Chapter VII
Trends of Web Services Adoption: A Synthesis

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ABSTRACT

The technology of Web services (WS) has been a hot area in the software industry for many years. Many organizations in the past 5 years have conducted surveys designed to get a profile of the state of Web services adoption in various subject areas. Some of those survey results are available free from the Internet. Since conducting a large scale Web services survey takes time and significant financial commitment, the research conducted in this chapter is a synthesis from published free survey results. All sources of surveys indicate Web services are being adopted more or less in all mid-size to large organizations because of realized benefits, and are anticipated to become a viable component of information systems infrastructure. Some of the current issues in Web services adoption and implementation are standards, training, and security.

INTRODUCTION

For software components to be reusable across different architectural environments new standards of integration and interoperability have been proposed and developed. The maturation of the Internet and the World Wide Web accelerates the idea for the global distributed computing. In order to make a large number of heterogeneous application systems on the Internet interoperable, many standards have been produced and practiced, for example, CORBA, COM, DCOM, and Java/RMI initiatives. Common object request broker architecture (CORBA) is a specification defined by the Object Management Group, DCOM is an extended version of COM of Microsoft’s distributed common object model, and Java/RMI is the remote method invocation mechanism. However, these
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Technologies are not compatible and are difficult to use. The success of these standards is rated as marginal (Chung, Lin, & Mathieu, 2003).

A recent approach to tackle the interoperability problem is XML-based Web services, or simply Web services (WS) (Alonso, Casati, Kuno, & Machiraju, 2004). The definition of Web services as offered by W3C (w3.org) is: “A Web service is a software application identified by a URI, whose interfaces and binding are capable of being defined, described and discovered by XML artifacts and supports direct interactions with other software applications using XML based messages via internet-based protocols.” This approach uses Web standards of HTTP, URLs, and XML as the lingua franca for information and data encoding for platform independence. Three XML-based protocols, one for communication, one for service description, and one for service discovery have become de facto standards. They are:

- The simple object access protocol (SOAP) provides a message format for communication among Web services.
- The Web services description language (WSDL) describes how to access Web services.
- The universal description, discovery, and integration (UDDI) provides a registry of Web services descriptions.

Additional standards that are essential for applications of Web services have been developed. Two major standards under the category of “Web services composition” are

the business process execution language for Web services (BPEL4WS) (Fischer, 2002), later called business process execution language (BPEL), and another competing standard called the business process modeling language (BPML) developed by the Business Process Management Initiative (BPMI, www.bpmi.org). Programming tools are now available for creating and composing Web services. For example, BPEL4WS has been incorporated in Microsoft’s ASP.Net and BPML has been incorporated in Java.

Solid Foundations in Web Services

It is obvious that Web services technology could be the catalyst for a potential revolution in providing “services” within a company and on the Internet, and its impact might be paramount. Web services are not only a key development area of the software industry in languages, tools, and standards, but also are very active in research both in industry and academic institutions (Zhao & Cheng, 2005). Because the platform of Web services is designed to allow complex composition of a new service from arbitrary (at least in theory) number of services, thus an important challenge is how to correctly describe, compose, and verify them. Many popular modeling languages for Web services such as BPEL4WS and BPML have theoretical underpinnings using Petri Nets (Petri, 1962) and Pi calculus (Milner, 1999). For example, Smith and Fingar (2003) claim that the conceptual representation and execution of business processes of BPML is based on Pi calculus.

Web Services and SOA

The concept and framework of Web services bring about a new level of abstraction over object- and component-oriented software development. This new level of abstraction is referred to as service oriented architecture (SOA) which is not tied to a specific technology. The Organization for the Advancement of Structured Information Standards (OASIS, www.oasis-open.org) defines SOA as “a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains. It provides a uniform means to offer, discover, interact with and use capabilities to produce desired effects consistent with measurable preconditions and expectations.” A simpler definition of SOA is: “A
standards-based approach to managing services made available by different software packages for reuse and reconfiguration” (Austvold & Carter, 2005). Any SOA architecture requires defined standards for services to be interoperable on the Internet or any other network independent of the underlying platform and programming language (Hamid, Nezhad, Benatallah, Casati, & Toumani, 2006). Lewis, Morris, Simanta, and Wrage (2007) point out that “SOA is an architectural pattern/style/paradigm and not the architecture of the system itself; SOA-based systems are about more than just technology; and SOA cannot be bought off-the shelf.” SOA can be implemented using Web services technologies, but it does not require the use of Web services technologies. Currently, Web services are becoming the technology of choice for realizing SOA. Since SOA is a broader concept than Web services, recent surveys have extended the core concerns in Web services to SOA planning and development.

