

TECHNOLOGY INTEGRATION AND INNOVATION: A MODEL
FOR MAKING WEB-SPREADSHEET APPLICATIONS
DATABASE-EMPOWERED

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TECHNOLOGY INTEGRATION AND INNOVATION: A MODEL FOR MAKING WEB-SPREADSHEET APPLICATIONS DATABASE-EMPOWERED

Abstract

This study presents a model for designing innovative hands-on training projects that enable students to learn the processes of technology integration and innovation by developing Web-enabled, database-empowered spreadsheet applications, without requesting a budget for new hardware and software. First, a framework of the model was established based on the review of related literature. Second, the framework of the model was assessed by testing three research hypotheses in a student computer lab. The testing results indicate that instructors can design innovative hands-on training projects by integrating available and free-downloaded hardware and software. Following the approach, students are able to develop, test, and support database-empowered Web-spreadsheet applications, as well as to download, install, and manage Web servers on their PCs.

Introduction

With the fast advancement of the Internet and Web technologies, many schools experience insufficient funds for providing students with the latest hardware and software to meet their hands-on learning needs. School administrators and faculty are interested in identifying creative ways to offer the cutting-edge technology training without increasing expenses. This study proposed to develop a model for designing innovative hands-on training projects that enable students to learn the processes of technology integration and innovation by developing Web-enabled, database-empowered spreadsheet applications for corporate knowledge management and e-commerce, without requesting a budget for new hardware and software.

This model was designed to achieve four objectives: (a) to help design innovative technology training projects without increasing expenses; (b) to develop e-business applications/solutions by integrating the Internet, spreadsheet, and database technologies; (c) to ensure the projects satisfy students' hands-on learning needs in developing dynamic, interactive, data-driven Web applications; and (d) to nurture students' creative-thinking skills through these innovative hands-on training projects.

Review of the Related Literature

The Internet and Web technologies are fundamentally changing the way business is done, the way software applications and services are built and delivered, and the way people work, study, and live. Companies and consumers have been experiencing the benefits of using Web-based interactive database applications (e.g., online shopping, banking, inventory and accounts management) and Web-based, interactive spreadsheet applications (e.g., mortgage calculator, retirement planning, and budgeting tools) for increasing user convenience and productivity in data analysis, information management, problem solving, and decision making (see, for example, Charski, 2000; Kulman, 1999; Perry, 2000; Wiener, 2000).

However, without being database empowered, Web-spreadsheet applications are unable to send data and calculation results to the corporate database and to accumulate corporate knowledge assets. Such data and calculation results on corporate intranet and Internet are crucial for companies to gain the

competitive advantages in the Internet economy, as now the challenge for managers is how to capture, harness, and develop that knowledge profitably (see, for example, Daughtrey, 1998; Downes, 2000; Harrington, 1999; Stewart, 1999; Wilson & Asay, 1999; Zuckerman & Buell, 1998). This gap indicates a need for developing Web-enabled, database-empowered spreadsheet applications for corporate intranet and Internet sites, which is one of the top 10 technology trends for 2001 (Biggs, 2001).

According to the 2000-2001 Occupational Outlook Handbook (Bureau of Labor Statistics, 2000), employers in all areas manage to hire individuals who can develop and support Internet, intranets, and Web applications. Corporate recruiters expect business school graduates they hire to have Web related skills, and more business schools are offering Internet and e-commerce training (Korry, 1999). But in the training of developing Web applications requiring data transactions, the lack of updated hardware and software or the restricted access to institutional Web servers often becomes the bottleneck limiting student hands-on learning activities. As West and Cornwell (1999) indicate, currently, a computer lab with 12 personal computers plus other hardware and software required for hands-on training in developing Internet, intranet, and Web-based database applications would cost more than \$110,000. In addition, the estimated annual expense of operating and updating the lab would require 30% of the original hardware and software cost. Therefore, Srinivasan, Guan, and Wright (1999) point out that creative ways of funding must be sought to keep technology current.

In order to meet the business needs and to overcome the hands-on training difficulties, this research proposed to develop a model that enables educators to design innovative hands-on training projects for students to develop Web-enabled, database-empowered spreadsheet applications by using free downloads of the trial versions of the latest technologies (Zhao, 2000). Therefore, there is no need for requesting a budget for new hardware and software.

