



WHITE PAPER

Application Server Cost of Ownership:

Oracle WebLogic and Coherence versus IBM WebSphere Application Server and eXtreme Scale

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A CRIMSON CONSULTING GROUP BUSINESS WHITE PAPER

This study was sponsored by Oracle but was designed and executed by Crimson Consulting Group as an independent, analytical evaluation with research participants screened to include comparable experience with deployments of both Oracle WebLogic Server and IBM WebSphere application servers.

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Executive Summary

In the midst of dizzying technological and economic change, one thing remains constant for organizations of all sizes: the pressure to reduce IT costs and extract the maximum business value from both existing and future IT investments. Application server platforms are a key tool in this effort, offering major benefits such as more efficient use of IT capacity, increased agility, and extended value for existing IT investments. They can also play a central role in the burgeoning cloud model. The choice of an application server platform is thus very significant for an organization, and decision-makers must consider a broad range of cost factors that operate over the entire lifecycle of such an investment.

Crimson Consulting Group conducted primary research and detailed analysis to investigate key cost differences in two leading Java EE-based application servers and related components: Oracle WebLogic Server and IBM WebSphere Application Server. We investigated both a “base configuration” comprising the application server itself and related management tools, and an “advanced configuration,” which adds the related in-memory data grid solutions, Oracle Coherence and IBM eXtreme Scale, along with a real-time environment. The advanced configuration is more representative of the kinds of deployments becoming more common as enterprise computing makes the transition to cloud computing.

Cost areas evaluated include acquisition, implementation, application deployment, testing, vendor support, management, and administration. Crimson combined this research with a *pro forma* cost analysis over a five year period.

The results indicate that the Oracle WebLogic application server platform enjoys a considerable total cost of ownership (TCO) advantage over IBM’s WebSphere platform, which is between 44% and 51% more costly than Oracle WebLogic. This is due to three primary factors:

Oracle’s performance advantage. Both primary and secondary research indicated better performance from Oracle WebLogic than IBM WebSphere, and even more of a difference for Oracle Coherence vs. IBM eXtreme Scale, in terms of the number of users and transaction throughput that can be supported. This performance difference impacts the acquisition costs (hardware and software licenses), vendor support costs, and ongoing operational costs. Oracle WebLogic performance was 10-20% better than IBM WebSphere, while Oracle Coherence performance was over 30% better than IBM eXtreme Scale.

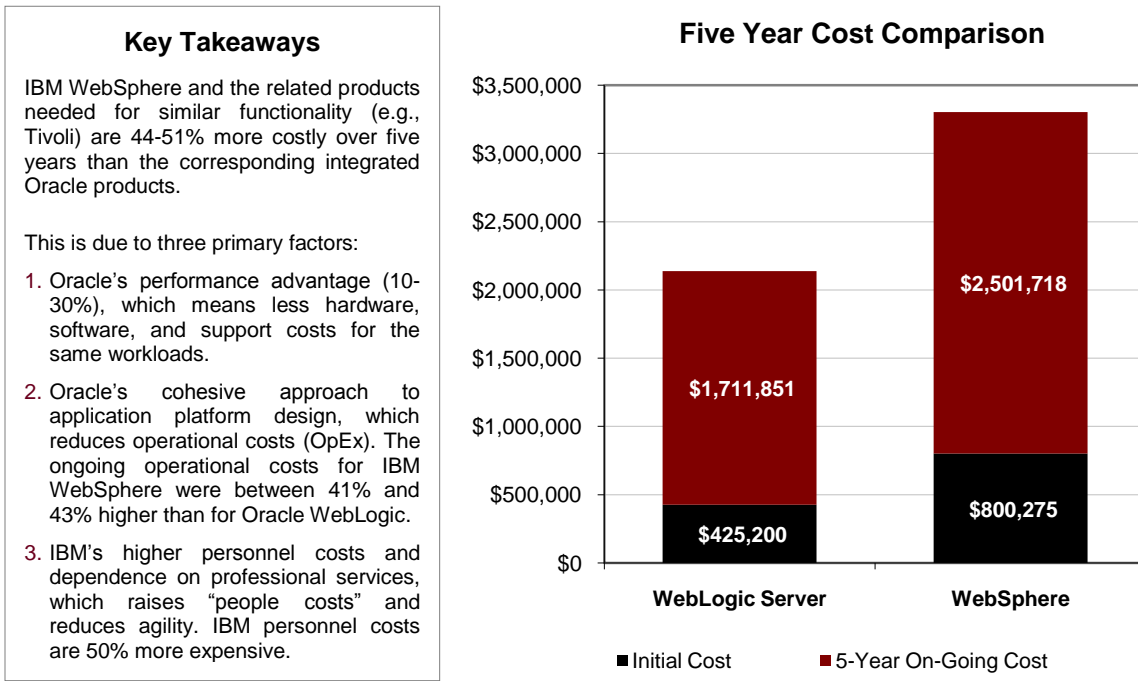
Oracle’s cohesive approach to its application server platform design. This was perhaps the most dramatic and consistent difference revealed by the interviews. As discussed at length throughout this paper, Oracle’s product cohesiveness and “out-of-the-box” functionality has two major benefits. First, it reduces acquisition and support costs (the latter being a function of licensing cost), which for IBM were between 60 and 68% higher than Oracle. Second, it holds down “people costs” by greatly reducing the time and effort involved in developing, deploying, and managing an application server-based business solution. As a result, in the *pro forma* model,

“Over five years, the IBM WebSphere application server platform proves to be between 44% and 51% more costly than the Oracle WebLogic platform, for equivalent capabilities and performance. The primary reasons for this difference are Oracle’s performance advantage, its superior cohesiveness, and the lower personnel skill level required to deliver similar results.”

ongoing operational costs (i.e. OpEx) for IBM WebSphere were between 41% and 43% higher than for Oracle WebLogic.

Oracle’s lower skill and training requirements. As explained in the Methodology section, our interviews probed the skill level required for each task. The results clearly reveal that companies adopting Oracle’s application server platform can get similar results from less skilled personnel. On average, IBM-trained personnel were 50% more expensive than Oracle-trained personnel. In addition, not only is it easier, and thus less expensive to train people up to the level needed even for tasks involved with an in-memory data grid, the interviews also indicated that IBM deployments tended to be more dependent on expensive professional services engagement. This not only affects the cost, but also has implications for the long-term stability of a solution when the expertise needed to maintain and extend it is not available in-house.

The summary results are presented in Figure 1, using a baseline configuration of 5 4-core servers hosting both the application server and in-memory data grid, which is representative of the types of deployments with which interviewees had experience.



Decision-makers should note that although this report shows a significant TCO advantage for Oracle based on the *pro forma* cost analysis, the requirements of any given specific implementation may change the TCO calculation to a greater or lesser degree. For each cost area analyzed, we explain the underlying assumptions, which are further illustrated in the primary research results reported in Appendix A. Decision-makers may wish to use this information to adapt the results of this report to their own circumstances.

Introduction

As a platform for developing, deploying, and integrating enterprise applications, the application server is arguably the foundation of modern enterprise computing. By facilitating functions common to all applications (e.g., connection, security, and integration), an application server enables developers to concentrate their efforts on implementing the business logic that supports key organizational goals, thus enabling IT to deliver greater value and increased agility.

The application server is also playing a fundamental role in the evolution of the “cloud,” taking on more and more of the functions needed to realize the next-generation vision of a seamless “grid” of interacting processes that enables application access to whatever resources are needed, whenever they are needed. Because of the increasing solution size and complexity this evolution entails, it makes more sense to speak of an application server platform, in recognition of the other components needed to support the functionality of the application server itself.

Critical Application Server Platform Components

Two components in particular should be noted by decision-makers evaluating an application server platform: management tools, and an in-memory data grid. The management tools available for an application server have a major impact on IT’s ability to manage complex application environments. Of primary importance is the ability to deliver as close to a “single pane of glass” view of the system as possible, no matter how many components are involved. Cloud computing places even more emphasis on ease of management and administration, including capabilities such as auto-provisioning and upgrading without downtime.

Furthermore, given increasing demands for performance, scalability, availability and transactional integrity, a growing percentage of application server implementations will include an in-memory data grid to push data closer to applications. The scalability offered by an in-memory data grid is also, of course, critical to cloud computing.

