Are all IT professionals created equally?

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ABSTRACT

Recruiting for IT professionals and preparing them for the job market appear to be two different things. Colleges typically go to great pains to distinguish between computer science, MIS, computer engineering, software engineering, and a host of other IT-related majors.

However, when recruiters come to campus and job descriptions are posted on the internet, the story is quite different. The cry is for IT (information technology) people who may major in any of the above-mentioned technology tracks.

This study investigates and identifies the difference in preparation of IT-related majors on four factors: business knowledge and skills, technology competence, project management competence, and team competence. The study identifies the differences and similarities in preparation and competence in each of four IT related majors. The results have implications for both educators and recruiters.

Keywords: IT skills, IT recruiting, IT academic preparation.

INTRODUCTION

Information technology has changed considerably over the past 25 years. The skills and capabilities of personnel going into the field have also changed. The recruiters for corporations appear to recruit indiscriminately. The advertisements for positions refer to Information Technology and, especially for new college graduates, there appears to be no difference between Management Information Systems (MIS), Computer Science (CS), Software Engineering (SE), and Computer Engineering (CE). On Monster.com a recent ad recruiting an Information Technology Team Leader, read as follows:

> *"The successful candidate will have a 4 year* ***computer science*** *or* ***business degree****. Work experience in the application development life cycle is required with additional skills in project management, quality assurance and business analysis practices a definite plus. In addition to the skills listed, candidates must demonstrate the following behaviors: team work, interpersonal skills, communication, planning/prioritization, and continuous learning."* (Markus, 1997)

This ad implies that recruiters view little difference in the skills of MIS majors relative to the skills of other Information Technology (IT) majors. In a 20 year content analysis of information systems job advertisements, Todd, McKeen, et al (1995) found that employers are looking for technical skills in the preparation of prospective employees, but they were not very specific in the undergraduate majors needed. A later study by Fang et al (2005) also discussed knowledge and skill requirements for entry-level graduates but neither did they go into detail on the undergraduate majors that would produce these skills.

A further examination of job postings in Monster.com was conducted in order to investigate differences that might be specified. In one search, entry level positions, posted over the past 30 days for IT and software development, were analyzed. Thirty-seven of the total of 64 positions (58%) did not specify any particular major. Twenty-seven of the positions identified computer science majors as appropriate preparation for the positions while nine of those stated that computer science or another IT related degree was also appropriate. A second review of job postings was conducted for entry level business systems analysts. Ninety-three postings were identified with 23% of them requiring one or more of the IT-related majors. The remaining more than 75% were non-specific as to major but were requiring technical skills. Thus, we might conclude that the major is less important than the skills developed. However, if differences do exist in these majors, then understanding where those differences lie would be helpful in the firms' recruiting of IT employees.

Two of the important functions of the Human Resources (HRM) department are recruitment and selection, of which Kleiman (1997) makes special note in his book tying human resources practices to competitive advantage. The research upon which Kleiman bases his text includes a major study by Huselid (1995). His dissertation provides the foundation for tying HR practices to strategic advantage. If the practices of recruitment and selection are implemented well, the firm will enjoy reduced costs that will lead to competitive advantage (Rynes and Barber 1990; Rynes, Bretz Jr et al. 1991; Nelson 1997). As a part of their function, the HR department will attempt to create a large pool of highly qualified candidates from which the functional manager may choose. The better the selection criteria and the quality of the pool, the more likely it is that the recruiting costs will be lower (Delaney and Huselid 1996) as will the turnover rate which falls when the hire is appropriate. While the functional manager, for example an IT manager, will participate in the requirements definition and the job analysis, it is usually the HR

department that will provide the first screen of the applicants (2009). Therefore, the more the HR department is able to target the recruits for specific jobs, the more likely they will reduce selection costs to the organization and ultimately, reduce turnover costs, and provide a source for competitive advantage.

To provide such direction, this study looks at the difference and similarities in preparation of students majoring in Management Information Systems as compared to three other IT-related majors: Computer Science, Software Engineering, and Computer Engineering. Four competencies of the individuals in these majors were examined:

- technology competence,
- project management competence,
- team competence, and
- business knowledge and skills.