Business Processes and SOA

Business process management (BPM) is a very popular topic in the software industry, business sector, and research communities today. Its importance is highlighted by the “reengineering” era of the 90s and the book Reengineering the Corporation by Michael Hammer and James Champy. They call for conducting analyses of all critical business processes of an organization because of potential existence of opportunities for making dramatic (not minor) improvements in operational effectiveness and efficiencies. Consequently, analysis, design, and construction of business process tools are needed. Since core business processes have strategic implications, being able to continuously make changes, designs, modifications, or even create new ones in short notice is a very desirable feature of the IT environment. Orchestration and choreograph languages for Web services and SOA are well suited to such an agile requirement.

Under the framework of Web services, the software industry has developed companion products using a graphical modeling approach for business process designs. For example, BPMI (www.bpmi.org) has developed a standard business process modeling notation (BPMN). It consists of a small set of readily understandable graphical notations for the designing of business processes and is convertible to BPML and BPEL4WS. Such products could raise the productivity and agility of IT and business analysts to a higher level.

Source of Survey Results and Interpretations

From trade magazines to professional journals, one could sense that the IT industry and end users have immense interest in learning the paces of adoption, benefits, and drawbacks of Web services and SOA. Unfortunately, the authors are unable to find an academic journal grade survey research article in this area. The research is based on survey results published on the Internet and aims to understand what the market trend looks like and reasons for adopting or not adopting such technologies. From the year 2001 to 2004, surveys conducted are limited to the subject of Web services, but beginning 2005, many surveys shift from Web services to a broader context of SOA. A reason could be that Web services adoption has reached to the mainstream among medium to large companies and the IT industry wants to emphasize more broader and fundamental issues underlying service oriented infrastructure. In analyzing free survey results, two difficulties among many others surfaced: 1) lack of clear definition of terms used and 2) numerical values are not additive. Due to the vastness of the Internet, it is inevitable that the research has overlooked some published surveys and therefore the article does not represent a total complete investigation. Nevertheless, the conclusions drawn from the synthesis of collected publications should shed new light in the use of publicly available surveys.
OBJECTIVES OF STUDY

The study intends to find some evidence of how companies/organizations motivate, adapt, apply, and benefit under the new paradigm of WS/SOA with an expectation that such findings would be useful addition to their own experience. The objectives can be simply explained in the diagram below. There are four primary target areas of interest:

1. Business applications - to get an understanding of the role of WS/SOA applications development.
2. People – to collect data on WS/SOA skill levels, acceptance, and support.
3. Technology – to identify what programming languages, tools, and standards used.
4. Organization – to learn the basic demographic organizational data, management commitment, policies, and so forth.

In order to find information in the four areas stated above, it is important to define what information is of interest for collection before conducting the study. Below are some examples of questions of interests.

- Find out whether companies are ready to adopt Web services/SOA, and if so, with what timeframe.
- Find out what kind of Web Services/SOA will emerge, and how they will be distributed (payable or not).
- Find out about choices in terms of technologies and solutions.
- Identify the main technological drivers and threats.
- Identify attitudes and concerns of developers in their development efforts in the Web services.
- Where would Web services/SOA be generating values for business?
- How much interest existed in applying WS/SOA to the supply chain operations?
- Readiness in using WS/SOA. What steps are taken to build a company’s WS/SOA capability?
- Internet-based procurement
- About future uses of and barriers to Internet-based e-commerce activities.

Due to the limitations of available data, it is difficult to find adequate answers to some of these questions, with the “organization” category

Figure 1.
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in particular. Nevertheless, published data do provide information to certain vital questions of interest. These areas are presented in the following sections.

REVIEW OF PUBLISHED SURVEYS

The name of Web services was first mentioned by Bill Gates in July, 2000 (Levitt, 2001). Beginning in the year 2001, surveys conducted reveal some aspects of Web services adoption characteristics. In this chapter, the concept of “adoption” is defined as any combination of the actions such as using, building, testing, implementing, and/or deploying. For each year an estimated mean adoption rate is calculated which is based on the average of the adoption rates found from that year’s published surveys.

