Are We Teaching What They Need?

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Abstract

Computer education needs to stay aligned with changing needs of business and industry. This paper analyzes the demands of our students' employers for particular hard skills, and for particular soft skills.

Also, we analyze the relative demand for a variety of hard skills and a variety of soft skills, in large firms and small firms. First, we found large firms on average wanted more soft skills (4.9) than small firms on average wanted (3.7). Secondly, we found that with the increasing size of small firms the number of hard skills wanted increased. Thirdly, the number of soft skills wanted by a large firm correlates with number of soft skills each wants.

We include observations about starting salary; and about correlations of project management/communication and leadership/communication.

We also note some surprising discrepancies indicating that some hiring managers lack understanding of computer technology, such as seeking Oracle skill but not database skill.

Computer System Infrastructure

Metropolitan State University serves a primarily adult population, who are returning for further knowledge and skills to either maintain or improve their careers. Many already have baccalaureate degrees. Others are close to completing those degrees, and intend to do so at Metropolitan State University. (Most students are transferring credits into our institution to complete their degrees.)

Metropolitan State tries to teach practical job knowledge, but also applied theory, which means the ability to apply the same knowledge/skills in a new environment, and to find and apply new knowledge/skills in the same environment. Of course, there is the highest level, which is to find/apply new knowledge/skills in a new or changed environment (Bloom, 1956).

This level of theoretical underpinning becomes important in the IT industry because of the rapidly changing technology that is used, and the continually changing demands on the IT departments. Examples of technology change include minor change, such as change of versions of operating systems, databases, programming languages, and application platforms, as well as continual hardware change. There are major technology changes as well, for example from perceiving client/server as three tiers, to perceiving it as n-tier (web based). There are shifts in the understanding of what enterprise applications are, with the advent of .NET and J2EE as enterprise application platforms. These shifts cause IT staff to find new knowledge/skills to apply to the same situation.

Given a continual churn in technologies used and challenges faced in IT departments, we are interested at Metropolitan State University to find how we can best prepare our students to be productive employees in those IT departments.

The research question is, "What skills and knowledge do hiring managers seek in Metropolitan University graduates, among that population of hiring managers who are helping fund tuition for one or more employees who are now attending Metropolitan State University."

There are two departments at Metropolitan State University that address needs of IT departments: the MIS program in the College of Management, and the CIS (Computer Information Sciences) program in the ICS department (Information and Computer Science). This paper is authored by two faculty members, one from each of those programs..

Relating Infrastructure to Teaching

The employability of our graduates relates to the skills and knowledge they obtain in our classes. Coordinating the academic standards to those of industry would strengthen both education and the industry.

Relevant Research

The rapidly changing technology and the increasing demand for technology skills, raises the question of how well universities are able to provide the technical and related knowledge that will equip their students to perform jobs in IS and IT (Lee and Trauth, 1995; Misic and Russo, 1999). Evidence exists that higher education institutions are aware of the danger of obsolescence of the IT skills emphasized by their programs and desire to incorporate the culture of change into these programs (Andrews and Niederman, 1998). As examples, Chand (1994) and Ross and Ruhleder (1993) present specific college IT programs that focus on meeting the changing needs of the IT professional.

Although technology has become ubiquitous, teaching technology can be a difficult process because of the continual changes in the field. It is almost impossible to keep up with these changes. This is particularly true of Information Systems (Farwell, 1995). It is difficult enough just to know the current state of the technology that your students need to be endowed with (Lee and Trauth, 1995; Misic and Russo, 1999, Castleman and Coulthard, 1999). Educational institutions have had difficulty keeping up with the changing needs of IS employers (Williamson, 1997).

Many educational institutions have not upgraded their programs to meet the needs of students who will become IT employees (Williamson, 1997). This challenge is not easy to resolve. There are both the technical and non-technical skills that need to be included in the traditional curriculum (Parker and Bailey, 1999).

The biggest problem is the lack of sufficient input from industry on the details of what would be needed in IS education to lead to successful graduates. This is part of the problem of procuring IS staff with appropriate qualifications (Leung, 1990).

