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An examination of web-based application development skills by industry professionals: A pilot study

Kenneth Sousa
Bryant College

Shaw K. Chen
University of Rhode Island

Maling Ebrahimpour
University of Nebraska

Kenneth Fougere
Bryant College

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Kenneth Sousa
Bryant College

Shaw K. Chen
University of Rhode Island

Maling Ebrahimpour
University of Nebraska-Lincoln

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Bryant College

ABSTRACT

The development of web-based, electronic commerce software has grown significantly in recent years. These software development applications have challenged information technology departments in business organizations to implement mission critical, strategic applications for their organization. That in turn creates a significant demand for the technology personnel to support the development process.

This research conducts a pilot survey of industry professionals to determine the necessary skills and training required of an undergraduate computer information systems professional seeking an entry-level position in a web-based application development environment. Respondents were asked to provide their opinion relating to the market importance and student competency for a list of technical and conceptual skills relating to the development of web-based applications. The difference between the respondents' scores (market importance vs. student competency) were compared to determine whether students attained a level of competency that was equivalent to the skill's importance in the marketplace. The results of our study suggest that information systems graduates do not possess a high level of competency in several web-based development skills considered important by the marketplace. For the twenty-eight skills included in the survey, fourteen of the skills showed significant differences in the respondents' scores. Specifically, the respondents believed that JAVA was the web development skill as having the largest gap between the market importance and the level of competency possessed by a graduating student.

INTRODUCTION

Over the last decade, the adoption and integration of technology has increased substantially focusing the role of technology within business organizations on the development and implementation of electronic commerce systems. These adoptions in technology have been motivated strategic, economic and competitive implications that are affected by the implementation of electronic commerce applications. Organizations are adopting this new technology in anticipation of gaining positive market exposure, increased efficiency and effectiveness. It will be important to implement these systems in a reduced time frame to leverage these benefits into tangible advantages and to establish the organization as an industry leader.

The rapid adoption rate of these systems in the marketplace coupled with their strategic implications have required business organizations to implement web-based systems in a shorter time frame than normally associated with information systems development. Since labor is an important component of successful applications development, recruiting and retaining technical personnel with the appropriate skills is a critical factor. The rapid deployment of these systems combined with the dynamic nature of technology innovations creates significant challenges for information technology management and recruiters to hire skilled personnel.

The goal of this research is to determine the necessary skills required of a successful developer of web-based applications. The results, therefore, will provide insight into the curriculum and educational needs for undergraduate students in computer information systems (CIS) majors. Specifically, the availability of practitioner-influenced data from industry professionals will assist in the definition and development of appropriate curriculum. This research will initiate a pilot study that will gather the perceptions of business and technology management who initiate, recruit and manage projects through the use of a survey instrument.

In order to gain a complete understanding of the technology skills required by business organizations, this pilot study must capture both the current importance of various skills required as well as the competency level of graduating CIS students entering the marketplace. The results of the pilot study could provide the basis for future studies of the skills required for web-based applications design and development by improving the curriculum and course development of the various information systems concentrations.

LITERATURE REVIEW

Recently, financial market changes and economic trends have altered the potential impact of electronic commerce over the last tow years. Electronic business-to-business transactions have not seen the growth and adoption that was once projected. In 1999, the number of online marketplaces was originally estimated to reach 100,000 sites (Luening, 2001). For example the Census Bureau reported that retail e-commerce sales for the fourth quarter was $10 billion; up 13.1% from the same period one year earlier (Anonymous, 2002a). Other projections estimate that combined e-commerce transactions, both B2C and B2B, could surpass $7 trillion by 2005 while the Gartner Group projects electronic B2B spending will increase 81% from the five-year period

beginning in 2001 (Grover, 2001; Cleary, 2001). Recent literature suggests that while there has been an "adjustment" in the development and implementation of electronic commerce systems within business organizations, their extinction is far from reality.

