An Alumni Assessment of MIS Related Job Skill Importance and Skill Gaps

Jerod W. Wilkerson
Sam and Irene Black School of Business
Pennsylvania State University, Erie
5101 Jordan Road
Erie, PA 16563
Jww16@psu.edu

ABSTRACT

This paper presents the results of a job skill survey of Management Information Systems (MIS) alumni from a Northeastern U.S. university. The study assesses job skill importance and skill gaps associated with 104 technical and non-technical skill items. Survey items were grouped into 6 categories based on prior research. Skill importance and skill gaps were analyzed for each category of skill items. Although the primary focus of the research is to highlight important skills and skills exhibiting skill gaps in each of the categories, the relative importance of the 6 categories is also compared. Consistent with prior work, the study finds skills in the non-technical categories to be more important to MIS career success than those in technical categories, but also identifies important technical skills, some of which exhibit skill gaps. These results, along with the survey and methodology used to obtain them, may help educators in MIS programs to better align MIS programs and the content of specific business and MIS courses with the current needs of MIS graduates.

Keywords: Job Skills, Computing Skills

1. INTRODUCTION

The skills required to succeed in the Management Information Systems (MIS) job market are constantly evolving as technology trends change. Periodic reevaluations of skill requirements are essential to ensure that MIS programs are providing graduates with the skills needed to succeed in the work place (Janicki, Kline, Gowan, and Konopaske, 2004; Janicki, Lenox, Logan, and Woratscheck, 2008). This paper presents the results of a skill assessment survey given to graduates of the MIS program of a Northeastern U.S. university who graduated with a B.S. degree between 2000 and 2010. The purpose of the study is to assess which skills are important for success at early career levels within MIS related careers, and what, if any, curriculum adjustments are needed. The study evaluates more skill items (104) than prior MIS job skill studies.

The study provides valuable information on what skills, abilities, techniques, programming languages, and tools are currently required by MIS professionals to succeed in their jobs. The study assesses both technical and 'soft' skills at both a macro and micro level of granularity. The macro level compares the importance of the skill categories used to group the skills in the survey. The micro level assesses skill importance and skill gaps within each category.

Specific objectives of the study include the following:

1. Identify which skills are important for success in early-career MIS positions,
2. Identify gaps that exist between required and actual skill levels,
3. Prioritize skills to be taught in an MIS curriculum.

2. RELATED RESEARCH

Various studies of MIS related skills and skill gaps have been conducted. Surveys have been conducted with current MIS students, MIS alumni, employees (who may or may not be alumni), employers, and educators. Other methods such as analysis of online job ads and focus groups have also been conducted. Table 1 shows the data collection methods used for 36 MIS job skill studies.

Surveys of current students (Golding et al., 2008) are useful in evaluating skill levels of students in an MIS program, but are of limited use in gathering information about skills needed for success in the work place due to the limited industry experience of the participants.

Surveys of alumni are of particular importance in evaluating the curriculum of specific programs because they target those with industry experience who are most representative of the students who will be affected by any curriculum changes. Prior surveys have been conducted on MIS alumni (Davis and Woodward, 2006; Koppi et al., 2009; Plice and Reinig, 2007; Sumner and Yager, 2008; Van Auken et al., 2011).

Authors	***Student Survey***	***Alumni Survey***	***Employer Survey***	***Employee Survey***	***Educator Survey***	***Job Ad Analysis***	***Other***
Alshare, Lane, and Miller (2011)	X				X		
Cappel (2001)			X				
Davis and Woodword (2006)		X					
Downey, McMurtrey, Zeltmann (2008)				X			
Fang, Lee, and Koh (2005)			X				
Gallivan, Truex, and Kvasny (2002)						X	
Golding, Tennant, and Donaldson (2008)	X		X		X		
Goles, Hawk, and Kaiser (2008)			X				
Gupta, Wang, and Ravichandran (1994)			X				
Hawk et al. (2012)			X				
Huang et al. (2009)						X	
Janicki et al. (2004)			X				
Janicki et al. (2008)			X				
Koppi et al. (2009)		X[1]					
Lee and Han (2008)						X	
Lee and Lee (2006)						X	
Lee et al. (2002)				X	X		
Lee, Trauth, and Farwell (1995)				X			
Leitheiser (1992)			X				
McMurtrey et al. (2008)				X			
Merhout, Havelka, and Hick (2009)							X[2]
Nelson (1991)				X			
Noll and Wilkins (2002)			X				
Plice and Reinig (2007)		X					
Richards et al. (1998)			X				
Richards, Marrone, Vatanasakdakul (2011)				X			
Sumner and Yager (2008)		X					
Tang, Lee, and Koh (2001)					X		
Tastle and Russell (2003)					X		
Tesch, Braun, and Crable (2008)			X				
Todd, McKeen, and Gallupe (1995)						X	
Trauth, Farwell, and Lee (1993)			X	X	X		
Van Auken et al. (2011)		X					
Woodward, Sendall, Ceccucci (2010)	X						
Yen et al. (2003)			X		X		
Zwieg et al. (2006)			X				X3

[1] *Recent graduates from multiple universities*
[2] *Employer focus groups*
[3] *Employer interviews*

Table 1: Summary of Data Collection Methods in MIS Job Skill Studies

Plice and Reinig (2007) conducted an alumni survey with the primary focus of determining whether the balance between business and technical content should be adjusted in an MIS program. They determined that their graduates tended to move into jobs requiring more managerial responsibilities over time, and that managerial skills and knowledge should receive greater emphasis than technical skills. This is consistent with the findings of other studies (Davis and Woodward, 2006; Golding et al., 2008; McMurtrey et al., 2008; Merhout et al., 2009; Noll and Wilkins, 2002).

Sumner and Yager (2008) also concluded that soft skills are more important to graduates of an MIS program than technical skills, but that a balanced curriculum that also prepares graduates in essential technical skills is needed. They concluded that knowledge and skills in emerging application development environments and web programming are particularly important technical skills for MIS graduates.

Fang, Lee, and Koh (2005) note that prior studies on IS related job skills have used various classifications of IS job skills, making comparisons of job skill studies difficult. They build on prior work (Lee et al., 1995; Todd et al., 1995) to propose a classification scheme consisting of: 1) Core IS Knowledge, which they further divide into Core Managerial IS Knowledge and Core Technical IS Knowledge, 2) Organizational Knowledge, 3) Interpersonal Skills, and 4) Personal Skills.

