

# Application Server Platform Management

## Cost Comparison: A White Paper

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*Abstract: This document summarizes the findings of a Crimson Consulting Group study on the costs associated with the management of application server platforms in medium and large data center environments. It presents a baseline cost model and compares IBM WebSphere, BEA WebLogic, and Oracle Application Server against this industry baseline.*

*The research was based on in-depth interviews with Application Server administrators of companies from a wide spectrum of industry sectors, as well as the review of product features and industry research. The study found that Oracle Application Server has the lowest management cost among the three application server platforms.*

May 2005



This study was funded by Oracle, but designed and executed by Crimson Consulting Group as an independent, analytical evaluation using primary research, industry data, and real-world deployment experience. The objective of the study was to better understand the costs associated with the management of application server platforms.

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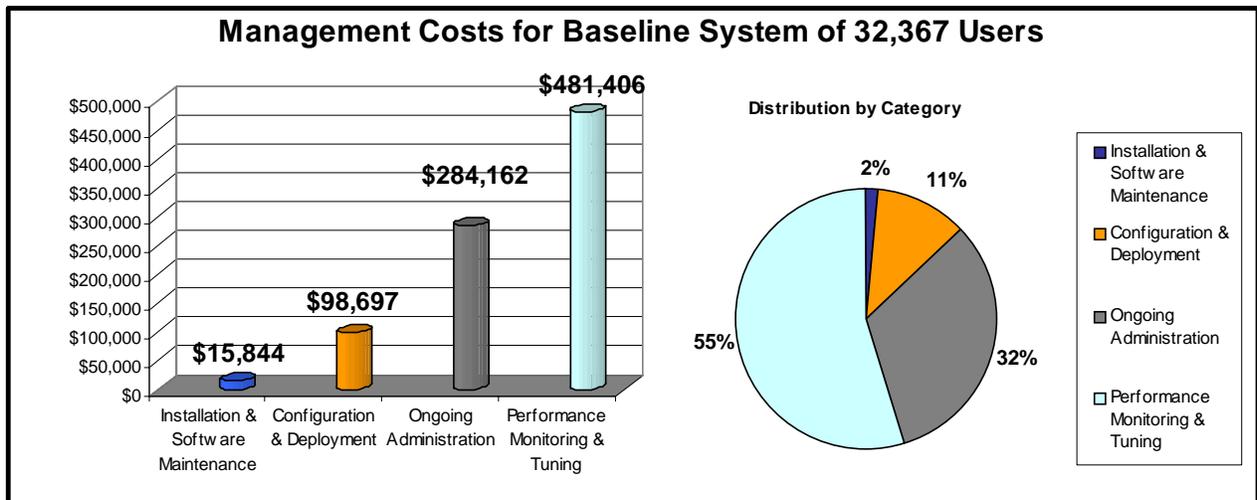
## Executive Summary

Numerous studies have shown that operational and management costs constitute the bulk of the total cost of ownership (TCO) for large data centers, but no detailed studies have so far been made to explore the source and nature of these costs as related to application servers.

Crimson Consulting has conducted such a study, focusing on the management activities related to application server platforms<sup>1</sup> and comparing products from the top three vendors: IBM, BEA, and Oracle. Our findings should help decision makers and administrators evaluate the cost impact of application servers from IBM, BEA, and Oracle in data center operations.

At an aggregate level, the Crimson study found that:

1. Management activities for application servers can be divided into four categories:
  - a. Installation & Software Maintenance
  - b. Configuration & Deployment
  - c. Ongoing Administration
  - d. Performance Monitoring & Tuning
2. The bulk (87%) of the system management cost comes from Ongoing Administration (32%) and Performance Monitoring & Tuning (55%); see Figure 1 for mean "baseline" costs.



**Figure 1: Management Costs for Baseline System of 32,367 Users (see Table 1)**

3. To reduce costs, firms are most often seeking:
  - a. Unified, actionable performance/availability monitoring
  - b. Diagnostic tools that span the entire environment, including not only the application server platform, but also other components like the database
  - c. Automated service level tracking to comply with service level agreements
4. The more complex a management activity, the higher the level of skill required to perform it and the longer it takes. Tools can reduce both the needed skill and time, significantly lowering management costs.

<sup>1</sup> Defined as a mix of application servers, portals, integration products, and development & management tools

Comparing the application server products from IBM, BEA, and Oracle, we found that:

1. Oracle has the lowest cost (80% below IBM, 70% below BEA) for all four management categories, particularly Ongoing Administration and Performance Monitoring & Tuning (see Figure 2 for projected costs).

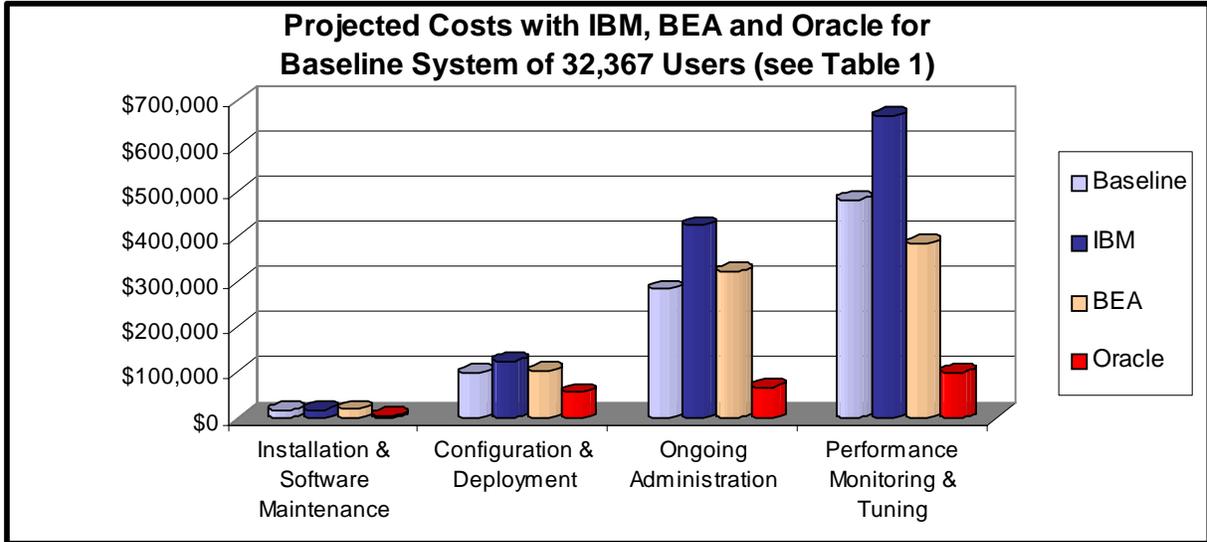


Figure 2: Projected Costs with IBM, BEA, and Oracle for Baseline System of 32,367 Users (see Table 1)

2. Much of Oracle's cost advantage comes from Oracle Enterprise Manager's unification/centralization of management for the whole environment, including the database.

## **Study Objectives**

System management is becoming increasingly expensive. In many data centers, there is a trend towards using multiple inexpensive processors in lieu of large mainframes to reduce hardware costs. Unfortunately, this also results in multiple software components, higher administrative and operational complexity, and ultimately higher management costs.

Various studies, including a recent one by Kant and Mohapatra (IEEE, 2004), estimate that roughly 80% of the Total Cost of Ownership (TCO) in large data centers relates to software operation and management. Studies also show that this is likely to increase further. Because of the growth in the number of Internet applications and application servers that run them, a significant portion of these costs can be attributed to the management of application servers.

Still, there have been no detailed studies to date on the source and nature of the costs of managing application servers. Crimson has now conducted such a study, comparing the top three application server vendors IBM, BEA, and Oracle. Our intent is that you will find this report useful when evaluating the TCO of application servers in general and those from IBM, BEA, and Oracle in particular.