Earlier studies provide insight that information technology projects will focus on e-business initiatives such as web development tools, web server software and security products. These projects, *"directly tied to strategic business needs,"* are visible with senior executives for their contribution to the organization (McGee, 2000). The organizational importance of these applications is confirmed by a survey in which 80% of information technology executives planned to increase their 2000 budget for electronic business and Internet solutions (McGee, 2000). The recent estimations of electronic commerce transaction volume would suggest that a suitable allocation of corporate resources is inevitable.

As the demand and importance for electronic commerce applications increases, information systems professionals will be needed to serve as the architects of these projects. Recruiting qualified information technology personnel for electronic commerce projects has become the highest priority for many organizations due to the critical nature of these projects. A significant number of managers surveys (72%) believe that the challenge of recruiting skilled personnel is a larger obstacle than the issues relating to the implementation of an electronic commerce strategy (Khirallah, 1999). The recruiting and retention of personnel having the proper skills will have a direct impact on whether organizations can deliver a competitive, successful electronic commerce strategy in a timely manner. Technical skills are viewed as the most important skill set which affects not only the flexibility of the IS infrastructure, but also the organizations competitive advantage (Byrd, 2001). Therefore, businesses will need to identify, attract and hire qualified information personnel with the appropriate skills for electronic commerce development such as front-end web development, integration with legacy systems and security.

Responding to industry experts who believe that business usage of the Internet will create the need for skilled personnel, several colleges and universities have developed independent courses or curricula tailored specifically to electronic commerce activities. Educational institutions are developing courses in supplier logistics; enterprise planning and data warehousing that will provide the foundation for electronic business development (Hromadka, 2000). The rapid speed to which these programs are being developed is illustrated in a listing compiled by The Association to Advance Collegiate Schools of Business (AACSB International) including 33 member institutions that have implemented e-business education as of February 2000 (Anonymous, 2000b). The challenge of developing appropriate curricula is increased because there is no generally accepted body of knowledge that defines electronic commerce programs. The contemporary nature of this technology, coupled with the lack of experience with curriculum development, may not provide rationale information to educators in order to implement sound educational decisions. Trauth, et al. (1993) believed that despite a shared vision of the IS professional, there is a gap between the industry needs and academic preparation. Their research asserted that businesses should provide consistent information to the educational community about their expectations while considering the mission of universities is career education, not job training.

Some institutions are responding quickly by developing programs in order to avoid being accused of providing "non-competitive" education. Some industry analysts have inferred that some of the programs may be more "flash than substance" and contend that web site development is more than trendy technology and presentation. Strategic planning and integration of strong marketing skills will be required to build a successful web platform (Mangan, 1999). The literature, including both academic and business perspectives, suggests that the interdisciplinary nature of electronic commerce activities requires a blend of general business concepts and technical skills. The composite technical skills required can be categorized into five categories (Heilman, 1999):

- Systems administration
- Hypertext Markup Language (HTML)
- Database management systems
- Scripting languages
- Network principles

The lack of codified body of knowledge and experience relating to this new technology limits the ability to implement rationale curriculum and course development. The purpose of this research is to determine the skills needed by information technology professionals desiring to specialize in electronic commerce development. To compile this knowledge, it will be necessary to survey business and industry leaders on the various technical and business skills that are considered to be important. The findings of this research should provide some guidance and direction for curriculum development in the area of electronic commerce education.

METHODOLOGY

This research compiled findings to assist in developing appropriate undergraduate curricula that will help fulfill the demands of the current business and technology environment. Gathering the necessary skills for this environment will provide direction and guidance on course development and content. However, to collect a full perspective on knowledge acquired by graduating students entering the market, the survey must concurrently ask the respondent for a level of competency in each of the skill areas as well. By gathering these factors for each skill, the data can be analyzed to determine both the level of importance selected by the respondents and also the competency of graduating undergraduate students as evaluated by their skill level upon entering the workforce.