Core IS knowledge "includes the knowledge that differentiates IS personnel from others in an organization" (Fang et al., 2005). Organizational knowledge includes knowledge of specific business functional areas (such as Accounting, Marketing, etc.). Interpersonal skills include team and communication skills. Personal skills include personal traits or abilities such as creative and critical thinking skills and personal motivation. Subsequent studies (Golding et al., 2008; McMurtrey et al., 2008; Tesch et al., 2008) including the current study, have organized their surveys according to the Fang et al. job skill classification scheme.

Prior studies have used skill gap analysis to identify differences between expected and actual skill levels of graduates and to recommend curriculum changes (Cappel, 2001; Fang et al., 2005; McMurtrey et al., 2008; Nelson, 1991; Richards et al., 2011; Tang et al., 2001; Tesch et al., 2008; Trauth et al., 1993). Tesh et al. (2008) found that the three skills with the highest gap between expected and actual skill level are: 1) ability to listen, 2) written communication, and 3) self-motivation. They note that these three skills were all in the top five in importance as ranked by an employer survey of job skills and that they are also all soft skills.

Cappel (2001) surveyed employers on both technical and soft skills and found the greatest skill gaps to be in soft skills. However, Cappel also noted skill gaps in 16 of the 19 technical skills included in the survey. Lee and Han (2008) analyzed hundreds of job ads posted on Fortune 500 companies' websites and concluded that for programmer/analysts, technical skills are more important than soft skills, although both types of skills are important.

From the research literature, it is clear that both MIS alumni and employers believe that soft skills are more important than technical skills. However, it is also clear that both soft and technical skills are important (Downey et al., 2008), and that significant skill gaps exist and must be addressed in both skill areas. Thirty of the thirty-six studies listed in Table 1 discuss the relative importance of soft versus technical skills, and almost all conclude that soft skills are more important than technical skills. However, this may represent an overemphasis of the importance of this distinction. Soft skills, such as personal motivation, ability to work effectively in teams, and communication ability, are essential skills of almost all business professionals and would be required for success in the workforce in almost any business position. However, these are not the skills that differentiate MIS professionals from other business professionals such as Accountants and marketing professionals who also must have these soft skills for career success. Therefore, this paper takes a balanced approach of presenting soft verses technical skill information gathered from the survey while emphasizing the important skills in each of the skill categories included in the survey.

3. RESEARCH METHOD AND MEASURES

A survey was created based on a thorough review of the literature on MIS related job skills and skill gaps. The literature review identified nineteen papers that each reported a significant number of MIS job skill items. The items from these papers were used as a basis for creating the survey. Items were extracted from the papers, duplicates and some other items were removed, and modifications were made to ensure consistent wording of the remaining items. Additional items were then added and the resulting survey was reviewed by two MIS faculty members. After some modifications based on feedback from the faculty members, two pilot tests were performed with MIS alumni. Refinements and clarifications were made after each pilot test.

Table 2 provides a summary of the papers from which job skill items were extracted. The columns in the table represent the categories of items in the resulting survey. An 'X' in a column indicates that the paper contains at least one item that appears in that category of the resulting survey.

The resulting survey (see appendix A) consists of 117 items. The first 12 items consist of demographic and employment questions. The second part of the survey consists of 104 MIS related skill and knowledge questions organized into categories according to the Fang et al. (2005) classification scheme. An additional category—Technical Competencies—was added.

Following the method of Meier, Williams, and Humphreys (2000) for each of the 104 skill and knowledge questions, participants were asked to rate their current level of competence and the current importance to success in their careers on a 5-point Likert scale anchored at 1 = "Not at all competent" or "Not at all important" and 5 = "Very competent" or "Very important". Figure 1 shows the layout of the survey.

Author	*Core Technical*	*Core Managerial*	*Organiz-ational*	*Inter-personal*	*Personal*	*Technical Competencies*
Cappel (2001)	X	X		X	X	X
Fang, Lee, and Koh (2005)	X	X	X	X	X	X
Golding, Tennant, and Donaldson (2008)	X	X	X	X	X	X
Goles, Hawk, and Kaiser (2008)	X	X	X	X		
Gupta, Wang, and Ravichandran (1994)	X	X		X	X	X
Huang et al. (2009)	X	X	X	X	X	X
Janicki et al. (2004)	X					X
Janicki et al. (2008)	X	X	X	X		X
Koppi et al. (2009)	X			X	X	
Lee and Han (2008)	X	X	X	X	X	X
Lee and Lee (2006)	X	X			X	
Lee et al. (2002)	X	X	X	X	X	X
Leitheiser (1992)	X	X	X	X	X	X
McMurtrey et al. (2008)	X	X	X	X	X	X
Merhout, Havelka and Hick (2009)			X	X	X	
Noll and Wilkins (2002)	X	X	X	X		
Richards et al. (1998)	X			X	X	X
Sumner and Yager (2008)	X			X	X	X
Todd, McKeen, and Gallupe (1995)	X	X	X	X	X	X

Table 2: Job Skill Categories Addressed by Prior Studies

The last question asked the participants to rank the categories in order of importance to success in their careers. For this question, the Organizational Knowledge category was divided into two subcategories: 1) knowledge of business functional areas, and 2) knowledge of a specific business or industry.

The survey was implemented as an online survey. Participation requests were sent to 626 alumni who graduated with a B.S. degree in MIS from a Northeastern U.S. university between the years 2000 and 2010. The initial requests were sent by e-mail to the 368 alumni for whom a valid e-mail address was available and by postal mail to the other alumni.

Approximately three weeks after the initial requests were sent, all participants who had not completed the survey were sent a reminder by postal mail to complete the survey within two weeks. A final e-mail request was sent two weeks later to all participants who still had not completed the survey for whom a valid e-mail address was available. This final request gave the participants three more days to complete the survey, after which no additional responses were accepted. A total of 102 completed responses were received for a response rate of 16.3%. Of the responses received, 6 were from alumni who were not currently employed in an MIS related position, so they were excluded from the results, leaving 96 useable responses.