The Impact of “Product Philosophy”

Unfortunately, when evaluating the Oracle WebLogic application server platform versus the IBM WebSphere platform, decision-makers must deal with very different packaging and integration philosophies that make a TCO comparison less straightforward than it otherwise might be. Oracle emphasizes an all-in-one approach to its application server platform that aims to supply the needed functionality in one cohesive product, whether Oracle WebLogic Enterprise Edition or Oracle WebLogic Suite, while IBM offers a large selection of separate products that must be assembled to provide the desired functionality.

“You can take experienced Java programmers and put them through Oracle training, and they’re up and running—I’ve even seen bright graduates fresh out of college get productive quickly.”

IT Architect, Tier-1 Bank

To make this white paper as useful as possible to such decision makers, we have tried to provide as much of an “apples to apples” TCO comparison as possible given this fundamental difference. For instance, we have considered only those components that most affect TCO, as discussed under “Products Compared,” rather than taking into account all of the components already integrated into the WebLogic products that would have to be purchased and managed separately in the IBM solution. For organizations to whom the additional integrated functionality available in

the Oracle products that we did not consider is important, the TCO difference would be more favorable to Oracle than presented here.

One final introductory note is necessary, concerning people costs. In general, Crimson’s primary research revealed that the Oracle products required a lower skill level, or less training time, for equivalent results, which accounts for no small portion of their TCO advantage. As one IT architect at a Tier-1 global bank commented, “With Oracle, you can take experienced Java programmers and they’re up and running — I’ve even seen bright graduates fresh out of college get productive quickly.”

Our methodology for quantifying this difference is discussed briefly in “Estimating “People Cost”” below, and the actual differences are touched on throughout the white paper and summarized in the tables in “Appendix A: Primary Research Results” at the end of this paper.

A Five Year Cost of Ownership Comparison

Crimson’s approach to cost of ownership seeks to highlight major cost areas, focusing in particular on those areas where there are substantive differences between application server platform alternatives. For TCO comparisons, Crimson uses a framework proven based on numerous studies in this area. It includes key cost categories over the life cycle of an application server infrastructure deployment that should be considered by executive and IT managers. These categories are listed and described in Table 1.

Table 1: Description of Cost Categories Included in Research & Analysis

Category	Description
Initial Cost: Acquisition & Implementation Costs	This category includes an “apples-to-apples” application server platform comparison, including the potential costs of any additional hardware/software or implementation effort required on each platform to provide comparable, requisite functionality. It also includes the cost for implementation including installation, configuration and testing of the application servers.
Ongoing Application Deployment & Testing Costs	This category includes the ongoing labor costs for deploying custom applications from test and staging environments to production environments. It also includes the ongoing interoperability testing and periodic testing for new releases and updates to the application servers and other infrastructure components.
Ongoing Vendor Support Costs	This category includes the hard costs for annual subscription support or maintenance agreements for the application server software and any additional software required.
Ongoing Administration & Management Costs	This includes the ongoing labor cost to configure, manage, and maintain the application servers.
Ongoing Monitoring, Diagnostics & Tuning Costs	This category includes the ongoing labor cost to monitor, tune, and optimize the application servers.
Other Cost Considerations	This category includes cost considerations identified in the study but not necessarily included in the cost of ownership model, such as the cost of planned/unplanned downtime and time-to-market considerations.

While there may also be substantive differences in terms of developer productivity and integration activities, our study was primarily geared towards basic platform infrastructure operations and therefore only this aspect of cost was included in our analysis. That said, our detailed

questionnaire did address these areas of developer productivity and integration, and yielded some more qualitative findings.

Research Methodology

Crimson’s cost analysis included research on current pricing and licensing policies, and structured, detailed interviews with staff at 16 organizations with application server and in-memory grid deployments. Out of these, 8 deployments had only WebLogic running, 2 had only Oracle Coherence running, 2 had both WebLogic and Coherence running and 4 had both IBM WebSphere and eXtreme Scale running.

For the anecdotal data (e.g. quotations and implications), we also drew upon interviews with other Oracle and IBM customers from recent research studies. The interviewees were selected based on their hands-on operational experience with each application server, and in some cases, with both application servers.

The participant environments were generally functionally comparable, though ranging in size from 5 to 127 application server hosts and 10 to 269 CPUs. Table 2 provides some salient statistics regarding the study participants’ application server deployment profile.

Table 2: Average application server deployment profile

Element	Average of Participant Companies
Average # of Sockets/CPUs	94
% of Deployments Utilizing Clustering	93%
Average Number of Full-Time Equivalent (FTE) Administrators	3.3
Average Number of Full-Time Equivalent (FTE) Developers	75.4

At each of these sites, we screened the administrators using a detailed questionnaire asking about their experience in managing application server platforms. This covered activities such as installation, configuration, patching/upgrading, deployment, cluster setup/configuration, instance creation, session management, monitoring and tuning. We then interviewed them in two phases. In Phase I, we asked them about high-level cost of ownership considerations, key management activities and frequencies. Their responses helped us build a costing model for management of application servers in a typical “baseline” environment.

Estimating “People Cost:” Skill-Adjusted Effort

The annual cost of managing an application server platform is the sum of the individual costs incurred for each 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=1.5, medium=1.0, low=0.5)

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

$$\text{Annual Cost} = \text{Frequency} \times \text{Duration} \times \text{Skill Factor} \times \text{Average Resource Cost}$$

⏟
⏟

Effort Index
Skill-Adjusted Effort

- **Effort Index** represents the total hours spent on an activity in one year.
- **Skill Factor** normalizes these hours to correspond to a “medium” or average-skilled administrator. For example, if a task requires 100 hours/year by a “high” skill administrator, we map it to 150 hours for a “medium” skill administrator.
- **Skill-adjusted effort** 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.

Products Compared

In this white paper, we compare the TCO of the application server platforms offered by Oracle and IBM for a typical base configuration:

- 5 servers¹
- 2 CPUs/server
- 2 cores/CPU
- 4 application server instances per server
- 4 unique applications

The “foundation” application server product for each vendor used in this comparison is:

- Oracle WebLogic Server 11g Enterprise Edition (WebLogic EE)
- IBM WebSphere Application Server Network Deployment V7 (WAS ND)

For the purposes of this white paper, we have looked at two application server platform configurations, a base configuration, and an advanced configuration, as explained below. We used prices current as of March 2011 to compare Oracle’s CPU-based pricing to IBM’s PVU-based pricing using an assumption of 70 PVUs per core (i.e. 140 PVUs for a dual-core processor) for the IBM licensing cost.² For both configurations, we included the cost of the integrated development environment (IDE), which is included in the Oracle products but a separate license from IBM. However, its contribution to overall TCO is minor.

Base Configuration

The base configuration comprises the application server and the management tools needed for ongoing management and monitoring. This functionality is supplied in Oracle WebLogic EE, but IBM customers must license additional products for equivalent capabilities. Table 3 lists the products included in the base configuration for both Oracle and IBM.

¹ As discussed in the “Initial Costs: Acquisition & Implementation” section, below, the performance advantage of the oracle solution revealed by our research requires that the equivalent IBM solution uses more servers.

² See <http://www-01.ibm.com/software/lot> for details on IBM pricing

Table 3: Components used in TCO comparison of base configuration

WebLogic EE & IBM Equivalent Products			
WebLogic EE	Extra Cost?	WebSphere Equivalent	Extra Cost?
WebLogic Server*	No	WebSphere Application Server Network Deployment (WAS ND)	No
WebLogic Clustering	No	Feature of WAS ND	No
JDeveloper / Eclipse / NetBeans	No	Rational Application Developer	Yes
Diagnostic Pack for Oracle Middleware	No	IBM Tivoli Composite Application Manager (ITCAM) for Application Diagnostics	Yes

* Note: Oracle Virtual Assembly Builder and Oracle VM Template for WebLogic are included with no extra cost in Oracle WebLogic EE. IBM Workload Deployer (formerly called WebSphere CloudBurst) must be licensed separately for virtual/cloud deployment. It is not part of this TCO comparison.