The goal of the research will be to determine whether graduating CIS students are sufficiently skilled in relation to the relative market importance of a specific skill. Therefore, the hypotheses developed to guide our research are as follows:

H0: No significant differences between the mean values of Graduating Student Competency and Market Importance. The competency of graduating students in the defined skill is relatively equal to the market importance of the skill.

H1: Significant differences exist between the mean values of the Graduating Student Competency and Market Importance. There is a difference between the competency of graduating students in the defined skill and the market importance of the skill.

In order to compile a list of technical and conceptual skills for the survey, several sources were utilized to assist in this effort. Using the research completed by Heilman (1999), as well as a combination of research articles (James, 2000; Stefanova, 2000; Srinivasan, 1999; Radcliff, 1998; Quittel, 1999), job placement advertisement analysis (Monster.com) and college curricula, a set of skills were gathered, considering both an industry and academic perspective. Skills that did not appear in multiple sources were excluded from the final survey list. Each of the skills were assigned and organized into categories as:

Category	Survey Skills
Languages	Java, Visual Basic, SQL, HTML, Active Server Pages, XML, C++, CGI
Page Composition Tools	Page Layout, Multimedia
Network Concepts	Firewalls, Encryption, Network Concepts, Topology
Web Development/Administration	Design, Statistics, Graphics Design, Privacy
Web Server Software	Microsoft IIS, Netscape, O'Reilly, Apache
General Knowledge	Databases, Data Mining, Business Concepts, Enterprise Resource Planning, Intranets, Extranets

The respondents were asked to provide two responses for each of the skills contained in the survey. The respondent's values related to their opinion of the skill's current importance in the market and the competency of a graduating student in that particular skill. The choices for each of the survey questions were based on a continuous scale (1 to 5) as well as a "No Opinion" response. In addition to the twenty-eight skills presented, the survey provided the respondent with the opportunity to add up to three additional skills of their choice. The respondent could enter the skill as well as the appropriate importance and competency values. The survey also asked the respondent to select an industry and position classification.

A list of 164 industry leaders, consultants and authors having significant knowledge in electronic commerce was compiled for the survey population. The industry members were identified as the leaders of information technology organizations recognized by industry publications as implementing successful electronic business applications. The source of the population was compiled using the organizations identified in "IT Excellence: Leading The Way In Technology Innovation" (Anonymous, 1999c). This report lists the organizations that have been cited for their early adoption and creative use of technologies that can help create significant business value for their companies (Anonymous, 1999d). The categories included application development, E-business, customer-relationship management, and business process/enterprise resource planning. Those organizations defined in the reports in the E-business category were included in

the survey population. For each of these organizations, a senior management member of the information technology division was identified. The chief information or technology officer of these organizations was targeted as a potential respondent to the survey. The consultants and authors were compiled by researching the leaders in their respective trades as identified through business publications, research and successful implementations. It is believed that each of these respondents could provide the necessary insight and experience to contribute to this study.

The survey was distributed in the traditional paper format to all members identified in the population. Each respondent was provided with an alternative submission method through a traditional hard copy survey or an online version of the survey. The letter to the respondent included a universal resource location address (URL) referencing a web page developed with an electronic version of the survey.

However, by using the electronic survey submission method, it is important to preserve the integrity of the survey results by eliminating duplicate or spurious respondents. Two actions were implemented to preserve the validity of the results. The web page address was not linked to any public web site. Therefore, only the respondents who received the survey package would have knowledge of the online survey instrument. In addition, the URL address contained in the letter contained a randomly assigned, unique identification number. Upon completion of the online survey, this identification number would be stored in the survey record to determine whether multiple entries were received from one respondent along with other system information; time and date stamp, remote computer name and browser identification.