## Methodology

This study was based primarily on customer interviews. For broad representation, Crimson chose medium to large firms from a wide range of industries including financial, aerospace, steel, sporting goods, research, publishing, armed forces, and telecommunications. A key requirement was that they have the current IBM WebSphere 5.x<sup>2</sup>, BEA WebLogic 8.x, or Oracle Application Server 10g in production, along with the associated management tools including those from ANT, BMC, Computer Associates, Cisco, EMC<sup>2</sup>, HP, IBM Tivoli, Mercury (including Topaz and LoadRunner), Micromuse, Nagios, Oracle, Symantec Veritas, and Wily Technology.

The environments for IBM, BEA, and Oracle were generally comparable, though ranging broadly from 10 to 133 application servers and 3,000 to 300,000 users each. Below are some salient statistics:

| Environment                         | Average |
|-------------------------------------|---------|
| Application server instances (CPUs) | 56      |
| Web applications                    | 12      |
| End users                           | 32,367  |
| Application server administrators   | 4       |
| Database Administrators             | 4       |

**Table 1: Industry "Baseline" Environment Corresponding to Average of All Interviewee Sites**

At each of these sites, we screened the administrators<sup>3</sup> using a detailed questionnaire asking about their experience in managing application server platforms. This covered activities such as patching/upgrading, deployment, cluster setup/configuration, session management, monitoring, and resource forecasting.

We then interviewed them in two phases. In Phase I, we asked them about regular management activities and frequencies. Their responses helped us build a costing model for management of application servers in a typical "baseline" environment.

With the model in place, in Phase II, we re-interviewed the administrators on the management tools used, skill required for their use, and the time spent for the tasks identified in Phase I. We paid particular attention to how these metrics related to the features of the application servers in production at the sites.

Using the data from Phase I and II, we compiled aggregate vendor-neutral data on application server management and vendor-specific cost comparisons of application servers from IBM, BEA, and Oracle.

When estimating the management costs, we ignored the potential costs of downtime and project delays resulting from software shortcomings. For example, if an application server is difficult to configure and causes production delays, we only considered the costs of additional administrator time, not the damages to the firm of going to market late. We also did not consider licensing/consulting costs for the software.

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<sup>2</sup> IBM has just released WebSphere 6.0, but we did not find this version in production at any of the sites; moreover, this version does not appear to have any new features that would substantially alter our findings or analysis.

<sup>3</sup> In some cases, the same administrator managed both the application server and database.

## Phase I: Management Activities

The goal of this phase was to identify management activities. Crimson found that although the environments varied widely, the management activities were similar. Below are the major categories assembled from the administrator responses; for the full list, see Appendix I: Application Server Management Activities.

1. **Installation & Software Maintenance:** installation, upgrades, and patching
2. **Configuration & Deployment:** configuration, policy conformance, instantiation/cloning, and deployment
3. **Ongoing Administration:** application life cycle management, inventory control, session/port management, backup/recovery, cluster management, and management data distribution
4. **Performance Monitoring & Tuning:** Log handling, performance thresholds setting, connection pool tuning, application/platform monitoring, diagnostics, service level compliance, trend analysis, and alerts management

For each of the management activities, interviewees provided us with detailed operational information, most important of which was the frequency at which they are carried out, such as daily or weekly. For details, see Appendix III: Detailed Survey Results.

During this first round of interviews, it became clear that to reduce management costs, firms are mainly looking for:

- a. Unified, actionable performance/availability monitoring
- b. Diagnostic tools that span the entire environment, including not only the application server platform, but also other components such as the database
- c. Automated service level tracking, including end-to-end tracing of transactions, to comply with service level agreements (SLAs)

## Phase II: Breakdown of Management Cost

With the aggregate list of management activities and their characteristics in hand, we returned to the administrators. The goal was to estimate the total management costs for each site and thereby compare the management costs for IBM, BEA, and Oracle.

### Estimating Annual Management Cost

The annual cost of managing an application server platform is the sum of the individual costs incurred for each management activity. To estimate these individual costs, we collected the following information for each activity:

1. Frequency (times/year)
2. Duration (hours)
3. Skill Factor: administrator skill (high=1.19, medium=1.0, low=0.83<sup>4</sup>)

Using this information, we calculated the yearly cost of management for each activity:

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<sup>4</sup> Skill levels correspond to “Total Compensation” in “Data Center Management Salary Survey,” April 2004

$$\text{Annual Management Cost} = \frac{\text{Effort Index}}{\text{Skill Adjusted Effort Index}} \times \text{Administrator Hourly Rate}$$

$$\text{Effort Index} = \text{Frequency} \times \text{Duration} \times \text{Skill Factor}$$

*Effort Index* represents the total hours spent on an activity in one year.

*Skill Factor* normalizes these hours to correspond to a “medium” skill administrator. For example, if a task requires 100 hours/year by a “high” skill administrator, we map it to 130 hours for a “medium” skill administrator.

*Skill Adjusted Effort Index* is the Effort Index adjusted by the Skill Factor to give the total hours required for the activity in one year by an average administrator.

*Administrator Hourly Rate* is taken to be a constant U.S. \$50/hour<sup>5</sup>.

### Overall Findings & Analysis

#### Management Cost: The Real Culprits

Using the data from Phase I and Phase II, we were able to estimate the annual management costs for all the sites in our study. The distribution of the mean costs for the four major activity categories is in Figure 3 (for full details, see Appendix III: Detailed Survey Results).

#### Tool Complexity

Complex tools add to management costs because they require skilled administrators and additional time to operate. They also limit scalability.

To assess the complexity of the IBM, BEA, and Oracle tools, we asked the interviewees the perceived complexity (low=1, medium=3, high=5) and importance (weights add to 1) for each management activity executed with their tool:

1. Typical online help needed
2. Administrator expertise required
3. Difficulty of tool(s) used

We then calculated the *Complexity Index* as the weighted average of the three complexities ( $\Sigma$  denotes sum):

$$\text{Complexity Index} = \sum_{\text{All 3 factors}} \text{Factor complexity} \times \text{Factor weight}$$

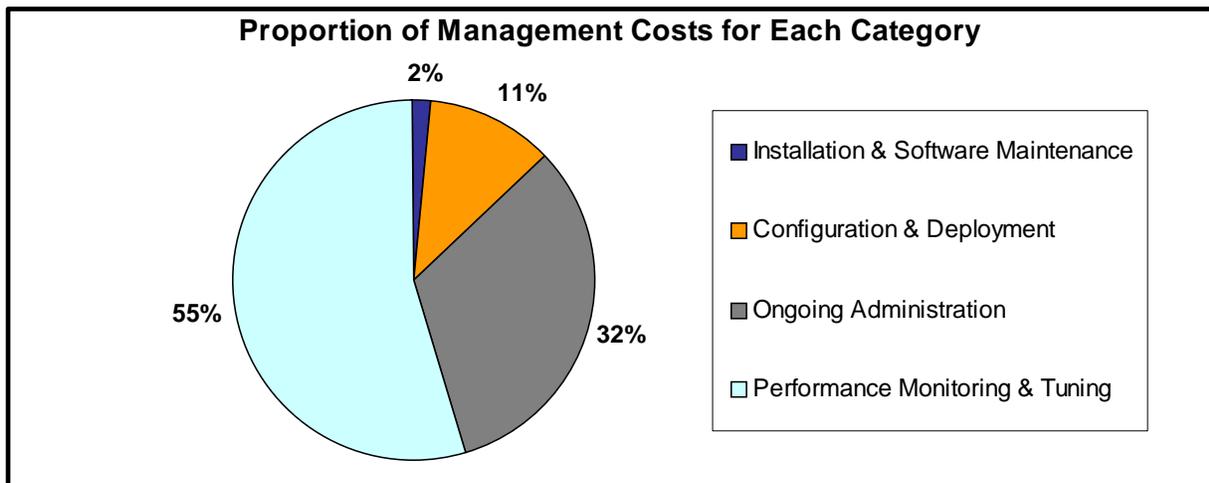


Figure 3: Proportion of Management Costs for Each Category

<sup>5</sup> Based on “Data Center Management Salary Survey,” April 2004

Most striking here are the high Administration and Performance Monitoring & Tuning costs. In line with past research, the bulk (87%) of the management cost comes from Administration (32%) and Performance Monitoring & Tuning (55%). Clearly, an application server platform that is strong in these two areas lowers management costs.