Research Problem and Hypotheses

The problem addressed in this study was to develop a model for designing innovative hands-on training projects that enable students to learn the processes of technology integration and innovation by developing Web-enabled, database-empowered spreadsheet applications, without requesting a budget for new hardware and software. The following three hypotheses were tested to accept or reject the feasibility of developing such a model.

- H1: Web, spreadsheet, and database technologies can be integrated for developing Web-enabled, database-empowered spreadsheet applications.
- H2: Free downloads of PC-compatible Web and database servers are available for developing Web-based client/server data communication networks.
- H3: Web-enabled, database-empowered spreadsheet applications can be developed in student labs without requiring a budget for new hardware and software.

Methodology

The study consists of the three major phases: (a) conceptualization of the model, (b) testing the hypotheses, and (c) refinement of the model.

Phase I. Conceptualization of the Model

An initial model was developed based on the literature review regarding the integration of the Internet, spreadsheet, and database technologies and the innovative hands-on training theory and design. A tentative framework of the model was structured as follows: First, procedures were developed for integrating the Web, spreadsheet, and database technologies to build Web-enabled, database-empowered spreadsheet applications. Second, appropriate Web servers, data servers, programming languages, and Web authoring tools were identified, selected, and downloaded from free-download sites for testing on PCs. After the first stage of testing, appropriate hardware and software were selected and integrated into the hands-on training projects without increasing expenses. Such hands-on training projects should be deliverable in any Windows 95/98/NT/2000/ XP-computer labs with the Internet access or via the Internet to remote PCs without requiring extra hardware. Learning through a hands-on project, students will not only be able to develop Web-enabled, database-empowered spreadsheet applications, but also know how to download and install Web servers, data servers, and how to build client/server networks.

Phase II. Testing Hypotheses

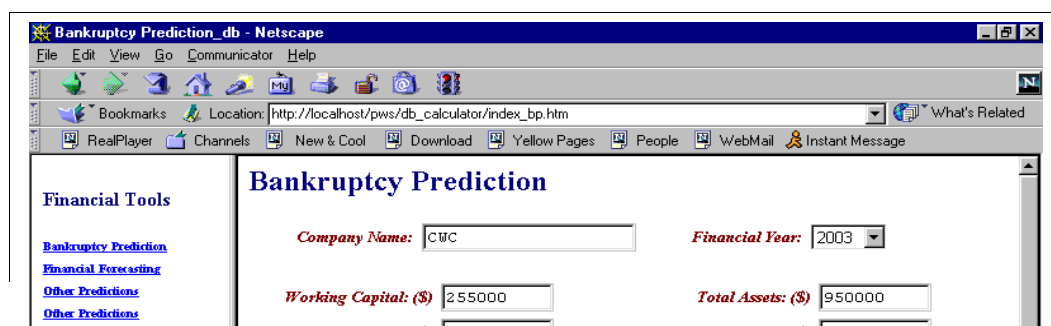
The tentative framework of the model was assessed by testing the research hypotheses in a student lab. Testing activities included (a) identifying, selecting, downloading, and installing a free Web server on PC and setting up an intranet, (b) creating a Web-enabled data server and database, (c) building a Web-enabled, database-empowered spreadsheet application (e.g., a bankruptcy prediction tool) with free, open-standard Internet technologies and tools, and (d) posting, testing, and managing the application on the Web.

Phase III. Refinement of the Model

The results of hypotheses testing were used to refine the model, which would enable educators to design innovative hands-on training projects. Learning through such hands-on projects, students will be able to develop Web-enabled, database-empowered spreadsheet applications, to download and install Web servers, data servers, and to build client/server networks. In the meantime, students will learn how to be innovative in using technologies and developing Web applications.

Results

Hypothesis 1 was supported: Web, spreadsheet, and database technologies can be integrated for developing Web-enabled, database-empowered spreadsheet applications. As Figures 1 and 2 show, Web-enabled, database-empowered spreadsheet applications can be developed by integrating HTML, ASP/JSP (Active Server Pages or Java Server Pages), VBScript/JavaScript, Access 97/2000/2002 database, ODBC (Open Database Connectivity), and Microsoft PWS (Personal Web Server) or IIS (Internet Information Server).



