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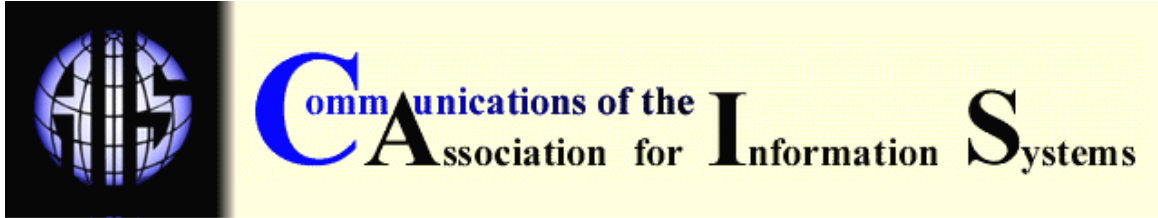
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IT Workforce Trends: Implications For IS Programs

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ABSTRACT

Findings in an IT workforce study support the emphasis of business content espoused by IS curriculum guidelines. Business domain and project management skills are critical to keep in house while technical skills were cited as the top skills sourced. Paradoxically, technical skills are those cited for entry-level positions. We discuss the issues raised by these findings and recommend several approaches for IS programs to consider. IS programs must offer a functionally integrated curriculum and deliver it in an experiential business context. We provide several examples of innovative pedagogical approaches and industry alliances which demonstrate mechanisms to provide students with a stronger business orientation in applying IT. We recommend a more proactive approach to enrollment including better promotion of IS programs.

Keywords: information systems curriculum, career tracks, enrollment, workforce, outsourcing, skills, entry-level, CIO, offshoring

I. INTRODUCTION

Recent trends, such as low enrollments in management information systems (IS)¹ programs in business schools and the move toward greater use of offshore development by U.S. and European-based firms, have raised concerns about the state of the IT discipline. Concerned about some of these trends, leadership of the Society for Information Management (SIM) sponsored a study about the IT workforce. Results suggest that demand for an IT workforce will remain stable through 2008. The study found a trend toward more outsourcing, however, indicating that some jobs will be moving from in-house to service providers. We identify the skills and capabilities that senior IT executives are looking for now and in the near future. The findings help us draw conclusions about what skills and capabilities are desired by managers of non-IT² organizations. Armed with recent data addressing workforce concerns of stability and the skills desired by IT managers, we turn to our mission of educating students in a changing profession. Is current pedagogy up to date? How can IS curriculum respond to future needs? Interpreting the study's results points IS faculty to a number of approaches that graduate and undergraduate IS programs can take.

We conclude that IS programs in business schools are well positioned to yield the skills and capabilities desired for IT professionals in the IT departments of organizations. Business schools have an advantage to address these issues over competing programs, such as computer science and information studies, since business school curricula include the functional area and management skills that IT executives in non-IT organizations believe are critical to keep in-house today and in the coming years. However, IS programs need improvement to attract students who can address the potential shortages in the IT workforce and to deliver the evolving skills that IT workers will need in the future.

Our primary recommendation is to provide a business-context education where students must develop the business, management, and client-facing technical skills that industry demands. To address this recommendation, IS programs need to respond on three fronts – pedagogy and curriculum, industry alliances, and enrollment issues. Each of these areas is addressed below, following a brief outline of the study's purpose, methodology, and key findings. This paper concludes with a discussion of issues related to enrollments and some final thoughts about the future of the IT profession.

II. THE IT WORKFORCE STUDY

PURPOSE OF THE IT WORKFORCE STUDY

In 2005, SIM sponsored research to understand current and future staffing needs, as well as the IT skills and capabilities desired both in internal IT departments and by IT service providers. SIM members, who represent senior IT management, expressed concerns over the workforce and links to academia at an annual meeting. Given the movement toward global sourcing, SIM members were also interested in determining how organizations access IT skills and capabilities. One goal of the study was to describe what skills universities should be providing their graduates who will work in the IT departments of non-IT organizations; for example, manufacturing, health

¹ The term IS will be used to describe business school programs that may be named also management information systems (MIS), computer information systems (CIS), or information technology (IT). This is to differentiate it from computer science, computer engineering, and information science programs.