Breaking these costs down across the different vendors, IBM, BEA, and Oracle, we found Oracle to have lower costs for all four categories; BEA was less expensive than the baseline in one category, Performance Monitoring & Tuning – see Figure 4.

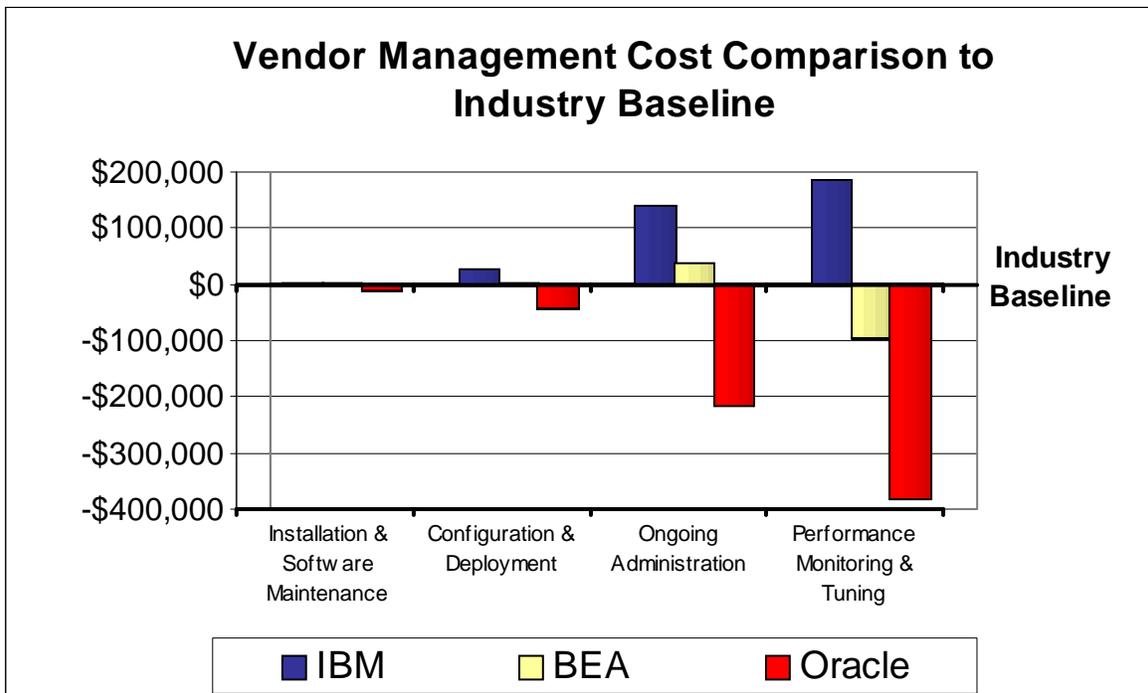


Figure 4: Management Costs for IBM, BEA, Oracle in Relation to Baseline

### Qualitative Survey Findings

The differences in costs can be largely explained by the management capabilities and functionalities of the products reported by the interviewed administrators (see Table 2). Note the correlation between product functionality and the requirements identified earlier in the study for cutting management costs (unified analysis, centralized diagnostics, and SLA compliance).

The most striking finding was that Oracle administrators tend to rely on one tool, Oracle Enterprise Manager 10g featuring Grid Control (Oracle Grid Control) to manage their entire environment. IBM and BEA administrators by contrast use multiple tools: WebSphere Console and Tivoli tools most often for IBM; Wily Technology, HP OpenView, and Mercury Interactive tools most commonly for BEA.

This appears to have paid off for Oracle: administrators have to learn and operate only one tool, without having to aggregate data between the tools – an issue reported by the IBM and BEA administrators. Oracle unifies the management of even the database within the same tool.

| Category                                       | IBM  | BEA  | ORACLE   |
|--|--|--|--|
| <b>Installation &amp; Software Maintenance</b> | <ul style="list-style-type: none"> <li>Automatic collection of administrator IDs/roles</li> <li>Upgrades/patches need full re-install</li> <li>Separate install for portal</li> </ul>      | <ul style="list-style-type: none"> <li>“Smart Update” coordinates patching from BEA site</li> <li>Multiple tools</li> <li>Extensive scripting needed</li> <li>Administrators have to be skilled</li> </ul> | <ul style="list-style-type: none"> <li>Unified, automated provisioning of full environment<sup>6</sup></li> <li>Automated security inspections and fixes</li> <li>Automated patch staging/application</li> </ul> |
| <b>Configuration &amp; Deployment</b>          | <ul style="list-style-type: none"> <li>Strong configuration features</li> <li>Tools not integrated; data/scripts scattered</li> <li>Advanced skills needed</li> </ul>                      | <ul style="list-style-type: none"> <li>Complex, forcing use of scripts</li> <li>Third-party tools required</li> </ul>  | <ul style="list-style-type: none"> <li>Upgrade assistant avoids re-configuration</li> <li>Simple, wizard-based</li> <li>Easy enforcement of standards &amp; best practices</li> </ul>                            |
| <b>Ongoing Administration</b>                  | <ul style="list-style-type: none"> <li>Automated notification and responses</li> <li>Handles mixed clusters</li> <li>Complex, mainly due to multiple WebSphere and Tivoli tools</li> </ul> | <ul style="list-style-type: none"> <li>Handles mixed clusters</li> <li>Needs extensive scripting</li> <li>Separate consoles for application server, portal, and integration</li> </ul>                     | <ul style="list-style-type: none"> <li>Single, integrated management tool</li> <li>Automation of tasks to simplify &amp; reduce errors</li> <li>Simplified notification and response</li> </ul>                  |
| <b>Performance Monitoring &amp; Tuning</b>     | <ul style="list-style-type: none"> <li>Multiple consoles complicate integration of system statistics</li> <li>No display of usage data</li> </ul>  | <ul style="list-style-type: none"> <li>Third-party (like Wily, HP, Mercury) products required</li> <li>In-house tools often needed for statistics</li> </ul>   | <ul style="list-style-type: none"> <li>System-wide monitoring</li> <li>End-to-end tracing of business transactions</li> <li>Easy SLA compliance</li> <li>Extensive out-of-the-box functionality</li> </ul>       |

**Table 2: Summary of Qualitative Analysis for Vendor Application Server Platforms Included in Study**

**Complexity Increases Cost**  
 Correlating the management costs for IBM, BEA, and Oracle with the corresponding *Complexity Index* values confirmed to us that complex tools do raise costs.

For example, the costs for the baseline system (32,367 users – see Table 1) with Ongoing Administration were \$424,840 for IBM, \$322,102 for BEA, and \$67,295 for Oracle; the corresponding Complexity Index values for the vendors were 2.89, 2.74, and 2.36 respectively.

Consistent with its lowest management cost, Oracle is the least complex overall. The Complexity Index for the different activities will also give you an idea of how your system will behave as it grows; complex tools tend to limit scalability.

See Appendix III: Detailed Survey Results for full results.