Advanced Configuration

We define the advanced configuration as the combination of products needed to supply the following products, tools, or functionality:

- Application server
- Management tools
- In-memory data grid
- Real-time environment

This functionality is an integral part of Oracle WebLogic Suite, but IBM customers must license additional products for equivalent capabilities. Table 4 lists the products included in the advanced configuration for both Oracle and IBM (for the sake of clarity, some components of Oracle WebLogic Suite that do not have an IBM equivalent and do not have a significant impact on TCO have been omitted).

Table 4: Components used in TCO comparison of advanced configuration

WebLogic Suite & IBM Equivalent Products			
WebLogic Suite	Extra Cost?	WebSphere Equivalent	Extra Cost?
WebLogic Server*	No	WebSphere Application Server Network Deployment (WAS ND)	No
WebLogic Clustering	No	Included in WAS ND	No
Web Cache and HTTP Server	No	Included in WAS ND	No
JDeveloper / Eclipse / NetBeans	No	Rational Application Developer (RAD)	Yes
Diagnostic Pack for Oracle Middleware	No	ITCAM for Application Diagnostics	Yes
Management Pack for Oracle Coherence	No	Mostly manual process to manage eXtreme Scale (there is a simple and unsupported IBM Tivoli Enterprise Monitoring Agent for WebSphere eXtreme Scale)	No
Coherence EE	No	WebSphere eXtreme Scale	Yes
JRockit Real Time	No	WebSphere Real Time	Yes

* Note: Oracle Virtual Assembly Builder and Oracle VM Template for WebLogic are included with no extra cost in Oracle WebLogic Suite. IBM Workload Deployer (formerly called WebSphere CloudBurst) must be licensed separately for virtual/cloud deployment. It is not part of this TCO comparison.

Note: because of the growing importance of high scalability in enterprise deployments, all of the following cost comparisons are based on the advanced configuration, unless otherwise noted.

Five Year Cost Summary

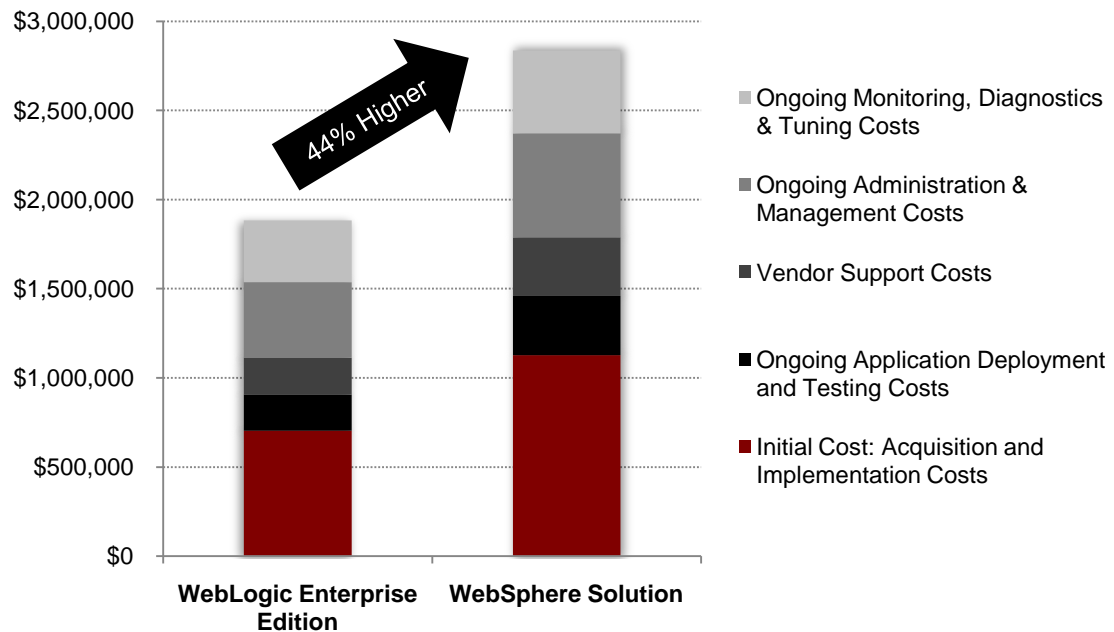
Table 5 and Table 6 outline the pro forma costs for the deployment scenario for the base and advanced configurations, respectively. The acquisition and ongoing support costs reflect current list prices less an average discount of 25%, while the “people costs” for implementation, deployment, testing, administration and management are based on the primary research data collected. All costs are listed in \$USD.

Base Configuration

Table 5: Five-Year Cost Summary for Base Configuration

Cost Category	WebLogic Enterprise Edition	WebSphere ¹	Difference as a % of WebLogic Cost
Initial Cost: Acquisition and Implementation Costs	\$703,757	\$1,058,773	50%
Ongoing Application Deployment and Testing Costs	\$203,713	\$330,744	62%
Vendor Support Costs	\$206,250	\$273,816	33%
Ongoing Administration & Management Costs	\$422,907	\$583,285	38%
Ongoing Monitoring, Diagnostics & Tuning Costs	\$346,015	\$465,564	35%
Cost over 5 Years	\$1,882,642	\$2,712,181	IBM WebSphere is 44% higher

¹IBM *pro forma* deployment requires more hardware due to lower performance, as discussed below in "Initial Costs: Acquisition & Implementation."

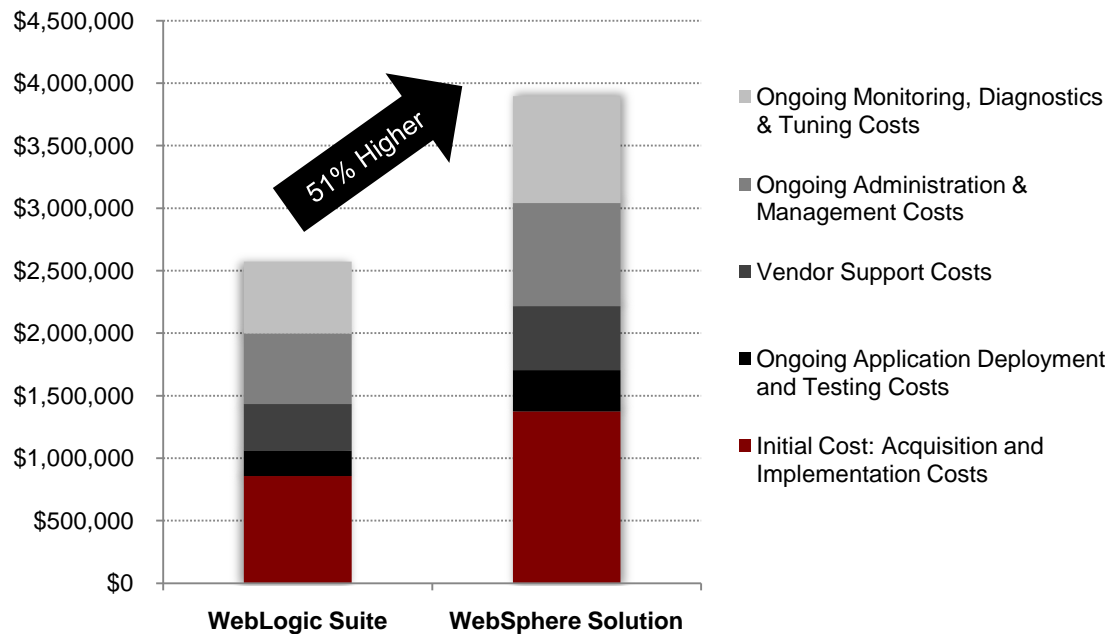


Advanced Configuration

Table 6: Five-Year Cost Summary for Advanced Configuration

Cost Category	WebLogic Suite	WebSphere ¹	Difference as a % of WebLogic Cost
Initial Cost: Acquisition and Implementation Costs	\$856,859	\$1,373,363	60%
Ongoing Application Deployment and Testing Costs	\$203,713	\$330,744	62%
Vendor Support Costs	\$371,250	\$511,602	38%
Ongoing Administration & Management Costs	\$563,876	\$823,196	46%
Ongoing Monitoring, Diagnostics & Tuning Costs	\$576,691	\$854,844	48%
Cost over 5 Years	\$2,572,389	\$3,893,748	IBM WebSphere is 51% higher

¹IBM *pro forma* deployment requires more hardware due to lower performance, as discussed below in "Initial Costs: Acquisition & Implementation."



