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ABSTRACT

Instructors should be concerned with how to incorporate the World Wide Web into an information systems (IS) curriculum organized across three areas of knowledge: information technology, organizational and management concepts, and theory and development of systems. The Web fits broadly into the information technology component. For the Web to be included as a viable IS component for developing solutions, management information systems (MIS) related Web implementations demand a complete assessment of systems architectures and consideration of complex Web application implementation issues. Significant design related technical issues in Web development drive the analysis of hardware platforms, workstation communication, and connectivity. Specific target platform and decision topics which must be addressed by instructors and students include: (1) markup language selection; (2) protocol selection; (3) script language selection; (4) bandwidth selection; (5) platform constraints; (6) server configuration and operation; (7) page design and development; and (8) Web implementation process. A number of organizations have begun to publish standards for their systems (architectures) to ensure component integration and proper system operation. The Department of Defense has developed and published a set of rules, the Defense Information Infrastructure (DII) Common Operating Environment (COE), which is the key to achieving this integration. (AEF)

ARCHITECTURE AND THE WEB

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INTRODUCTION

Today's information systems (IS) students, the IS managers of tomorrow, are being bombarded by software advertising describing the new technologies that can be used to implement management information systems, including many creative Internet tools. However, recent results of "Curriculum 95", the findings of a joint task force of ACM, AIS-ICIS, and DPMA, don't address this new and exciting technology or the critical role it may play in the future.

Instructors must be concerned with how to incorporate the Web into an IS curricula organized across three areas of knowledge, (which the Task Force endorsed): Information Technology, Organizational and Management Concepts, and Theory and Development of Systems. The Web appears to fit broadly into the Information Technology component which includes Computer Architectures, Algorithms and Data Structures, Programming Languages, Operating Systems, Telecommunications, Database Systems, and Artificial Intelligence. Unfortunately, the Web seems touches all of these technologies simultaneously, and lacking research on the impact from this rapidly changing force, may eventually be "something more" according to the seers of the trade journals.

Members of the field who are charge with teaching about IT may be tempted to immediately dive in, and focus upon narrow techniques that utilize the Web (or tools) that may soon become obsolete. They may also tend to gloss over the Web, focusing solely upon the theoretical issues and traditional systems categories and topics so that the linkage between these theoretical issues and the technological status quo in the field is lost, with the student possibly seeing the instructor as "far behind the times" and irrelevant.

HISTORY AND THEORY

The theoretical issues addressed by the field today concern understanding the value of information, the strategic application of information within organizations, and the methods by which information systems may be constructed, maintained, and evaluated. While a consensus exists within the field about the importance of these three guiding questions, the same cannot be said about the powerful enabling information technologies (typically validated through the marketplace) that have depicted IS as a discipline continually beset by fads, each one of which in its time is proclaimed to be the latest paradigm shift, in the spirit of Thomas Kuhn. The difficulty is that the discipline has had, in fact, more than its share of genuine paradigm shifts, beginning with the shift from a batch, data processing model to an interactive, Management Information Systems (MIS) model, from a centralized, mainframe-oriented model to a decentralized, client-server model, and now to an integrated, component-based, network-oriented model.

Managers have addressed these forces (attempted to control or accommodate IT change) with organizational structures, technology, and information systems components that must have greater flexibility and more rapid payback than ever before, and in the process have as often as not neglected the longer term implications of their strategies. This appears to have caused the emerging issues in the field to be concerned with assessing the value of IS, the strategic use of flexible and adaptive IS in the management of virtual organizations, and the process of change, with special references (today) to the adoption of IT within virtual organizations.

Research evidence does not yet fully indicate how the Web relates to these organizational changes.

It does appear to support the flexible and adaptive requirements for the management of virtual organizations, and may promote an organization's ability to implement change. However, for the Web to be included as a viable IS component for developing solutions, Management Information Systems (MIS) related WWW implementations demand a complete assessment of systems architectures, and consideration of complex Web application implementation issues.

WWW MIS PLATFORM

Significant design related technical issues in WWW development drive the analysis of hardware platforms, workstation communications, and connectivity. Students must recognize that the WWW is a visual medium. Therefore, "web publishing" is fundamentally different from print publishing. Student designers must determine if special features such as data compression are to be added to WWW systems, requiring upgrades to initial systems? Will WWW MIS change the requirements for tools for network monitoring and management, lead to the retraining of network administrators, server synchronization, and server-independent namespaces? Could a WWW MIS create new or subtle differences in data storage and data translation techniques that lead to the loss of data when files are transferred from one environment to another. (Noticeable when transferring files which have been heavily formatted with special fonts and graphic images). Finally, what increased security considerations and application execution and performance concerns are presented by a WWW MIS? The specific target platform and decision topics which must be addressed by instructors and students include:

1. Markup language selection. HTML, and SGML are evolving from the printing industry. This has led to language extensions that may not be supported by different browsers. The designer must choose between developing for the lowest common denominator, using proprietary language extensions that some customers might not be able to see, or maintaining multiple versions of a product. Students (as designers) must recognize that the WWW was originally meant for the sharing of static documents but WWW applications are evolving in the direction of dynamic and multimedia presentations increasing pressures for proprietary extensions to markup languages and protocol standards.

