

Skill Requirements for Entry-Level IS Graduates: A Report from Industry

Craig Van Slyke, MIS Ohio University

Copeland Hall 236 Athens, OH 45701 (740) 593-0819 vanslyke@ohiou.edu

Marcy Kittner, CIS

The University of Tampa 401 W. Kennedy Blvd. Tampa, FL 33606 (813) 253-3333 mkittner@alpha.utampa.edu,

Paul Cheney, ISDS University of South Florida 4202 E. Fowler, CIS 1040 Tampa, FL 33620-7800 (813) 974-5524 pcheney@coba.usf.edu

ABSTRACT

Detennining what skills employers of new IS graduates desire is important in guiding IS educators in designing curriculum and in advising students. This study reports the results of a pilot study which attempts to gain insight into the previously mentioned question. The findings indicate that basic technical skills, such as systems analysis and design, and database concepts, and non-technical skills, such as teamwork and communications skills, are more important than specific technical skills.

INTRODUCTION There is much debate over how universities and colleges should prepare their graduates for successful entry into the job market. Information Systems (IS) departments are faced with the same issues that drive the aforementioned debate: how to educate their students so they can get good jobs, and also be successful in their careers. In addition, IS departments are faced with problems related to the dynamic nature of information technology (IT). Issues such as the emergence (and possible decline) of client/server and the associated decline in mainframes, how to harness the power of the Internet, and the rise in end-user computing all raise questions regarding how IS educators should prepare their students for the "new" world. Which language(s) should be emphasized--C, COBOL, Visual Basic? Should Data Communications be a required course? These and other questions require a knowledge of the nature of the IS profession, including how to successfully enter that profession.

While several studies in the recent IS literature have examined what skills help IS professionals advance in their careers (Cheney; et al., 1990; Leitheiser, 1993; Lee, et al, 1995), few have studied the

skills that employers look for when hiring recent graduates. This is the purpose of the study reported here--to try to determine just what skills employers find important when making hiring decisions regarding recent IS graduates. This paper reports the results from the first phase of an investigation into the importance placed on various skills.

The paper is organized as follows. We begin by setting the scope of the project and discussing why it is important. This is followed by a discussion of previous research that relates to this project. Next, the methodology used in this study is described. Then we present the study's results--including how they compare with the recent 1995 curriculum guidelines (Cougar, 1995). Finally, we discuss the study's implications and draw some conclusions.

SCOPE AND IMPORTANCE OF THE STUDY The study reported here is preliminary in nature--it is the first phase of a two phase project. This phase has two goals. First, we hope to gain preliminary insight into the following research question: What skills do employers of recent IS program graduates find important when evaluating job candidates for entry-level positions?

Also, as an extended pilot study, we want to refine our data

gathering instrument primarily by refining the list of skills. While the results from any preliminary study should be taken with some skepticism, we feel that the sample (described in the Methodology section) represents a cross section of IS employers and that the results reported here may be at least somewhat representative of the feelings of IS employers as a whole.

It is important for IS educators to understand what employers desire when searching for and selecting new graduates for career positions (Nelson, 1988). Research such as that reported here can help educators in several ways. First, the results can help guide curriculum decisions (Nelson, 1988), such as what courses to require, or what languages to teach. In addition, individual educators can use the results to help them in designing individual courses. For example, the heavy importance placed on team and group work (see the Results section) may lead educators to emphasize team projects more than they would otherwise. Finally, the results can be used to help with advising duties. Students routinely seek guidance regarding course selection, and a good knowledge of what employers seek in new graduates can clearly help educators provide students with sound advice.

PREVIOUS RESEARCH IS researchers have paid little attention to entry-level job skill requirements. Studies have examined skill requirements within specific IS job classifications, such as systems analysts (Mistic, 1996), as well as skill requirements for IS professionals in general (Lee, et al., 1995; Athey, et al., 1995-1996; Prabhakar, 1996), but have not specifically investigated skill requirements for entry into the IS profession. In this section we briefly discuss the findings of previous studies which have researched job skill requirements.

