the location the user authentication data is stored, and the resulting privileges.

#### **3.2.1 Enterprise Manager Console**

The console allows for the creation of user logins within the database. This is the default for smaller environments.

#### **3.2.2 Enterprise Security Manager**

Enterprise Security Manager is a separate tool providing for the management of all of enterprise users, their authorizations and roles. An enterprise user is provisioned in the LDAPv3 compliant Oracle Internet Directory server (OID).

### **3.3 Maintaining availability**

Availability comes from a combination of technologies, because the threats to continuity of operations come in a number of forms.

**Real Application Clusters is Oracle's cluster database solution – it keeps serving data as long as even a single node is available.**

#### **3.3.1 Real Application Clusters**

Real Application Clusters is Oracle's cluster database server. As nodes are added to the cluster, the database becomes more resistant to failure. As nodes come and go from the cluster, availability is unaffected. This allows unprecedented management flexibility in performing hardware maintenance without hurting overall availability. Enterprise Manager recognizes cluster databases and treats them similarly to single-node instances of Oracle, hiding the complexity from the administrator. When changes are made, Enterprise Manager handles the details of change propagation, regardless of the number of nodes.

#### **3.3.2 Data Guard**

Data Guard protects against site failure by shipping log data to a remote location, where a standby database is maintained. Enterprise Manager provides a wizard to

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<sup>6</sup> Gartner, 2001

administer Data Guard. Here too, complexity is hidden from the administrator, as the wizard reduces dozens of steps to a single mouse click. Failover and switchback, for example, are performed in a single administrative operation. Organizations can at will designate any server in the Data Guard network as their current primary machine, further aiding maintenance and reducing planned downtime.

### 3.4 Maintaining performance

Performance consists of initial configuration followed by ongoing homeostatic measures to preserve performance in the face of environmental changes. Oracle9i Database and Enterprise Manager cooperate in this process to reduce the burden on administrators. The database's recommendations are translated into easily interpreted graphical displays that guide the administrator to optimal decisions. While the console ship with significant functionality already included, it is targeted toward reactive use. For proactive use, or more challenging situations, the Diagnostics and Tunings Packs should be used to supplement the console.

Testing prior to production can usually only partially simulate actual runtime conditions. As user and data loads increase over time, it is essential to be ready to take corrective action if performance falls off.

#### 3.4.1 Enterprise Manager - Diagnostics Pack

Diagnostics Pack is a set of applications integrated with Enterprise Manager that provides the tools required for monitoring the Oracle environment, including: databases, host systems, web servers and Oracle applications. A part of the Oracle Enterprise Manager product family, the Oracle Diagnostics Pack covers the key facets of Oracle diagnostics: lights-out monitoring and notification, real-time diagnostics, historical data analysis and web-based reporting.

#### 3.4.1 Enterprise Manager - Tuning Pack

Tuning Pack is a set of applications integrated with Enterprise Manager that provides automated database analysis and tuning. The Tuning Pack identifies opportunities to increase database performance by tuning database instance settings, indexes, SQL statements and space usage. Proactive database tuning with the Tuning Pack can increase system responsiveness and reduce the cost of database maintenance.

### 3.5 Maintaining packaged applications

Packaged applications vary considerably in their architecture and administration. Oracle provides solutions for the cases below, but many independent applications are administered via separate mechanisms (outside of the Enterprise Manager framework) provided by their programmers.

Application management packs enable more holistic management of enterprise applications with the underlying software and hardware.

#### 3.5.1 Management Pack for E-Business Suite

The Management Pack for Oracle E-Business Suite offers end-to-end management of the E-Business Suite platform, giving administrators 24x7 system availability and high system throughput. It provides a complete view into every tier of the Oracle Applications system, managing every key subsystem and correlating information

across multiple tiers of the Oracle Applications technology stack. The Management Pack for Oracle Applications provides all the tools necessary to maximize system availability, improve system efficiency, and achieve optimal resource utilization.

### **3.5.2 Management Pack for SAP R/3**

Management Pack for SAP R/3 is a set of tools for monitoring, diagnosing, and planning an SAP R/3 environment. The pack builds on the Oracle Enterprise Manager host and database management framework and incorporates the SAP R/3 system as a peer to its other managed services.