The screenshot shows a Netscape browser window titled "Bankruptcy Prediction Information - Netscape". The address bar displays "http://localhost/pws/db_calculator/bankruptcy_info.asp". The main content area features a table with the following data:

Company Name	Financial Year	Working Capital (\$)	Total Assets (\$)	Retained Earning (\$)	Operating Income (\$)	Market Value of Stocks (\$)	Total Debt (\$)	Sales (\$)	Edward Altman's "Z_score"	Input Date	Input Time
ABC Corp	2001	280000	850000	200000	150000	450000	350000	988000	3.36	3/6/01	9:48:37 AM
Redk, Inc.	2002	19000	156000	12000	22300	830	1035000	25000	0.9	3/7/01	10:12:19 AM
CWC	2003	255000	950000	250000	200000	510000	350000	1050000	3.48	7/12/01	9:52:49 AM

Figure 2. Bankruptcy Prediction Information Retrieved from a Web-Enabled Database File on Office Access 97.

Hypothesis 2 was supported: Free downloads of PC-compatible Web and database servers are available for developing Web-based client/server data communication networks. An Internet search at <http://serverwatch.internet.com/> identified more than 30 Web servers such as AOL server, Apache, iPlanet Web server, Microsoft IIS 4.0/5.0, Microsoft PWS 4.0, Netscape Enterprise, Sambar Server, and WebSitePro, to name just a few. Many of these Web servers are freeware.

For example, PWS 4.0 is the top-download, free personal Web server for Windows 95/98/NT personal computers (Figure 3). PWS 4.0 includes Microsoft Transaction Server (MTS), MS Message Queue (MSMQ) Server, Index Server, and Exchange Server. Once PWS 4.0 is installed on a Windows personal computer, it turns the computer into a small-scale Web server that enables the instructor to teach students how to set up intranets and how to develop Web-based, dynamic, interactive spreadsheet and client/server database applications for corporate knowledge management and e-commerce.