Therefore, this study attempts to answer the following questions: are there any significant differences between students majoring in MIS and those majoring in other IT-rated disciplines respect to four critical IS skills (technical, project management, team and business). In addition, this research will also investigate if there are any differences among the other three IT-related disciplines with respect to the four critical IS skills above. The study is intended to point out the differences between the preparation and the skills that an employer might expect in their job specification and hiring.

Review of Related Literature

Successful IS professionals need a proper mix of both "soft" skills (e.g. business, project management, and team) and "hard" IT skills (e.g. software, hardware, and networking). Tesch et al. (2003) showed user satisfaction, career satisfaction, job performance were all impacted by discrepancies in business, interpersonal, and technology management skills. Byrd et al. (2004) found correlations between IS skills (technical, business, interpersonal and technology management) and the flexibility of a firm's IS infrastructure and the relative contribution of firm's IT to its competitive advantage. Another study by Chen et al. (2005) discussed the differences between IS staff and IS users and found that the staff rated oral communication more importantly than users and that IS users rated written communications as more important. Gupta and Wachter (1998) found that the skill base for IS personnel had broadened significantly to include many of the soft skills such as teamwork, communication, and creativity. A traditional approach to IT education may not encompass these issues (Gupta, Wang, & Ravichandran, 1994).

However, references to "hard" skills dominate today job postings. Gallivan (2004), after studying 2297 IS job advertisements (both in print and on-line), points out that "hard" technical skills still comprise the vast majority of ad content. In printed ads, "hard" technical skills represent as much as 95% of the ad, with the remaining content devoted to "soft" skills such as communication, leadership and interpersonal skills. Gallivan also reported that content related to "hard" skills dominates, but to a lesser extent, on-line ad content, a media where word count restrictions are less prevalent.

Such over-emphasis on "hard" skills by recruiters is in direct opposition to the IT users and managers who believe IT professionals need more "soft" skills. For example, Leitheiser (1992) surveying 107 Midwestern MIS managers found that interpersonal skills were rated as the most important skills for IS professionals followed next by skills in business, programming and

analysis & design. Expanding the targeted sampling group to IS managers, end-user managers, IS consultants, and IS professors, Trauth (1993) analysis showed that the four groups were in relative agreement in their view that ability to analyze business problems and to analyze IS solutions for the business problems were the top two skills for an IS professional. In another related study, Lee (1995) reported that business functional knowledge and interpersonal/management skills were considered the most important skills for an IS professional while technical skills were viewed as the least important. Richards (1998), based on a survey of 47 IS managers, found that the most highly regarded skills by the sample group were those associated with business or interpersonal skills, while technical skills received the lowest ratings. And Jaing (1994) taking a different approach by surveying 164 recruiters directly involved in hiring IS professionals, revealed that the recruiters themselves believed "soft' skills, such as motivation to work, oral communication, maturity, and appropriate self confidence as the most important, they also felt the least important skills related to computer literacy.

While the previously mentioned studies clearly reveal the importance of both "soft" and "hard" skills for the current IS professional, other research has also shown that these skills have not been equally developed. A study by Yen et al. (2003) demonstrates that, in Taiwan, academics rate the use of tools more important than practitioners and that practitioners rate the "soft skills" such as communication, strategy, and leadership more important than academics. Research by Tang (2000) reveals that educators believed students are deficient in four of the top five "soft" IS knowledge/skills (interpersonal communication skills, critical thinking skills, interpersonal behavior skills and systems development methodologies) and seven of the top ten "soft" skills. However, they also believed students were not deficient in any of the top five technical skills and only deficient in one (#9- 4th generation languages) of the top ten. And Cappel (2001), investigated skill deficiency from the perspective of industry professionals found significant deficiency in "hard" skills when comparing *actual* to *expected* performance in 16 out of 19 skills ($p \leq .05$; with 8 skills being highly significant at $p \leq .001$). Of the 18 "soft" skills investigated, all 18 had significant deficiencies ($p \leq .05$; with 16 being highly significant at $p \leq .001$). With such high deficiencies in IS skills particularly in areas such as general IS knowledge and organizational knowledge, it is evident that academia must respond.