Successful IS professionals need to possess both good technical skills and interpersonal and communications skills (Nelson, 1988; Cheney, et al., 1990; Leithiser, 1993). Most extensive studies of skill requirements find that the "soft" skills -human relations, communications, organizational skills and the like- are at least as important as technical skills, especially as the professional moves into more managerial roles (Nelson, 1988; Cheney, et al., 1990; Lee et al., 1995).

The practitioner literature has also examined IS skill requirements. For example, studies of skill requirements for systems analysts tend to agree with the findings of academic researchers--a mix of interpersonal, technical and organizational skills provides for a sound skill foundation for the IS professional (Blank & Barratt, 1988; Mistic, 1996).

As we have seen in this section, there is some level of agreement as to what skills are desirable for IS professional to possess. However, none of the studies cited specifically examines the skill set necessary for successful entry into the IS profession, which is the subject of this study.

In the following section, the methodology used to investigate the previously mentioned research question is described.

METHODOLOGY

In this section, we discuss the methodology used in this study. We begin by describing the instrument development process, follow with a description of the sample used, and conclude by describing how the instrument was administered.

The first step in developing the instrument was to develop an initial list of skills to include in the questionnaire. In order to accomplish this we drew from several sources, including recruiting material from major employers, employment listings obtained from university placement departments, internship listings, help wanted advertisements and informal discussions with placement personnel. Skills included in prior studies were also included. The authors performed this step independently and the lists were then consolidated. This consolidated list was aggregated into groups of related skills, including general IS skills, programming languages, operating systems, networking, database management systems, other IS skills, general skills and business-related skills. The authors discussed and reached agreement on the groupings.

After constructing the initial skills list, a draft of the actual instrument was prepared and administered to several knowledgeable individuals, including industry professionals and faculty members with industry experience and/or knowledge of the IS job market. This pilot test served several purposes. First, comments from the pilot test were used to improve the skills list and the questionnaire layout. Subjects for the pilot test were also asked to mark how long they spent in taking the survey. This estimate was included in a participation request message sent to possible subjects.

In order to get a reasonably representative cross-section of employers for this survey we used several sources to obtain possible participants. These sources included local IS-related help wanted advertisements, recruiting advertisements in Computerworlds Campus Edition (1996), job posting on several Internet employment sites, and national employers with local offices known to the authors. An email message or phone call was used to request the organization's participation which resulted in 35 favorable responses.

The sample includes organizations from a variety of industries, including utilities, consulting, government, financial services, insurance, education, software development, and retail. The respondents are also geographically dispersed, although the majority are from the central Florida area. While this sample certainly can not be considered to be random, it does seem to represent a cross-section of employers and may be satisfactory for a preliminary study.

The questionnaire was administered both in paper form and via email. Although the sample size in this preliminary study is insufficient to test for significant differences between the paper and email questionnaire, visual inspection did not reveal any consistent differences. Subjects were asked to rate each skill on a scale of 1 (not important) to 5 (critical). Respondents also had the opportunity to add skills to the given list.

RESULTS Analysis of the questionnaires received to date reveals some interesting information, which is reported in this section. Each group of skills will first be discussed individually. This is followed by a brief comparison of these results to findings of earlier studies, and we finish by drawing some general conclusions regarding the results. Summary results are shown in Appendix A. Detailed results appear in Appendix B.

GeneralIS Skills: The responses for this skill group display variability in the mean ratings for the various individual skills, although not as much as some of the other skill groups. While the group mean rating was above the overall mean rating (3.582 vs.

3.414), some of the skills were rated relatively low. For example, CASE tools (2.400) and telecommunications (2.933) were both below the overall mean. Conversely, database concepts (4.533), systems analysis and design (4.267) and structured programming (4.063) were among the more highly rated skills. Informal discussions with recent graduates indicates that many employers are "quizzing" job prospects on their systems analysis and database concepts skills by asking applicants to read data and process models and by asking extensive questions on database concepts.

There were some surprising results in this category; most notably the low rating of telecommunications. Given the recent interest in electronic commerce, the Internet, and intranets, the authors anticipated that telecommunications would be more highly rated. There are several possible explanations for this result. It may be that employers look more toward computer science graduates for their telecommunications needs. Another possibility is that these subjects were more interested in specific areas within the telecommunications umbrella, especially given the high rating of the networking skill group (group mean of 3.700, discussed later). Another possibility is that the term "telecommunications" is simply too general. It should be noted that the relatively high standard deviation (1.387) in the ratings indicates that our respondents were not in agreement as to the importance of telecommunications skills.