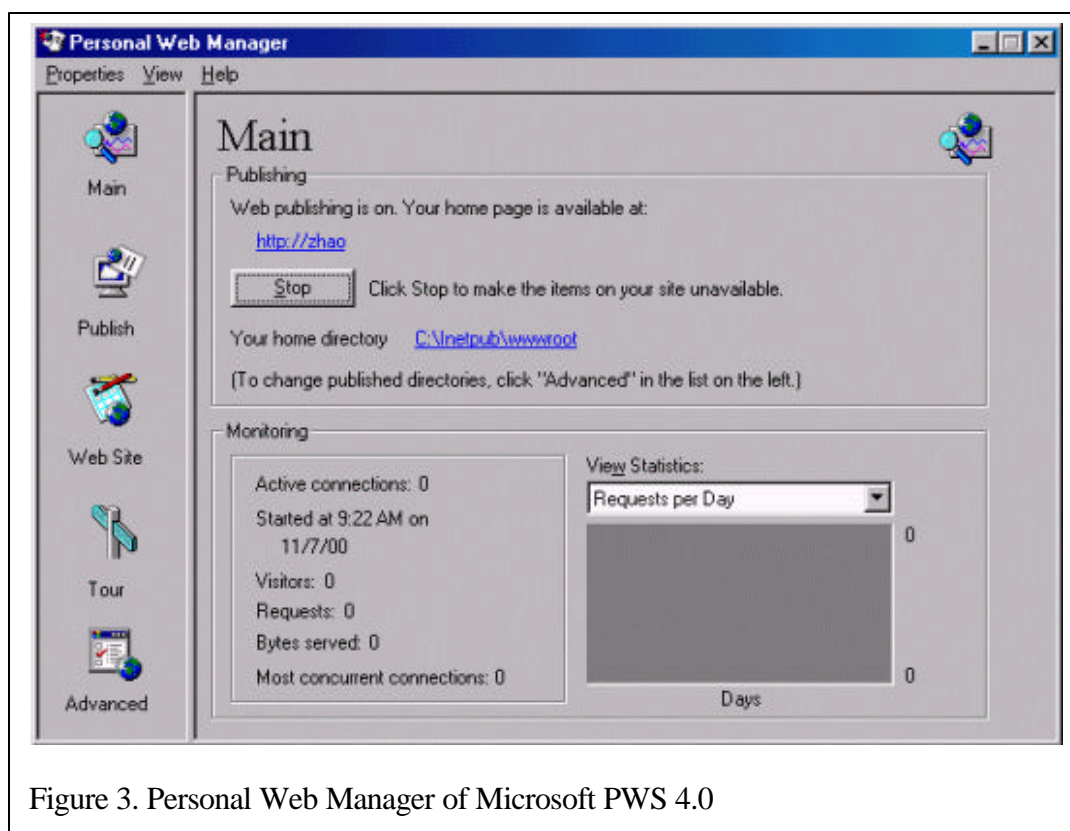


Figure 3. Personal Web Manager of Microsoft PWS 4.0

Hypothesis 3 was also supported: Web-enabled, database-empowered spreadsheet applications can be developed in student labs without requiring a budget for new hardware and software. The minimum required hardware and software for developing Web-enabled, database-empowered spreadsheet applications are (a) a PC with Windows 95 and the Internet access, (b) Access 97, (c) Netscape Composer and Windows Notepad, and (d) a free-downloaded Web server. Most student computer labs meet these requirements or have better hardware and software. If FrontPage or other advanced Web development tool is available, students can use it instead of using Netscape Composer and Windows Notepad.

Summary

As the findings of the study indicate, the model for designing innovative hands-on training projects that enable students to learn the processes of technology integration and innovation by developing Web-enabled, database-empowered spreadsheet applications, without requesting a budget for new hardware and software, is workable. The minimum hardware and software requirements are Windows 95 PC with the Internet access, Access 97, Netscape Composer, Windows Notepad, and a free-downloaded Web server. University computer labs usually meet or surpass these requirements. Therefore, instructors can consider using this model to design innovative projects that satisfy students' hands-on learning needs in developing dynamic, interactive, database-empowered Web-spreadsheet applications for corporate knowledge management and e-commerce.

References

- Biggs, M. (2001, January). Technologies to watch in 2001. InfoWorld, 23(5), 74.
- Bureau of Labor Statistics. (2000). The 2000-2001 occupational outlook handbook [On-line]. Available: <http://www.bls.gov/oco/ocos042.htm>.
- Charski, M. (2000, January 17). Online loans click for homes, cars and school. U.S. News & World Report, 128(2), 58.
- Daughtrey, T. (1998). Intelligence everywhere: How technology can enlighten and empower. Quality Progress, 31(6), 21-24.
- Downes, L. (2000, July). E-business strategies: Invisible capital. Industry Standard, 3(26), 211-214.
- Harrington, A. (1999, November). The big ideas. Fortune, 140(10), 152-154.
- Korry, E. (1999, June 3). This morning business report. National Public Radio (Morning Edition).
- Kulman, L. (1999, December 13). Holiday shopping spree.com. U.S. News & World Report, 127(23), 68-70.
- Perry, J. (2000, June 19). Online calculators give the measure of your days. U.S. News & World Report, 128(24), 61.
- Srinivasan, S., Guan, J., & Wright, A. (1999). A new CIS curriculum design approach for the 21st Century. Journal of Computer Information Systems, 39(3), 99-103.
- Sternberg, R. J., & Lubart, T. I. (1995). Defying the crowd: Cultivating creativity in a culture of conformity. New York: Free Press.
- Sternberg, R. J. O'Hara, L. A., & Lubart, T. I. (1997). Creativity as investment. California Management Review, 40(1), 8-21.
- Stewart, T. A. (1999, September). See Jack. See Jack run Europe. Fortune, 140(6), 124-136.

- West, C. J., & Cornwell, L. W. (1999). Using hands-on exercises in the business data communications course. Journal of Computer Information Systems, 39(2), 2-5.
- Wilson, L. T. & Asay, D. (1999). Putting quality in knowledge management. Quality Progress, 32(1), 25-31.
- Wiener, L. (2000, June 26). Getting the home mortgage of your dreams shouldn't keep you up nights. U.S. News & World Report, 128(25), 67.
- Zhao, J. J. (2000). Buy low and sell high: An investment approach to hands-on training in Web-database applications. Journal of Computer Information Systems, 40(4), 20-26.
- Zuckerman, A. & Buell, H. (1998). Is the world ready for knowledge management? Quality Progress, 31(6), 81-84.