Distinguishing the MIS Major

As a means of better serving the industrial community, by developing the aforementioned skills, and to make a clear distinction between MIS and other IT related majors, the Association for Computing Machinery (ACM), the Association for Information Systems (AIS) and the Association of Information Technology Professionals (AITP) commissioned the development of a curriculum model for IS undergraduate majors (Gorgone, et al., 2003). The goal of the new model was to develop the skills and knowledge needed by IS professionals that have been relatively constant over time. These skills included broad business knowledge, analytical and critical thinking skills, interpersonal and team skills, technical design and development skills. In essence, the Model Curriculum, like curriculum models for other disciplines seeks to provide undergraduate majors with the "right" mix of skills necessary to be productive in positions within their field of expertise.

MIS is unlike majors such as:

- Computing science, which focuses more on study of the theoretical foundations of information and computation (Denning, 2005), or

- Software engineering, where the focus is on the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software is the cornerstone of the discipline (*IEEE Standard Glossary of Software Engineering Terminology*, 1991) or
- Computer engineering, which combines elements of both computer science and electrical engineering and "embodies the science and technology of design, construction, implementation, and maintenance of software and hardware components of modern computing systems and computer-controlled equipment." (*Curriculum guidelines for undergraduate degree programs in computer engineering*, 2004)

On the other hand, the MIS major focuses on developing professionals with the ability to integrate information technology solutions and business processes to meet the information needs of the organization. This allows the organization to achieve a competitive advantage and to be more effective and efficient in their business processes. Professionals in this field utilize technology as an instrument to enable functional areas of the organization to process and distribute information. MIS professionals must understanding the technical side of information systems and have a clear understand of the organization and how it functions. Additionally, they must appreciate and disseminate how the information systems may be used within the organizational functions. Due to their understanding of both the technical and organizational factors, professionals in MIS tend to participate in the design, implementation, and management of new systems and may even take the lead role on the project team. Additionally, they are likely to be the person to work closely with other organization managers and serve a bridging role between organizational professionals and other computing professionals. Training for those looking for a career as an MIS professional must include not only technical skills such as systems analysis, database and some programming languages, but also must emphasize competency in the areas of business functions, project management, teamwork, and have good written and oral communication skills.

METHODOLOGY

In order to determine the difference between students majoring in MIS and the three other IT-related disciplines, a survey was conducted to assess undergraduate students' skill level in relation to project management, teams, and technology and business. The survey was conducted at the end of the semester in a variety of IT-related undergraduate classes in a small college in the northeastern region of the United States. The college has four schools including a school of business (AACSB accredited) and a separate school of engineering (with all programs ABET accredited). These two schools account for approximately 2/3 of the 4000 total student population. A variety of IT-related majors are offered including a management information systems major offered from the School of Business and two IT-related engineering majors: computer engineering and software engineering. The School of Science offers the computer science major.

The survey was distributed in classes in which we expected to find the four IT-related majors. A total of 182 responses were received although the response set was reduced to 93 since our interest was only in the comparison of IT-related majors. The usable responses are shown in Table 1. While the response rates varied in classes, the proportion of each of the majors represented ranged from 39% to 65% with an average of 52.5% overall.

Table 1 Sample Distribution

Major	# Respondents	# Majors in College	% Representation
MIS	50	77	64.9%
Computer Science	17	44	38.6%
Software Engineering	14	26	53.8%
Computer Engineering	12	30	40.0%
Total	93	177	52.5%

Of the 93 respondents, approximately 43% were seniors, 26% juniors, and 29% were sophomores. Only 15% of the respondents were female. This is probably to be expected given the technical nature of the major and the lack of females entering these majors.

Measures

Student Major. In order to define the major, respondents were asked to check a box on the survey. Instead of offering an open-ended question, the fixed alternative choice allowed for no confusion for the respondents. The analysis was conducted on only the four IT-related majors previously mentioned: management information systems (MIS), computer science (CS), computer engineering (CSE), and software engineering (SE).
IS Skills. Technology skills were measured from an adaptation of Nelson's (1991) IS skill instrument. We also adapted items to measure project management skills, team skills, and business knowledge and skills from Lee et al. (1995). They developed and validated items on