² Non-IT organizations are defined as those whose primary objective is producing goods or services other than IT hardware, software, or services.

care, financial services, or any client firms of IT service providers. In this section, we first summarize the methodology of the IT workforce study that SIM decided to fund at its annual meeting. This summary is followed by a presentation of some of the results of the workforce study, in the area of skill and capability needs. We then make several recommendations for how the academic IS discipline should respond to these needs.

METHODOLOGY OF THE IT WORKFORCE STUDY

The research was conducted by a team of twenty U.S. and European investigators (see About the Authors for a list of collegial collaborators) via structured interviews with 104 senior IT managers. The research sample drew from a variety of industry sectors and organization sizes and was solicited from SIM e-mails, meetings, newsletters, and researcher contacts. Individual respondents tended to be knowledgeable and experienced senior managers consisting of SIM members and recommended colleagues. CIOs and senior vice president/vice president levels made up 61% of the respondents. The other respondents likewise held responsible management positions (executive directors, directors, and managers). Over 60% of the respondents had been in their current positions three years or more, and 89% had over 10 years experience in the IT field. Taken as a whole, the respondents are experienced managers with extensive knowledge of IT and IT workforce needs.

We report the data according to organization size³. Table 1 shows the distribution across industry sectors.

Respondents were asked about demographics of their IT organizations and projections through 2008. Researchers recorded data about a variety of skills shown in Appendix I. The detailed findings of the study are available in Zwieg, *et al.* [2006].

Table 1. Organizations by Industry and Size					
	Fortune 500	Large	SME	Total	%
Manufacturing, Mining, Utilities	14	4	4	22	30
Finance and Insurance	10	4	3	17	23
Professional Services		2	2	4	5
Other ⁴	10	9	12	31	42
Total	34	19	21	74	100
Percentage	46	26	28	100	

Totals may not equal the total number of organizations or respondents because some respondents did not answer every question.

³ Organization Size is categorized in USD revenue or for not-for-profit organizations in total expenses as : Fortune 500 = $\geq 3B$, Large = $\geq 500M$ and $< 3B$, and SME = $< 500M$

⁴ Includes education, health care, not-for-profit, government, retail, entertainment, logistics, delivery services, etc.

FINDINGS OF THE IT WORKFORCE STUDY

We emphasize two important points regarding the sample and results. First, the organizations included in our analysis are non-IT firms; that is, their primary business is producing goods and services other than IT hardware, software, or services. Second, the sample has a proportionally larger share of Fortune 500 organizations (>3B USD) than found in the overall population of organizations in the U.S.⁵ This may be due to the method of solicitation but it is not reflective of the SIM membership which has a small portion of very large firms. These factors may have implications for interpreting the results, which is explored later.

One major finding dispels the myth of catastrophic IT job loss. Overall, the number of IT jobs in non-IT organizations is likely to remain stable from 2005 to 2008. There will be an increase in the use of third-party providers. Offshoring will increase but primarily through domestic third-party providers for example, a U.S. based service provider will have development performed in their Indian or Eastern European development center. Though we only considered the near term from 2005 to 2008, it is likely that in the longer term (2011 and beyond), the retirement of the baby boom generation will create a fairly rapid growth in IT-related jobs. The steady demand for an IT workforce, coupled with the current decline in IT-related enrollments in universities and the pending increase in baby-boomer retirements, may signal an IT workforce shortage.

Our second major finding is that the skills that IT departments believe to be critical to retain in-house, given their ability to purchase services in the market place, are related to business domain knowledge, project management, and client-facing skills such as systems analysis and design. Paradoxically, however, the skills that the companies in our study look for when hiring entry-level employees are programming and other technical skills. Not surprisingly, communication and industry knowledge are desired, but they are also cited among the skills most often missing in new hires.

We briefly outline some of the findings below, by providing some details of the skills most desired and from where they are sourced.