It is important to keep in mind that the study does not use all surveys conducted in the past because they are either not easily available or they require huge fees for access. This study uses data primarily published on the Internet and accessible to the public. The form of the free survey results that are available are often contained in a briefing or in a summery style of news release, not a complete report. This form of data is usually the result of data analysis, not the raw data, thus has limitations for interpretation. However, the data do carry useful information and have value when they are used collectively.

Some WS survey data are available in the year 2000; for example, Evens Data Corporation reports 42% of the large companies surveyed started working on WS standards. For what follows, this report will compile survey results annually beginning from the year 2001. Unfortunately, the context of each survey is not the same from year to year, thus it causes follow-up difficulties. At any rate, an assessment of the mean WS adoption rate is determined using the average adoption rate reported in that year.

2001 Surveys

Two well-documented survey reports available from the Internet are published by TechMetrix Research (2001, 2002). In 2001, TechMetrix Research conducted a survey titled “Web Services Adoption & Technology Choices” among the subscribers of TechMetrix/SQLI’s TrendMark- ers newsletters. A key finding is that “28% of companies claim to have already started using/ building Web Services”. The responses come from various countries of the world. The survey contains information such as company size, geographical distribution, job title, and industry type. The aims of the study are to find out the readiness of Web services adoption, what kind of Web services will emerge, the main drivers and threats, and technology choices and solutions. This chapter only uses portions of data from these surveys. A survey by Evans Data Corporation (EDC) finds 80% are already incorporating the leading Web services standards (i.e., XML, WSDL, SOAP, and UDDI) into applications. The key point learned from the survey is that 2001 is a year of companies showing evidence of significant interest in experimenting and believing in the potential of the new paradigm of Web services.

2002 Surveys

An interesting finding is that WS adoption rate may be very much dependent upon the software vendor’s product. An example is a survey conducted among the users of Borland Software during its user conference which indicates that an unprecedented 80% of respondents are either currently using Web services or are planning to use them in the very near future. Borland customers are using Web services across many industries, but of those surveyed, a surprising 24% are in healthcare, 14% are in finance, and 14% are in government. Unfortunately the report cannot differentiate the percentage of the adopted from
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those of the planned. In another report, IDC has estimated that just 5% of U.S. businesses in 2002 had completed a Web services project. This 5% will not be used for the average adoption rate because it only concerns completed Web services. Evans Data Corp. survey reveals in its summer 2002 Enterprise Development Management Issues Survey that 75% of the companies are incorporating some level of WS functionality into their applications.

Fontana (2002) quotes the result from the Hurwitz Group’s Web Services Primary Research Opportunity Study, which is based on a polling of 300 IT professionals, that 45% of companies are implementing Web services, while another 36% are testing the technology. When the two percentages are added it equals 81%. The results also show that 47% are using Web services for internal integration projects and 25% for external integration projects.

From the same survey conducted by Tech-Metrix Research in 2001, which was rerun in 2002/2003, the percentage of already started Web services projects stays around 27%. A survey of CIOs by BEA Systems (Hayday, 2002) in Europe shows 54% of European companies adopted Web services, and 59% expect benefits.

2003 Surveys

According to Mimoso (2004a), of 273 Global 1000 companies surveyed recently by Westbridge Technology, 37% are currently using Web services in production, and 26% plan either to deploy a Web service within 6 months or to complete a proof of concept (a combined adoption rate of 63%). Of those using Web services, 70% are using them internally, while 48% are exposing them to the Internet for business-to-business transactions. Gartner Dataquest (2003) released the results of several surveys on North American enterprises’ adoption of Web services and the analysis showed that virtually all the respondents were using some form of Web services or plan to do so within the next 12 months.

In a survey conducted by IDC (2004), it shows about 61% of government organizations (central/local) are already using Web services. The estimated average WS adoption rate (of 63% and 61%) in this period is 62%.