RESULTS

The number of valid survey responses was 17 (11% response of population) with one response being discarded due to a duplicate survey number. The skill variables were separated into six categories. The survey required the respondent to provide two values, the market importance and graduating student competency, for each of the twenty-eight skills. In addition, respondents were also allowed to provide a response of "no opinion" (referred to as NO in the survey) if they did not possess enough information or experience in the skill. Table 1 provides a frequency distribution for each of the skills and the associated responses.

The survey data was analyzed comparing the paired difference between the measurements using a nonparametric statistical method. This method calculated the absolute values of each response based on two related variables in order to test the hypothesis that the two variables have the same distribution. This test, which includes no assumptions about the shape of the distribution, considers the magnitude of differences within pairs and assigns more weight to pairs that show large differences than those variable pairs that show small differences. The test statistic is based on the ranks of the absolute values of the differences between the two variables.

In order to properly analyze the results of the survey, it is important to determine the differences between the paired variables relating to the importance and competence values relative to each skill. To accomplish this properly, two statistical tests were performed: 1) analysis of vari-

Table 1. Survey Frequency Distribution

	Market Importance							Graduating Competency						
Skill (Category)	**NO**	**1**	**2**	**3**	**4**	**5**	**Total**	**NO**	**1**	**2**	**3**	**4**	**5**	**Total**
Languages (LAN)														
Java	0	0	1	1	9	6	17	2	2	5	3	4	1	17
VB	1	1	4	3	6	2	17	3	0	4	5	4	1	17
SQL	0	0	1	5	5	6	17	2	0	5	5	2	3	17
HTML	0	0	0	8	5	4	17	2	1	3	3	5	3	17
ASP	2	0	3	5	7	0	17	4	2	4	3	2	2	17
XML	1	1	1	5	5	4	17	3	5	3	2	2	2	17
C++	0	0	6	6	3	2	17	2	1	6	5	1	2	17
CGI	3	4	2	4	4	0	17	7	2	4	3	1	0	17
Page Composition Tools (PAGE)														
Page Layout	2	0	3	4	7	1	17	4	1	4	4	2	2	17
Multimedia	3	0	3	6	3	2	17	5	2	6	2	0	2	17
Network Concepts (NET)														
Firewalls	0	1	0	3	2	11	17	3	3	4	3	2	2	17
Encryption	0	2	1	2	6	6	17	4	3	3	5	1	1	17
Network	0	1	1	6	6	3	17	2	3	5	3	3	1	17
Topology	0	1	1	7	6	2	17	2	2	6	3	2	2	17
Web Development/Administration (DEV)														
Design	1	1	2	2	5	6	17	4	1	3	2	3	4	17
Statistics	1	1	2	3	7	3	17	5	2	4	4	0	2	17
Graphics	1	1	5	1	6	3	17	4	2	5	0	2	4	17
Privacy	0	1	3	4	5	4	17	4	4	3	3	0	3	17
Web Server Software (SERV)														
Microsoft IIS	1	0	1	3	5	7	17	3	2	1	4	2	5	17
Netscape	3	0	3	3	6	2	17	6	3	1	2	1	4	17
O'Reilly	5	1	6	4	1	0	17	7	3	4	2	1	0	17
Apache	4	0	6	3	3	1	17	6	2	3	3	1	2	17
General Knowledge (GEN)														
Database	0	0	0	3	4	10	17	2	0	3	5	2	5	17
Mining	0	0	2	4	9	2	17	2	4	4	3	3	1	17
Business	0	0	3	10	3	1	17	3	3	2	5	3	1	17
ERP	0	0	3	2	9	3	17	3	3	3	4	2	2	17
Intranets	0	0	1	6	8	2	17	2	4	2	5	3	1	17
Extranets	0	0	1	5	8	3	17	3	4	3	2	4	1	17

ance (ANOVA) to determine if there was any significant differences between values and 2) the non-parametric, Wilcoxon Signed Rank Test to calculate the differences, if any, between two related variables.