*“The documentation of IBM WebSphere is scattered, making it hard to find the information needed to solve a problem.”*  
 —Fortune 50 IT Corporation

*“There are many tools that we use for [BEA] management that are not integrated.”*  
 —Fortune 500 Publishing Company

<sup>6</sup> Including applications, application server, portal, integration components, and database

## Detailed Quantitative Survey Findings

### Installation & Software Maintenance

Activities in this category cover installation, upgrades, and patching. The comparison of cost, effort and skills for each vendor as compared to the industry baseline is shown in Figure 5.

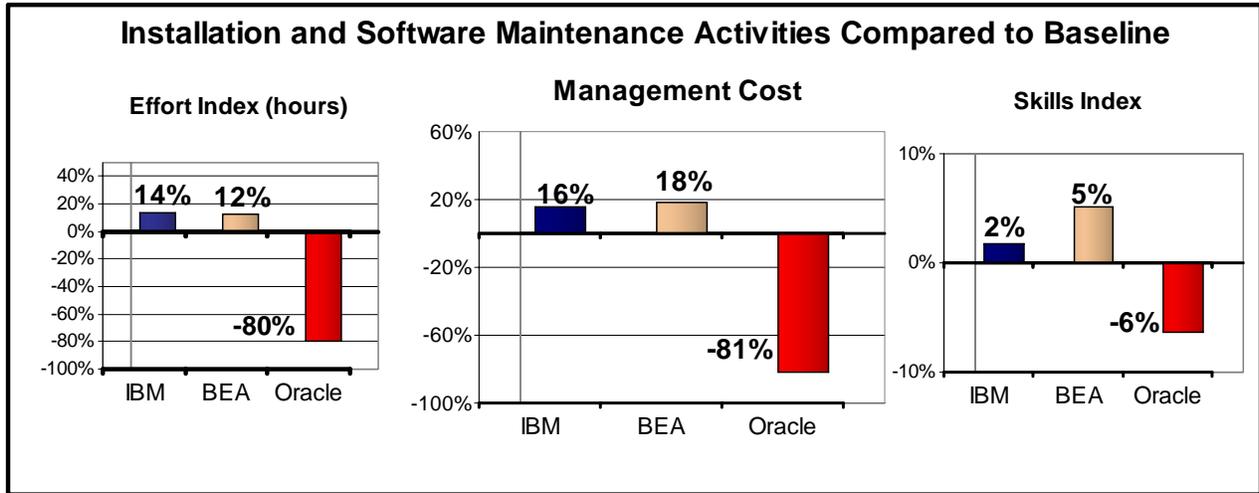


Figure 5: Installation & Software Maintenance

A common issue for IBM was that upgrades/patches required a full re-install. Though administrators have developed scripts for automatic installation, patching still has to be done manually. These install issues are likely responsible for IBM's high cost.

*"Initial IBM setup/configuration is manual, with a steep learning curve; it is hard to install without IBM help. The Portal product triples the level of complexity."*

—A Major Fortune 25 Bank

BEA administrators, by contrast, reported extensive use of scripting. Although scripts automate many routine activities, developing/maintaining them is difficult and needs skill, which adds to the cost; skilled administrators are also harder to find. We found BEA administrators to be generally more skilled than IBM's and Oracle's.

Oracle administrators said that Oracle Grid Control works out of the box and needs lower skill/effort. For example, the tool automatically looks for security issues and applies critical security patches as necessary.

| Category                                       | IBM   | BEA  | ORACLE   |
|--|---|--|--|
| <b>Installation &amp; Software Maintenance</b> | <ul style="list-style-type: none"> <li>Automatic collection of administrator IDs/roles</li> <li>Upgrades/patches need full re-install</li> <li>Separate install for portal</li> </ul> | <ul style="list-style-type: none"> <li>"Smart Update" coordinates patching from BEA site</li> <li>Multiple tools</li> <li>Extensive scripting needed</li> <li>Administrators have to be skilled</li> </ul> | <ul style="list-style-type: none"> <li>Unified, automated provisioning of full environment<sup>7</sup></li> <li>Automated security inspections and fixes</li> <li>Automated patch staging/application</li> </ul> |

Table 3: Summary of Qualitative Analysis for Installation & Software Maintenance

<sup>7</sup> Including applications, application server, portal, integration components, and database

Looking at the Complexity Index, we found IBM and BEA tools to be on par with the baseline; Oracle was simpler primarily because of Oracle Grid Control’s simplified patching and cloning capabilities. This lower complexity also in part explains Oracle’s cost advantage.

**Configuration & Deployment**

This category covers configuration, policy conformance, instantiation/cloning, and deployment activities related to application server platform. The comparison of cost, effort and skills for each vendor as compared to the industry baseline is shown in Figure 6.

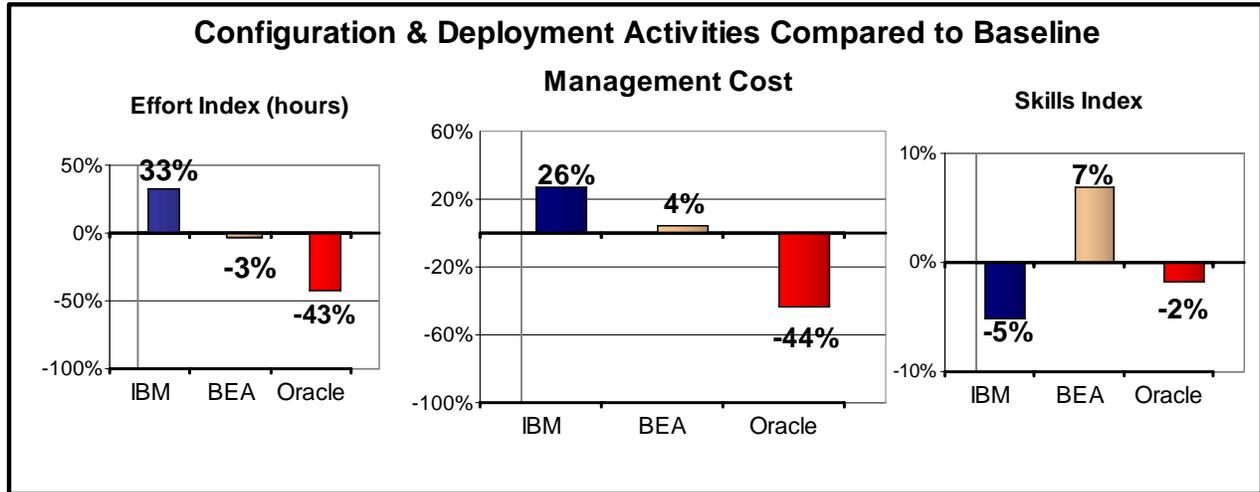


Figure 6: Configuration & Deployment

The IBM administrators we interviewed found the many (over 500) configuration management features of WebSphere console and Tivoli comprehensive.

*“The high functionality provided by the IBM WebSphere console allows an administrator to easily perform any task needed to manage the system.”*  
 —Fortune 50 IT Corporation

However, they also felt overwhelmed: the tools (for example, the WebSphere Application Server and Portal consoles) were not well integrated, and the administrators had difficulty in aggregating the information distributed across the tools.

BEA administrators, while they automated many of the configuration tasks with scripts, found the scripts to be tricky to develop and maintain.

At Oracle sites, administrators benefited from simplified configuration and deployment of system-wide components with wizards, without the usual need for advanced J2EE expertise.