Because of the somewhat low response rate, the gender and number of years since graduation of respondents was compared to those of non-respondents to test for non-response bias. Of the respondents, 24.51% were female, whereas 19.12% of the non-respondents were female. A t-test indicated no significant difference ($p = 0.228$) in gender between respondents and non-respondents. The average number of years since graduation was 7.28 for respondents and 7.13 for non-respondents. A t-test indicated no significant difference ($p = 0.614$) in graduation year between respondents and non-respondents. These results indicate that a non-response bias does not exist in the sample data with respect to gender or graduation year, although a non-response bias may still exist on other factors.

To improve comprehension of the results, and to maintain consistency with prior research (Meier et al., 2000), the importance and competency scores were converted to a 100-point scale by subtracting 1 from the mean and multiplying by 25, and a competency gap score was calculated for each item by subtracting the mean scaled competency score from the mean scaled importance score. Positive scores indicated items with skill gaps (items whose

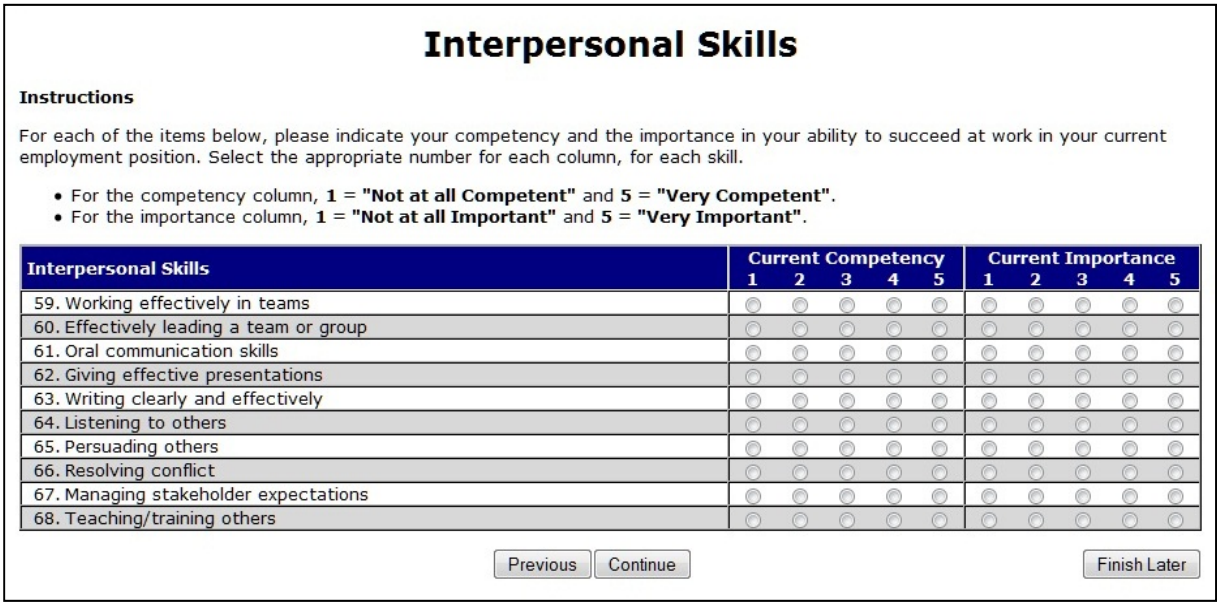

Figure 1: Online Survey Layout

importance is higher than their competence), with higher numbers representing higher skill gaps.

As noted by Meier et al. (2000), skill gap scores are not sufficient for prioritizing items to be considered when making curricular adjustments. Focusing exclusively on a measure of skill gaps would result in an under-emphasis of important items for which skill gaps are low under the current curriculum. This would result in curriculum adjustments focusing on current skill gaps and possibly ignoring important skills for which skill gaps do not currently exist—resulting in new skill gaps in the revised curriculum. Therefore, a 'priority' score, which considered both importance and skill gap, was calculated. The following equation, used by Meier et al. to calculate priority, was used:

$$priority = \frac{(i + (i - c))}{2}$$

where 'i' is skill importance and 'c' is skill competency.

The priority score highlights the items with the highest importance and the highest skill gaps, which are the items that should receive the greatest attention when making curricular adjustment decisions.

4. LIMITATIONS

This study is limited by the fact that the survey was only given to graduates of one MIS program from one Northeastern U.S. university. These graduates may come from similar backgrounds and almost certainly have more similarities in their college education than would be true of the general population of MIS graduates. This may contribute to a selection bias in these results. MIS programs also tend to direct graduates to certain types of jobs where skill requirements match the current program. This would cause the results to more closely match the current program than would be true if the survey were conducted on a more diverse population of MIS graduates.

These results may represent local or regional skill and technology preferences. This study was conducted on alumni from a Northeastern U.S. university, and although responses were received from 17 U.S. states and Japan, the majority of responses (67%) were received from alumni who are currently employed in the same state as the university at which the study was conducted.

The survey respondents began their careers during a particularly dynamic period of time in the MIS field, including a period of high failure rates of dot.com companies and a major recession in the U.S. These factors may have influenced the types of jobs MIS graduates were able to get, and therefore, their opinions about job skill importance.

The survey did not include questions about the expected future importance of MIS job skills. Therefore, the study makes an implicit assumption that current skill importance is an accurate predictor of future skill importance.

5. DEMOGRAPHIC RESULTS

Respondents ranged in age from 22 to 47 with an average age of 31. Of the respondents, 24.51% were female and 75.49% were male. This gender difference is not surprising because the majority of MIS graduates are male, including 83.71% of those receiving requests to participate in the survey. All respondents held a bachelor's degree and 20 (20.8%) held a master's degree. Respondents had an average of 7.4 years of industry related experience with a minimum of 1 and a maximum of 15. Most respondents (84%) had 10 or fewer years of industry related experience, while only 12 respondents (12.5%) were currently working in their entry-level position. The average number of management levels above an entry-level position was 1.9, with 71.7% being two or fewer levels above entry-level and 43.5% being zero or one level above entry-level.

Based on the demographics of the sample, it was concluded that the target respondents—alumni in early-career MIS positions—was reached.

More than 1/3 of the respondents (34.4%) were employed by companies having 10,000 or more employees. Table 3 shows the number of respondents by employer size category.