The null hypothesis for this analysis would indicate that respondents believed that there are no differences between the competency and market importance of a skill based on the mean scores based on an observed significance level, or p-value. Conversely, a calculated p-value which is less then the observed significance level of the test would translate to a rejection of the null hypothesis, illustrating a strong indication that there are differences between the measured value and the mean scores. The ANOVA test was completed and found that 14 of the 28 variable pairs showed significant differences ($p<.05$). The ANOVA results, as shown in Table 2, calculated the largest negative Z-score for JAVA (-2.992), Firewalls (-2.831) and Intranets (-2.754).

The Wilcoxon Signed Rank Test calculates the difference between variable pairs for related variables (McClave, 1995). For this test, the difference for each respondent's variable pair values is calculated by subtracting the market importance from the graduating student competency value. The number of positive, negative and tie values are counted as well as the mean rank, positive and negative, for each of the variable pairs. In addition, the test calculated a sum of the negative and positive values for each of the variables. The differences between these summary values illustrate the magnitude of the values, positively or negatively, as shown by the survey data.

The smaller value of T, the greater the indication that the two probability distributions will exhibit differences. The sample size and alpha value are used to determine the rejection region using a table. For this example, based on n=8 and $\alpha = .05$ provides a T_0 value of 4. Therefore, H_0 will be rejected if $T \leq T_0$. The smaller of the ranked sums provides the value of T (6.5). Therefore, this example provides sufficient evidence to indicate that the rankings differ with respect to $\alpha = .05$.

For the Wilcoxon test, the competence and market importance variables were paired with each of the skills identified in the survey to identify the difference between these values. Based on the objective of this research, it is important to determine the difference, if any, between the competency of graduating students and the market importance for each skill defined in the survey. Therefore, the Wilcoxon test requires each of the related variables to be paired in the form of an arithmetic formula to generate a value to determine the difference between responses. Based on the respondent's survey values, the formula used for this test was:

[Graduating Student Competency] - [Marketing Importance]

A listing of the results of the Wilcoxon Rank Test for all variable pairs having significant differences is shown on page 130.

Table 2. Results of ANOVA Test and Means

Skill (Category)	Z	Asymp Sig
Languages (LANG)		
Java	-2.992	0.003*
VB	-0.345	0.730
SQL	-2.280	0.023*
HTML	-1.413	0.158
ASP	-1.221	0.222
XML	-1.975	0.048*
C++	-0.845	0.398
CGI	-1.890	0.059
Page Composition Skills (PAGE)		
Page Layout	-1.121	0.262
Multimedia	-2.197	0.028*
Network Concepts (NET)		
Firewalls	-2.831	0.005*
Encryption	-2.508	0.012*
Network	-2.360	0.018*
Topology	-1.768	0.077
Web Development/Administration (DEV)		
Design	-1.897	0.058
Statistics	-2.333	0.020*
Graphics	-0.940	0.347
Privacy	-2.154	0.031*
Web Server Software (SERV)		
Microsoft	-1.727	0.084
Netscape	-1.403	0.161
O'Reilly	-0.816	0.414
Apache	-0.514	0.607
General Knowledge (GEN)		
Database	-2.228	0.026*
Mining	-2.379	0.017*
Business	-1.095	0.273
ERP	-2.585	0.010*
Intranets	-2.754	0.006*
Extranets	-2.701	0.007*