Initial Costs: Acquisition & Implementation

Performing an accurate comparison of the initial costs of an application server platform is a difficult task, and what is presented here is necessarily a simplification intended as a guide for decision-makers. Building on this outline, IT professionals faced with choosing an application server platform must do their homework, gaining a thorough understanding of what is included in each offering and what needs to be added or developed separately to provide similar performance and functionality. More important, and what cannot be addressed here is that such a comparison is scenario-specific, based on functional requirements, vendor pricing/licensing rules, customer-specific discounts, and the dynamics of a deployment over time.

As detailed in Table 6, below, the initial costs considered in this white paper are:

- Hardware
- Software Licenses
- Installation: people cost of installing hardware and software
- Initial Configuration/Customization: people cost of configuring the software to fit business needs
- Integration: people cost of integrating the solution with existing systems and architecture

People costs include both internal resources and the cost of consultants.

Hardware and Software

The first two categories, hardware and software licenses, are dependent not only on vendor pricing but on the relative performance of the two solutions. Our research indicates that better performance is available from Oracle WebLogic than IBM WebSphere in a clustered environment, based on a number of factors.

“Oracle Coherence requires 20-30% less hardware than IBM eXtreme Scale for the same performance.”

Chief Technology Officer
Professional Services Firm

Interviewee responses concerning the number of users supported suggest that the performance advantage of WebLogic over WebSphere is around 10-20% in real world environments. These interview results are in accordance with the published SpecJAppserver2004 and JOPS benchmarks for the two application servers, as well as more recent results from the SPECjEnterprise2010 performance benchmark,³ along with the linear scalability of Oracle WebLogic demonstrated in many actual customer implementations. All customers have consistently raved about the performance and scalability of WebLogic Server.

Our research also shows that customers who have deployed both Oracle Coherence and IBM eXtreme Scale estimated 30% higher performance with Oracle Coherence than IBM eXtreme Scale, both in terms of the number of users that could be supported and in increased transactional throughput. For instance, one interviewee with extensive experience testing both vendors' application servers and in-memory data grid said, "Oracle Coherence requires 20-30% less hardware than IBM eXtreme Scale for the same performance."

Another interviewee with experience of both also characterized eXtreme Scale's transaction support as "weak." However, it should be noted that he also stated that he had seen no

³ See <http://www.spec.org/jEnterprise2010/results/jEnterprise2010.html>

difference in the performance of the application servers themselves — that the major advantage for Oracle in his experience came with the use of Coherence.

The results of our interviews lead us to attribute this Coherence advantage to its extremely fast in-memory performance. For example, faster cluster communications and the use of the compressed Portable Object Format (POF) can reduce object size by 30-70% thus improving performance significantly. By contrast, eXtreme Scale does not support this compressed object format. This results in more network traffic and larger data grid sizes.

Based on the above factors and other customer feedback from our primary research, we estimate the performance difference for the purposes of this TCO study at 10% for the base configuration, and 40% for the advanced configuration. It should be noted, however, that this estimate is based mostly on customer experience with high-transaction e-commerce web sites.

Thus, for the advanced configuration, an IBM implementation requires 7 servers vs. 5 for an Oracle implementation, making the IBM solution 40% more expensive in terms of hardware. (For the base configuration, the difference is 20%: 6 servers for IBM vs. 5 for Oracle.) Of course, this differential will become even more significant as the deployment size becomes larger.

The software license calculation is complicated somewhat by the difference between Oracle's per-core pricing (multiplied by a "core factor") and IBM's somewhat more complex Processor Value Unit (PVU) pricing model. Thus, we have

- 10 Oracle software licenses (both base and advanced configuration) vs.
- 12 (base) or 14 (advanced) IBM software licenses

In addition, customers must license multiple IBM products to get the same functionality as Oracle WebLogic Enterprise Edition or WebLogic Suite. For example, IBM WebSphere users have to license the following components separately in order to have comparable capabilities as WebLogic Suite: WebSphere eXtreme Scale, WebSphere Real Time, IBM Workload Deployer (formerly called WebSphere CloudBurst), and IBM Tivoli Composite Application Manager (ITCAM) for Application Diagnostics, etc. This makes IBM licensing almost 120% more expensive for both the base and advanced configurations.

Initial "People" Costs

The skill level advantage enjoyed by Oracle over IBM was clearly demonstrated by our research results for the initial people costs of application server deployment, which elicited detailed information about the time and skill level required for the tasks associated with installation, initial configuration and customization, and integration. Initial people costs also include the first year of application deployment and infrastructure testing, but because these areas are also ongoing costs, they are discussed later in "Application Deployment and Infrastructure Testing."⁴

"Oracle's scripting tools make it easy to automate a lot of configuration tasks."

Application Infrastructure Manager
Large Financial Services Firm

For installation, our research indicated an overall 35% skill-adjusted effort advantage for per-server installation tasks for Oracle WebLogic over IBM WebSphere in the advanced configuration, and slightly less for the base configuration. For per-domain installation tasks, what

⁴ More detailed results for the following cost areas may be found in the tables in "Appendix A: Primary Research Results"

stood out was the overall Oracle skill-adjusted effort advantage in management software installation (needed in both configurations), which was 51%. Overall, this was the dominant factor in the difference between installation costs. Although no interviewees commented directly on this in the installation section of the interviews, as we shall see in “Administration and Management Cost,” below, every IBM component has its own management console, which explains the difference here.

It was apparent from the response of Oracle customers that WebLogic required less initial configuration and customization out of the box than IBM WebSphere. This may be ascribed to the extensive set of server and cluster setup tools available in WebLogic, which include a configuration wizard and domain templates along with streamlined scripting. The differences between Oracle and IBM in skill level required varied much more widely than for installation. For instance, in the base configuration, our research revealed a notable skill-adjusted effort advantage for Oracle WebLogic in policy conformance (setting up global policies) at 104% and customization and custom script development at 118%.⁵

“Oracle has done a better job of integrating the products it has acquired than IBM.”

Infrastructure Architect,
IBM Professional Services Partner

In addition, while the skill-adjusted effort for cluster configuration in the base configuration was practically the same, for cluster setup with an in-memory data grid, Oracle Coherence enjoyed a 239% skill-adjusted effort advantage over IBM eXtreme Scale and 104% advantage in cluster expansion. One research participant experienced with both vendors’ products stated that “Coherence is easier to work with than eXtreme Scale, especially when it comes to configuration and tuning.” Interview results indicated that administrative complexity was an issue with eXtreme Scale, especially since there is no GUI nor any default configuration as there is with Coherence. All configurations must be done either programmatically or via an XML configuration file.

Oracle also enjoyed an advantage in integration costs. Participants familiar with WebLogic cited this application server’s extensive set of pre-built integration hooks (especially those for widely-used Oracle enterprise products such as Database 11g, PeopleSoft applications, and Siebel CRM solutions) as one reason for this. Others noted the superior integration of WebLogic and Coherence compared to that of WebSphere and eXtreme Scale. One interviewee with experience of both products commented that “Oracle has done a better job of integrating the products it has acquired than IBM.”

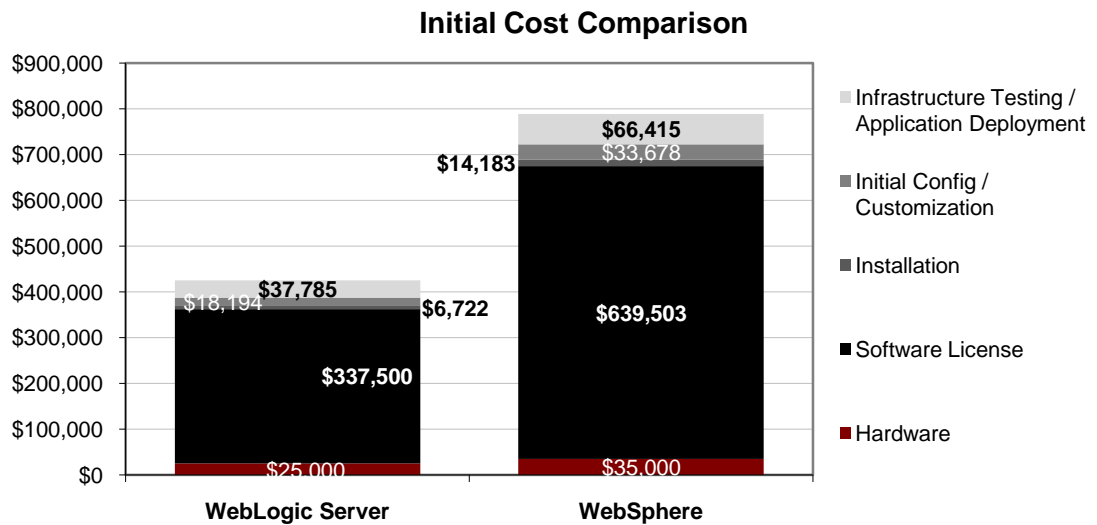
As a result, IBM WebSphere solution typically requires the customer to have many more support personnel to support the products compared to Oracle over five years. It impacts not only how much they cost to acquire the products initially, but also how much they cost to support the products in an on-going basis, which we will discuss in the following section.