Programming Languages: The skills in the programming languages skill group received, in general, relatively low ratings. The mean rating for the skills in the group (2.862) was well below the overall mean (3.414). However, there was significant variability in the ratings within the group as evidenced by the group standard deviation of 1.441. Not surprisingly; several "hot" programming languages were rated highly such as Visual Basic (4.000), C (3.647), and C++ (3.706).

Not surprisingly; "older" languages did not fare well. ADA (1.733), RPG (1.667) and Assembler (1.733) all received ratings well below the group and overall means. The authors were somewhat surprised by the relatively low rating of COBOL (2.733), given recent reports of signing bonuses for COBOL knowledgeable graduates. It may be that employers feel that they can train individuals in programming COBOL as long as they are equipped with good basic skills. This is especially true of large organizations--traditionally heavier users of COBOL--since they have the resources to train new graduates. Anecdotal evidence from some of our recent graduates indicates that this may be the case, although no firm conclusions should be drawn. It is also interesting to note the relatively high standard deviation of the COBOL ratings, indicating that our subjects were not in agreement as to the importance of COBOL skills.

Operating Systems: Similar to the programming skills group, the operating systems (OS) skill group shows wide variability in the ratings of individual skills with a group standard deviation of 1.498. In general, PC and workstation OSs tend to be rated highly; while mainframe OSs were rated well below the overall and group (3.094) means. The exception to this generalization is with O/S 2, which had a very low rating of 1.933. Our respondents rated skill with Windows/Windows 95 (4.375) and Unix (4.294) as important, while JCL (2.375), VMS (1.933) and CICS (2.00) were rated as being relatively unimportant. The ratings in this category were not unexpected. Even though the predictions of the disappearance of the mainframe were pre-

mature, it seems reasonable that there is an existing supply of professionals knowledgeable in mainframe OS's, so employers look to recent graduates for knowledge in newer operating environment.

Networking: As a skill group, networking was rated higher than the overall mean (3.700 vs. 3.414). All but three of the skills in this category (email administration, system security, and interoperability) received ratings above the overall mean. However, unlike the programming category, none of the low rated skills were substantially below the overall mean. It appears that almost any networking skill is desirable, but particularly popular were Windows NT (4.313), Novell Netware (4.125) and client/server (4.294) skills. This is not surprising considering the current popularity of these areas. It is also interesting to note that in the higher rated skills, the standard deviation of ratings was low relative to the lower rated skills. It appears that there is general consensus on the "hot" skills--a consensus not reached on the less popular skills.

Database Management Systems: As in the programming languages and operating systems categories, the database management system (DBMS) skill group exhibits wide variation in how subjects rated the various skills (standard deviation of 1.420). Although the group mean of 3.278 is slightly below the overall mean (3.414), several of the individual skills received ratings well above the mean. For example, Oracle (3.938), and Sybase (3.600), both proprietary DBMS, and SQL (4.375), a nonproprietary database query language, were all rated above the overall mean. This is not an anticipated result--Oracle, Sybase and SQL are increasingly popular in industry. Informal discussions with recent graduates confirm that many employers are indeed interested in database skills in general, and in Oracle and SQL skills in particular.

Other Information Systems Skills: The skills in this grouping were placed in this category only because there was not a natural place for them in another group. Because of this, it seems inappropriate to discuss the group as a whole, so the discussion is restricted to individual skills within the group. Only two of the skills in this group, PC applications (3.563) and end-user support (3.438) were rated higher than the overall mean rating (3.414). This may reflect the fact that these skills are more general in nature, while the lower rated skills in this category tended to be more specialized.

