

J2EE PLATFORM: A SINGLE, UNIFIED STANDARD FOR e-BUSINESS APPLICATION INTEGRATION

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ABSTRACT

This research tests the hypothesis "Java 2 Enterprise Edition (J2EE) platform provides a single, unified standard for e-business application integration", theoretically and empirically. Theoretical examination reveals how the J2EE technologies, such as EJB, Java Servlet, JSP, RMI-IIOP, JMS, JTA/JTS, Java IDL/CORBA, JDBC, JNDI, Java Mail, Java-XML, and JCA, enable companies to eliminate their endless struggle for connecting heterogeneous system. For this empirical study, questionnaires were sent nationally and internationally to 120 IT professionals representing various companies. Their responses were analyzed critically in terms of strengths and weaknesses of the J2EE platform. This research tests statistically the hypothesis in question based on the participant's experience in the J2EE. From these theoretical and empirical evaluations, this research concludes that the J2EE platform provides a single, unified standard for successful end-to-end e-business application integration.

INTRODUCTION

If a company is to be successful in its e-business strategy, there must be an integration of its new web-based applications across the network, connecting n-tier client/server systems within the same company and between companies. Application developers have struggled with the integration complexity for a long time. Enterprise Information Systems (EIS) and other vendors have provided their own proprietary interfaces at various levels to minimize integration complexity. Unfortunately, there existed no previous industry standard infrastructure for communicating between disparate systems. Presently, Sun Microsystems and its Java Community Process (JCP) partners are providing an industry standard, called Java 2 Enterprise Edition (J2EE) platform, to solve the integration problem. The objective of this study is to evaluate the effectiveness of the J2EE platform in providing an end-to-end e-business application integration.

RESEARCH METHOD

The hypothesis of this study is "J2EE platform provides a single, unified standard for e-business application integration". This research tests the hypothesis theoretically and empirically. Theoretically, it evaluates the effectiveness of the J2EE platform in providing e-business application integration, by analyzing its technologies. Through a survey, this study empirically evaluates how different companies utilize the J2EE platform for an end-to-end e-business integration solution. Data for this research was collected from companies in the Pittsburgh area along with a few Fortune 500 companies including select businesses in India and Japan. 120 IT professionals representing these national and international companies were contacted and asked to complete questionnaires regarding

the strengths and weaknesses of the J2EE platform. Their responses were evaluated critically. This research conducts a binomial test on the hypothesis in question based on the experience of the survey-respondents. From these theoretical and empirical evaluations, conclusions are derived about the effectiveness of the J2EE platform in providing an end-to-end e-business application integration solution.

THEORETICAL EVALUATION OF THE EFFECTIVENESS OF THE J2EE

J2EE platform and its implementation: J2EE platform (Cattel, 2001) is a single, unified industry standard to support development, deployment and management of distributed transactional applications in the context of middleware containers. J2EE is not merely a Java programming language. It also includes a set of services consisting of technologies, and a set of programming application interfaces (APIs) which support an end-to-end e-business solution. The J2EE also supports the Internet protocols, such as the HTTP, TCP/IP, and SSL. Noteworthy J2EE technologies (Gould, 2000) and their services toward e-business application integration are summarized in Table 1.

Table 1: J2EE technologies and their services	
J2EE Technologies	Service
Enterprise Java Beans (EJB)	Provides automatic support for middleware services
Java Servlet/ Java Server Page (JSP)	Links web-server to the thin-client front ends, and back-end systems
Remote Method Invocation- Internet Inter ORB Protocol (RMI-IIOP)	Integrates one Java application with another Java or non-Java application
Java Messaging System (JMS)	Supports asynchronous messaging of business data across the enterprise network
Java Mail	Provides an access to Java Mail Server
Java Transaction Architecture (JTA) / Java Transaction Service (JTS)	Provides support for distributed transactions
Java IDL / CORBA	Integrates new applications with legacy systems through CORBA interface
Java Naming and Directory Interface (JNDI)	Provides connectivity to heterogeneous enterprise naming and directory services
Java Database Connectivity (JDBC)	Supports uniform access to a variety of relational databases
Java-e-Xtensible Markup Language (Java-XML)	Supports the transfer of formatted data between applications or servers, and between businesses
Java Connector Architecture (JCA)	Integrates J2EE platform with existing Enterprise Information Systems (EIS)

Each of the above technologies contributes a certain functionality to the e-business integration solution and all technologies together provide an end-to-end e-business applications integration (Linthicum, 2001). So it is a single, unified standard.

SURVEY AND THE RESULTS

Types of participants: The participants represented in this research are information technology professionals. 120 questionnaires were mailed/mailed to IT professionals of companies in different countries. Thirty-four (28%) companies responded. All participants currently use the J2EE platform, and seven of them use the Microsoft.NET platform in addition to the J2EE platform. The types of companies represented in the survey are listed below in Table 2.

Type of Company	# of Responses	% of Responses
Computer Service	14	41%
Finance	6	17%
Consulting Service	4	12%
Transportation	4	12%
Manufacturing	3	9%
Other	3	9%

"Other" in this table includes e-shopping, media-service, and health-care.