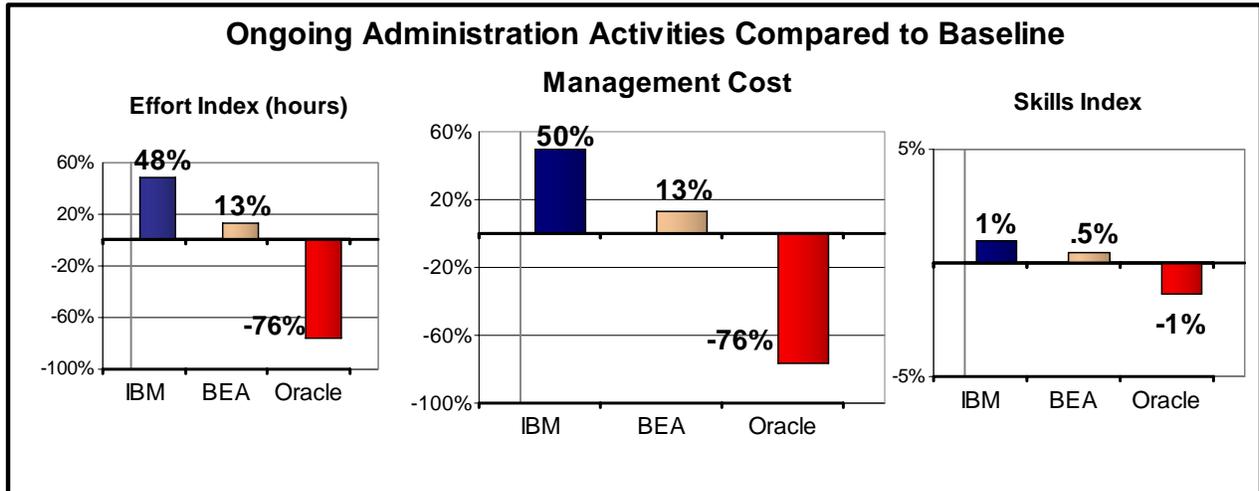
| Category                              | IBM   | BEA   | ORACLE  |
|---------------------------------------|---|---|---|
| <b>Configuration &amp; Deployment</b> | <ul style="list-style-type: none"> <li>Strong configuration features</li> <li>Tools not integrated; data/scripts scattered</li> <li>Advanced skills needed</li> </ul> | <ul style="list-style-type: none"> <li>Complex, forcing use of scripts</li> <li>Third-party tools required</li> </ul> | <ul style="list-style-type: none"> <li>Upgrade assistant avoids re-configuration</li> <li>Simple, wizard-based</li> <li>Easy enforcement of standards &amp; best practices</li> </ul> |

Table 4: Summary of Qualitative Analysis for Configuration & Deployment

**Ongoing Administration**

This category includes application life cycle management, inventory control, session/port management, backup/recovery, cluster management, and management data distribution (for collaboration between administrators).

The comparison of cost, effort and skills for each vendor as compared to the industry baseline is shown in Figure 7.



**Figure 7: Ongoing Administration**

The difference between IBM, BEA, and Oracle was most dramatic in this category, with Oracle costing well below the baseline. Much of this is attributable to Oracle Grid Control, which integrates the administration of all system components – for example, it is possible to manage application server ports directly from the tool (rather than by editing the configuration files, as is typical.)

| Category                      | IBM  | BEA  | ORACLE  |
|-------------------------------|--|--|---|
| <b>Ongoing Administration</b> | <ul style="list-style-type: none"> <li>Automated notification and responses</li> <li>Handles mixed clusters</li> <li>Complex, mainly due to multiple WebSphere and Tivoli tools</li> </ul> | <ul style="list-style-type: none"> <li>Handles mixed clusters</li> <li>Needs extensive scripting</li> <li>Separate consoles for application server, portal, and integration</li> </ul> | <ul style="list-style-type: none"> <li>Single, integrated management tool</li> <li>Automation of tasks to simplify &amp; reduce errors</li> <li>Simplified notification and response</li> </ul> |

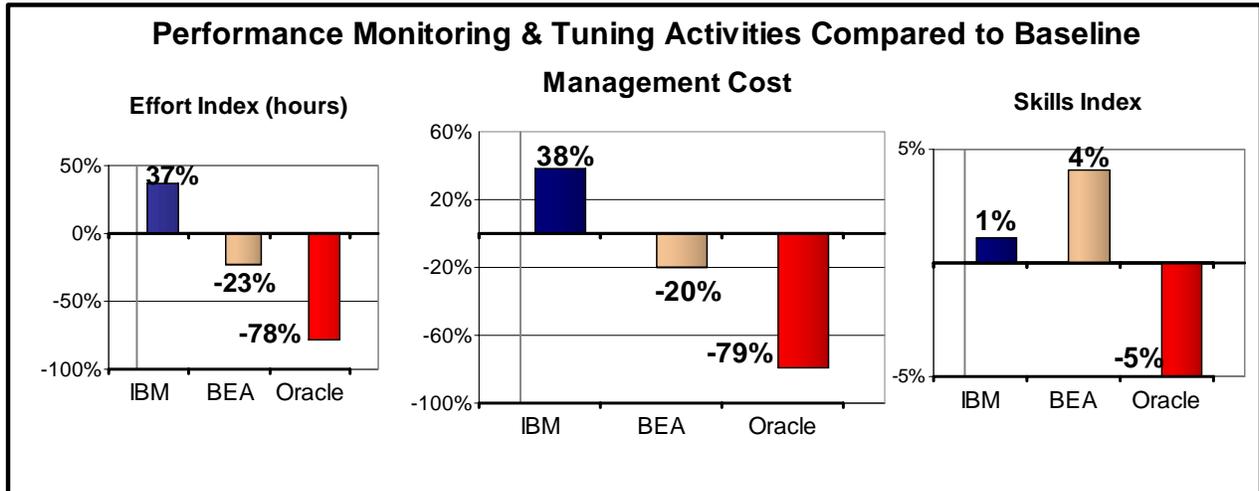
**Table 5: Summary of Qualitative Analysis for Ongoing Administration**

IBM and BEA exhibited a Complexity Index similar to that of the baseline; Oracle’s was 12% lower, contributing to its cost advantage. For example, Oracle administrators found it simpler to deal with one URL to refer to all application server instances.

**Performance Monitoring & Tuning**

This category covers log handling, performance thresholds setting, connection pool tuning, application/platform monitoring, diagnostics, service level compliance, trend analysis, and alerts management.

The comparison of cost, effort and skills for each vendor as compared to the industry baseline is shown in Figure 8.



**Figure 8: Performance Monitoring & Tuning**

With IBM, administrators found it hard to work with multiple IBM/Tivoli tools and aggregate the various statistics. For example, the IBM application server and portal use different consoles.

BEA administrators also had similar issues, but with the partner tools that they used (Wily Technology, HP, and Mercury were mentioned the most). In some cases, they had resorted to building tools in-house.

At Oracle sites, administrators said that they found it convenient to manage the whole environment with one tool. Some even reported routinely performing root-cause analysis of performance problems down to an SQL statement because of Oracle Grid Control’s ability to also manage the Oracle Database.

| Category                                   | IBM   | BEA  | ORACLE   |
|--|---|--|--|
| <b>Performance Monitoring &amp; Tuning</b> | <ul style="list-style-type: none"> <li>Multiple consoles complicate integration of system statistics</li> <li>No display of usage data</li> </ul> | <ul style="list-style-type: none"> <li>Third-party (like Wily, HP, Mercury) products required</li> <li>In-house tools often needed for statistics</li> </ul> | <ul style="list-style-type: none"> <li>System-wide monitoring</li> <li>End-to-end tracing of business transactions</li> <li>Easy SLA compliance</li> <li>Extensive out-of-the-box functionality</li> </ul> |

**Table 6: Summary of Qualitative Analysis for Performance Monitoring & Tuning**

In terms of the Complexity Index, BEA was the highest due to the need to use multiple tools. For IBM, use of multiple tools also complicated management. The simplicity of its tool likely contributed once again to Oracle’s lower cost.

## Conclusion

Crimson's detailed study of application server platform management was illuminating. We have confirmed that Ongoing Administration and Performance Monitoring & Tuning indeed constitute the bulk of the management cost, in fact as high as 87%. To reduce these costs, management tools need to provide unified analysis, centralized diagnostics and management, and an ability to perform service-level tracking and management. In addition, simpler tools help lower overall management cost as expected.

