Three "Hot" Emerging Technologies: What They Are, and What They Mean for IS Education

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Abstract

In the IS 2002 model curriculum, course IS2002.9 is entitled "Physical Design and Implementation in Emerging Environments." As academics who have worked in a high-tech environments periodically for several years, we have experienced first-hand the disconnect that exists between IS education and practice. This paper looks at some of the "hot" issues emerging in industry and what that means to IT education. The article starts with a general discussion of the current trends in the field of IS, and then discusses the "buzz" surrounding "hot" technologies. The article then describes some studies and a theory associated with "buzz" and takes the view that not all "buzz" is negative. Then the article lists three "hot" emerging technologies, and discusses them in detail. Finally the article discusses the ramifications of these new emerging technologies within the context of the IS curriculum.

KEYWORDS: emerging technologies, IT buzzwords, P2P computing, grid, web service, IS curriculum, IS2002.9

1. INTRODUCTION: BACKGROUND AND MOTIVATION

It is fair to say that the field of Information Systems (IS) is growing and changing everyday. There are new concepts (complete with new "buzzwords"), new techniques, new approaches, and new systems. IS educators are faced with the task of introducing these to students and offering courses in them. In particular, in the recently announced IS 2002 Model Curriculum, the IS2002.9 course has a suggested title of "Physical Design and Implementation in Emerging Environments." Faculty members who offer courses in emerging areas of IS face the challenge of keeping abreast of the latest developments and technologies. There is also the unspoken, but recognized "discomfort" about whether the teaching materials and curricula coincide with the requirements of the real world. A question often in the minds of academics is: "Is there a disconnect that exists between academia and the industry when it comes to IS education versus practice?"

This paper considers the questions of "what is out there, why are they important, what is coming down the road, and what IS educators can do about this?" While the authors suggest three technologies, they realize that there are many emerging technologies that could be include in the IS2002.9 course. We suggest this organizing vision: *Information Systems Of the future are going to be massively distributed, collaborative systems.*

2. CURRENT TRENDS IN IS

With the IS2002.9 course in Emerging Environments, academics must decide what "emerging environments" to include. While there are many possibilities, we suggest that the following topics are worthy of study and could be included in the course:

- Peer-to-peer (P2P)

- Web Services and Business to Business (B2B)
- Grid Computing.

One of the most notable technological developments in computing over the last two decades has been the emergence of computer networks and distributed computing. This has undoubtedly led to the emergence, growth and adoption of the Internet. Today the Internet, as well as the associated Intranet and Extranet technologies has exponentially grown into a massive engine that drives the flow of commerce, information and communication globally. The developments in computer science have had ramifications in the field of information systems management, causing certain important trends to appear in the practice of information systems:

- IS architecture: The overall architecture of information systems has gradually moved from a "centralized" to a client-server based architecture over the last decade. More recently, completely distributed architectures have emerged in corporate computing.

- IS processing locales: By "processing locales" we refer to the location in the computer network where a bulk of the processing is done. Information systems have moved from the hierarchical and centralized-processing model to massively distributed processing.

- IS applications: The most commonly used IS applications have also evolved to make use of developments in IS architectures and technologies. IS applications started out being single-user, single-process applications. From that extreme, they have progressively become more collaborative, integrated, intelligent multi-user, and massively distributed applications.

From a corporation's information systems management point of view, the following have happened:

- IS/IT architectures have relentlessly moved away from the centralized and client/server architectures to massively distributed architectures where every node on a network is both a server and a client.

- Information and data processing strategies have progressed from hierarchical processing to "randomly-distributed" collaborative processing. Some of the buzz words emerging from this trend are "edge-computing" and an "opportunistic collaboration or "free-agent" model. Here edge computing refers to "a class of applications that takes advantage of resources – storage, cycles, content, human presence – available at the edges of the Internet…" (Shirky, 2000).

- New and non-traditional paradigms and applications have emerged. Some of the most widely known are: e-commerce, mobile computing, P2P computing, grid computing and web services.

We suggest that these three topics really form our fore-stated vision that: *Information Systems of the future are going to be massively distributed, collaborative systems.*

3. IS EDUCATION

A cursory analysis of current IS curricula in several IS departments reveals that academic IS departments in universities have typically responded by offering courses in networking, web technologies (web applications design and development, web server technology, web site creation, web security, and how to create on-line businesses using combinations of these), e-commerce, e-media, etc, in addition to computer programming, data management and systems analysis. While not explicitly named the same as the IS2002.9 model curriculum course of "Physical Design and Implementation in Emerging Environments," these courses would seem to give students that insight into what is on the cutting edge of technology. While this list seems comprehensive, open questions as to the breadth, depth and technical detail remain. We believe that the most important question that IS educators should focus on should be: *How relevant is the IS education in the way it prepares students for the real world?*

To answer that, IS academic departments should continually scan current and future IS environments, identifying the most promising and relevant emerging technologies, filtering the "noise" and "hype," and framing curricula that would best prepare IS students to succeed in the real world.