Table 2 Factor Analysis

	No. items	α	Items	Factor 1	Factor 2	Factor 3	Factor 4
			I have the ability to …				
Business Skills & Knowledge	5	.92	… interpret business problems.	.85			
			…understand the business environment.	.82			
			…various business functions.	.78			
			…learn about business functions.	.74			
			… develop appropriate technical solutions to business problems.	.73			
Technology Skills	6	.89	…access data (e.g., data retrieval, queries, etc.).		.84		
			…program (e.g., in COBOL, FORTRAN, BASIC, etc.).		.84		
			…build models (e.g., formulate and solve complex simulation models).		.83		
			…handle data communications.		.77		

			…use software packages (e.g. LOTUS 1-2-3, MACDRAW, etc.).		.73		
			…develop (design and implement) databases using a generalized database management system (e.g., IMS, TOTAL, DB2, dBASE III, etc.).		.68		
Team Skills	4	.87	…work closely with others.			.86	
			…work cooperatively in a team environment.			.82	
			…execute work in a team. environment.			.81	
			…deal with ambiguity.			.63	
Project Management Skills	3	.91	…organize projects				.83
			…lead projects				.77
			…plan projects				.70
			Eigenvalues	8.5	3.2	1.6	1.0
			% of variance explained	44.7	17.0	8.5	5.0

critical skills and knowledge requirements of IS professionals. Confirmatory factor analysis was conducted on the seven items from Nelson's study and the 15 items from Lee's work. Several items were eliminated due to cross-loading. The results are shown above in Table 2.

Alpha coefficients were calculated for the items comprising the four factors. The modified scales included four constructs with the following alpha coefficients: .92 (Business Skills), .89 (Technology Skills), .87 (Team Skills), and .91 (Project Management Skills). All scales were consistent with prior literature as noted above.

The constructs were calculated by using the loading factors as regression weights. Thus, the appropriate weight was given to each item in the overall construct score. This method calculates a mean score of 0 for each construct with a standard deviation of 1.0.

ANALYSIS AND RESULTS

An Analysis of Variance (ANOVA) was used for testing the significant difference across groups with a post hoc analysis (LSD) used to test the differences between each of the pairs of majors. Results showed significant differences among the IT-related majors for both Business Skills ($F=4.89$, $df=3,102$, $p<.01$) and Technical Skills ($F=5.06$, $df=3,102$, $p<.01$) while there was no significant difference across majors in either Team Skills (($F=1.69$, $df=3,102$, p=n.s.) or Project Management Skills ($F=.53$, $df=3,102$, p= n.s.).

The post hoc analysis, which compared each pairs of majors, also revealed some significant differences. With respect to Business Skills, there are significant differences between the MIS majors and all other IT-related majors (see Table 3).

Table 3 Post hoc Comparisons of Business Skills and Knowledge

Business Knowledge & Skills	Mean	1	2	3	4
(1) MIS	.34				
(2) Software Engineer	-.35	*			
(3) Computer Engineering	-.38	*			
(4) Computer Science	-.39	***			

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

MIS majors have significantly higher level Business Skills and Knowledge than software engineers, computer engineers or computer science majors. MIS majors typically fall within the business school in a business administration degree in which they are required to take a business core. Thus, our findings make perfect sense. The MIS major is a subset of a business major, which, by definition, is trained, and therefore more comfortable identifying and solving business problems.

We next examined project management skills. In this case there is no significant difference across the majors on project management skills. Likewise, there is no significant difference between any two majors on Project Management Skills. This may be due to the fact that students in each of these majors work on projects and are not more or less likely to be prepared to organize, lead and manage projects. Whether they have skill or experience to manage these projects is another question.

We next examined potential differences in technology skills and found there is a significant difference between MIS and software engineering (see Table 4). Additionally, there were significant differences between software engineering and the other two IT-related majors.

Table 4 Post hoc Comparison of Technology Skills

Technical Knowledge & Skills	Mean	1	2	3	4
(1) Computer Engineering	.46				
(2) Computer Science	.22				
(3) MIS	-.03				
(4) Software Engineering	-.92	***	***	**	

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

Finally, we investigated Team Skills. As stated previously, there is a significant difference across the four majors as to the acquisition of Team Skills. The post hoc comparisons reveal that the MIS perceptions of Team Skills are only significantly different with respect to Computer Science as noted in Table 5. Interestingly, computer science exhibited the highest team skills of all groups. We would have expected that the MIS majors who take many business courses with a team focus to fare well on this scale. However, in this situation, we might hypothesize that computer science majors must do considerable work in teams as they appear to be more comfortable and confident about their ability to work in teams.