Although we set out to investigate the management of application server platforms (comprising application server, portal, integration, and management tools), we found that other key components such as database and end-user applications play key roles in the overall cost of management. A tool that can combine the management of the application server platform with that of these other components tends to further reduce management costs.

Our study showed that Oracle Application Server 10g and Oracle Grid Control provide the simplest, most unified management of application server platform and related environmental components. We found that combining management of the database is especially useful in improving productivity and cutting management costs.

Given these advantages, Crimson Consulting believes that Oracle Application Server 10g can result in a total management cost that is 80% below that of IBM WebSphere 5.x and 70% less than that of BEA WebLogic 8.x<sup>8</sup>.

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<sup>8</sup> One Financial Services company CIO/CTO interviewed had a surprisingly similar assessment: "*Oracle Grid Control is 80% lower in TCO when compared with other tools.*"

## **Appendix I: Application Server Management Activities**

### **Installation & Software Maintenance**

- ◆ Application server installation
- ◆ Management software installation
- ◆ Upgrade
- ◆ Patching

### **Configuration and Deployment**

- ◆ Application Server configuration (i.e. Web server, portal, J2EE, etc.)
- ◆ Ensuring environment conforms to configuration and/or security best practices/policies
- ◆ Instance creation/cloning
- ◆ Application deployment (local and remote)

### **Ongoing Administration**

- ◆ Moving applications from test environment to production environment
- ◆ Moving product-specific metadata from test environment to production environment
- ◆ Environment configuration manageability between environments (dev, QA, stage, prod)
- ◆ Database management
  - Instance creation/cloning
  - Instance management
  - Storage management
  - Security management (e.g. users, roles, profiles)
  - Schema management (tables, indexes, views, etc.)
  - Backup and Recovery
  - Database and/or Oracle Home Cloning
- ◆ Software/hardware/operating system inventory management and tracking/comparing those inventories
- ◆ Session management/failover
- ◆ Port management
- ◆ Performing monitoring or management tasks from mobile/wireless device
- ◆ Referring to online help and/or documentation for assistance in completing management tasks
- ◆ Application Server backup and recovery
- ◆ Distribution of management data (i.e. status, problems, resolutions, etc.) across team of administrators for collaboration
- ◆ Cluster Management
- ◆ Customizing and extending user interface and functionality of management tools

### **Performance Monitoring & Tuning**

- ◆ Accessing and viewing log files for diagnostic purposes
- ◆ Determining/setting thresholds for performance monitoring
- ◆ Data source connection pool tuning
- ◆ Monitoring performance of the application server environment
- ◆ Monitoring performance of the application's real end user experience
- ◆ Monitoring performance of the application via business transactions which emulate/simulate end users
- ◆ Diagnosing performance problems and determining where the performance bottleneck lies (i.e. Application Server, Database, Network)
- ◆ Ensuring service levels are being satisfied
- ◆ Business process-oriented monitoring and management (including BPM/BPEL and BAM monitoring and management)
- ◆ Determining trends or establishing base lines in performance levels based on historical performance data
- ◆ Configuring tool to receive alert notifications (e-mail, pager)

**Appendix II: Survey Summary**

|                                     | <b>Average Baseline Data</b> |                     |  |                               |
|-------------------------------------|------------------------------|---------------------|--|-------------------------------|
| <b>Management Activity</b>          | <b>Effort Index (hours)</b>  | <b>Skill Factor</b> | <b>Skill Adjusted Effort Index (hours)</b> | <b>Management Cost Factor</b> |
| Installation & Software Maintenance | 308                          | 1.03                | 317  | \$ 15,844                     |
| Configuration & Deployment          | 1,926                        | 1.03                | 1,974                                      | \$ 98,697                     |
| Administration                      | 5,518                        | 1.03                | 5,683                                      | \$ 284,162                    |
| Performance Monitoring & Tuning     | 9,268                        | 1.04                | 9,628                                      | \$ 481,406                    |
| <b>Total Management Activity</b>    |                              |                     |  | <b>880,108</b>                |

|                                     | <b>IBM WebSphere</b>        |                     |  |                               |
|-------------------------------------|-----------------------------|---------------------|--|-------------------------------|
| <b>Management Activity</b>          | <b>Effort Index (hours)</b> | <b>Skill Factor</b> | <b>Skill Adjusted Effort Index (hours)</b> | <b>Management Cost Factor</b> |
| Installation & Software Maintenance | 351                         | 1.05                | 367  | \$ 18,329                     |
| Configuration & Deployment          | 2,567                       | 0.97                | 2,496                                      | \$ 124,816                    |
| Administration                      | 8,170                       | 1.04                | 8,497                                      | \$ 424,840                    |
| Performance Monitoring & Tuning     | 12,683                      | 1.05                | 13,317                                     | \$ 665,847                    |
| <b>Total Management Activity</b>    |                             |                     |  | <b>1,233,832</b>              |

|                                     | <b>BEA WebLogic</b>         |                     |  |                               |
|-------------------------------------|-----------------------------|---------------------|--|-------------------------------|
| <b>Management Activity</b>          | <b>Effort Index (hours)</b> | <b>Skill Factor</b> | <b>Skill Adjusted Effort Index (hours)</b> | <b>Management Cost Factor</b> |
| Installation & Software Maintenance | 346                         | 1.08                | 373  | \$ 18,668                     |
| Configuration & Deployment          | 1,873                       | 1.10                | 2,051                                      | \$ 102,536                    |
| Administration                      | 6,224                       | 1.04                | 6,442                                      | \$ 322,102                    |
| Performance Monitoring & Tuning     | 7,125                       | 1.08                | 7,703                                      | \$ 385,167                    |
| <b>Total Management Activity</b>    |                             |                     |  | <b>828,473</b>                |

|                                     | <b>Oracle Application Server 10g</b> |                     |  |                               |
|-------------------------------------|--------------------------------------|---------------------|--|-------------------------------|
| <b>Management Activity</b>          | <b>Effort Index (hours)</b>          | <b>Skill Factor</b> | <b>Skill Adjusted Effort Index (hours)</b> | <b>Management Cost Factor</b> |
| Installation & Software Maintenance | 62                                   | 0.96                | 59   | \$ 2,974                      |
| Configuration & Deployment          | 1,105                                | 1.01                | 1,113                                      | \$ 55,644                     |
| Administration                      | 1,325                                | 1.02                | 1,346                                      | \$ 67,295                     |
| Performance Monitoring & Tuning     | 2,037                                | 0.98                | 2,001                                      | \$ 100,039                    |
| <b>Total Management Activity</b>    |                                      |                     |  | <b>225,952</b>                |

|                                     | <b>Baseline</b>         | <b>IBM</b>              | <b>BEA</b>              | <b>Oracle</b>           |
|-------------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| <b>Management Activity</b>          | <b>Complexity Index</b> | <b>Complexity Index</b> | <b>Complexity Index</b> | <b>Complexity Index</b> |
| Installation & Software Maintenance | 2.78                    | 3.1                     | 3.30                    | 1.98                    |
| Configuration & Deployment          | 2.38                    | 1.95                    | 2.90                    | 2.25                    |
| Ongoing Administration              | 2.67                    | 2.89                    | 2.74                    | 2.36                    |
| Performance Monitoring & Tuning     | 2.57                    | 2.66                    | 2.64                    | 2.14                    |
| <b>Total Management Activity</b>    | <b>2.60</b>             | <b>2.65</b>             | <b>2.90</b>             | <b>2.18</b>             |