Business domain knowledge and project management are the skills that insure a long-term successful career path. We found that business domain skills such as functional area process knowledge, industry knowledge, and business process re-engineering were considered critical to keep in-house (see Figure 1).

Critical capabilities for mid-level employees are a combination of project management, technical, and business domain capabilities (see Figure 2). The predominant category of skill sets for mid-level positions is in project management, with six of the top ten skills in this category. The technical skills are the client-facing skills of analysis and design.

Looking toward the future, the skills indicated as newly important by 2008 are in the categories of business domain, sourcing, IT administration, and project management, along with two technical skills (IT architecture/standards and security) (see Figure 3).

The critical entry-level capabilities are programming and other technical skills (see Figure 4). However, communication and industry knowledge are also cited as critical and often missing from new hires.

⁵ The United States Small Business Administration states that over 99% of U.S. businesses have less than 500 employees. <http://www.sba.gov/advo/research/data.html>. Worldwide, the definition of "small business" varies, based on revenue and number of employees. However, SMEs represent a large percentage of the economy in most countries.

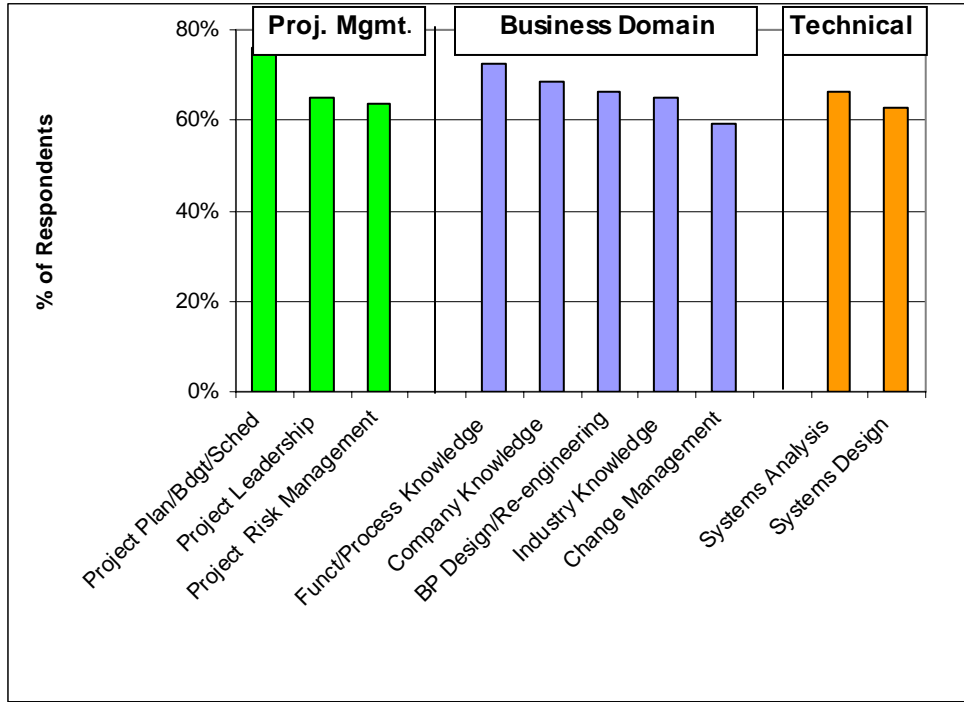


Figure 1. Top Skills Critical to Retain In House

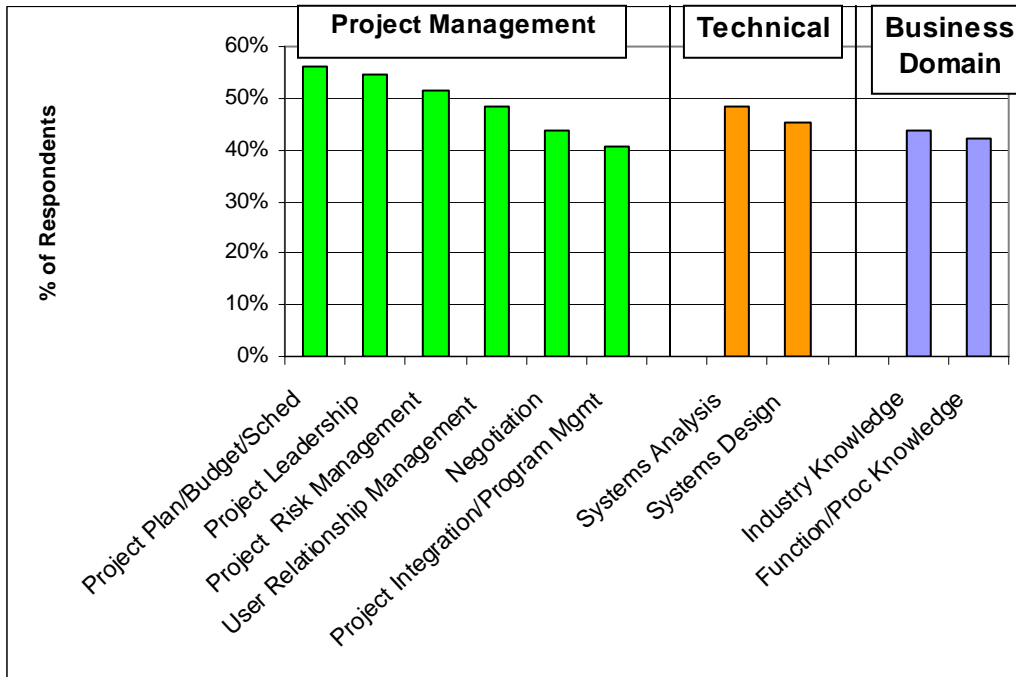


Figure 2. Most Desired Mid-Level Skills

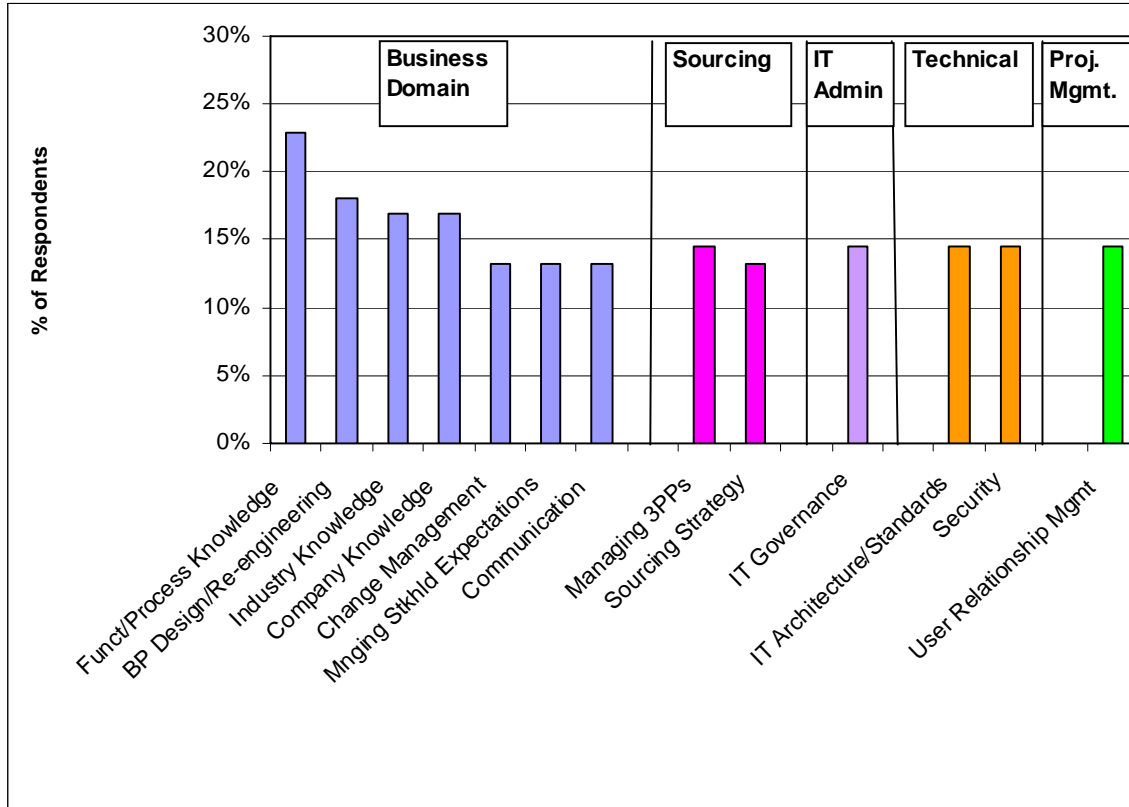


Figure 3. Newly Important Skills

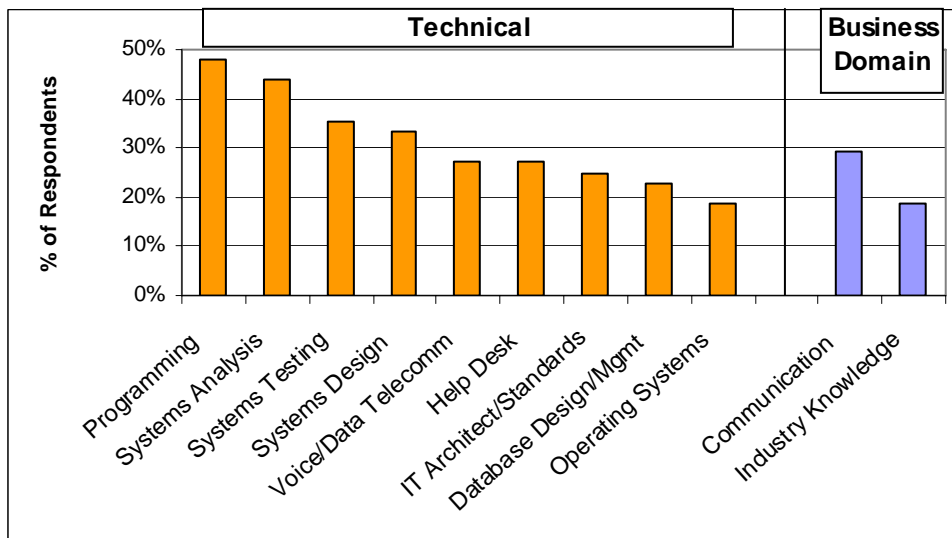


Figure 4. Top Desired Entry-Level Skills

These technical capabilities in Figure 4 are also the most frequently cited as targets for outsourcing (see Figure 5). They are often referred to as commodity skills. This poses a threat to new graduates since the desired skills at the entry level are the same as those most outsourced. It will certainly limit opportunities for students with only technical skills.