### **3.5.3 Custom Integration with Enterprise Manager**

ISVs can integrate their management facilities with Enterprise Manager via a provided expansion framework. The advantage of this is in the installation and training savings that result from making custom application administration yet another component launched from Enterprise Manager.

## **3.6 Backup & Recovery of database**

Backup and recovery are critical to the protection of a database. While both operations are important, it should be noted that far more backups are performed than recoveries, so the former has a far greater effect on management efficiency.

**Recovery is an infrequently performed task, so any flaws in one's backup strategy are often discovered only when it is too late to correct them. As databases grow larger over time, tools such as RMAN reduce the opportunity for human error around backup and recovery.**

### **3.6.1 Recovery Manager**

Recovery Manager (RMAN) is an Oracle tool that allows you to back up, copy, restore, and recover datafiles, control files, and archived redo logs. You can invoke RMAN as a command line utility from the operating system prompt or use the GUI-based Enterprise Manager Backup Manager.

RMAN automates many of the backup and recovery tasks that were formerly performed manually. For example, instead of requiring you to locate appropriate backups for each datafile, copy them to the correct place using operating system commands, and choose which archived logs to apply, RMAN manages these tasks automatically.

## **3.7 Change Management**

### **3.7.1 Change Management Pack**

Oracle Change Management Pack eliminates errors and loss of data when upgrading databases to support new versions of applications. The pack analyzes the complex dependencies associated with application change and automatically performs the required schema upgrades. From a central graphical user interface, users initiate changes safely with easy-to-use wizards that walk users through the steps required for the schema changes.

**Changing the schema of a production database is often a challenging undertaking because of numerous dependencies. Change Management Pack increases efficiency and reduces error during these upgrades.**

## 4. MANAGEMENT FUTURES

Oracle9i Database as described up to this point has been depicted as it is typically used – a traditional manual installation onto custom hardware. This we refer to as the *general computing* model. While this describes the usage of companies with a traditional data center and IT staff, Oracle’s management flexibility opens the door to some other opportunities to further reduce cost.

### 4.1 Oracle Standard Infrastructure

Oracle Standard Infrastructure is a computing model that standardizes customer environments. It addresses the entire hardware and software stack, including server hardware, operating system, storage and network. Its design goal is to further remove complexity, compared with the General Computing model, making costs lower and more predictable.

In the General Computing model, taking into account the differences in hardware, options, operating systems version and patches applied, each customer ran the Oracle database on an essentially unique platform. This variability makes support much more difficult for software vendors, and more expensive for customers.

Under the Oracle Standard Infrastructure program, Oracle and its partners reduce costs by providing advance certification, installation, configuration and testing. As the number of novel or unknown factors in customer computing environments drops, so do costs.

Infrastructure assistance is available in published “blueprint” forms from Oracle. These blueprints are architectural design guides built to address specific business needs such as high availability or resilient backup. Two examples of these are:

- **VOS Initiative** - Veritas, Oracle and Sun are working together to create tested combinations of their respective products. These combinations are supported by a jointly staffed escalation center created just for this purpose.
- **ECOstructure** - Under the ECOstructure Initiative, EMC, Cisco and Oracle have combined forces to deliver a set of thoroughly tested technology blueprints. These contain guidelines for designing, implementing and managing a highly scalable, reliable IT platform, built on components provided by these three companies. A joint development center tests the blueprints to verify performance under availability, scalability and security challenges.

### 4.2 Certified Configurations

Certified Configurations are computing hardware with factory-loaded Oracle software. They are integrated stacks of hardware and software that can be deployed very quickly. They are pre-installed, pre-tuned and fully stress-tested. A

Reducing platform variability lowers costs for customers and enables Oracle to provide a more reliable product.

certified configuration is orderable via a single part-number from selected vendors.

The certified configuration approach delivers a number of benefits to customers including:

- Simplified purchasing
- Streamlined deployment
- Improved infrastructure management
- Improved serviceability
- Reduced implementation risk
- Lower cost-of-ownership

According to a Hurwitz Group report, "IT managers believe that on average they could save 30% in overall TCO costs by using a solution that provides the benefits of the Oracle Certified Configuration approach."<sup>7</sup>

Several versions are currently available: Oracle8i Database, Oracle9i Database, Oracle9i Real Application Clusters, Oracle9iAS and Oracle E-Business Suite.<sup>8</sup>

### 4.3 Oracle Technology Outsourcing

Earlier sections of this paper focused on the duties performed by an in-house administrator. While this is still the typical case, the Internet changes the situation in that it allows for remote administration. For some organizations, retaining their local server, but contracting for administration by third parties is a desirable way to cut administrative costs.