2. Protocol selection. Misunderstanding of the relationships between the various protocols: HTTP, Gopher, and Telnet may lead to mixing protocols, such as HTTP and Gopher (when systems are being created from pre-existing parts) and increasing the complexity of maintenance and operation.

3. Script Language Selection. Scripting languages are evolving (Java, VB extensions, CGI/perl Scripts, etc.) and must be evaluated.

4. Bandwidth selection (availability determination). Necessary bandwidth for WWW MIS must be estimated. It may not be available, even if the desired level of functionality can be achieved with available programming tools.

5. Platform Constraints. Different platforms (various flavors of UNIX, Windows NT, etc.) may handle protocols differently, requiring that all file names be lower case, while other platforms may not impose this requirement.

6. Server Configuration and operation. Planning for server configuration and operation can be overlooked in favor of WWW page design. Unique support and operational concerns must be incorporated into the overall systems design.

7. Page Design and Development. It may appear to be relatively is easy to create a minimally functional WWW page. This can lead to the conclusion that all WWW based development is easy to accomplish. Formalized project management, configuration controls, testing, etc. may then be neglected in favor of ad-hoc "hobby shopping" with an end result of no final delivery of the WWW MIS.

8. WWW Implementation Process. Students must weigh the overall "opportunities" offered from WWW MIS to select or design an appropriate implementation process. WWW may be used to facilitate communication and business processes across departments and technological platforms. The WWW acts as a

toolset for developing applications to manage, measure, and revise work processes spanning multiple workers, applications, and organizations. The WWW technology may also enable units to forward forms, and minimize steps taken by users to complete work processes. One primary WWW outcome may well be to effectively to compress the time between tasks. This is the impact of new WWW systems which use data entry applications to streamline the flow of information and eliminate paper.

A typical student (planning a project or development effort) may need to consider architectural issues requiring that one select from a number of competing environments at this time. Lotus Notes provides an environment in which Web-based applications can be developed rapidly by non-technical staff with a minimum of training and guidance from IS professionals. Oracle provides an environment in which structured data can be effectively managed, which is relatively easily integrated into other operating environments, such as both Lotus Notes and the Web, and for which a relatively large number of competent IS professionals are available. Windows NT version 4.0 provides a robust platform for the deployment of Client/Server and Web-based systems, yet minimizes the system management burden present in other operating environments, such as Novel Netware and the various flavors of UNIX.

RECOMMENDED: A PROACTIVE RESPONSE

A number of organizations have now begun to publish standards for their systems (architectures) to ensure component integration and proper system operation. Techniques for measuring conformance are also required so one can determine whether or not a component is compliant with an architecture, to identify current or potential interoperability problems, and define what improvements can be made to achieve compliance. One very large organization, the DoD (Department of Defense) has recognized that an unprecedented degree of integration and interoperability is required of DoD systems, both for legacy systems and for systems that are under construction. It has developed and published the Defense Information Infrastructure (DII) Common Operating Environment (COE) is the key to achieving this vision of integration. All new Defense Information System Agency (DISA) systems are being built using the DII COE while existing DISA systems are being migrated to use the DII COE. OSD has recently issued a directives that military systems, except for weapon control systems, use the DII COE.

The DII COE is a complex set of rules (which can be used to address the inclusion of the Web and its components). Compliance is presented as eight levels of progressively deeper integration, because compliance cannot be an all or nothing proposition for legacy systems. The levels progress from a state of "peaceful coexistence" to "federation of systems" to true integration. The levels of compliance map to levels of interoperability, and that interoperability increases as the level of DII compliance increases.

The appendixes to the architectural framework contains a series of questions, in a checklist format, which are organized by compliance level. The philosophy behind this design for the compliance checklists is to begin with an agreement on a set of standards that ensure non-interference when installed on the same LAN, then non-interference when installed on the same workstation, and finally to interoperability through sharing the same software and data.

The COE is presently available for NT only on Intel-based platforms (e.g., 80x86, Pentium). The NT questions in the checklists are applicable only to that hardware environment and will be upgraded as required if NT support is made available for non-Intel platforms. The concept conveyed by the checklist items are applicable regardless of the hardware platform or operating system, but for clarity are often worded in such a way as to make the statement operating-environment-specific. The checklists are organized in such a way as to evaluate individual segments, but the compliance of individual segments can be eventually combined into a composite compliance level.

IS managers may eventually wish to organize their own compliance checklists to present their own architectural vision for an organization. Students may need to be taught how to identify and adopt compliance categories and levels, defined by an organization, that promote a

reasonable approach to migrating legacy systems into an adopted or developed COE for an organization. The Web technologies may well offer a previously unavailable opportunity to ensure that legacy systems do not destructively interfere with each other when located at the same operational site.

IMPLICATIONS FOR THE WEB

Instructors must help students deal with the Web marketing approaches which currently attempt to infiltrate users at department levels. The student must walk a fine line between the centralization that reduces flexibility and decentralization (without architecture, checklists, or standards) which can cause duplicate system deployments, and solutions that are not interoperable. Instructors may want to inoculate their students against the marketing hype which says the best way to deploy is to quickly involve the users in a content creation exercise with easy to use products. Creating a solid internet and intranet solution involves establishing a clear architectural vision, enterprise decision structures, and open standards based technologies.

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