⁵ An add-in product, Tivoli Change and Configuration Management Database, mentioned by one participant, is available for configuration automation. It was not included in the TCO analysis; because of its costs and dependencies on other Tivoli products also not included, its inclusion would have made the comparison even less favorable to IBM.

Table 7: Cost Comparison and Key Assumptions for Initial Cost: Acquisition & Implementation

Initial Cost: Acquisition & Implementation	WebLogic Suite	WebSphere	Difference as a % of WebLogic Cost
Hardware	\$25,000	\$35,000	40%
Software License	\$337,500	\$639,503	89%
Installation	\$6,722	\$14,183	111%
Initial Configuration/ Customization	\$18,194	\$33,678	85%
Integration	\$469,443	\$651,000	39%
Infrastructure Testing ¹ & Application Deployment (Year 1)	\$37,785	\$66,415	76%
Total Initial Costs: Acquisition & Implementation	\$894,644	\$1,439,778	WebSphere is 61% higher

¹Infrastructure testing and application deployment are for application server only. See Appendix for more detail.



Key Assumptions for Initial Costs	
WebLogic Suite	WebSphere
<ul style="list-style-type: none"> ■ Hardware: Cost includes 5 servers (2 dual-core CPUs each) @ \$5,000 per server ■ Software Licenses: Licensing for 10 Cores of WebLogic Suite with a 25% discount applied. ■ Installation*: Based on 43 hours (including installation of software and servers) ■ Initial Configuration/ Customization*: Based on 145 hours for application server configuration, cluster configuration and instance creation and cloning ■ Integration: Based on 2259 hours for infrastructure integration and 770 hours for application integration ■ Infrastructure Testing & Application Deployment (Year 1): Based on 162 hours of infrastructure testing (interoperability) and 413 hours of testing new major release or update. <p>*Skill-adjusted effort index based on averaged/normalized primary research. See Appendix A for additional primary research details</p>	<ul style="list-style-type: none"> ■ Hardware: Cost includes 7 servers (2 dual-core CPUs each) @ \$5,000 per server; 2 additional server required in WebSphere environment to account for 40% performance delta ■ Software Licenses: Licensing for 12 WAS ND PVUs plus supporting software ■ Installation*: Based on 92 hours (including installation of management software for servers) ■ Installation: Based on 92 hours for installation of software and servers ■ Initial Configuration/Customization*: Based on 268 hours for application server configuration, cluster configuration and instance creation and cloning ■ Integration: Based on 3300 hours for infrastructure integration and 900 hours for application integration ■ Infrastructure Testing & Application Deployment (Year 1): Based on 301 hours of infrastructure testing (interoperability) and 680 hours of testing new major release or update. <p>*Skill-adjusted effort index based on averaged/normalized primary research. See Appendix A for additional primary research details</p>

Ongoing Costs: Application Deployment and Infrastructure Testing

With application deployment and infrastructure testing, we now begin the consideration of ongoing costs for the two platforms.

For application deployment (both initial and ongoing), our research indicated a 60% skill-adjusted effort advantage for developers and a 44% skill-adjusted effort advantage for administrators in the Oracle WebLogic Server deployments as compared to the IBM WebSphere deployments. Research participants noted the automation available with Oracle WebLogic (e.g. the WebLogic Deployment Framework, which automates the deployment of applications and provisioning of virtual hardware resources) both for deploying applications to multiple machines in a cluster and for moving applications from development to a production environment, as opposed to the more

manual, script-based approach noted by participants experienced with the IBM environment.⁶ WebLogic Server also supports zero-downtime side-by-side deployment, which enables an organization to deploy or upgrade the server cluster without interrupting the service to the end users. This is particularly important for e-commerce or critical financial applications, where any downtime can mean thousands or millions of dollar of lost revenue.

In infrastructure testing, Crimson’s research probed two important tasks: middleware interoperability testing, and testing new releases of and updates to application server stack. The greater complexity of the IBM solution and the higher level of skills it requires leads to an overall skill-adjusted effort advantage of 71% for Oracle. Participant responses indicate that the greater complexity of the IBM platform arising from the need to integrate many disparate products accounts for much of this difference.

“WebLogic is a very stable product that is easy to configure and deploy.”

Senior Project Manager
Large Cosmetics Manufacturer

The difference was most pronounced in middleware interoperability testing, with Oracle participants noting in particular that WebLogic’s “pre-integration” with other Oracle products such as Oracle Database 11g and Oracle SOA Suite reduced the amount of middleware testing they had to do. Some interviewees were, or had experience in, using Oracle Coherence with non-Oracle application servers; no interoperability problems were noted.

Based on the primary research, infrastructure testing is assumed to occur every three years; only Year 4 is shown below, as Year 1 was included in “Initial Costs: Acquisition & Implementation,” above.

The primary research did not consider deployment and infrastructure testing costs for the vendors’ in-memory data grids, so the data in this section are the same for both the base and advanced configurations.

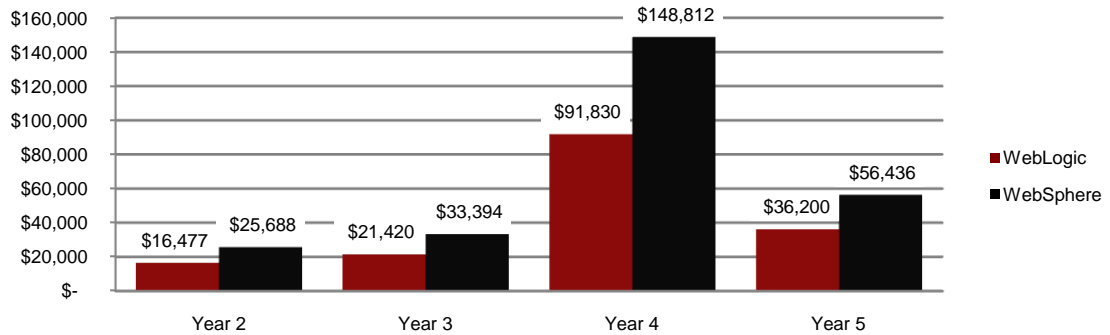
Table 8: Five-Year Cost Comparison & Key Assumptions for Application Deployment & Testing

Ongoing Deployment and Testing Costs ¹	WebLogic Suite	WebSphere	Difference as a % of WebLogic Cost
Application Deployment (Years 2-5)	\$114,619	\$178,689	56%
Infrastructure Testing (Year 4)	\$63,984	\$105,400	65%
Total Deployment and Testing Costs	\$203,713	\$330,744	IBM WebSphere is 62% higher

¹Infrastructure testing and application deployment are for application server only. See Appendix for more detail.

⁶ Although a deployment manager is available as an add-on to WAS ND, it was not cited by interviewees and was not included in this analysis.