### Appendix III: Detailed Survey Results

| Activity Analysis  | Industry Baseline Model        |                        |                   |              |                                  |
|--|--------------------------------|------------------------|-------------------|--------------|----------------------------------|
|  | Est Avg Frequency (x per year) | Est Avg Effort (hours) | Total Effort/Year | Skill Factor | Complexity Index (1-5, 5 = High) |
| <b>Installation &amp; Software Maintenance</b>   |                                |                        |                   |              |                                  |
| Application server installation  | 11                             | 9.0                    | 99                | 1.01         | 2.4                              |
| Management software installation   | 10                             | 3.5                    | 35                | 1.04         | 3.0                              |
| Upgrade  | 8                              | 4.7                    | 38                | 1.04         | 3.0                              |
| Patching   | 38                             | 3.6                    | 137               | 1.02         | 2.7                              |
| <b>Configuration &amp; Deployment</b>  |                                |                        |                   |              |                                  |
| Application Server configuration (i.e. web server, portal, J2EE, etc.)   | 149                            | 3.3                    | 492               | 0.99         | 2.1                              |
| Ensuring environment conforms to configuration and/or security best practices/policies   | 118                            | 3.0                    | 354               | 1.10         | 2.9                              |
| Instance creation/cloning  | 23                             | 3.2                    | 74                | 1.05         | 2.6                              |
| Application deployment (local and remote)  | 165                            | 6.1                    | 1007              | 0.96         | 1.9                              |
| <b>Ongoing Administration</b>  |                                |                        |                   |              |                                  |
| Application life cycle management  |                                |                        |                   |              |                                  |
| Moving applications from test environment to production environment  | 101                            | 6.1                    | 616               | 1.02         | 2.2                              |
| Moving product-specific metadata from test environment to production environment   | 56                             | 5.3                    | 297               | 1.07         | 2.9                              |
| Environment configuration manageability between environments (dev, qa, stage, prod)  | 102                            | 2.8                    | 286               | 1.07         | 3.2                              |
| Software/hardware/operating system inventory management and tracking/comparing those inventories                                 | 52                             | 10.7                   | 556               | 1.05         | 3.0                              |
| Session management/fail over   | 132                            | 6.4                    | 845               | 1.11         | 3.1                              |
| Port management  | 166                            | 2.9                    | 481               | 1.02         | 2.5                              |
| Referring to online help and/or documentation for assistance in completing management tasks                                      | 217                            | 2                      | 369               | 0.94         | 2.1                              |
| Application Server backup and recovery   | 171                            | 4                      | 735               | 1.06         | 3.1                              |
| Distribution of management data (i.e. status, problems, resolutions, etc.) across team of administrators for collaboration       | 304                            | 3                      | 760               | 0.89         | 1.7                              |
| Cluster Management   | 108                            | 5                      | 572               | 1.07         | 2.9                              |
| <b>Performance Monitoring &amp; Tuning</b>   |                                |                        |                   |              |                                  |
| Accessing and viewing log files for diagnostic purposes  | 372                            | 2                      | 558               | 1.04         | 2.3                              |
| Determining/setting thresholds for performance monitoring  | 122                            | 19                     | 2269              | 1.03         | 2.9                              |
| Datasource connection pool tuning  | 19                             | 2                      | 44                | 1.03         | 2.6                              |
| Monitoring performance of your application server environment  | 227                            | 2                      | 499               | 0.98         | 2.1                              |
| Monitoring performance of your applications' real end user experience  | 230                            | 1                      | 322               | 1.00         | 2.5                              |
| Monitoring performance of your application via business transactions which emulate/simulate end users                            | 217                            | 14                     | 3103              | 1.08         | 2.9                              |
| Diagnosing performance problems and determining where the performance bottleneck lies (ie Application Server, Database, Network) | 151                            | 6                      | 951               | 1.08         | 3.2                              |
| Ensuring service levels are being satisfied  | 252                            | 3                      | 731               | 1.04         | 2.4                              |
| Determining trends or establishing base lines in performance levels based on historical performance data                         | 135                            | 5                      | 608               | 1.07         | 2.2                              |
| Configuring tool to receive alert notifications (e-mail, pager)  | 87                             | 2                      | 183               | 0.84         | 1.6                              |

| Activity Analysis  | IBM WebSphere          |                   |              |                                  |
|--|------------------------|-------------------|--------------|----------------------------------|
|  | Est Avg Effort (hours) | Total Effort/Year | Skill Factor | Complexity Index (1-5, 5 = High) |
| <b>Installation &amp; Software Maintenance</b>   |                        |                   |              |                                  |
| Application server installation  | 18.8                   | 11                | 1.05         | 3.2                              |
| Management software installation   | 8.5                    | 85                | 1.13         | 3.9                              |
| Upgrade  | 4.3                    | 34.4              | 1            | 2.6                              |
| Patching   | 5.8                    | 220.4             | 1            | 2.7                              |
| <b>Configuration &amp; Deployment</b>  |                        |                   |              |                                  |
| Application Server configuration (i.e. web server, portal, J2EE, etc.)   | 2                      | 298               | 0.96         | 1.7                              |
| Ensuring environment conforms to configuration and/or security best practices/policies   | 2.8                    | 330.4             | 1.1          | 3                                |
| Instance creation/cloning  | 2.5                    | 57.5              | 0.96         | 1.8                              |
| Application deployment (local and remote)  | 11.4                   | 1881              | 0.87         | 1.3                              |
| <b>Ongoing Administration</b>  |                        |                   |              |                                  |
| Application life cycle management  |                        |                   |              |                                  |
| Moving applications from test environment to production environment  | 4.6                    | 464.6             | 1.01         | 2                                |
| Moving product-specific metadata from test environment to production environment   | 2.4                    | 134.4             | 0.96         | 2.2                              |
| Environment configuration manageability between environments (dev, qa, stage, prod)  | 2.4                    | 244.8             | 1            | 2.8                              |
| Software/hardware/operating system inventory management and tracking/comparing those inventories                                 | 16                     | 832               | 1.19         | 5                                |
| Session management/fail over   | 8.5                    | 1122              | 1.14         | 3.7                              |
| Port management  | 5.7                    | 946.2             | 1.06         | 3.2                              |
| Referring to online help and/or documentation for assistance in completing management tasks                                      | 2.3                    | 499.1             | 0.92         | 1.5                              |
| Application Server backup and recovery   | 8.3                    | 1419.3            | 1.1          | 3.2                              |
| Distribution of management data (i.e. status, problems, resolutions, etc.) across team of administrators for collaboration       | 5.3                    | 1611.2            | 0.83         | 1.3                              |
| Cluster Management   | 8.3                    | 896.4             | 1.19         | 4                                |
| <b>Performance Monitoring &amp; Tuning</b>   |                        |                   |              |                                  |
| Accessing and viewing log files for diagnostic purposes  | 1.6                    | 595.2             | 1.05         | 2.5                              |
| Determining/setting thresholds for performance monitoring  | 54                     | 6588              | 1.13         | 3.4                              |
| Datasource connection pool tuning  | 3                      | 57                | 1.01         | 2.6                              |
| Monitoring performance of your application server environment  | 3.3                    | 749.1             | 1.01         | 2.3                              |
| Monitoring performance of your applications' real end user experience  | 0.8                    | 184               | 1            | 2.8                              |
| Monitoring performance of your application via business transactions which emulate/simulate end users                            | 3                      | 651               | 1.1          | 3.7                              |
| Diagnosing performance problems and determining where the performance bottleneck lies (ie Application Server, Database, Network) | 6.5                    | 981.5             | 1.05         | 3                                |
| Ensuring service levels are being satisfied  | 9.5                    | 2394              | 1.1          | 3                                |
| Determining trends or establishing base lines in performance levels based on historical performance data                         | 1                      | 135               | 1            | 2.3                              |
| Configuring tool to receive alert notifications (e-mail, pager)  | 4                      | 348               | 0.8          | 1                                |