* $p < .05$

Table 3. Wilcoxon Signed Rank Test Results

	Number of Respondents[1]				Mean Rank[1]		Sum of Ranks		
Skill	Neg	Pos	Tie	Total	Neg	Pos	Negative	Positive	Difference
Java	11	0	4	15	6.00	0.00	66.00	0.00	-66.00
Firewalls	10	0	4	14	5.50	0.00	55.00	0.00	-55.00
Intranets	9	0	6	15	5.00	0.00	45.00	0.00	-45.00
Extranets	9	0	5	14	5.00	0.00	45.00	0.00	-45.00
Database	8	2	5	15	6.13	3.00	49.00	6.00	-43.00
Encryption	8	1	4	13	5.44	1.50	43.50	1.50	-42.00
Network	8	1	6	15	5.25	3.00	42.00	3.00	-39.00
ERP	8	0	6	14	4.50	0.00	36.00	0.00	-36.00
SQL	7	1	7	15	4.86	2.00	34.00	2.00	-32.00
Privacy	7	1	5	13	4.71	3.00	33.00	3.00	-30.00
XML	6	2	6	14	5.33	2.00	32.00	4.00	-28.00
Mining	7	0	8	15	4.00	0.00	28.00	0.00	-28.00
Multimedia	6	1	5	12	4.42	1.50	26.50	1.50	-25.00
Statistics	6	0	6	12	3.50	0.00	21.00	0.00	-21.00

[1] Calculated as [Graduating Competency] - [Market Importance]

The table has been sorted in descending order by the sum of the ranks difference values. The range of values each paired variable difference will be determined by the sample size of the survey. The positive and negative range boundary can be calculated by the sum of the numbers up to the value of the sample size (17). For this survey, the valid range of values for this column is -153 to 153. A calculated difference value that lies on the outer boundaries of this range illustrates a large difference in the sample response to the paired variable. Similarly, a summary value equal to zero would suggest that there are no differences between the paired responses provided by the survey data.

The results of the Wilcoxon Rank Test showed that the first four variable pairs did not provide a positive mean rank. Therefore, none of the survey respondents provided a higher score for the graduate competency value over the market importance. In each of these cases, there was a significantly larger gap between the respondents' values of these skills. In addition, less than one-third of the responses for each skill calculated a "tie" between the values of the mean differences. Many of the remaining skills received only one or two positive differences between the respondents' opinions.

FINDINGS

The results of the Wilcoxon test indicate that each of the variables showing significant differences has calculated a negative difference for the sum of the rankings value asserting that the respondents believed, in general, that graduating CIS students need a higher level of proficiency to become successful web-development professionals. The following tables summarize the Wilcoxon sum of the rank values as well as the means for the two variables (graduating competency, market importance) separated those skills rejecting the null hypothesis (Table 4a) and skills that allow the acceptance of the null hypothesis (Table 4b).

Table 4. Research Findings

Skill	Category	Mean Graduating Competency	Mean Market Importance	Wilcoxon Sum of Rankings
Java	LAN	2.80	4.18	-66.00
Firewalls	NET	2.71	4.29	-55.00
Intranets	GEN	2.67	3.65	-45.00
Extranets	GEN	2.64	3.76	-45.00
Database	GEN	3.60	4.41	-43.00
Encryption	NET	2.54	3.76	-42.00
Network	NET	2.60	3.53	-39.00
ERP	GEN	2.79	3.71	-36.00
SQL	LAN	3.20	3.94	-32.00
Privacy	DEV	2.62	3.47	-30.00
XML	LAN	2.50	3.63	-28.00
Mining	GEN	2.53	3.65	-28.00
Multimedia	PAGE	2.50	3.29	-25.00
Statistics	DEV	2.67	3.56	-21.00

These skills were found to have significant differences ($p > .05$).

Skill	Category	Mean Graduating Competency	Mean Market Importance	Wilcoxon Sum of Rankings
Topology	NET	2.73	3.41	-34.00
Microsoft	SERV	3.50	4.13	-33.00
HTML	LAN	3.40	3.76	-27.00
ASP	LAN	2.85	3.27	-23.00
Design	DEV	3.46	3.81	-22.00
Business	GEN	2.79	3.12	-18.00
Netscape	SERV	3.18	3.50	-16.00
C++	LAN	2.80	3.06	-14.00
Page Layout	PAGE	3.00	3.40	-13.00
Graphics	DEV	3.08	3.31	-11.00
CGI	LAN	2.30	2.57	-10.00
Apache	SERV	2.82	2.92	-8.00
VB	LAN	3.14	3.25	-4.00
O'Reilly	SERV	2.10	2.42	-3.00

These skills were found to have significant differences ($p > .05$).