Employer Size Category	*Number of Respondents*
Less than 10	4
10 – 99	9
100 - 499	18
500 - 999	8
1,000 – 4,999	17
5,000 – 9,999	7
10,000 or More	33

Table 3: Respondents by Employer Size Category

6. RESULTS

The results in the following sections start by presenting information about the relative importance of the categories included in the survey and then present skill importance and skill gap information within each of the categories. Appendix B shows the importance rankings segregated by position level, and appendix C shows the skill gap and curriculum priority rankings.

6.1 Skill Importance Results

The three most important skills (all from the Personal category) are: 1) accomplishing assignments, 2) dependability, and 3) managing time effectively. All 15 items from the Personal category are in the top 20 most important items and all 10 Interpersonal items are in the top 28.

The 14 least important items are all from the Technical Competencies category, with three of the 4 least important items being programming languages. All programming languages included in the survey are in the 13 least important items. Table 4 shows the relative importance of each of the skill categories. Category importance was determined by calculating a combined mean scaled importance valued for all items in the category.

Category	*Scaled Mean*	*Rating Question Mean*
Personal	87.55	59.00
Interpersonal	81.56	60.00
Core Managerial IS Knowledge	60.72	82.75
Organizational	51.78	89.63
Core Technical IS Knowledge	43.77	58.00
Technical Competencies	25.72	86.00

Table 4: Relative Importance of Skill Categories

According to this measure, the importance of the categories is roughly in order from least to most technical. Interestingly, this is almost the reverse of the category rating when determined by survey question number 117 (shown in the Rating Question Mean column of Table 4) which asked the respondents to rate the categories by importance. This may indicate that respondents are biased toward thinking technical topics are more important to their career success than they actually are. Alternative explanations for this discrepancy are discussed in the Discussion and Conclusion section.

The organizational category may provide information on the usefulness for MIS students of pursuing certain business topics through course electives or minor programs. Operations is most important, followed by Marketing and Finance. The difference between Marketing and Finance was not statistically significant. Table 5 shows the five business functional topics included in the survey, listed in order of importance. The 'p-value' column indicates the p-value resulting from a t-test used to compare the mean of each row with the mean of the row directly below it in the table.

Functional Topic	*Scaled Mean*	*p-value*
Operations	58.59	.000***
Marketing	38.02	.399
Finance	36.98	.005**
Accounting	30.47	.045*
Economics	25.78	-

*p<=.05, **p<=.01, ***p<=.001

Table 5: Relative Importance of Business Functional Topic Knowledge

Tables 6 through 11 show the scaled mean importance scores for the items in each category, with items in each category listed in order from most to least important. The categories are presented in order of importance as indicated in Table 4. An item with a scaled mean of 50 is equivalent to receiving an average score of 3 on the survey (on a scale of 1 to 5), and an item with a scaled mean of 75 is equivalent to receiving an average score of 4 on the survey. Items receiving scores higher than 50 can be considered to be important to career success, whereas items receiving scores less than 50 can be considered to be unimportant to career success.

As shown in Table 6, the fifteen items in the Personal category ranged in importance from a scaled mean of 93.75 to 79.43, indicating that all personal skill items measured in the survey are important to career success. The top six Personal items all have a scaled mean of 90 or higher, and the average of all Personal items is 87.55.

Skill	*Scaled Mean*
71. Accomplishing assignments	93.75
79. Dependability	93.75
74. Managing time effectively	92.71
78. Attention to detail	90.36
75. Perform multiple tasks at the same time	90.10
70. Analyzing problems and developing solutions (critical thinking skills)	90.10

72. Learning new skills and concepts	87.24
77. Working under pressure	87.24
81. Willingness to take initiative	86.46
80. Personal Motivation	86.20
82. Organization skills	85.16
76. Working independently to accomplish a goal or objective	84.90
73. Making decisions	84.37
83. Passion for application of technology to solve business problems	81.51
69. Generating new ideas (creative thinking skills)	79.43

Table 6: Importance of Personal Category Items

Table 7 shows the scaled mean importance of the ten items from the Interpersonal category. These items ranged in importance from 91.41 to 73.18, with an average of 81.56. 'Listening to others' was the most important skill in this category, followed closely by 'Oral communication skills'. Communication and team skills were the most important in this category, with the top five skills being either communication related skills or effectively working in or leading a team. All but two of the Interpersonal items had a scaled mean importance above 75.

Skill	*Scaled Mean*
64. Listening to others	91.41
61. Oral communication skills	89.84
59. Working effectively in teams	89.58
63. Writing clearly and effectively	86.72
60. Effectively leading a team or group	79.17
68. Teaching/training others	78.39
65. Persuading others	77.86
62. Giving effective presentations	75.52
67. Managing stakeholder expectations	73.96
66. Resolving conflict	73.18

Table 7: Importance of Interpersonal Category Items

Table 8 shows the scaled mean importance of the eight items from the Core Managerial IS Knowledge category. These items ranged in importance from 81.25 to 32.81. The most important item in this category was 'Applying information technology to business problems/opportunities'. Two of these items, 'Managing finances and budgets' and 'Managing outsourcing or off-shoring', had a scaled mean importance score below 50.

Skill	*Scaled Mean*
42. Applying Information technology to business problems/opportunities	81.25
44. Creating and managing project plans and schedules	73.96
43. Understanding of management principles	67.71
41. Awareness of IS technological trends	66.15
40. Visions about IS/IT competitive advantage	60.26
46. Managing project risk	55.73
45. Managing finances and budgets	47.92
47. Managing outsourcing or off-shoring	32.81

Table 8: Importance of Core Managerial IS Knowledge Category Items

Table 9 shows the scaled mean importance of the items in the Organizational category. These items ranged in importance from 72.92 to 30.47. The two most important items in this category are 'Knowledge of a specific business industry' and 'Knowledge of a specific company or organization'. The most important business functional topic, and the only one scoring above 50, is Operations. Finance was considered to be more important than Accounting, and Economics was the least important.