General Skills: This skill group consisted of skills which were not technical in nature, and did not fit into the business-related skills group. These skills were seen by respondents as being of considerable importance, as reflected by the mean rating of the skills in this group (4.373), which is much higher than any other skill group. The networking group, the second most highly rated group, had a mean rating of over 0.60 points lower than the this group's. There was also little variability in the ratings. The overall standard deviation for the group (0.709) was much lower than the group standard deviations of any other group, indicating that these subjects were in general agreement on the ratings. All of the skills in this group received ratings higher than the overall mean (3.414). In

fact, the lowest rated skill in this group, leadership (3.706) was still considerably higher than the overall mean. The highest rated skill in this group, analytical ability (4.824), was also the most highly rated overall. Both oral (4.529) and written (4.353) communications skills were highly rated, as was listening skill (4.529), confirming what many IS educators have been telling students for some time. It also appears that

the ability to work in groups and teams is important to employers, as evidenced by the high ratings for working with others (4.471), team-work (4.529), and ability to work in groups (4.529). Employers also seem to desire IS employees who are self-motivated (4.647).

The message sent by these subjects seems consistent with that sent by the practitioner press--"soft" skills are increasingly important for IS professionals. Several recent articles indicate that executives are demanding that IS professionals become more skilled in such areas as writing memos and listening closely to their associates (Davis, 1993) and that communications and interpersonal skills are more important than technical skills (Mistic, 1996).

Business Related Skills: The authors were somewhat surprised by the mediocre ratings of the skills in the business related skills group (group mean of 3.402). Only understanding business function areas (3.882) was rated well above the mean, although user interviewing (3.471) and quality assurance (3.471) were both slightly above the overall mean (3.414). We expected that the skills in this category would be more highly rated. It is possible that employers feel that if new hires possess the types of skills found in the general skill group they can acquire the business related skills once they are on the job.

These findings seem to be in general agreement with prior studies of the skill requirements of IS professionals. This study's findings on the importance of interpersonal, communications and analytical skills agree with findings of earlier studies which point to the need for interpersonal, communication and business skills for experienced IS personnel (Leitheiser, 1993; Lee et al., 1995).

In this section, we presented and discussed the results of our survey. In some cases, the results followed what most IS educators might suspect; in others, the results were quite surprising. But the employers surveyed in this study seem to be sending some loud and clear messages. First, the importance of general thinking, communication, and interpersonal skills such as analytical, team-work, and listening skills is clear, at least in this sample. Employers want IS graduates who can think, communicate, and work well with others. They also want individuals who have a good grounding in basic IS skills such as systems analysis and design and database concepts. These employers seem to be less interested in more specific technology skills.

In the next section, we will examine how well our results match with the often cited IS'95 curriculum guidelines (Cougar, et al., 1995).

COMPARISON TO 15'95 CURRICULUM GUIDE One of the possible implications of this research is its impact on curriculum design. Skills assessments and curriculum guidelines are both important in helping IS departments prepare for jobs in IS. In that vein, a comparison of the findings of this survey to the IS'95 undergraduate curriculum guideline's attributes of IS program graduates (Cougar, et al., 1995) may be interesting. IS'95 is a report from a joint curriculum development effort of the Association for Computing Machinery, the Association for Information Systems, the Data Processing Management Association and the International Conference on Information Systems. In addition to providing a model undergraduate IS curriculum, IS'95 describes output attributes of graduates. In an effort to compare our results to the desired attributes as

expressed in 15'95, we mapped skills from our survey onto the 15'95 graduate attributes. (A summary of this mapping is available from the first author.)

For the most part, the skills that were rated highly by our respondents fit with the desired attributes of 15 graduates as expressed by 15'95. (The interested reader is directed to the published 15'95 guideline for further explanation of the attribute categories.) For example, communication skills received universally high ratings by our respondents and are also noted as desirable attributes of 15 graduates by 15'95. The same holds true for the other attribute categories.

CONCLUSIONS Based on the preliminary results of this study, it seems that employers find basic technical, and "soft" skills more important than more specialized technical skills when evaluating recent IS graduates for entry-level positions. This is, in general, in agreement with previous studies of the skill required as IS professionals advance in their careers. Further, it appears that these results are also, generally, in keeping with the recent 15'95 curriculum guidelines (Cougar, et al., 1995).