2004 Surveys

A Gartner survey of 110 companies indicates that 54% are already working on Web services projects or plan to begin such projects this year (Leavitt, 2004). It is interesting that 34% of developers indicate that they are deploying Web services applications to their users (Evens Data Corporation, 2004), which is a 7% increase from fall of 2003. In a survey of 280 large North American firms by Forrester Research (Leavitt, 2004) 66 (23%) respondents said their Web services were either in production or in development. Yankee Group surveyed more than 400 enterprise IT decision makers in 2004 Enterprise Web Services Survey 48% of those surveyed have Web services in production, 39% say plan to join them within the next 12 months. If it is assumed that by the year end half of the 39% has successfully put WS in production then Yankee’s survey could mean a 67.5% WS adoption rate.

The Radicati Group said in a report entitled “Web Services Market 2004-2008” that 52% of Web services deployments have occurred in the United States, with the rest of the world accounting for the remaining 48%; Europe accounts for 39% of all deployments this year, followed by Asia Pacific with 6% and the rest of the world with 3%.

2005 Surveys

WebMethods (2005) reported that SOAs and Web services are catching on with global 2000 companies. From the responses of 480 survey
respondents, more than 80% of respondents deploy Web services within their enterprises. In one IDG study, 28% of respondents stated that their companies are implementing SOA. A Forrest Research survey of large North American companies reported that more than 70% of respondents have already implemented SOA. Austvold and Carter (2005) of AMR Research state that 21% of their survey respondents have deployed SOA and 33% plan to implement it within a year. Using the AR survey data it is projected that the adoption rate for SOA is around 36.5% (sum of 21% and 16.5%). The survey by AMR is from 134 companies with at least 1,000 employees. The main anticipated benefit of adopting SOA from the respondents is “faster and more flexible reconfiguration of business process.”

The Information Week (Babcock, 2005) survey reveals reasons for adoption and difficulties during the adoption in two questions:

1. What is your company’s business case for adopting an SOA or Web services standards? Top five responses are: standardization (60%), business process automation (59%), business flexibility (52%), operational savings (48%), and better integration with business partners (43%).

2. If your adoption has fallen short of expectations, which of the following reasons best describes why? Top three responses are: Legacy systems could not be cost-effectively integrated (50%), cost more than expected (33%), and introduced more complexity into IT system (36%).

Vahidy’s (2005) survey report finds how most components of SOA were used in actual deployments; two items relevant to this chapter are: Web services (71%) and BPM framework (14%). The survey also finds most companies (57%) have standardized on Web services as an SOA component.

### Predicting Investments in SOA

As discussed in the beginning, SOA is getting more attention as it is more general than WS. But Web services are one of the major implementations of SOA today, which means the two are closely related. Surveys for the future direction of SOAs conducted by Yakee Group of Boston in 2004 and 2005 reveal the following:

1. Projections in 2005 (Mimoso, 2004b). Seventy-five percent plan on investing in the technology and staffing necessary to enable a service-oriented architecture. By industry, the greatest investments in SOA are coming from the wireless telecom and manufacturing markets (78%), financial services (77%), and healthcare (71%).

2. Projections in 2006 (Stansberry, 2005). The surge of SOA implementation in 2006 reaches saturation in many verticals: wireless (93%), retail (92%), financial (89%), manufacturing (76%), and government (75%).

However, a 2005 IDG Research Services Group survey reveals that SOA is not a well understood concept by the IT professionals because the survey finds an almost even split between people who claim some familiarity with SOA (52%) and those who admit they have not a clue (48%). In that same IDG study, 28% of respondents stated that their companies are implementing SOA, with about half of those SOA implementers merely conducting pilot projects.

### 2006 Surveys

A surprisingly good piece of complete SOA survey results conducted by eBizQ (2006) is published free on the Internet. The survey was conducted online on the eBizQ Web site and received responses from 313 companies in 21 industries. The
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top-five industries were technology, financial/banking, public sector/government, insurance, and healthcare/pharmaceutical. Key findings of the SOA survey are as follows:

1. In the four stages of SOA adoption the respondents are distributed as: exploration (34%), planning (17%), pilot (21%), and deployed (28%). If exploration rate is excluded, the adoption rate is 66%.

2. The distribution of number of Web services in production is: 0-10 (49%), 10-50 (31%), 50-100 (8%), and more than 100 (12%);

3. The majority of services (59%) deployed are for internal use. The industries offers of higher external availability of services are technology, financial/banking, and public sector/government. The survey also contains information on SOA governance issues.