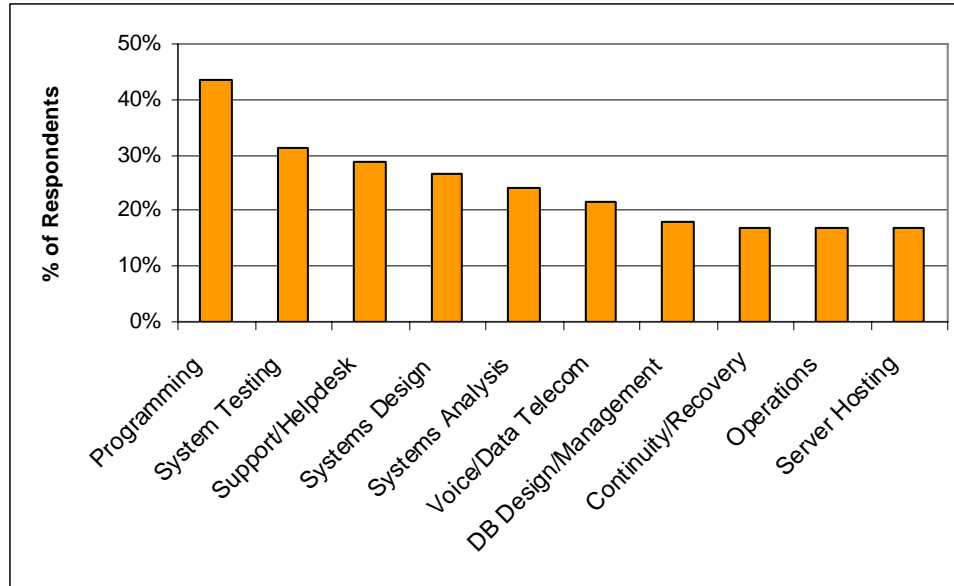


Figure 5. Top Skills Sourced to Third-Party Providers

What does this mean for IS programs? There appears to be a disconnect among the entry-level skills, skills critical to keep in-house, newly important skills, and mid-level skills. How would an entry-level worker develop the critical skills needed to move up?

IMPLICATIONS FOR HIGHER EDUCATION - ACCENTUATE THE POSITIVE, ELIMINATE THE NEGATIVE

It is important to view these results as providing useful insight into the value of IS programs at both the undergraduate and graduate levels. Initially, the results bode poorly for those in the field at larger organizations because basic technical skills are those required of entry-level employees, and they are the most likely outsourced. Therefore, one can conclude that there will be fewer opportunities for technical graduates at larger firms. This may vary depending on the emphasis of the IS program. Some are comparable to computer science programs. The more important message from our study, however, is that IT senior management wants to hire graduates with a foundation of technical skills, but also with business domain knowledge and project management skills and the ability to work closely with non-technical departments and users.

The findings indicate that, for the hiring sector represented in the analysis above – IT departments in non-IT organizations – IS programs in business schools are taking the right approach to preparing tomorrow’s IT workforce, by teaching technical skills, but also by teaching business fundamentals, analysis and design, and the capabilities to communicate and work on projects effectively.

The IS programs offered in the business schools at many universities are designed to emphasize a mixture of skills and capabilities for their students. The goal of these programs is to produce graduates with sufficient technical knowledge to manage IT and understand its critical role in organizations. This means that while the graduates may not be as well versed in every business aspect that IT management is looking for, they have the capacity to quickly broaden their business concepts based on an education in which IT skills are learned in relation to how they apply to the business environment. This orientation furnishes IS graduates with a different and more relevant set of skills and capabilities than those acquired by a graduate with a computer science degree, which teaches technology without a solid grounding in areas of management and business.

III. CURRICULUM RECOMMENDATIONS

THE BUSINESS CONTEXT

Our findings emphasize the importance of a management focus and business context in IS programs more than ever. Pedagogically, we see the need to integrate the following areas: business domain knowledge such as company and industry knowledge, and related problem solving; project management and related team skills; client-facing and related analysis and design of solutions to meet real-world problems. The findings also indicate that students could benefit from topics related to sourcing such as negotiation, virtual team management, and ethnic diversity.

Therefore, the primary recommendation emphasizes that IS programs provide a business-context-driven education to provide students with the business and client-facing skills that industry demands. A traditional classroom setting using traditional approaches to teaching, such as lectures, reading assignments, and individual homework tasks, does not easily provide a business setting. Integration of the skill area topics requires the application of concepts, which demands a more active mode of learning and more concrete linkage of abstract concepts to problem solving.

We believe that a context-driven education benefits IS students and future IT employees more than a traditional approach. Gartner [Morello, 2005] and *CIO* magazine [Overby, 2006] have discussed the change in the IT profession to a more business-centered focus than the technical orientation of the past. George, *et al.* [2005] recommended that IS programs focus more on why IT is valuable to a company than on how it works. They also recommend more integrated curricula and closer ties to industry.

Based on prior research and our findings, it is also clear that the integration of IT and how it is applied in business will be important for those who pursue long-term careers and advancement in organizations similar to those in our study. This was pointed out over a decade ago, when the topic was the emergence of IT decentralization and the shift to end-user computing [Lee *et al.*, 1995]. More recently, Ang and Slaughter [2004] studied the career path of IT workers by examining if they were hired using an industrial or craft strategy. They found that the more managerial jobs, such as Chief Information Officer (CIO), applications manager, and infrastructure manager, are usually governed by an *industrial* strategy, where employees enter the organization through a limited number of ports of entry and progress along clearly marked job ladders. They are selected based on higher education requirements but also receive training in skills and knowledge specific to the organization, and advance due to both merit and personality. This strategy leads to lower turnover and higher tenure.