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APPENDIX A - SUMMARY RESULTS

Skill Category	Mean	Median	St. Dev.
General IS	3.582	4.0	1.179
Programming Languages	2.862	3.0	1.441
Operating Systems	3.094	3.0	1.498
Networking	3.700	4.0	1.097
DBMS	3.278	4.0	1.420
Other IS	3.024	3.0	1.297
General	4.373	4.0	0.709
Business Related	3.402	3.0	1.171

APPENDIX B - SUMMARY RESULTS

Skill	Mean	Median	St. Dev.
<u>General IS</u>			
Sys. An. & Des.	4.267	5.0	0.961
CASE tools	2.400	2.0	0.986
Database concepts	4.533	5.0	0.640
System testing	3.938	4.0	0.929
DSS an. & des.	3.200	3.0	1.265
Telecommunications	2.933	3.0	1.387
OO an. & des.	3.467	4.0	1.125
Prototyping	3.333	4.0	1.113
Documentation	3.625	4.0	1.025
Structured prog.	4.063	4.0	0.772
<u>Prog. Lang.</u>			
COBOL	2.733	3.0	1.668
C	3.647	4.0	1.412
C++	3.706	4.0	1.404
Visual Basic	4.000	4.0	1.155
4GLs	3.071	3.0	1.328
HTML	3.353	4.0	1.115
RPG	1.667	1.0	0.976
ADA	1.733	1.0	1.163
Assembler	1.733	1.0	0.961
Unix Shell Script	3.000	3.0	1.211
Java	3.063	4.0	1.237
Delphi	2.267	3.0	1.163
<u>Operating Systems</u>			
Unix	4.294	4.0	0.772
MS-DOS	3.563	3.5	1.263
Windows / Windows 95	4.375	5.0	0.806
OS/2	1.933	2.0	0.884
Windows NT	3.941	4.0	0.899
JCL	2.375	2.0	1.455
VMS	1.933	1.0	1.335
CICS	2.000	1.0	1.363
<u>Networking</u>			
Windows NT Server	4.313	4.0	0.602
Novell Netware	4.125	4.0	0.619
Client/Server	4.294	4.0	0.686
Email administration	2.938	3.0	1.289
System security	3.133	3.0	1.060
TCP/IP	3.875	4.0	1.088
Interoperability	3.071	3.0	1.207

Skill	Mean	Median	St. Dev.
<u>DBMS</u>			
Clipper	1.733	1.0	0.961
DB2	2.667	3.0	1.447
Informix	3.133	3.0	1.356
MS Access	3.375	4.0	1.455
Oracle	3.938	4.0	1.289
SQL	4.375	4.5	0.719
Sybase	3.600	4.0	0.986
<u>"Other" IS</u>			
Distributed systems	3.133	3.0	1.246
EDI	3.200	3.0	1.265
MS Back Office	2.867	3.0	1.506
PC applications	3.563	4.0	1.315
Lotus Notes	2.875	3.0	1.360
AI development	2.067	2.0	1.033
End-user support	3.438	4.0	1.209
End-user training	3.000	3.0	1.095
<u>General</u>			
Analytical ability	4.824	5.0	0.393
Assertiveness	3.882	4.0	0.781
Creativity	4.235	4.0	0.664
Listening	4.529	5.0	0.514
Oral communications	4.529	5.0	0.624
Written communications	4.353	4.0	0.702
Organizational ability	4.294	4.0	0.772
Prioritizing tasks	4.353	4.0	0.702
Self motivation	4.647	5.0	0.606
Working with others	4.471	5.0	0.624
Teamwork	4.529	5.0	0.624
Ability to work in groups	4.529	5.0	0.514
Problem solving	4.647	5.0	0.493
Critical thinking	4.294	4.0	0.686
Problem diagnosis	4.353	4.0	0.493
Ability to follow directions	4.353	4.0	0.702
Ability to work with users	4.176	5.0	1.015
Leadership	3.706	4.0	0.985
<u>Business Related</u>			
Understand business function areas	3.882	4.0	0.993
Perform cost/benefit analysis	3.294	3.0	1.312
Perform feasibility analysis	3.059	3.0	1.435
User interviewing	3.471	3.0	1.231
Project management	3.235	3.0	1.091
Quality assurance	3.471	3.0	0.874



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