Application Deployment & Testing Costs (Annual)



Key Assumptions for Ongoing Applications Development, Deployment, and Infrastructure Testing

WebLogic Infrastructure	WebSphere Infrastructure
<ul style="list-style-type: none"> 4 applications Ongoing Application Deployment*: Based on 39 developer and 16 administrator hours per application per year, years 1 - 5 Infrastructure Testing*: Based on 162 hours for infrastructure testing (interoperability) and 413 hours testing new releases or major updates. Pro forma modeling assumes these major testing activities take place every three years (year 1 and year 4). <p>*Skill-adjusted effort index based on averaged/normalized primary research. See Appendix A for additional primary research details</p>	<ul style="list-style-type: none"> 4 applications Ongoing Application Deployment*: Based on 62 developer and 24 administrator hours per application per year, years 1 - 5 Infrastructure Testing*: Based on 301 hours for infrastructure testing (interoperability) and 680 hours testing new releases or major updates. Pro forma modeling assumes these major testing activities take place every three years (year 1 and 4). <p>*Skill-adjusted effort index based on averaged/normalized primary research. See Appendix A for additional primary research details</p>

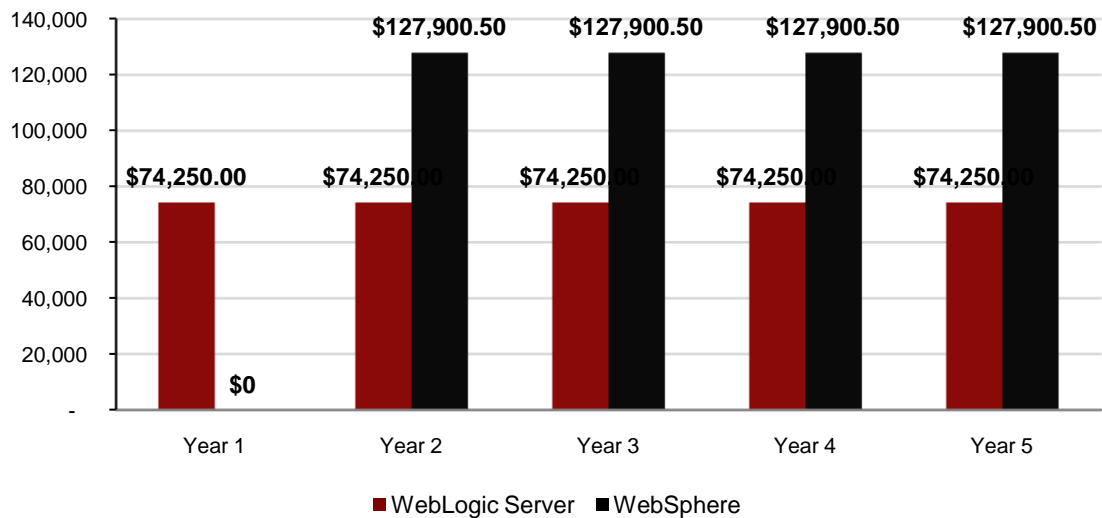
Ongoing Costs: Vendor Support

The support fees for Oracle is 22% of the software license, applied to all five years, while for IBM support cost is 20%, and the first year is included in the application server software license (note: IBM annual support cost is typically 25% of license cost for many other products such as IBM DB2 and Tivoli, etc). However, due to Oracle WebLogic Suite's lower base cost and the reduction in the number of software licenses due to its performance advantage (see the Hardware and Software section, above, where IBM's costs in both categories are higher relative to Oracle), even with the first-year advantage and slightly lower support percentage, Oracle vendor support enjoys a 38% advantage in support costs over five years.

Table 9: Five-Year Cost Comparison & Key Assumptions for Vendor Support Costs

Vendor Support Costs (5 years)	WebLogic Suite	WebSphere	Difference as a % of WebLogic Cost
Annual Maintenance/Support Contracts	\$371,250	\$511,602	38%
Total Vendor Support Costs	\$371,250	\$511,602	IBM WebSphere is 38% higher

On-Going Software Support Cost



Key Assumptions for Vendor Support Costs	
WebLogic Infrastructure	WebSphere Infrastructure
<ul style="list-style-type: none"> Oracle annual maintenance/support fee is 22% of software license cost per year, with a 25% discount applied for annual subscription. 	<ul style="list-style-type: none"> IBM annual maintenance/support fee is 20% of application server software license cost per year, with a 25% discount applied for annual subscription. The first year of support is included in the software license.

Ongoing Costs: Application Server Administration, Management, Monitoring and Tuning Costs

Managing and monitoring an application server infrastructure involves many different tasks, as outlined in Table 10. In these areas, the multiplicity of products needed to manage an IBM deployment and the generally higher skill required for IBM operations both contributed to a higher cost of ownership.

Table 10: Representative Management and Monitoring Tasks

Administration & Management Activities	Performance Monitoring, Diagnostics and Tuning Activities
<ul style="list-style-type: none"> ■ Upgrade(s) ■ Patching ■ Environment configuration between environments (Dev, QA, Stage, Production) ■ Database management ■ Session Management / Failover ■ Port Management ■ Referring to online help / documentation ■ App server backup and recovery ■ Cluster management ■ Distribution of management data (status, problems, resolutions) across team of admins 	<ul style="list-style-type: none"> ■ Data source connection pool tuning ■ Monitoring performance of the application server environment ■ Diagnosing performance problems and determining where the performance bottleneck lies (i.e., App Server, Database, Network) ■ Ensuring service levels are being satisfied ■ Determining trends or establishing base lines in performance levels based on historical performance Data ■ Configuring tool to receive alert notifications (e-mail, pager)

Administration and Management Cost

Here, too, primary research indicated that Oracle’s integrated approach offers TCO advantages. Oracle users noted four tools in particular as being useful in management:

- WebLogic Admin Console
- WebLogic Clustering Configuration Wizard
- WebLogic Scripting Tool (WLST)
- WebLogic Rolling Upgrade

By contrast, participants familiar with IBM did not identify one particular tool, but noted the need to install different management products (mostly Tivoli) to accomplish these tasks, in addition to the management tools supplied with each separate component. As one of these noted, “Practically every IBM product in the application server environment has its own management console.”

Overall, for the tasks associated with managing the base configuration (the application server alone, without the in-memory data grid), Oracle enjoyed a 38% advantage in terms of skill-adjusted effort. For some tasks, such as database management and application server backup/ recovery, the difference was minimal. Tasks for which the Oracle WebLogic server enjoyed a marked skill-adjusted effort advantage (>90%) include cluster management and session management/failover. The Rolling Upgrade feature, in which each server in a cluster is individually upgraded and restarted while the other servers in the cluster continue to host an

“Practically every IBM product in the application server environment has its own management console.”

Independent Middleware Consultant,
Focused on Telcos

application, was noted by one participant. The Smart Upgrade utility, which reduces the time and effort to upgrade and patch WebLogic servers, may also play a part in this advantage.

However, one participant experienced with both vendors' products noted that "although restarting the server in a failover situation takes a comparable amount of time for the WebLogic and WebSphere application servers, once you add in the data grids, Coherence is better." (Our primary research did not specifically address failover management for the vendors' in-memory data grids; this comment was offered in the discussion preliminary to the actual quantitative survey.) The apparent mismatch between his experience of the base configuration and the overall research results was, of course, not discovered until all the responses had been tabulated, and we were unable to follow up with him to probe further.

On tasks associated with in-memory data grid management, our primary research indicates that Oracle Coherence had an overall 60% skill-adjusted effort advantage over IBM eXtreme Scale. However, the advantage varied widely by task. For one task, managing persistence to database, there was no difference at all, for others, such as upgrades and patching, the difference in skill-adjusted effort was over 200%. Most of the tasks investigated here did not require a great deal of time for either solution; for the one task that did, partitioning data, the Oracle advantage was 60%.

"Although restarting the server in a failover situation takes a comparable amount of time for the WebLogic and WebSphere application servers alone, once you add in the in-memory data grids, Coherence is better."