In Gartner’s (2006) survey of telecommunication carriers on SOA the adoption rate by that industry is at 90%.

A survey conducted by CodeFutures (2006) from 5000 U.S. and European Java developers reveals the following, based on a 10% response rate:

1. 76% of enterprises using Java are using or SOA.

2. Over 30% have scalability problems and 56% have performance problems due to bottlenecks.

3. The vast majority of Java developers surveyed believe they have high performance requirements.

4. About one third of the Java developers surveyed had groups using C++ as well, and Web services technology is still relevant for C++ development.

Surveys sponsored by Mindreef Inc. (2006) in September and October of 2006, conducted by Hurwitz & Associates, found 99 IT executives from companies in North America and the UK with a size greater than 250 employees who had

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expressed an interest in SOA or Web services. Approximately two-thirds of respondents surveyed (66%) had begun their SOA journey.

Following is a table summarizing the WS/SOA adoption rates from year 2001 to 2006. A mean score is calculated for each year as the estimated adoption rate. Note that the last 2 years adoption rates are focused on the SOA.

**BENEFITS AND THREATS**

Published surveys also have revealed information on motivations and reasons for nonadoption of Web services and SOA. Their findings seem quite consistent across different surveys. They are summarized in two categories: benefits and technical drivers, and threats.

**Benefits and Technical Drivers**

- Standards compliance and interoperability.
- Business agility and business process optimization.
- Scalability.
- Tools for development productivity.
- Tools for administration.
- Reuse services.
- Lower integration costs.
- Faster delivery of products.
- Making application development more flexible.
- Increase customer satisfaction and revenue.
- Important to business goals.
- Mainframe modernization.
- They reduce the burden of internal and external integration.
- They allow for true reusability.
- They are a platform-independent facilitator, enabling data to flow across applications and systems.
- They break down internal silos by providing information across traditional technological barriers.
- Web services extend the life of legacy systems by extracting specific business processes, such as licensing and appointment and quoting, and making them available in new forms.

**Threats**

- Security and authentication issues.
- Interoperability issues (e.g., noncompliant SOAP implementations).
- Lack of standard business schemas.
- Service level agreement of WS providers.
- Lack of awareness in the business.
- Developing effective ROI cases.
- Standards compliance and interoperability.
- Scalability.
- Tools for development productivity.
- Tools for administration.
- General knowledge of SOA within their enterprise.
- Governing development standards within their enterprise.
- Determining return on investment for SOA development and deployment efforts.
- Getting organizational buy-in.

**CONCLUSION**

Publicly available and free survey results on the adoption of WS and SOA are available in limited ways in that they either are contained in news releases or in reports. Even though the data are limited they still contain valuable information. One can conclude that Web services/SOA technology is now becoming critical and has widespread acceptance, even though the technology development is not entirely complete. WS and SOA are
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being recognized as generating benefits because the technology provides a platform for making the business process agile and optimized. A simple example of using the mean yearly WS adoption rate reported above can show trends. In the years 2001 to 2006, the percentages of major companies or organizations started projects of some kind involving WS/SOA are 54%, 66%, 62%, 48%, 62%, and 75%. The first four percentages are WS adoption rates and the latter two are SOA adoption rates. Roughly between 2001 and 2005, about half of the U.S. businesses were using WS. Apparently the adoption rate is on the rise in WS and SOA. In fact, the same phenomenon is true in Europe. Beginning in 2006, more companies have entered into SOA, and SOA is the center of attention among IT developers. It is safe to conclude that WS/SOA are in the mainstream or a pacing technology of the technology lifecycle. Another conclusion could be drawn is that Web services are primarily used internally within an organization; external use of Web services is rather limited. Further, more the data reviewed have information on “what motivates or deters the users from using Web services.” That information is useful not only to managers and end users but also to IT vendors. Language-wise, Java and Microsoft.net are used by an equal number of SOA developers. Other information contained in the survey but not extracted here are technologies used, governance policies, industry group differences, and so forth.

In reading the published surveys, some questionnaire designs and interpretations are vague. For example, Austvold and Carter (2005) of AMR Research report does not make it clear whether WS is considered as a part or subset of SOA. Another issue is when a company may be declared as an adopter of WS/SOA. It is obvious that this research must be continued in order to answer the research objectives set forth in the early part of this chapter.

REFERENCES