Skill	*Scaled Mean*
48. Knowledge of a specific business industry	72.92
49. Knowledge of a specific company or organization	71.35
50. General business functions and principles	71.09
56. Business ethics and privacy issues	67.19
55. Operations	58.59
57. Legal issues	48.96
58. Globalization issues, trends, and requirements	48.18
54. Marketing	38.02
52. Finance	36.98
51. Accounting	30.47
53. Economics	25.78

Table 9: Importance of Organizational Category Items

Table 10 shows the scaled mean importance of the items in the Core Technical IS Knowledge category. These items ranged in importance from 72.40 to 20.79. This category contains a combination of skills associated with systems analysis, systems design, and implementation. Most of the skills associated with systems analysis in this category scored above 50, while all but one of the items that would be considered design or implementation scored at or below 50.

The one design or implementation item that scored above 50, was "Anticipating implementation problems", which scored highest in this category.

Table 11 shows the scaled mean importance of the technical competencies included in the survey. These items exhibited a large range of importance from 75.78 to 3.65. This large range of scores is not surprising because a wide range of technical competency items were included in the survey—some of which have been experiencing declining usage for decades (such as COBOL programming which received the lowest importance score). The most important technical competency is 'Using spreadsheet tools', with a scaled importance score of 75.78. The next most important technical skill was 'Using SQL Server' with a scaled importance score of 51.04. The difference between these scores was significant at the 0.001 level of alpha. The two lowest scoring items in this category are programming in specific programming languages (C and COBOL), and the five lowest scoring items, all receiving a score below 10, involve using specific programming languages or database management systems (DBMSs). These results may be at least partially explained by the fact that some technologies are declining in popularity and usage, while others are increasing. For example using SQL Server (a DBMS that may be considered to be increasing in popularity) ranks 2nd highest among the technical competencies included, with an importance score of 51.04, while Sybase ranks 3rd lowest with an importance score of only 5.47.

Skill	***Scaled Mean***
20. Anticipating implementation problems	72.40
14. Gathering and documenting system requirements	70.31
38. Creating effective documentation for applications	70.05
36. Using a specific computer operating system	65.36
33. Using a specific database management system (Oracle, Sybase, SQL Server, MySQL, etc.)	61.98
39. Creating or evaluating computer security and privacy policies	51.82
13. Performing a feasibility analysis	51.82
35. Using software testing tools and strategies	50.00
19. Designing system architecture	46.88
30. Data modeling	44.79
16. Designing user interfaces	44.27
31. Writing stored procedures, views, and triggers	42.19
21. Computer programming	41.67
29. Using a specific software development methodology	40.10
22. Programming in a scripting language	39.21
32. Performance tuning of databases	38.80
25. Developing web applications	37.76
15. Writing use cases	37.24
24. Developing applications in multiple environments/platforms	36.46
27. Creating web pages and web sites	35.26
26. Developing web services	35.00
17. Performing object-oriented design	34.47
34. Creating data warehouses or data marts	32.81
23. Programming in an object-oriented language	30.79
18. Applying software design patterns	28.72
37. Working in a mainframe environment	20.83
28. Using software development frameworks (Spring, Struts, Hibernate, etc.)	20.79

Table 10: Importance of Core Technical IS Knowledge Category Items

Skill	***Scaled Mean***
104. Using spreadsheet tools (Excel, Lotus, Quattro Pro, etc.)	75.78
101. Using SQL Server	51.04
115. Creating Flow Charts	48.18
105. Using project management tools (MS Project, etc.)	44.53
108. Using report generators (Crystal Reports, Cognos, Impromptu, etc.)	39.06
114. Creating Data Flow Diagrams (DFDs)	39.06
100. Using Oracle	35.68
109. Using data analysis and data mining tools	35.42
98. Using MS Access	35.26
111. Using business intelligence platforms (Bus Objects, Cognos, Oracle, etc.)	32.55
103. Using data warehousing tools	32.55
107. Using Enterprise Resource Planning (ERP) tools (SAP, etc.)	30.73
110. Using OLAP tools (PowerPlay, Pivot Tables, etc.)	29.43
113. Using Agile development methods	28.65
112. Using integrated development environments (IDEs) (Visual Studio, Eclipse, etc.)	27.08
95. Creating HTML pages	26.30
96. Processing XML documents	25.78
99. Using MySQL	22.14
91. Using the .Net Framework	21.35
116. Creating or reading UML diagrams	19.27

88. Programming in Java	18.75
89. Programming in Visual Basic	17.45
85. Programming in C#	17.19
93. Developing applications using ASP	16.41
106. Using statistics tools (SAS, SPSS, Minitab, etc.)	15.36
92. Using the Java J2EE Framework	14.06
90. Programming in PHP	10.94
94. Developing applications using JSP	10.68
97. Using DB2	8.16
86. Programming in C++	7.03
102. Using Sybase	5.47
84. Programming in C	3.65
87. Programming in COBOL	3.65

Table 11: Importance of Technical Competency Category Items

Because database professionals and computer programmers use specific DBMSs and programming languages and not others, these specific skill importance results should not be used to assess the importance of computer programming or database usage in general. Item number 33 in the Core Technical IS Knowledge category assessed the importance of using DBMSs in general. This item received an importance score of 61.98, which is higher than the highest specific DBMS score of 51.04 for item 101—Using SQL Server. Similarly, item number 21 in the Core Technical IS Knowledge category, which assess the importance of computer programming in general, received an importance score of 41.67 which is much higher than the highest individual programming language ranking of 18.75 for item 88—Programming in Java.

Although the use of some database management systems ranks very low on importance, the 5th most important skill in the Core Technical IS Knowledge category (out of 27 skills) is 'Using a specific database management system.' SQL Server is the most important DBMS, followed by Oracle and MS Access. Table 12 shows the six database management systems included in the survey, listed in order of importance. The differences are all statistically significant except the difference between Oracle and MS Access and the difference between DB2 and Sybase.

DBMS	***Scaled Mean***	***p-value***
SQL Server	51.04	.001***
Oracle	35.68	.477
MS Access	35.26	.002**
MySQL	22.14	.000***
DB2	8.16	.075
Sybase	5.47	-

*p<=.05, **p<=.01, ***p<=.001

Table 12: Relative Importance of Database Management Systems

Programming Language	***Scaled Mean***	***p-value***
Java	18.75	.327
Visual Basic	17.45	.469
C#	17.19	.038*
PHP	10.94	.020*
C++	7.03	.008**
C	3.65	N/A
COBOL	3.65	-

*p<=.05, **p<=.01, ***p<=.001

Table 13: Relative Importance of Programming Languages

Java is the most important programming language included in the survey, followed closely by Visual Basic and C#. As shown in Table 13, the differences between the top three programming languages are not statistically significant. The least important programming languages are C and COBOL.