Table 5 Post hoc Comparisons on Team Skills

Team Skills	1	2	3	4

(1) Computer Science	.40	
(2) Software Engineering	-.10	
(3) MIS	-.11	*
(4) Computer Engineering	-.18	

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

In summary, MIS majors have a significantly different and a higher level of business knowledge and skills than any of the other IT-related majors. Software engineering majors have a significantly different and lower level of technology skills than any other IT-related major and computer science majors had a significantly different and higher score on Team Skills than MIS majors.

DISCUSSION & CONCLUSIONS

Our initial thoughts were that there should be differences in the skills of IT-related majors that should be identified for recruiters and candidates. Understanding the differences would be helpful in the firms recruiting of IT employees

The Human Resource Department (HR) in a typical organization is the gate keeper for employee recruitment and while hiring departments or functions understand specific needs, HR is likely to select a larger group of people to fill recruitment pool. If they had a better understanding of specific strengths and weaknesses of graduates, they would be better able to target recruits and reduce the costs to the organization.

The implications of our findings are that if employers want to hire someone with business skills and knowledge, all IT majors are not created equally. They should clearly hire the MIS major. Likewise, if other IT-related majors want to be considered for these positions, perhaps they should focus on obtaining a minor in business.

Regarding technology skills, it is inappropriate to say that software engineering majors have a lower level of technology skills than the other IT-related majors. However, our explanation for this finding is that Software Engineering majors have different technical skills. The technology skills in our study appear to be more in line with software packages and business applications and not of the same type studied by Software Engineering majors. While this does not diminish the level or importance of the technology skills of software engineering majors, it is important to recognize that, in this case also, all IT majors are not created equally. Recruiters may want to differentiate among the specific technology skills that are obtained in the various majors.

Finally, while the findings seem to suggest that computer science majors have superior team skills at least with respect to MIS majors (and probably with respect to the other majors given the larger difference – significance most likely limited by the small group size), we should be very careful in interpreting this result. Computer science majors typically work in teams with other computer science majors (as do the other non-MIS majors). However, MIS majors are often placed on teams with other business majors, where technology seems like a foreign language. It is our speculation that when placed in a cross-functional team environment with business centered individuals, the performance of MIS majors would be comparable if not superior to computer science majors. This statement by no means suggests that no further development of team skills is necessary by MIS majors. On the contrary, anecdotal evidence by

the researchers and other faculty in the school of business clearly identify the need to for MIS majors to develop better team skills.

RESEARCH LIMITATIONS AND FUTURE DIRECTION

One of the limitations of this study is that it is a self assessment by students. The perception of differences does not necessarily test whether the differences actually exist. This study lays the groundwork for further work specifically testing actual skill differences. Further, we must ask if employers see a difference in skills, if functional managers and Human Resource recruiters see a difference in skill levels.

From a curricular perspective, how do these skills develop over the curriculum and is there a difference as students progress through the program? Are there changes that should be made to make the job skill requirements more specific to further differentiate the majors or should there be a curricular move to make the majors more similar?

Finally, the more that the recruiter as the gatekeeper understands the differentiated skills of IT-related majors, the more likely there will be a better match between job requirements and recruit and lead to a cost competitive advantage for the firm. The recruiters and the recruits need to understand that all IT majors are not created equally.

In conclusion, this paper identifies the differences between MIS and other IT-related majors in four critical skill areas. Recruiters do not focus on the differences among the majors and appear to recruit indiscriminately. This study identifies the differences and makes suggestions for recruiters and educators so that they may select the appropriate mix of skills for potential employees.

By adopting the curriculum model for IS undergraduate majors (Gorgone, et al., 2003), we determined that differences really do exist (at least with respect to student perceptions) between MIS and other IT-related majors in both "hard" and "soft" IT skills. Some differences even exist between various IT-related majors.

There are several limitations to this study. First, the sample size is small for several majors, namely software and computer engineering. Our study was limited to one university. Finally, this research indirectly provides a limited test of the effectiveness of the IS undergraduate curriculum model in developing these "hard" and "soft" IT skills in IS majors. Evidence that such distinctions exist and in what areas they exist provides academia with some recommended areas for improvement.

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