Casteleman and Coulthard (1999) emphasize the importance of career building and preparing the students to make informed career decisions. A student cannot develop a career path without knowledge of the possibilities. Schein (1971, 1978) developed the career path theory. This theory developed a set of career path changes and analyzed the value of each. Two common career path models are the pyramidal (move up through the regular company hierarchy; (Chesebrough and Davis, 1983) and the two path model, that is, having a technical and managerial ladder (Lash and Sein, 1995).

Another model, the career anchor model, emphasizes the employee's view of what makes or can make the employee's career a success (Ginzberg and Baroudi, 1988). A career orientation refers to a cluster of self-perceived needs, values, and talents that give a shape to an employee's career decisions (Igbaria, et al., 1991). The different career dimensions are expected IS personnel orientations or anchors, and the dimensions influence what IS personnel want to do in the future (Crepeau, et al., 1992).

The difficulty with this approach is that is emphasizes the employee and what the employee regards as important for career rather than what the company regards as

important. In spite of this difficulty some companies have adopted this model for the sake of employee satisfaction. To allow the employees to progress in areas that they desired leads to better employee satisfaction (Igbarria, Greenhaus, and Parasuraman, 1991).

Hingorani and Sankar (1995) surveyed graduates' perceptions of skills needed for success and compared the results with those required by industry. They found that students were aware of the needs of industry.

There has been a need to establish critical knowledge and skills required of an IS employee. Such knowledge and skill can be divided into technical, business, organizational, and consulting areas. The IS executive of today needs both business and technical perspectives (Brown and Magill, 1994; Emery, 1991). Functional and organizational skills are becoming increasingly important for IS positions, particularly for IS managers (Benbasat, et al., 1980; Cheney, et al., 1990; Cheney and Lyons, 1980; Khan and Kukalis, 1990; Todd, et al., 1995).

Rada (1999) regarded skills like programming, network, database, and security as being in the technical area. Skills like interpersonal communication, problem solving, collaboration, and dealing with change are regarded as human skills. Skills such as goals and objectives, policies and procedures, and organization culture are regarded as organizational. The IS executive's organizational skills cannot replace technical ones. A successful IS executive should have knowledge and skills in both organizational and technical areas (Jiang and Klein, 1995; Justman and Teubal, 1993).

The IS field is relatively young and evolving from its interdisciplinary roots, including reference disciplines such as computer science, management science, and organizational behavior (Alavi and Carlson, 1992; Kraemer and Dutton, 1991; Stolen, 1993).

Keen (1988) developed the importance of roles rather than tasks. Thus we emphasize what an employee does rather than how the employee operates. Rapid changes in information systems (IS) changes the skills and knowledge required of IS professionals (Virgo, 1992). These changes lead to new roles for IS professionals (United Communications Group, 1988). IS professionals with solid business backgrounds should be better able to fit in with future business needs, and to develop a more effective relationship with the needs of management. This suggests the need for IS professionals that possess a combination of interpersonal, technical, and business skills. Such skills would allow them to analyze problems, integrate applications, and implement new business processes built around information technology (Farwell, Kuramoto, Trauth, and Winslow, 1992).

Knowledge refers to the content or information needed to perform adequately in a job. Skills are the specific processes necessary to meet the current requirements of a particular job (Cheney, et al., 1990).

National Science Standards are a means to develop standards as a criteria for judging the quality of what students know and do. It is based on developing best practices (National Research Council, 1996).

SCANS (Secretary's Commision on Achieving Necessary Skills, 1991) defines desired competencies as: reading, writing arithmetic/math, listening, speaking, thinking skills (creative thinking, decision making, problem solving), using the minds eye (know how to learn, reasoning), personal responsibility, self esteem, sociability, self management, integrity. These are the areas of general competencies that any student needs.

Theory Section

We found some surveys on this type of subject on the web. One was the International Parking Institute Technology Committee Vendor Technology Survey (Easley, 2003) and another was the Washington County Education Survey (Maher and Birnbaum, 2002). These showed the ideas that we were trying to capture but we decided to develop the survey based on our own knowledge and issues that were apparent from understanding the local industry.

Following are the questions in the survey:

How many Metropolitan State graduates have been hired into your organization that you know of?

Do you consider these graduates successful in your enterprise?