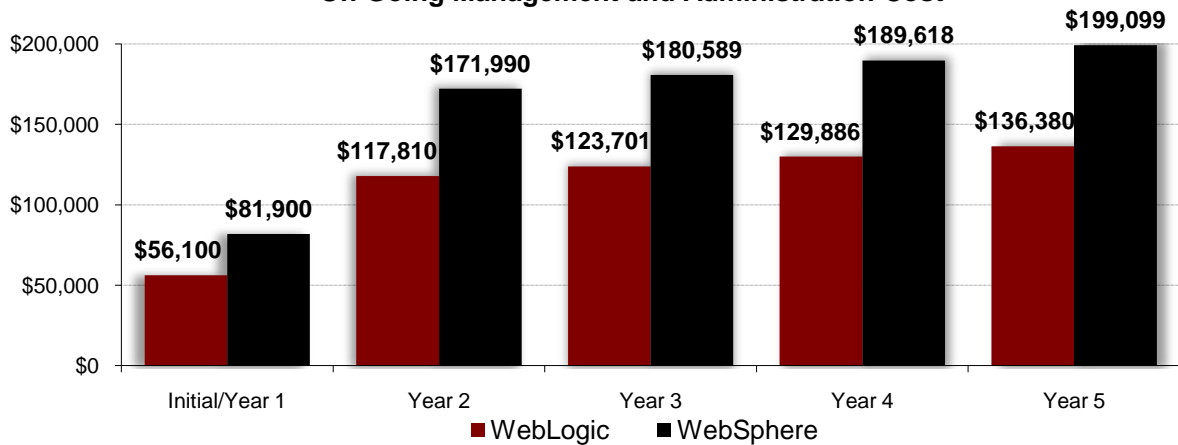
Application Server Benchmarking Expert
Professional Services Provider

Table 11: Five-Year Cost Comparison & Key Assumptions for Administration & Management Costs

Administration & Management Costs (5 years)	WebLogic Suite	WebSphere	Difference as a % of WebLogic Cost
Administration & Management	\$563,876	\$823,196	46%
Total Administration & Management Costs	IBM WebSphere is 46% higher		

See Appendix for more detail.

On-Going Management and Administration Cost



Key Assumptions For Management and Administration Cost

WebLogic Suite	WebSphere Solution
<ul style="list-style-type: none"> ■ Management/Administration*: Management cost based on 396 hours per administrator per year. Average skill factor for tasks is 1.0. ■ Staffing Baseline: Cost model assumption is 2.6 FTE administrators (2.1 for application server, 0.5 for in-memory data grid). Staffing for Year 1 assumed to be at 50% of Years 2 – 5 due to the initial deployment time, with a 5% estimated annual increase in resource cost. <p>*Skill-adjusted effort index based on averaged/normalized primary research. See Appendix A for additional primary research details</p>	<ul style="list-style-type: none"> ■ Management/Administration*: Management cost based on 579 hours per administrator per year. Average skill factor for tasks is 1.5 ■ Staffing Baseline: Cost model assumption is 2.6 FTE administrators (2.1 for application server, 0.5 for in-memory data grid). Staffing for Year 1 assumed to be at 50% of Years 2 – 5 due to the initial deployment time, with a 5% estimated annual increase in resource cost. <p>*Skill-adjusted effort index based on averaged/normalized primary research. See Appendix A for additional primary research details</p>

Monitoring, Diagnostics, and Tuning Costs

When analyzing the monitoring aspects of TCO, interviewee responses made it apparent that the disjointed nature and greater complexity characteristic of IBM deployments required more effort to perform ongoing monitoring. This difference was even more notable with the full application server infrastructure due to the more complete visibility into the in-memory data grid offered by the Management Pack for Oracle Coherence.

Overall, for the tasks associated with monitoring the base configuration (the application server alone, without the in-memory data grid), Oracle enjoyed a 35% advantage in terms of skill-adjusted effort. For some tasks, such as diagnosing problems and finding the bottleneck or determining historical trends, the difference was minimal. The task for which the Oracle WebLogic

server (base configuration) enjoyed the greatest skill-adjusted effort advantage (85%) was data source connection pool tuning.

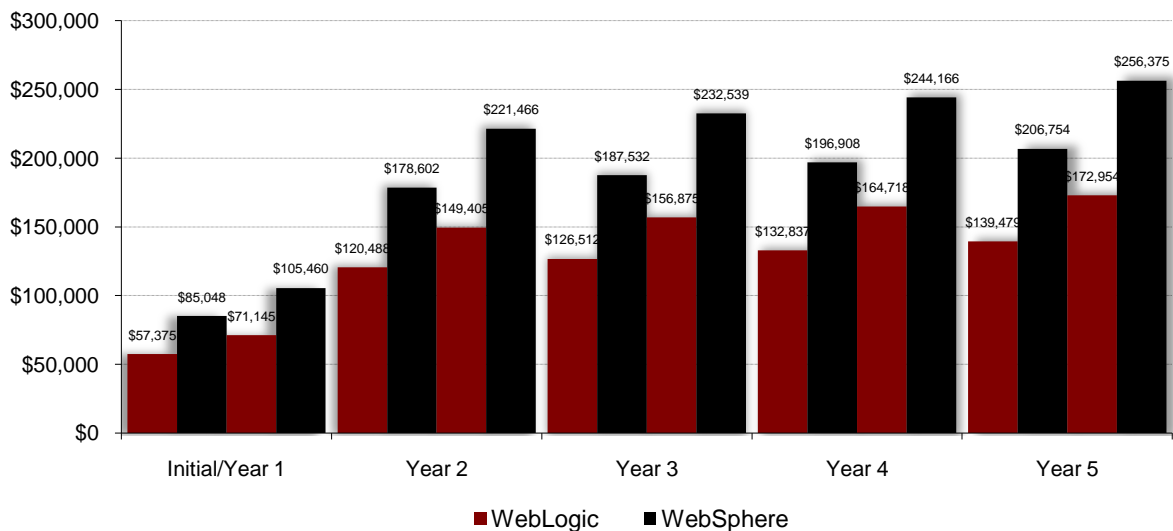
The overall Oracle skill-adjusted effort advantage was considerably more marked for in-memory data grid monitoring, diagnostics, and tuning activities at 90%. A standout advantage was ensuring SLAs, at over 200%. Data source connection pool tuning also scored high, and for the task which required the most time for both Coherence and eXtreme Scale, monitoring performance of the cluster nodes, participant responses pegged Oracle at over a 100% advantage in terms of skill-adjusted effort. It is primarily due to the features in Management Pack for Oracle Coherence, which eases the lifecycle management of Coherence. In the case of eXtreme Scale, a lot of the management and administration tasks are manual in nature.

Table 12: Five-Year Cost Comparison & Key Assumptions for Monitoring, Diagnostics and Tuning Costs

Monitoring, Diagnostics, and Tuning (5 years)	WebLogic Suite	WebSphere Solution	Difference as a % of WebLogic Cost
Monitoring, Diagnostics, and Tuning	\$576,691	\$854,844	48%
Total Monitoring, Diagnostics, and Tuning	\$576,691	\$854,844	IBM WebSphere is 48% higher

See Appendix for more detail.

On-Going Performance Monitoring, Diagnostics and Tuning



Key Assumptions For Monitoring, Diagnostics, and Tuning Cost	
WebLogic Suite	WebSphere
<ul style="list-style-type: none"> ■ Monitoring/Diagnostics/Tuning*: Based on 549 hours per administrator per year. Average skill factor for tasks is 0.9. ■ Staffing Baseline: Cost model assumption is 3.1FTE administrators (2.6 for application server, 0.5 for in-memory data grid). Staffing for Year 1 assumed to be at 50% of Years 2 – 5 due to the initial deployment time, with a 5% estimated annual increase in resource cost. <p>*Skill-adjusted effort index based on averaged/normalized primary research. See Appendix A for additional primary research details</p>	<ul style="list-style-type: none"> ■ Monitoring/Diagnostics/Tuning*: Management cost based on 3335 hours per administrator per year. Average skill factor for tasks is 1.4. ■ Staffing Baseline: Cost model assumption is 3.1FTE administrators (2.6 for application server, 0.5 for in-memory data grid). Staffing for Year 1 assumed to be at 50% of Years 2 – 5 due to the initial deployment time, with a 5% estimated annual increase in resource cost. <p>*Skill-adjusted effort index based on averaged/normalized primary research. See Appendix A for additional primary research details</p>

Conclusion

Crimson Consulting Group's primary research and analysis indicates that the Oracle WebLogic application server platform enjoys a considerable TCO advantage over IBM's WebSphere platform: over five years, IBM is 44% more expensive for the base configuration and 51% more expensive for the advanced configuration, as broken down in Table 13.