The advantages of this approach are that organizations retain physical ownership of their data and thus avoid concerns about sudden shutdown of hosting companies, but are able to benefit from the administrative economies of scale that accrue from use of a highly-skilled, part-time remote administrator. Expensive skills can be used on an as-needed basis, with none of the traditional problems of locating and engaging such employees; the remote DBA service assumes these burdens. A recent IDC report states

“Choosing an ASP for application outsourcing can have a significant and positive impact on organizations of any size and in any industry.”<sup>9</sup>

Oracle Corporation itself offers this service in the form called Oracle Technology Outsourcing. Under this program, Oracle experts monitor and maintain your Oracle software either in one of Oracle’s data centers or remotely in your data center, freeing your staff from routine, non-strategic tasks.

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<sup>7</sup> *Achieving Faster Time-to-Benefit and Reduced TCO with Oracle Certified Configurations*, Hurwitz Group, March 2002

<sup>8</sup> [http://www.oracle.com/ip/std\\_infrastructure/content.html](http://www.oracle.com/ip/std_infrastructure/content.html)

<sup>9</sup> *The Financial Returns of Software as a Service: Oracle E-Business Suite Outsourcing* IDC, 2002

**The Internet makes physical location a minor detail. Management services can be delivered at a distance, lowering costs and raising quality.**

The benefits of this are considerable. In addition to secure and reliable technology management, Oracle Technology Outsourcing customers have saved up to 46% on their database administration costs when compared to the traditional off-line, in-house model. They have also been able to reduce support resolution time by 50%, and reduced unplanned outages by as much as 60%.

For further information, please see: *Oracle Technology Outsourcing: Lower Costs and Greater IT Efficiency*.<sup>10</sup>

## 5. CONCLUSION

Effective systems management is the most direct method of reducing the total cost of your IT environment. Without it, any savings you were able to realize by negotiating a good price or choosing bargain software will quickly disappear.

Oracle9i Database was designed to provide enterprise technology paired with significant self-tuning capabilities and time saving tools. Advanced self-management features in Oracle9i Database provide the foundation for administrative simplicity. Exposing underlying server functionality and enhancing it with graphical interfaces, Oracle Enterprise Manager keeps administrators informed and in control. This powerful and elegant design makes Oracle9i the most cost-effective foundation for your business applications.

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<sup>10</sup> [http://oracle.com/online\\_services/index.html](http://oracle.com/online_services/index.html)

## APPENDIX

Here is a summary of individual features Oracle9i Database provides for specific manageability challenges.

Challenge	Oracle9i Features
Installation & configuration of products	<ul style="list-style-type: none"><li>• Oracle Universal Installer</li><li>• Certified Configurations</li><li>• On-line Services</li></ul>
Maintaining user authentication	<ul style="list-style-type: none"><li>• Enterprise Manager – Console</li><li>• LDAP Directory Integration</li></ul>
Maintaining availability	<ul style="list-style-type: none"><li>• Enterprise Manager – Real Application Clusters</li><li>• Enterprise Manager – Data Guard</li><li>• Enterprise Manager – Change Management Pack</li></ul>
Maintaining performance	<ul style="list-style-type: none"><li>• Enterprise Manager - Console</li><li>• Enterprise Manager – Diagnostics Pack</li><li>• Enterprise Manager – Tuning Pack</li></ul>
Maintaining packaged applications	<ul style="list-style-type: none"><li>• Enterprise Manager - Management Pack for E-Business Suite</li><li>• Enterprise Manager - Management Pack for SAP R/3</li><li>• Enterprise Manager - Custom extensions</li></ul>
Backup & recovery of database	<ul style="list-style-type: none"><li>• Enterprise Manager - Recovery Manager</li><li>• Import/Export utilities</li></ul>
Upgrade products to new versions	<ul style="list-style-type: none"><li>• Enterprise Manager – Change Management Pack</li><li>• Enterprise Manager – Data Guard</li><li>• On-line schema change</li></ul>



**White Paper Title**

**March 2002**

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