What's the typical length of time that these graduates have been in your organization?
___ to ____ years

What types of positions do new graduates take? (check all that apply)

___ help desk	___ assist users with applications
___ network technologist	___ application upgrade
___ junior developer	___ developer
___ other (please list here:)	

What skills will you be looking for in the next 1 ½ years (check all that apply):

____C++/Java	____ RDBMS development
____.Net/J2EE	____ Oracle
____VB.NET	____ SQL Server (Microsoft)
____ASP/JSP	____ DB2 (IBM)
____ODBC/JDBC	____ OODB
____ Servlets	____ UML/ System Design
____ Applets	____ Code testing/ maintenance
____ VBScript/ Jscript	____ Project Management
____ Network skills	____ Business Analyst Skills

____ LAN
____ WAN
____ Web app development
____ DCOM
____ OS: Unix
____ OS: Windows
____ OS: Linux (Open Source)
____ Application Servers
____ Web Logic (BEA)
____ Web Sphere (IBM)

(including requirements analysis)
____ Requirements analysis
____ System specification
____ Network Design Skills
____ Team Lead Skills
____ Pre-sales support skills
____ Internal system support skills
____ Team player skills
____ Communication skills
____ Presentation
____ Report writing

How many people do you have in IT in your organization?

How many people in departments outside IT interface with IT as their primary duty?

How many people in departments outside IT depend on computer skills as their primary skill?

Do you see any of the above growing in numbers over the next 2 years?

Where do you look for new graduates? (check all major sources)
____ from ads that your organization runs?
____ private college job fair(s)?
____ public college job fair(s)?
____ UM job fair(s)?
____ online resumes (Hotjobs, etc)
____ other: _____ (referrals, etc)

What is the average starting salary for new-grads in your organization?

In most classes of the MIS and ICS Curriculum units we passed out surveys that had an accompanying letter that told that the goals of the survey were to develop a curriculum that was suited to local industry needs and asked the manager of the company involved to fill in the survey and send it in an envelope that was addressed and postage paid to Larry Gottschalk at Metropolitan State University. The students were to give the envelope to their supervisor, if that person knew about the technology of the company, or to a person in management who knew about the technology of the organization if their supervisor was not technically knowledgeable. We made a trial run of about a hundred such surveys and got about seven returns. From this we decided we needed to hand out a thousand of the surveys to get a reasonable number of returns. From these surveys we obtained 38 returned surveys. This is not a very high percentage but we had two sources of loss of return. The students may not have given the survey to anyone and the manager they gave it to may not have wanted to fill out the survey. In future research we intend to develop a more robust method of distributing the surveys.

Results

A note about mangers recruiting for specific skills versus theoretical knowledge

There are a number of indications that specific skills are being looked for in our graduates, not the theoretical underpinning!

Example 1: WebSphere and WebLogic are software packages (i.e., specific tools) of a class called "application servers". It is interesting to note (figure 2) that of the four that indicated a need for WebLogic trained IT persons, NONE indicated a need for the more generic "application server" trained IT persons! Of the nine that indicated a need for WebSphere trained IT persons, only two indicated a need for application server trained IT persons! This might indicate that hiring managers focus on specific product skills, which is disappointing given the mission that we perceive of providing theoretical underpinning behind the specific skills. This is even more disappointing in light of the fact that knowledge of one application server is highly transferable to use of another application server.

The same pattern appears with database (figure 1). Of the 10 indicating a need for Oracle (specific tool) trained IT persons, only three indicated a need for RDBMS development skills (the generic theoretical underpinning). Of the 14 indicating a need for SQL Server (specific tool) trained IT persons, only four specified RDMB development skills. Of the five specifying a need for DB2 (specific tool) trained IT persons, none specified RDMS development skills.

What competencies are most in demand?

The two competencies that received the highest number of votes were Web application development (figure 3) and communication skills (figure 4), both receiving a vote from 50% of respondents.

Web application development requires the integration of a number of technical skills, plus the ability to understand business need and how to design to meet that need. This is a proper focus for a four-year computer or MIS degree.

It is gratifying that communication skill is wanted by 50% of the respondents. The soft skill of communication is the ability to write and speak clearly and logically, which stands behind a successful IT career. The university is well positioned to provide education in this area.

Tying for second with 44% of the vote for each were 1) code testing/maintenance (figure 3), 2) project management (figure 4), and 3) team player skills (figure 4).