Table 13: 5-Year Cost Comparison of Oracle WebLogic vs. IBM WebSphere

Cost Category	IBM Cost Premium: Base Configuration	IBM Cost Premium: Advanced Configuration
Initial Cost: Acquisition and Implementation Costs	50%	60%
Ongoing Application Deployment and Testing Costs	62%	62%
Vendor Support Costs	33%	38%
Ongoing Administration & Management Costs	38%	46%
Ongoing Monitoring, Diagnostics & Tuning Costs	35%	48%
IBM Cost Premium Over 5 Years	44%	51%

This is due to three primary factors:

Oracle's performance advantage. Both primary and secondary research indicated better performance from Oracle WebLogic than IBM WebSphere, and even more of a difference for Oracle Coherence vs. IBM eXtreme Scale, in terms of the number of users and transaction throughput that can be supported. This performance difference impacts the acquisition costs (hardware and software licenses), vendor support costs, and ongoing operational costs. Oracle WebLogic performance was 10-20% better than IBM WebSphere, while Oracle Coherence performance was over 30% better than IBM eXtreme Scale.

Oracle's cohesive approach to its application server platform design. This was perhaps the most dramatic and consistent difference revealed by the interviews. As discussed at length throughout this paper, Oracle's product cohesiveness and "out-of-the-box" functionality has two major benefits. First, it reduces acquisition and support costs (the latter being a function of licensing cost), which for IBM were between 60 and 68% higher than Oracle. Second, it holds down "people costs" by greatly reducing the time and effort involved in developing, deploying, and managing an application server-based business solution. As a result, in the *pro forma* model, ongoing operational costs (i.e. OpEx) for IBM WebSphere were between 41% and 43% higher than for Oracle WebLogic.

Oracle's lower skill and training requirements. As explained in the Methodology section, our interviews probed the skill level required for each task. The results clearly reveal that companies adopting Oracle's application server platform can get similar results from less skilled personnel. On average, IBM-trained personnel were 50% more expensive than Oracle-trained personnel. In addition, not only is it easier, and thus less expensive to train people up to the level needed even for tasks involved with an in-memory data grid, the interviews also indicated that IBM deployments tended to be more dependent on expensive professional services engagement. This not only affects the cost, but also has implications for the long-term stability of a solution when the expertise needed to maintain and extend it is not available in-house.

About Crimson Consulting

We help executives achieve market leadership.

Crimson is a management consulting firm focused on marketing. Our clients include Adobe, Cisco, eBay, Hitachi, HP, IBM, Intel, Microsoft, Oracle, SAP, Seagate, Symantec and Verizon. We are experts in the marketing of technology solutions.

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Appendix A: Primary Research Results

Following is the aggregated results of our detailed primary research into the various activities for each area of the deployment life cycle.

Installation Activities

Activity	Oracle WebLogic			IBM WebSphere		
	Avg Time (Total)	Skill Factor	Skill-adjusted effort	Avg Time (Total)	Skill Factor	Skill-adjusted effort
Scales Per Server						
App server Installation	5.1	1.0	5.1	5.0	1.5	7.5
Coherence/EXtreme Scale	2.7	1.0	2.7	3.0	1.5	4.5
Scales Per Domain						
Mgmt software installation	2.2	1.3	2.7	3.7	1.5	5.5
Installing back end database connection (RAC other)	1.5	1.3	1.8	1.3	1.5	2.0
Total	Not Totaled Due to Different Scaling Factors					

Configuration/Customization Activities

Activity	Oracle WebLogic			IBM WebSphere		
	Avg Time (Total)	Skill Factor	Skill-adjusted effort	Avg Time (Total)	Skill Factor	Skill-adjusted effort
Scales Per Server						
Cluster Configuration	5.3	1.1	5.6	4.0	1.5	6.0
Scales Per Instance						
Policy Conformance	2.3	1.0	2.3	3.0	1.5	4.5
Instance Creation/Cloning	4.1	1.0	4.1	4.0	1.5	6.0
Scales Per Environment						
Customization/Custom Script Development	3.7	1.0	3.7	5.3	1.5	8.0
Total	Not Totaled Due to Different Scaling Factors					

Testing Activities

Activity	Oracle WebLogic			IBM WebSphere		
	Avg Time (Total)	Skill Factor	Skill-adjusted effort	Avg Time (Total)	Skill Factor	Skill-adjusted effort
Interoperability testing with middleware components	67.5	1.2	162.0	100.3	1.5	301.0
Testing for new updates and releases to app server stack	86.0	1.2	412.8	113.3	1.5	680.0
Total	Not Totaled Due to Different Scaling Factors					

Application Deployment Activities

	Oracle WebLogic			IBM WebSphere		
Activity	Avg Time (Total)	Skill Factor	Skill-adjusted effort	Avg Time (Total)	Skill Factor	Skill-adjusted effort
Application Deployment - Developers	1.4	1.2	38.9	2.1	1.3	62.3
Application Deployment - Administrators	4.0	1.0	16.4	4.7	1.3	23.5
Total	Not Totaled Due to Different Scaling Factors					

Management/Administration Activities

	Oracle WebLogic			IBM WebSphere		
Activity	Avg Time (Total)	Skill Factor	Skill-adjusted effort	Avg Time (Total)	Skill Factor	Skill-adjusted effort
Upgrade(s)	2.5	1.0	4.9	2.9	1.3	7.3
Patching	2.0	1.0	4.0	2.3	1.3	5.8
Environment configuration between environments (Dev, QA, Stage, Production)	7.3	1.0	29.0	6.9	1.5	41.6
Port Management	1.2	1.0	1.2	1.6	1.0	1.6
Session Management / Failover	1.0	1.0	1.0	1.3	1.5	1.9
App Server Backup/Recovery	5.3	1.0	5.3	5.7	1.0	5.7
Cluster management	2.3	1.0	2.3	3.0	1.5	4.4
Database management	2.1	1.0	4.2	1.8	1.5	5.3
Restarting server in a failover environment	0.8	1.0	15.5	0.9	1.5	26.0
Distribution of management data (status, problems, resolutions) across team of admins	2.8	1.0	11.0	3.0	1.5	18.0
Business Transaction Tracking	28.3	1.0	170.0	25.0	1.5	225.0
Total	248.4			342.6		

Management Activities: In-Memory Grid

	<i>Coherence</i>			<i>ExtremeScale</i>		
Activity	Avg Time (Total)	Skill Factor	Skill-adjusted effort	Avg Time (Total)	Skill Factor	Skill-adjusted effort
Upgrade(s)	0.7	0.5	0.7	0.8	1.5	2.4
Patching	0.7	0.5	0.7	0.8	1.5	2.4
Persistence to Database	0.8	1.5	1.3	0.8	1.5	1.3
Partitioning Data	33.3	1.0	133.3	35.3	1.5	212.0
Indexing data for client access	1.0	1.0	12.0	1.0	1.5	18.0
Total			148.0			567.6

Monitoring, Diagnostics, and Tuning Activities

	<i>Oracle WebLogic</i>			<i>IBM WebSphere</i>		
Activity	Avg Time (Total)	Skill Factor	Skill-adjusted effort	Avg Time (Total)	Skill Factor	Skill-adjusted effort
Data source connection pool tuning	2.2	1.0	26.7	2.8	1.5	49.5
Monitoring performance of the application server environment	7.0	1.0	84.8	6.8	1.5	121.5
Monitoring performance of the application's real end user experience	8.5	1.1	108.1	8.5	1.5	153.0
Diagnosing performance problems and determining where the performance bottleneck lies (i.e., App Server, Database, Network)	9.8	1.0	121.7	7.0	1.5	126.0
Ensuring service levels are being satisfied	3.3	1.0	39.0	3.0	1.5	54.0
Determining trends or establishing base lines in performance levels based on historical performance Data	3.0	1.1	6.3	2.5	1.5	7.5
Configuring tool to receive alert notifications (e-mail, pager)	2.3	1.0	27.0	2.5	1.5	45.0
Total			413.6			556.5

Monitoring, Diagnostics, and Tuning Activities – Coherence/ExtremeScale

Activity	Coherence			ExtremeScale		
	Avg Time (Total)	Skill Factor	Skill-adjusted effort	Avg Time (Total)	Skill Factor	Skill-adjusted effort
Data source connection pool tuning	2.0	1.0	4.0	3.3	1.5	10.0
Monitoring performance of the cluster nodes	5.3	1.0	64.6	7.4	1.5	133.2
Ensuring service levels are being satisfied	3.3	1.0	9.5	6.4	1.5	28.8
Determining trends or establishing base lines in performance levels based on historical performance Data	4.3	1.1	9.1	6.3	1.5	19.0
Configuring tool to receive alert notifications (e-mail, pager)	4.0	1.0	48.0	3.7	1.5	66.0
Total			135.2			257.0