Thus the main strategic questions for academic IS departments are:

- What are the observable trends in Information Technology?
- What is happening in the industry?
- What should the academe do about it?
- Which is the right trend?

Unfortunately for the IS departments, this is no easy task. The field of IS abounds with buzzwords, trends and hype. Some prominent buzzwords currently prevalent in the field of IS/IT include "Grid," "ERP," "P2P," "web services," "e-commerce," "data warehouse," "CRM," "m-commerce" and many more. These buzzwords can frequently account for the content of the IS2002.9 Emerging Technologies course.

4. THREE EMERGING TECHNOLOGIES (OR BUZZWORDS)

The organizing visions (see part 2 Current Trends in IS – above) have gone hand in hand with the emergence of three current "hot" areas in IS, namely,

- P2P computing
- B2B and web services
- Grid computing

These technologies can be considered to be mutually exclusive and can be implemented and used in that manner. However, they also overlap each other in numerous ways. The rest of this paper will explore these three technologies as a basis for an "emerging environments" course and for IS curriculum developers.

5. EMERGING TECHNOLOGY I: P2P COMPUTING

The term "P2P computing" emphasizes the shift away from centralized and client/server models of computing to a fully decentralized, distributed model of computing. During the last year and a half, the term "P2P," or "peer-to-peer" has aggressively moved towards the center-stage of the computing field. With P2P computing, the accent has shifted from storing content in, and serving from, centralized servers to storing and serving (at least some of) the content from the client-side. In this model, the content provider manages his/her content in a local client, and shares the content with anyone who is allowed to access the content. Responsibility for content creation, storage and security dwells on the client side. This has a lot of ramifications for the way in with corporate data is distributed.

There are several *advantages* to using the P2P approach to resource sharing. By shifting the responsibility for content to the client side, server-side management of diverse resources can be vastly reduced. Server managers need not be responsible for the integrity of the content. Problems arising from centralized distribution of content could be averted. The *disadvantages* include factors such as reduced security and reduced integrity of content arising from client-side mismanagement.

Making Business Sense of P2P Computing

Currently, much of the corporate data and content within "global" organizations are distributed by replicating and distributing such data and content using centralized content repositories. That is, the data is globally distributed, but made available within a location or geographical area by using a "central" server that is responsible for serving the content to clients located within the area. The advent of peer-to-peer (P2P) computing has changed this approach. The P2P approach is increasing being used within organizations as a means to rapidly distribute multi-media corporate content.

6. EMERGING TECHNOLOGY II: B2B AND WEB SERVICES

"B2B" or "business-to-business" computing has existed for more than a decade. The earlier B2B systems have relied primarily on EDI or Electronic Data Interchange, which is implemented by building dedicated "virtual" private networks between two or more interconnected organizations, such as manufac-

turers, suppliers, etc. This sort of traditional B2B has suffered from a host of problems such as incompatibility between the internal systems of the players, security issues, the lack of an easy way to add and remove players, etc. For these reasons, legacy B2B systems are very expensive to set up and operate, and never really fulfilled their promise of offering seamless interconnectibility between disparate business systems and networks.

The advent of the Web and a host of other associated technologies such as XML (Extended Markup Language) have provided a new approach to implementing B2B, by using the notion of web services.

WHAT ARE WEB SERVICES?

Clay Shirky (2002) describes web services thus: "Web Services are enterprise applications that exchange data, share tasks, and automate processes over the Internet. They are the logical successor to EDI, and their usefulness is imminent for some (though not yet all) businesses. As a new class of Internet-native applications, Web Services promise to increase interoperability, and lower the costs of software integration and data-sharing with partners. As they are based on simple and non-proprietary standards, Web Services are designed to make it possible for computer programs to communicate directly with one another and exchange data regardless of location, operating systems, or languages."

ENABLING TECHNOLOGIES

The technologies that make up web services provide a way to find, describe, and utilize remote services in an XML-based, programming language agnostic manner. There are three core technologies that make up web services: SOAP, WSDL, and UDDI.

SOAP (Simple Object Access Protocol) (W3C, 2002) is a W3C Technical Recommendation using XML formatted messages to access services on remote computers. SOAP messages are transport independent, but most often associated with HTTP.