There is a body of knowledge behind how to do code testing and maintenance well. Perhaps this needs to become the focus on a particular course.

Project management, along with design and staff management, are the most general of the IT skills. There are certifications that accompany project management. The ICS department covers project management in the Software Engineering course. The MIS program provides an entire course on project management and augments this in systems analysis courses.

Team player skills are what are learned in courses that involve teams. We have kept team participation as the key element of several capstone courses.

Third place was SQL Server (figure 1), a clear technical only skill. There are certification programs in SQL Server available at technical colleges, and at private vocational institutes. It is interesting that SQL Server received votes from 41% of the respondents, whereas the generalist and more theoretical competency of RDBMS development was only selected by 11% of the voters.

The fourth area was network skills (figure 2), which is a collection of individual skills, and suggests support for our comprehensive approach to networking technology. We have several courses in networking technology in the ICS department. In MIS we study networking technology as a survey of the management methods. That means the students need to develop an ability to understand the technology enough to make management decisions on this subject.

The fifth competency area was a tie between 1) Business Analyst skills (figure 4), which is a specialty of our College of Management, 2) System Specification (figure 4), which is a competency requiring a broad understanding of technologies available, 3) internal system support skills (figure 4) which requires familiarity with a number of technologies, and 4) presentation skills (figure 4), a generalist competency.

Correlations between
1) numbers of hard skills wanted,
2) numbers of soft skill wanted,
3) size of firms.

The soft skills that were listed in the questionnaire are also listed in figure 4.

The hard skills cover all the technical skill and knowledge that could be offered or are being offered, and are listed in figures 1, 2, and 3.

The chart "Skills By Increasing Size in Small Firms" (figure 6) shows that the larger the size of the IT department (which goes from 1 person in rank order position 1, to 15 people in rank order position 14) the more hard skills that are wanted. (There is an outlier at rank position 2.) This is counter-intuitive, since the fewer the number of people in an IT group, the more each person needs to know. A possible explanation is that with the increasing size of IT department, the more kinds of hardware it is supporting, and the IT

department is looking for people that can span all the hardware supported. It will be interesting to see if this trend holds in a larger data sample. There is no correlation between rank order size of the smaller IT departments and the number of soft skills wanted.

The chart "Skills By Increasing Size in Large Firms" (figure 5) shows a correlation between the number of hard skills wanted by a firm and the number of soft skills wanted by a firm. We have not formulated an explanation.

The average number of skills wanted in the large firm group versus the small firm group is as follows:

	Avg # hard skills wanted	Avg # soft skills wanted
Large Firms	6.3	4.9
Small Firms	6.5	3.7
All Firms	6.4	4.3

These numbers indicate hardly any variance between large and small firms in average number of hard (technical) skills wanted, but that small firms value the soft skills less than do large firms, which follows conventional wisdom.

Starting salary

There was little variance in starting salary of persons with an IT emphasis in their bachelor degree. Although it ranged form $30,000 to $60,000, there was a strong clustering at $40,000 to $45,000. Therefore, it was not worth finding correlation with other data.

Where employers look for potential employees

The places where employers looked for potential employees seems quite uncorrelated to the other columns also.

Conventional wisdom about role of UML

It is generally assumed that UML is the underpinning of requirements analysis and system specification. (It is the "example" or "default" methodology used in textbooks that cover requirements analysis and system specification.)

Only four respondents who wanted Requirements Analysis and System Specification skills also wanted UML.

Eight respondents wanted Requirements Analysis and System Specification skills but did not specify UML, which is twice as many. Three respondents wanted UML skill, but did not specify Requirements Analysis and System Specification skills as being needed.

Project Management and Communication skills

In this area, there is measurable correlation. Eleven wanted both Project Management and Communication skills; only four wanted Project Management but not Communication skills, and none wanted Communication skills without also specifying Project Management.

Team Lead and Communication skills

Every respondent looking for a Team Lead also wanted Communication skills.