The five skills illustrating the largest difference between competency and importance by respondents are Java, Firewalls, Intranets, Extranet and Databases. These skills, by the basis of the large difference in ranking values, require more attention to develop stronger core competency upon graduation. Several other skills also showed a negative difference as calculated by the Wilcoxon text, but dropped dramatically from Java (-66) to Statistics (-21). The results

indicate that the respondents do not believe students possess the necessary skills for Java and Firewalls because there were no positive differences between the respondents' values while the other three skills resulted in some positive values.

It should be noted that many of these skills illustrating large negative differences also calculated high mean scores for market importance by the respondents. These high scores provide additional foundation for the findings of this research. However, we believe that this research would be myopic to focus only on the differences calculated by the Wilcoxon test. For example, a large negative ranking coupled with a relatively low market importance (for example < 2.50) would indicate a low competency for a skill that is not considered important for the development of web-based applications. All of those skills showing significant differences scored high values of market importance with Multimedia having the lowest value (3.29).

Each of the respondents was asked to provide an industry classification on the survey transmittal. Over half of the respondents (9) were employed by financial services organizations with the remainder in various industries. Based on the industry demographics of the respondents, the survey records were coded into two categories: financial services and other. Since the response rate was low for this pilot study, we do not believe that any analysis specific to industry classification would be valid.

SUMMARY AND CONCLUSIONS

The objective of this research was to determine what skills are necessary to be a successful developer of web-based applications. This basis of the research was the administration of pilot survey to determine the perception of industry leaders specific to electronic commerce and web-based applications. Since this area of information technology and application development has exploded in a short period of time, it was important that the result of this study provide some insight on whether the skills of computer information systems graduates are fulfilling the level of skill deemed important by the market.

The results of the study survey suggest that the web development skills of computer information systems graduates do not reflect the demands of their future employers. The analysis of the survey data asserted that several skills illustrate a difference between the current market importance and the competency of graduating technology students. Based on the results of this research, graduating students seeking information technology development positions in electronic commerce require additional competency in Java, firewall, intranet, extranets and database concepts. The results of the survey showed only one programming language within the first eight test results (Java). The results of the signed rank test could be used as a framework for program and curriculum development relating to electronic commerce/business programs.

While the conclusions of this pilot study may appear negative, the results should not be considered alarming. In a competitive business environment, it would be highly unlikely that employers would believe that students have been sufficiently prepared with all the necessary skills required by the industry. Employers expect highly trained and skilled employees in order to

be immediately productive with minimal training and investment. In addition, the highly evolving electronic commerce and web-based technology environment requires business organizations to react more rapidly to changes in required skills than the ability of educational institutions to provide these resources. Considering that business organizations are constantly challenged to maintain an up-to-date technology infrastructure coupled with properly trained information technology personnel, educational institutions are not immune from these same challenges in the development and modification of their curriculum and associated courses.

Since this research was framed as a pilot study, the small sample size associated with the survey response is a primary limitation. Therefore, future research could provide additional insight by expanding sample size used in the distribution of the survey to include regional information systems personnel who are actively engaged in recruiting web development specialists. In addition, a sample population targeted outside of New England might provide insight to gain an understanding of any geographical differences required by business organizations hiring entry-level information systems specialists. This would allow a more accurate appraisal of the technology market as well as changes to the perceptions of student preparation and training.

This study presented a limited insight on the perceptions of technology skills and competency in relation to various industries. Administration of the survey could be focused on a specific industry to gain additional knowledge of current trends in application development and competitive pressures. This research study could also select two industries, financial services and manufacturing, to determine if there are any differences in the skills required by either industry. This information might prove valuable for academic institutions that may specialize in one particular industry.

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