Importance of e-business application integration: All participants responded stating that enterprise application integration is critical to the success of their companies, and 87% of the participants indicated that B2B application integration is critical to the functioning of their companies.

J2EE platform and application servers: The participants in this research use multi-tier client/server systems. Their client tier communicates with the web servers and application server through HTTP (31 responses), RMI-IIOP (7 responses), XML/ HTTP (19 responses). The survey-participants use different application servers to suit their needs as presented in Table 3.

Application Servers	J2EE Implementationstatus	# of Responses	% of Responses
BEA WebLogic	Full Implementation	15	44%
IBM WebSphere	Full Implementation	7	21%
Sun iPlanet	Full Implementation	5	15%
Pramati 3.0	Full Implementation	3	9%
Other	Full and partial Implementation	4	12%

"Other" in this table includes JBoss, Secant Extreme Server, Sun's Reference Implementation, and Borland AppServer. Secant Extreme Server is having only a partial implementation of the J2EE currently, but soon it will fully implement the J2EE standard.

Enterprise Application Integration: The main problems that the companies experience in enterprise application integration are a) connecting heterogeneous clients/servers (17 responses), b) connecting heterogeneous back-end systems (29 responses), c) connecting legacy applications written other than in Java (24 responses), d) connecting non-relational database (14 responses), e) connecting mainframe transaction Systems (14 responses), f) building applications quickly and efficiently (33 responses). Though the companies are using all of the J2EE technologies to solve these problems, the most commonly used technologies are listed in Table 4:

Technologies	Number of Responses		
	Priority 1	Priority 2	Priority 3
EJB	8	7	5
JDBC	5	5	3
Java-XML	9	7	7
Servlets	4	4	7
JCA	8	7	8
Other	-	4	4

"Other" in Table 4 includes RMI-IIOP, JMS, Java Mail, and JTA.

Three points are assigned to the first priority, two points to the second, and one point to the third. The total points for each technology are calculated through the multiplication of each response by the number of priority points. Java-XML (48 points) takes first place. The JCA (46 points) follows it at second place even though only 23 survey participants use it. As time progresses, JCA, Java-XML, and EJB will be playing an important role in the enterprise application integration.

B2B application integration: 87% of the participants in this survey face the problem of maintaining a high degree of inter-operability between their applications and the businesses with which they collaborate. 23 (69%) of the participants use Java-XML for B2B application integration. In addition to it, these participants use one or more web services. 6 (18) utilize B2B integration brokers. The most commonly used web service is SOAP (84% of respondents). 24 respondents consider J2EE's capability to bring Java applications from server to mobile devices not sufficient at present. However, Sun is expanding its capabilities to reach out mobile devices, such as cell phone, and PDA.

Current weaknesses of the J2EE: One limitation of the J2EE is associated with JMS and security. 30 (90%) participants desire tighter integration between JMS and security. 24 (72%) require more capabilities of monitoring the delivery of messages. Another limitation is concerned with the Java Connector Architecture. All 23 respondents using the JCA agreed upon its limitations, such as the lack of bi-directional communication, lack of support for asynchronous

transaction, lack of support for metadata, and lack of built-in support for XML. Sun has already planned to correct these limitations in the JCA Version 2.0.

Statistical testing of the hypothesis: Based on their experience, the survey-participants rated the hypothesis that "J2EE platform provides a single, unified standard for e-business application integration". Three respondents(9%) strongly agreed; nineteen (56%) agreed; eleven (32%) moderately agreed; and one (3%) of them abstained. No one disagreed with the hypothesis.

Assuming that if $p > 0.5$, the hypothesis is accepted, a binomial test is conducted. The two groups, such as "agree" and "strongly agree" are combined into one, which determines probability of success; and the "moderately agree" group determines the probability of failure. The binomial test results in accepting the hypothesis at a 96% confidence level.

Comparison of the J2EE and Microsoft. NET: The J2EE is a standard while Microsoft. NET is product suite. Both have features that allow companies to accelerate rapid application development, and thereby, to decrease time-to-market. Each possesses its own unique advantages over the other, such as portability of the J2EE, and language neutrality of the Microsoft. NET. In this research survey, 23 participants use the JCA. Others will be using it soon or are waiting for the upcoming JCA Version 2.0. From the 23 respondents using the JCA, 22 (96%) rated it as superior to Microsoft.NET tools for e-business integration solution. On the whole, 33 (97%) favored J2EE technologies "better than" Microsoft.NET in providing e-business application integration.

CONCLUSION

Theoretically, the J2EE is capable of eliminating the long time struggle, which companies experience in bridging the gap between the heterogeneous systems. Empirically, the binomial test reveals the acceptance of the hypothesis - "J2EE platform provides a single, unified standard for e-business application integration" - at a 96% confidence level. The results also indicate that the J2EE needs to be improved with additional capabilities. While comparing the J2EE with the Microsoft.NET platform, this research discovered that 97% of the survey respondents consider the J2EE platform as better than the Microsoft.NET platform for providing e-business application integration. From these theoretical and empirical evaluations resulting in recommendatory support for the hypothesis, this research arrives at a conclusion that the J2EE platform provides a single, unified standard for e-business application integration.

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