6.2 Skill Gap and Curriculum Priority Results

Skill gaps were identified for 21 of the 104 skill items included in the survey. However, a comparison of the mean importance and competency scores for each skill gap item indicates that only 7 of the skill gaps are statistically significant.

Table 14 shows the skill gap information by skill category. All of the statistically significant skill gaps are from the Personal and Interpersonal categories. Of the 21 total skill gaps identified, 10 are from the Personal category and 5 are from the Interpersonal category. The 10 items from the Personal category represent 2/3 of the total items in the Personal category, and the 5 items from the Interpersonal category represent 50% of the total items in the Interpersonal category. Of the 6 remaining skill gap items, 3 are from the Core Technical IS Knowledge category, 2 are from the Technical Competencies category, and 1 is from the Core Managerial IS Knowledge category. No skill gaps were identified from the Organizational category.

Consistent with both the importance results and the skill gap results, the categories with the highest curriculum priority are Personal and Interpersonal. Appendix C shows all items listed in descending order by curriculum priority. Of the 20 items with the highest curriculum priority, all but

one are from the Personal or Interpersonal categories—including 14 of the 15 total Personal items. The remaining Personal item has the 22nd highest curriculum priority, and all Personal and Interpersonal items are included in the 29 highest curriculum priority items.

7. DISCUSSION AND CONCLUSION

Consistent with prior studies, these results indicate that 'soft' skills are more important to MIS professionals' career success than technical skills. Direct comparisons of skill importance with the results of prior studies is difficult because no prior study evaluated a list of skills as extensive as those evaluated in the current study. However, observations of similarities and differences between this and prior studies are still possible. Fang et al. (2005) evaluated only three Personal skills and found their order of importance to be 1) critical thinking skills, 2) personal motivation, and 3) creative thinking skills. The current study evaluated 15 Personal skills and found critical thinking to be 5th most important. However, the three Personal skills evaluated by Fang et al. appear in the same importance order in the current study (5th, 10th, and 15th).

Fang et al. evaluated only two Interpersonal skills and found their order of importance to be: 1) team skills and 2) communication skills. McMurtrey et al. (2008) also found team skills to be more important than communication skills. The current study found listening and oral communication skills to be more important than working effectively in teams, but found working effectively in teams to be more important than written communication skills

Skill	*Skill Gap*	*p-value*
Personal		
74. Managing time effectively	7.55	.001***
75. Perform multiple tasks at the same time	3.38	.029*
78. Attention to detail	3.12	.029*
71. Accomplishing assignments	2.86	.047*
70. Analyzing problems and developing solutions (critical thinking skills)	2.08	.148
73. Making decisions	1.56	.213
72. Learning new skills and concepts	1.04	.318
69. Generating new ideas (creative thinking skills)	0.52	.417
82. Organization skills	0.52	.396
77. Working under pressure	0.26	.451
Interpersonal		
64. Listening to others	5.73	.004**
67. Managing stakeholder expectations	5.47	.008**
61. Oral communication skills	4.94	.009**
63. Writing clearly and effectively	2.34	.118
65. Persuading others	0.52	.415
Core Managerial IS Knowledge		
41. Awareness of IS technological trends	0.79	.374
Core Technical IS Knowledge		
39. Creating or evaluating computer security and privacy policies	2.86	.143
20. Anticipating implementation problems	2.35	.133
32. Performance tuning of databases	1.69	.204
Technical Competencies		
92. Using the Java J2EE Framework	2.08	.204
88. Programming in Java	1.04	.366

*p<=.05, **p<=.01, ***p<=.001

Table 14: Skill Gaps by Category

.

Fang et al. evaluated two Core Managerial IS Knowledge skills and found their order of importance to be: 1) awareness of IS technology trends and 2) visions about IS/IT competitive advantage. The current study evaluated eight skills in this category and found three to be more important than either of the skills evaluated by Fang et al., but the skills that were common in this category appeared in the same order of importance in the current study as in Fang et al.

In the Core Technical IS Knowledge category, Fang et al., McMurtrey et al., and the current study all found database knowledge to be more important than computer programming. Fang et al. and the current study found the ability to create documentation to be most important in this category, whereas, this skill was not evaluated by McMurtrey et al. These results indicate that although the current study evaluates a much larger number of skills than prior studies, the results are comparable to prior job skill studies.

The study found programming with specific programming languages and using specific database management systems to be among the least important skills of MIS graduates, although using database management systems in general (without specifying a particular system) was still considered to be important, with an importance score of 61.98. Additional research should be performed to identify a minimum level of programming and database knowledge that is required for career success of MIS graduates.

There are important differences among computer programming and database usage skills. Among database management systems, SQL Server was found to be most important, with Oracle as a distant second. Among

programming languages, Java, Visual Basic, and C# were all more important (with no statistically significant differences between them) than PHP, C++, C and COBOL.

Although these results seem to indicate that soft skills are more important than technical skills, there are at least two reasons why caution should be exercised in using these results as a reason to de-emphasize technical skills in MIS programs. First, the list of technical competencies evaluated in this study includes specific items that are known to be in declining usage, such as COBOL and Sybase, which would have the effect of lowering the mean importance ranking of the entire category. Second, the importance of skills evaluated in the soft skill categories, such as Personal and Interpersonal tend to be complementary. Respondents are likely to view all skills in the Personal and Interpersonal categories as being important to their career success. However, respondents are likely to view only a small subset of technical skills that are directly related to their employment position as being important to their career success. Because different positions require different technical competencies, the resulting high and low scores given by individual respondents would cancel each other out, resulting in a lowering of the importance rankings of both the individual items in the technical competencies category and the mean importance ranking of the category. This canceling effect would also lower the average importance rankings of the Core Technical IS Knowledge category, because for example, database administrators would rate programming skills as being less important than database skills, and programmers would rate database skills as being less important than programming skills.