Figures:

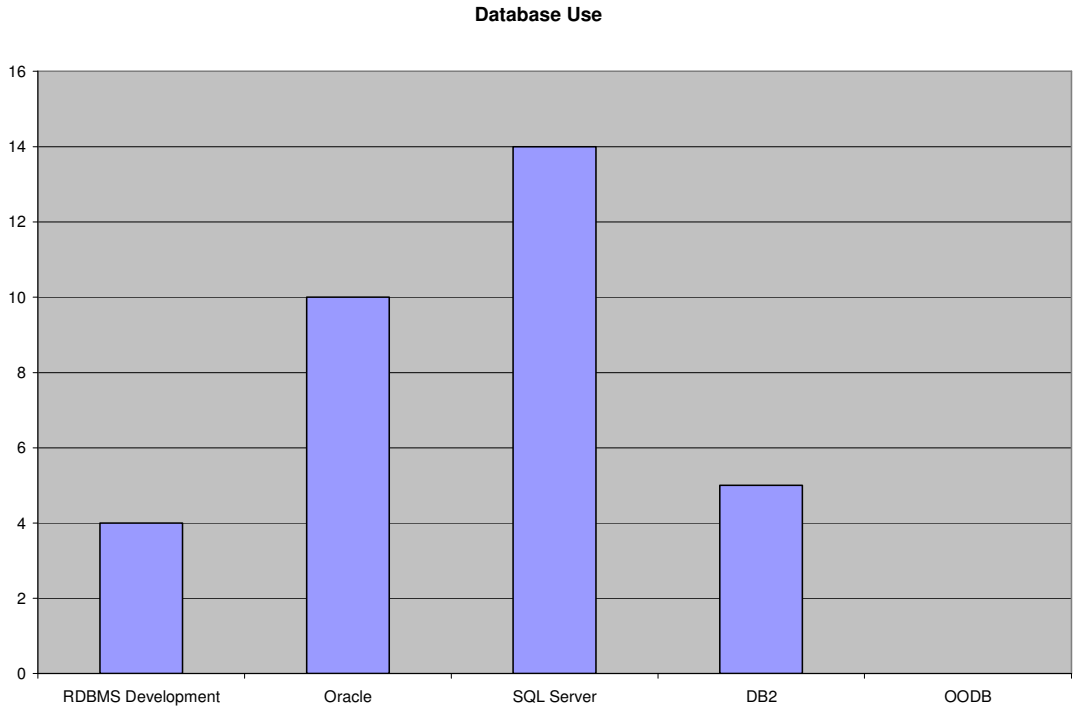

Figure 1: Database use

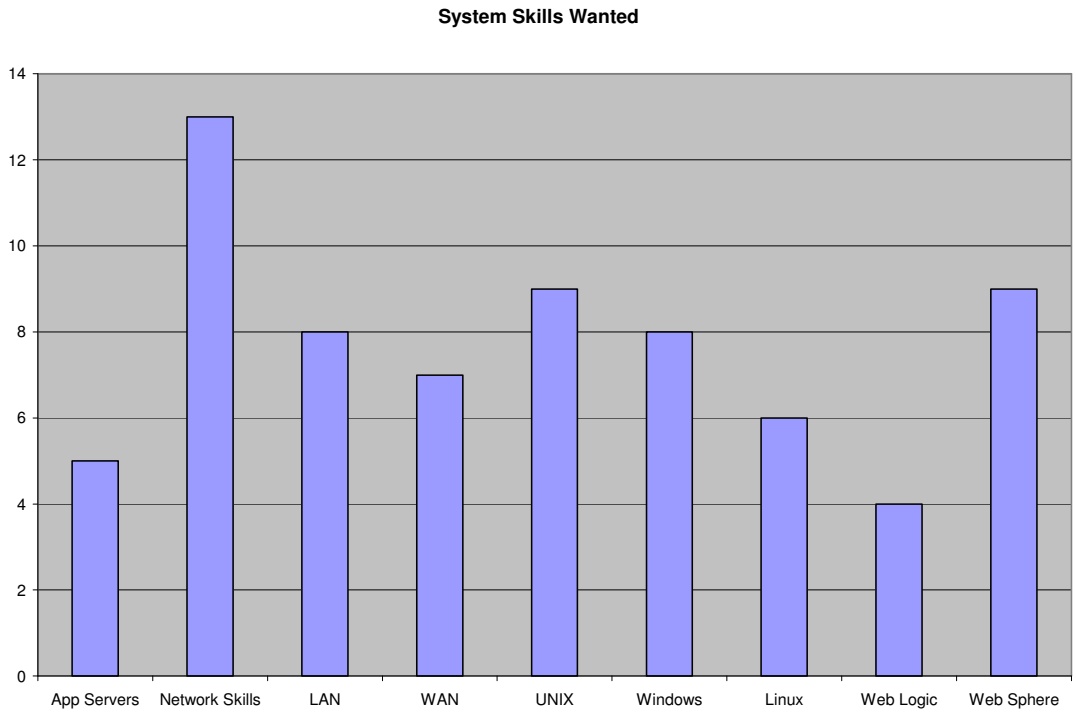

Figure 2: System skills wanted

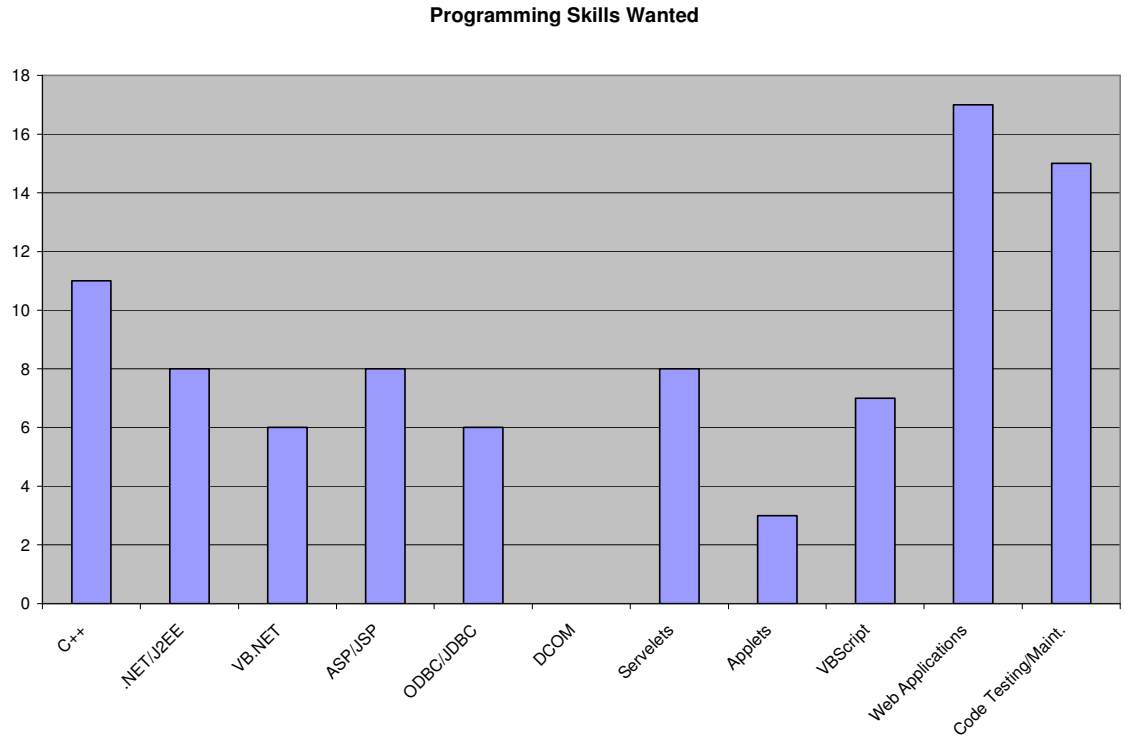

Figure 3: Programming skills wanted

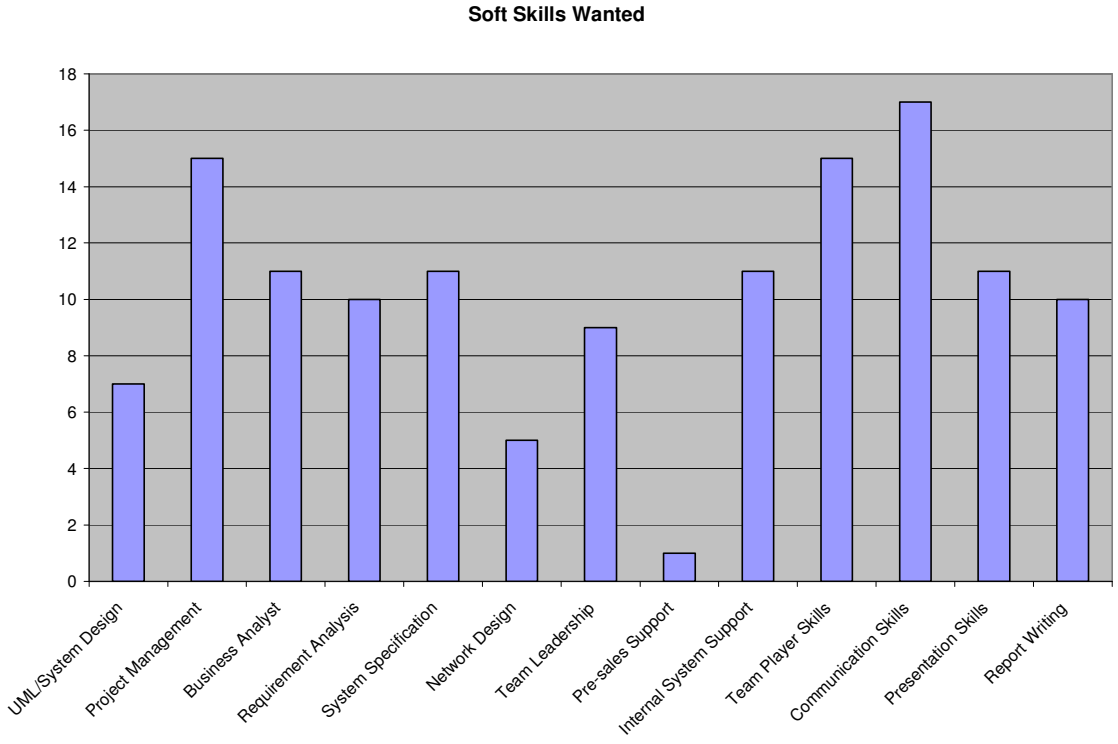

Figure 4: Soft skills wanted

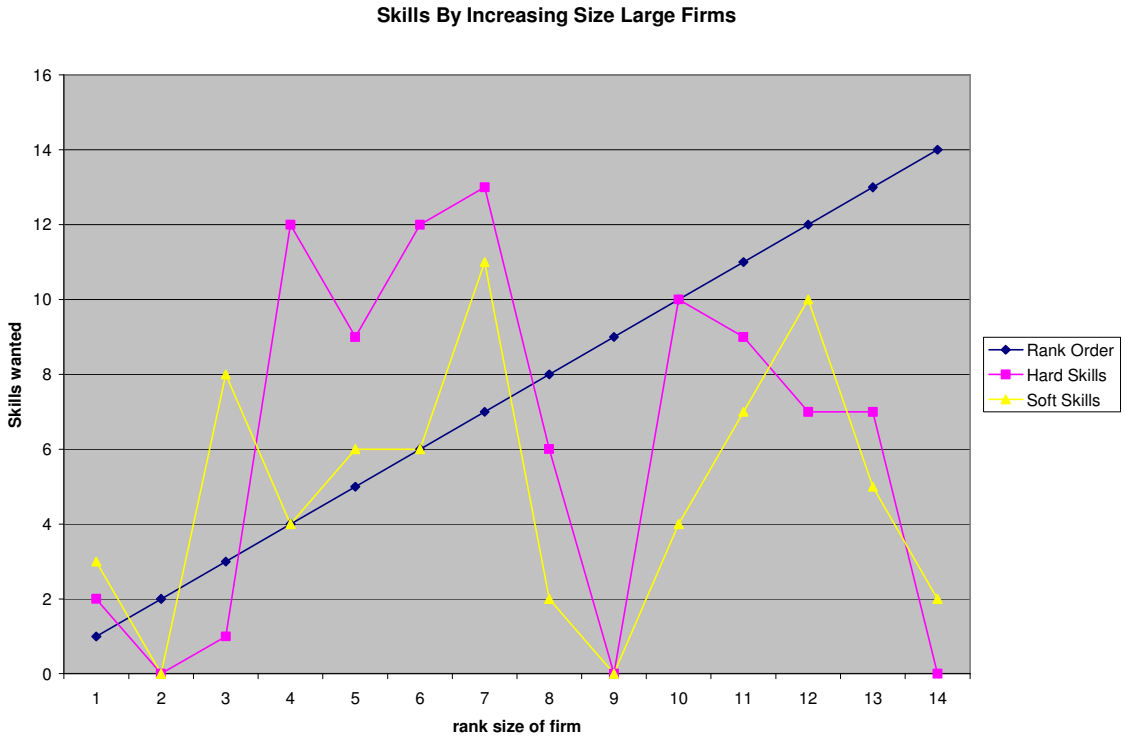

Figure 5: Skills by increasing size of large firms