WSDL (Web Services Description Language) (W3C, 2001) is an XML document format that describes the operations performed by a service. This includes the formats of inputs and outputs for each method, as well as the location at which the service is to be accessed.

UDDI (Universal Description, Discovery and Integration) (UDDI.ORG, 2000) is a platform-independent open framework for advertising described services. It affords search-based discovery and aids in the integration of services into other business processes. It is the phone book for services. UDDI has three main data types: technical models, services, and businesses.

A technical model (tModel) defines the contract for a service type, often using a WSDL document to supplement the UDDI (W3C, 2001). Services can implement one or more technical models. For example a model for the time of day service may define a method for *getLocalTime().* Any service registered as implementing the tModel for time of day service will have the *getLocalTime()* method. This is similar to the interface-implementation programming model. The programmer knows at design time that the methods of the interface will be available, regardless of the actual implementation.

In the web services approach, given a service type that one wishes to access, several steps must be taken to find and invoke a service implementing the service type. A service provider registers its services with the UDDI server. Service requestors access the UDDI and then request the service they need from the appropriate service provider. This XML message is sent across the network in a SOAP envelope. The envelope is received by the service provider, which unwraps it and provides the requested service. The results are repackaged in a SOAP envelope and sent back to the service requester. (Note that the 'request' and 'reply' are not restricted to work only within a particular environment, such as the HTTP environment. One can safely assume that they will work well in other environments, such as email, ftp, etc.)

7. EMERGING TECHNOLOGY III: GRID COMPUTING

The growing popularity of the Internet along with the availability of powerful computers and high-speed networks as low-cost commodity components are changing the way

we do computing. These new technologies enable the clustering of a wide variety of geographically distributed resources, such as supercomputers, storage systems, data sources, and special devices and services that can then be used as a unified resource. This new paradigm is popularly termed as "Grid" computing. The Grid is analogous to the electrical power grid and aims to couple distributed resources and offer consistent and inexpensive access to resources irrespective of their physical location.

The following are the common functions of the Grid (from Foster et al, 2001):

- Marshal resources from multiple sites to execute large applications
- Allow transparent access to data in a geographically distributed computing environment with many users working independently
- Execute applications on remote resources
- Enable widely distributed locations to collaborate on problems - either technical or business - asynchronously or synchronously
- Manage and better use spare compute cycles for low-priority applications

A computational grid allows for coordinated sharing of all computational resources such as data, files, CPU cycles, applications, etc. among a group of organizations or individuals who may come together temporarily to form what is called a "virtual organization (VO)." Members of the virtual organization have rules on access, sharing, control and maintenance of all the resources.

Foster et al (2001) give the following as examples of VOs: the application service providers, storage service providers, cycle providers, and consultants engaged by a car manufacturer to perform scenario evaluation during planning for a new factory; members of an industrial consortium bidding on a new aircraft; a crisis management team and the databases and simulation systems that they use to plan a response to an emergency situation; and members of a large, international, multiyear high energy physics collaboration.

VOs have certain common characteristics: the need for flexible sharing relationships, precise control features (policies) governing all aspects of resource sharing, accounting and maintenance.

GRID: THE BUSINESS ANGLE

Grid technologies complement rather than compete with existing distributed computing technologies. For example, enterprise distributed computing systems can use Grid technologies to achieve resource sharing across institutional boundaries. In the application service provider (ASP) and storage service provider (SSP) space, Grid technologies can be used to establish dynamic markets for computing and storage resources, hence overcoming the limitations of current static configurations.

8. CONCLUSION: WHAT DO THESE TECHNOLOGIES MEAN TO IS EDUCATION?

This concludes our description of three emerging (or buzz) technologies. As IS educators involved in the IS2002.9 Physical Design and Implementation in Emerging Environments course, we realize that there are many technologies that could be covers. We feel that these technologies are worthy of inclusion in the IS2002.9 course. We suggest this organizing vision: *Information Systems of the future are going to be massively distributed, collaborative systems.*

This paper has **not** aimed at prescribing a particular strategy that should be adopted by IS educators. Instead, the main aim of this paper is to discuss some of the emerging "hot" technologies, and then make a case that "hot" technologies should not be dismissed as mere "buzz." With the inclusion of a specific core course on emerging environments in the IS 2002 curriculum model, IS departments should be cognizant of these emerging technologies, and recognize them for what they are. It is also important to note that IS departments should not hastily re-orient their entire curricula and focus just on these technologies. It should be remembered that numerous IS departments joined

the "e-commerce" band-wagon and started programs and majors in e-commerce, only to fail due to not thinking through the "organizing vision" of e-commerce – what are its foundations, components and business reasoning.

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