This canceling effect, combined with the inclusion of items in the technical competencies category that are known to be in declining usage, may explain the difference (shown in Table 4) in the average importance rankings of the categories when evaluated based on the mean importance of the skills in the category versus the rankings resulting from the direct rating of skill category importance. When performing a direct rating of skill category importance, respondents rated the Personal category—which was highest by mean skill importance—as only 5th most important out of 6 categories, and they rated Technical Competencies—which was last by mean skill importance—as 2nd most important. This may indicate agreement on the overall importance of technical skills, while also indicating disagreement on which technical skills are important. Additional research is necessary to evaluate whether this discrepancy is a result of the canceling effect described above and how it impacts this and other job skill studies.

The largest skill gaps and the highest priority items for curriculum adjustment are in the areas of Personal and Interpersonal skills. Of the 21 items exhibiting skill gaps, all but 5 are from the Personal and Interpersonal categories and all of the statistically significant skill gaps are from these two categories. Similarly, of the 20 items with the highest curriculum priority, all but 1 are from the Personal and Interpersonal categories. The items in these categories are equally applicable to all business majors, indicating that the compelling need for curriculum adjustment in our MIS program is in the general business portion of the major. These results also highlight a need to teach and reinforce Personal and Interpersonal skills in all courses of the major (Downey et al., 2008). These results indicate that schools considering curriculum adjustments in their MIS programs should carefully consider whether Personal and Interpersonal skills are appropriately emphasized and reinforced throughout the curriculum.

The items with the highest curriculum priority are: managing time effectively, listening to others, accomplishing assignments, oral communications skills, and dependability. The technical competency with the highest curriculum priority, and the only one appearing in the top 1/3 of curriculum priority items, is 'Using spreadsheet tools'. Only two items from the Core Technical IS Knowledge category—anticipating implementation problems and creating effective documentation—were in the top 1/3 of curriculum priority items.

Although this research has made a significant contribution to the understanding of the skills required of MIS graduates to succeed in the work place, the most important contribution may be in the survey and research methodology used. The survey (presented in its entirety in appendix A) along with the research methodology described here, can be used by any MIS program wishing to gain an understanding of the MIS related skills contributing to the success of its graduates and any skill gaps that may exist in its current MIS curriculum.

8. REFERENCES

Alshare, K. A., Lane, P. L., and Miller, D. (2011) "Business Communication Skills in Information Systems (IS) Curricula: Perspectives of IS Educators and Students," Journal of Education for Business,Vol. 86, No. 3, pp.

Cappel, J. J. (2001) "Entry-Level IS Job Skills: A Survey of Employers," Journal of Computer Information Systems,Vol. 42, No. 2, pp. 76-82.

Davis, D. C., and Woodward, B. (2006) "An Analysis of Skills Required of Graduates of an Information Systems Program," Information Technology, Learning, and Performance Journal,Vol. 24, No. 2, pp. 11-21.

Downey, J. P., McMurtrey, M. E., and Zeltmann, S. M. (2008) "Mapping the MIS Curriculum Based on Critical Skills of New Graduates: An Empirical Examination of IT Professionals," Journal of Information Systems Education,Vol. 19, No. 3, pp. 351-363.

Fang, X., Lee, S., and Koh, S. (2005) "Transition of Knowledge/Skills Requirement for Entry-Level IS Professionals: An Exploratory Study Based on Recruiters' Perception," Journal of Computer Information Systems,Vol. 46, No. 1, pp. 58-70.

Gallivan, M. J., Truex, D. P. I., and Kvasny, L. (2002) "Changing Patterns in IT Skill Sets 1988-2003: A Content Analysis of Classified Advertising," The DATA BASE for Advances in Information Systems,Vol. 35, No. 3, pp. 64-87.

Golding, P., Tennant, V., and Donaldson, O. (2008) "An empirical classification of employability skills for entry level IS/IT Professionals," Paper presented at the AIS SIG-ED IAIM Conference, Paris, France.

Goles, T., Hawk, S., and Kaiser, K. M. (2008) "Information Technology Workforce Skills: The Software and IT

Services Provider Perspective," Information Systems Frontiers,Vol. 10, No. 2, pp. 179-194.

Gupta, J. N. D., Wang, P., and Ravichandran, R. (1994) "An Assessment of Information Systems Education Needs in Taiwan," International Journal of Information Management,Vol. 14, No. 5, pp. 369-384.

Hawk, S., Kaiser, K. M., Goles, T., Bullen, C., Simon, J. C., Beath, C. M., Gallagher, K. P., and Frampton, K. (2012) "The Information Technology Workforce: A Comparison of Critical Skills of Clients and Service Providers," Information Systems Management,Vol. 29, No. 1, pp. 2-12.

Huang, H., Kvasney, L., Joshi, K. D., Trauth, E., and Mahar, J. (2009) "Synthesizing IT Job Skills Identified in Academic Studies, Practitioner Publications and Job Ads," Paper presented at the SIGMIS Conference on Computer Personnel Research, Limerick, Ireland.

Janicki, T. N., Kline, D., Gowan, J. A., and Konopaske, R. (2004) "Matching Employer Needs With IS Curriculum: An Exploratory Study," Information Systems Education Journal,Vol. 2, No. 21, pp.

Janicki, T. N., Lenox, T. L., Logan, R., and Woratscheck, C. R. (2008) "Information Systems/Technology Employer Needs Survey: Analysis by Curriculum Topic," Information Systems Education Journal,Vol. 6, No. 18, pp.

Koppi, T., Sheard, J., Naghdy, F., Chicharo, J., Edwards, S. L., Brookes, W., and Wilson, D. (2009) "What Our ICT Graduates Really Need from Us: A Perspective from the Workplace," Paper presented at the Eleventh Australasian Conference on Computing Education, Darlinghurst, Australia.

Lee, C. K., and Han, H.-J. (2008) "Analysis of Skills Requirement for Entry-Level Programmer/Analysts in Fortune 500 Corporations," Journal of Information Systems Education,Vol. 19, No. 1, pp. 17-27.

Lee, D. M. S., Trauth, E. M., and Farwell, D. (1995) "Critical Skills and Knowledge Requirements of IS Professionals: A Joint Academic/Industry Investigation," MIS Quarterly,Vol. 19, No. 3, pp. 313-340.