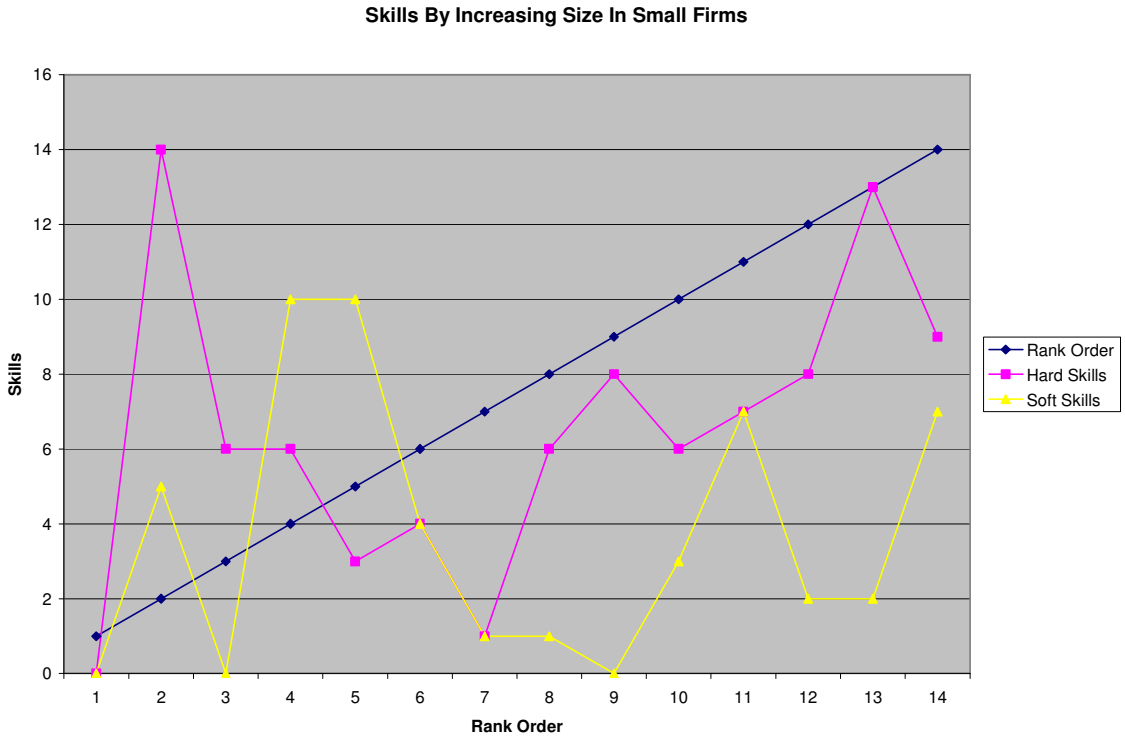

Figure 6: Skills be increasing size of small firms

Conclusions

It would seem that our major in CIS and our major in MIS are well suited to providing a mixture of specialist skills and more general competencies.

Given the need for generalist competencies, and for integration of a number of technologies in some of the hard competencies that received high votes, the role of the university versus the technical college in providing IT persons seems clear.

Also, since on-line universities are currently directing their attention to highly visible product specific IT skills, the role of the university versus on-line educational institutions seems clear also.

For further research

In a future survey we hope to engage the industry leaders more directly so we will get a larger percent return of results. We hope to test a method of obtaining the addresses and/or telephone numbers of managers who we could write or call directly. This would provide a more direct route to the subjects of our survey.

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