| Activity Analysis  | BEA WebLogic           |                   |              |                                  |
|--|------------------------|-------------------|--------------|----------------------------------|
|  | Est Avg Effort (hours) | Total Effort/Year | Skill Factor | Complexity Index (1-5, 5 = High) |
| <b>Installation &amp; Software Maintenance</b>   |                        |                   |              |                                  |
| Application server installation  | 6.9                    | 75.9              | 1.06         | 2.6                              |
| Management software installation   | 4.0                    | 40                | 1.13         | 3.7                              |
| Upgrade  | 8.3                    | 66.4              | 1.07         | 3.7                              |
| Patching   | 4.3                    | 163.4             | 1.06         | 3.2                              |
| <b>Configuration &amp; Deployment</b>  |                        |                   |              |                                  |
| Application Server configuration (i.e. web server, portal, J2EE, etc.)   | 3.0                    | 447               | 1.06         | 2.8                              |
| Ensuring environment conforms to configuration and/or security best practices/policies   | 4.8                    | 566.4             | 1.13         | 2.8                              |
| Instance creation/cloning  | 5.8                    | 133.4             | 1.13         | 3.2                              |
| Application deployment (local and remote)  | 4.4                    | 726               | 1.06         | 2.8                              |
| <b>Ongoing Administration</b>  |                        |                   |              |                                  |
| Application life cycle management  |                        |                   |              |                                  |
| Moving applications from test environment to production environment  | 12.4                   | 1252.4            | 1.13         | 3                                |
| Moving product-specific metadata from test environment to production environment   | 13.0                   | 728               | 1.19         | 3.9                              |
| Environment configuration manageability between environments (dev, qa, stage, prod)  | 4.3                    | 438.6             | 1.13         | 3.9                              |
| Software/hardware/operating system inventory management and tracking/comparing those inventories                                 | 14.8                   | 769.6             | 0.95         | 2.1                              |
| Session management/fail over   | 7.3                    | 963.6             | 1.19         | 3.7                              |
| Port management  | 2.0                    | 332               | 1.00         | 2.3                              |
| Referring to online help and/or documentation for assistance in completing management tasks                                      | 2.0                    | 434               | 0.94         | 2.6                              |
| Application Server backup and recovery   | 2.8                    | 478.8             | 1.01         | 2.8                              |
| Distribution of management data (i.e. status, problems, resolutions, etc.) across team of administrators for collaboration       | 1.3                    | 395.2             | 0.89         | 1.4                              |
| Cluster Management   | 4.0                    | 432               | 0.92         | 1.7                              |
| <b>Performance Monitoring &amp; Tuning</b>   |                        |                   |              |                                  |
| Accessing and viewing log files for diagnostic purposes  | 2.0                    | 744               | 1.06         | 2.1                              |
| Determining/setting thresholds for performance monitoring  | 3.1                    | 378.2             | 1.00         | 3                                |
| Datasource connection pool tuning  | 2.5                    | 47.5              | 1.06         | 3                                |
| Monitoring performance of your application server environment  | 1.8                    | 408.6             | 1.00         | 1.9                              |
| Monitoring performance of your applications' real end user experience  | 2.5                    | 575               | 1.10         | 3                                |
| Monitoring performance of your application via business transactions which emulate/simulate end users                            | 9.7                    | 2104.9            | 1.13         | 2.8                              |
| Diagnosing performance problems and determining where the performance bottleneck lies (ie Application Server, Database, Network) | 10.0                   | 1510              | 1.19         | 4.1                              |
| Ensuring service levels are being satisfied  | 1.1                    | 277.2             | 1.00         | 2.1                              |
| Determining trends or establishing base lines in performance levels based on historical performance data                         | 8.0                    | 1080              | 1.19         | 2.3                              |
| Configuring tool to receive alert notifications (e-mail, pager)  | 1.8                    | 156.6             | 0.90         | 2.1                              |

| <b>Oracle Application Server 10g</b>   |                               |                          |                     |   |
|--|-------------------------------|--------------------------|---------------------|---|
| <b>Activity Analysis</b>   | <b>Est Avg Effort (hours)</b> | <b>Total Effort/Year</b> | <b>Skill Factor</b> | <b>Complexity Index (1-5, 5 = High)</b> |
| <b>Installation &amp; Software Maintenance</b>   |                               |                          |                     |   |
| Application server installation  | 1.4                           | 15.4                     | 0.92                | 1.5                                     |
| Management software installation   | 0.4                           | 4                        | 0.87                | 1.3                                     |
| Upgrade  | 1.5                           | 12                       | 1.05                | 2.8                                     |
| Patching   | 0.8                           | 30.4                     | 1.01                | 2.3                                     |
| <b>Configuration &amp; Deployment</b>  |                               |                          |                     |   |
| Application Server configuration (i.e. web server, portal, J2EE, etc.)   | 4.9                           | 730.1                    | 0.94                | 1.7                                     |
| Ensuring environment conforms to configuration and/or security best practices/policies   | 1.2                           | 141.6                    | 1.07                | 2.8                                     |
| Instance creation/cloning  | 0.8                           | 18.4                     | 1.07                | 2.8                                     |
| Application deployment (local and remote)  | 1.3                           | 214.5                    | 0.95                | 1.7                                     |
| <b>Ongoing Administration</b>  |                               |                          |                     |   |
| Application life cycle management  |                               |                          |                     |   |
| Moving applications from test environment to production environment  | 1.4                           | 141.4                    | 0.92                | 1.5                                     |
| Moving product-specific metadata from test environment to production environment   | 1.3                           | 72.8                     | 1.07                | 2.6                                     |
| Environment configuration manageability between environments (dev, qa, stage, prod)  | 1.5                           | 153                      | 1.07                | 2.8                                     |
| Software/hardware/operating system inventory management and tracking/comparing those inventories                                 | 1.7                           | 88.4                     | 1.01                | 1.9                                     |
| Session management/fail over   | 1                             | 132                      | 1.01                | 2                                       |
| Port management  | 0.8                           | 132.8                    | 1.01                | 2                                       |
| Referring to online help and/or documentation for assistance in completing management tasks                                      | 0.7                           | 151.9                    | 0.95                | 2.3                                     |
| Application Server backup and recovery   | 1.2                           | 205.2                    | 1.07                | 3.2                                     |
| Distribution of management data (i.e. status, problems, resolutions, etc.) across team of administrators for collaboration       | 0.6                           | 182.4                    | 0.95                | 2.3                                     |
| Cluster Management   | 0.6                           | 64.8                     | 1.1                 | 3                                       |
| <b>Performance Monitoring &amp; Tuning</b>   |                               |                          |                     |   |
| Accessing and viewing log files for diagnostic purposes  | 0.8                           | 297.6                    | 1.01                | 2.3                                     |
| Determining/setting thresholds for performance monitoring  | 3.8                           | 463.6                    | 0.95                | 2.3                                     |
| Datasource connection pool tuning  | 0.8                           | 15.2                     | 1.01                | 2.3                                     |
| Monitoring performance of your application server environment  | 1                             | 227                      | 0.94                | 2.1                                     |
| Monitoring performance of your applications' real end user experience  | 1                             | 230                      | 0.89                | 1.7                                     |
| Monitoring performance of your application via business transactions which emulate/simulate end users                            | 0.8                           | 173.6                    | 1.01                | 2.3                                     |
| Diagnosing performance problems and determining where the performance bottleneck lies (ie Application Server, Database, Network) | 1.2                           | 181.2                    | 1.01                | 2.6                                     |
| Ensuring service levels are being satisfied  | 0.9                           | 226.8                    | 1.01                | 2.1                                     |
| Determining trends or establishing base lines in performance levels based on historical performance data                         | 1                             | 135                      | 1.01                | 2                                       |
| Configuring tool to receive alert notifications (e-mail, pager)  | 1                             | 87                       | 0.83                | 1.67                                    |