Lee, S., Koh, S., Yen, D., and Tang, H.-L. (2002) "Perception Gaps Between IS Academics and IS Practitioners: An Exploratory Study," Information and Management,Vol. 40, No. 1, pp. 51-61.

Lee, S. M., and Lee, C. K. (2006) "IT Manager's Requisite Skills," Communications of the ACM,Vol. 49, No. 4, pp. 111-115.

Leitheiser, R. L. (1992) "MIS Skills for the 1990s: A Survey of MIS Managers' Perceptions," Journal of Management Information Systems,Vol. 9, No. 1, pp. 69-91.

McMurtrey, M. E., Downey, J. P., Zeltmann, S. M., and Friedman, W. H. (2008) "Critical Skill Sets of Entry-Level IT Professionals: An Empirical Examination of Perceptions from Field Personnel," Journal of Information Technology Education,Vol. 7, pp. 101-120.

Meier, R. L., Williams, M. R., and Humphreys, M. A. (2000) "Refocusing Our Efforts: Assessing Non-Technical Competency Gaps," Journal of Engineering Education,Vol. 89, No. 3, pp. 377-385.

Merhout, J. W., Havelka, D., and Hick, S. N. (2009) "Soft Skills versus Technical Skills: Finding the Right Balance for an IS Curriculum," Paper presented at the Americas Conference on Information Systems, San Francisco, California.

Nelson, R. R. (1991) "Educational Needs as Perceived by IS and End-User Personnel: A Survey of Knowledge and Skill Requirements," MIS Quarterly,Vol. 15, No. 4, pp. 503-525.

Noll, C. L., and Wilkins, M. (2002) "Critical Skills of IS Professionals: A Model for Curriculum Development," Journal of Information Technology Education,Vol. 1, No. 3, pp. 143-154.

Plice, R. K., and Reinig, B. A. (2007) "Aligning the Information Systems Curriculum with the needs of industry and graduates," Journal of Computer Information Systems,Vol. 48, No. 1, pp. 22-30.

Richards, D., Marrone, M., and Vatanasakdakul, S. (2011) "What does an Information Systems Graduate need to Know? A focus on Business Analysts and their role in sustainability," Paper presented at the 22nd Australasian Conference on Information Systems, Sydney, Australia.

Richards, T., Yellen, R., Kappelman, L., and Guynes, S. (1998) "Information Systems Manager's Perceptions of IS Job Skills," The Journal of Computer Information Systems,Vol. 38, No. 3, pp. 53-57.

Sumner, M., and Yager, S. E. (2008) "An Investigation of Preparedness and Importance of MIS Competencies: Research in Progress," Paper presented at the ACM SIGMIS CPR Conference on Computer Personnel doctoral consortium and research, Charlottesville, Virginia, pp. 97-100.

Tang, H.-L., Lee, S., and Kho, S. (2001) "Eduational Gaps as Perceived by IS Educators: A Survey of Knowledge and Skill Requirements," Journal of Computer Information Systems,Vol. 41, No. 2, pp. 76-84.

Tastle, W. J., and Russell, J. (2003) "Analysis and Design: Assessing Actual and Desired Course Content," Journal of Information Systems Education,Vol. 14, No. 1, pp. 77-90.

Tesch, D. B., Braun, G. F., and Crable, E. A. (2008) "An Examination of Employers' Perceptions and Expectations of IS Entry-level Personal and Interpersonal Skills," Information Systems Education Journal,Vol. 6, No. 1, pp.

Todd, P. A., McKeen, J. A., and Gallupe, R. B. (1995) "The Evolution of IS Job Skills: A Content Analysis of IS Job Advertisements from 1970 to 1990," MIS Quarterly,Vol. 19, No. 1, pp. 1-27.

Trauth, E. M., Farwell, D. W., and Lee, D. (1993) "The IS Expectation Gap: Industry Expectations versus Academic Preparation," MIS Quarterly,Vol. 17, No. 3, pp. 293-307.

Van Auken, S., Chrysler, E., Wells, L. G., and Simkin, M. (2011) "Relating Gap Analysis Results to Information Ssytems Program Attitudes: The Identification of Gap Priorities and Implications," Journal of Education for Business,Vol. 86, No. 6, pp. 346-351.

Woodward, B. S., Sendall, P., and Ceccucci, W. (2010) "Integrating Soft Skill Competencies Through Project-based Learning Across the Information Systems Curriculum," Information Systems Education Journal,Vol. 8, No. 8, pp.

Yen, D. C., Chen, H.-G., Lee, S., and Koh, S. (2003) "Differences in perception of IS knowledge and skills between academia and industry: findings from Taiwan,"

International Journal of Information Management,Vol. 23, No. 6, pp. 507-522.

Zwieg, P., Kaiser, K. M., Beath, C. M., Bullen, C., Gallagher, K. P., Goles, T., Howland, J., and Simon, J. C. (2006) "The Information Technology Workforce: Trends and Implications 2005-2008," MIS Quarterly Executive,Vol. 5, No. 2, pp. 101-108.

AUTHOR BIOGRAPHY

Jerod W. Wilkerson earned B.S. and M.S. degrees in Accounting from Brigham Young University and a Ph.D. in Management Information Systems from the University of Arizona. Prior to earning his Ph.D. and joining the faculty at Penn State, Erie, he spent several years in industry working as a software developer, a project and business manager, and a consultant. He founded and served as President of The Object Center—a consulting and training company focused on object technology and web development. His consulting and training clients have included the U.S. Department of Defense, several state and local government agencies in Utah and Texas, and over 20 business organizations—including Lockheed Martin, Raytheon Missile Systems, GMAC, J.P. Morgan Chase, and Iomega.

STATEMENT OF PEER REVIEW INTEGRITY

All papers published in the Journal of Information Systems Education have undergone rigorous peer review. This includes an initial editor screening and double-blind refereeing by three or more expert referees.

Copyright ©2012 by the Education Special Interest Group (EDSIG) of the Association of Information Technology Professionals. Permission to make digital or hard copies of all or part of this journal for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial use. All copies must bear this notice and full citation. Permission from the Editor is required to post to servers, redistribute to lists, or utilize in a for-profit or commercial use. Permission requests should be sent to the Editor-in-Chief, Journal of Information Systems Education, editor@jise.org.

ISSN 1055-3096