Other, more technical jobs, such as programmer, database administrator, network specialist, and systems programmer, were governed by a *craft* strategy, where employees are viewed as having skills that are less organization specific and more mobile. Thus there often exists more loyalty to the profession than to the organizations that employ them. The craft strategy leads to higher turnover and lower tenure.

Findings indicate that employment in non-IT companies through the industrial model should increase, while employment in craft-like positions will decline. These findings indicate that if graduates hope to advance in IT departments of organizations, they will need to develop their skills in different ways than IT education has traditionally delivered. In the past, the traditional IT education has emphasized the craft of the profession, for example, programming. Furthermore, graduates will need a wider breadth of skills and experiences if, on entry to the job market, they are to avoid being stranded in technical jobs that could be outsourced in the future.

We recommend that IS programs respond to our findings on three fronts – pedagogy and curriculum, industry alliances, and enrollment issues. The IS discipline will need to challenge some assumptions and practices in order to produce the type of IT professional that our respondents call for. These changes are not just curriculum-related, but pedagogical and

structural. The organizational structure of a department and program structure of curriculum may need to adapt. This becomes challenging when institutional systems do not support integration and collaboration across disciplines and alliances with industry. We also make recommendations to bolster enrollments, given the potential for an IT workforce shortage.

IV. PEDAGOGY AND CURRICULUM

MODEL CURRICULA

Several IS curricula proposals including MSIS 2006 and IS 2002 emphasize the integration of a range of skills and the need for IT professionals to have a “real world perspective” [Gorgone, *et al.*, 2006; Gorgone, *et al.*, 2003]. The results of the IT workforce study and our recommendations are consistent with these model curricula proposals. We extend these recommendations by calling for the need to bring a range of knowledge and skills and by suggesting a variety of learning approaches. The IT Workforce study analysis indicates companies hire graduates with a foundation of technical skills, but also with business domain knowledge and project management skills. This leads us to emphasize greater experiential learning [Kolb, 1984]. Experiential learning encourages a balance of approaches, which can be viewed along two continuums, between active and reflective learning, and abstract and concrete conceptualization of ideas.

IS 2002 [Gorgone *et al.*, 2003] emphasizes the integration of a range of skills. Strategically, our recommendations fit with the IS 2002 curriculum recommendations and the needs of the companies in our study. The MSIS 2006 Model Curriculum [Gorgone *et al.*, 2006] addresses many of the graduate-level issues we have discussed. The prerequisites shift from IT hardware and software to IS-focused business prerequisites. The report shows a substantial increase of management content in the core, including a project and change management course and an IS strategy and policy course. The capstone is designed to address management issues as well as technical ones in integrating systems. More importantly, the revision calls for strengthened emphasis on business process and globalization concepts. The goals of an MSIS program, as stated in the report, include developing broad business and real world perspectives as well as communication, interpersonal and team skills.

The MSIS 2006 Model Curriculum also calls for four electives courses grouped into career tracks, one of which is managing sourcing and global projects. Other researchers have called for philosophically similar curriculum changes. Hirschheim *et al.* [2005] recommend focusing on client-facing capabilities such as business process modeling. King [2004] calls for strategic technology assessment courses. Davis *et al.* [2004] recommend offshore management courses. While the Model Curriculum does not have room in the core for individual courses in sourcing, the topic can be included in several courses.

Some master's programs have created career tracks or multiple courses in IT Outsourcing. These include, for example, Stevens Institute of Technology [<http://howe.stevens.edu/MSIS/ITO.html>] and Carnegie Mellon University [<http://strategic.isri.cmu.edu/elearning/outsourcing.jsp>]. The Stevens program is one of the most comprehensive, with a four-course concentration that can also be pursued as a certificate program. Supporting the increasing interest in this topic is the arrival of new books that could be used as textbooks, such as Carmel and Tjia [2005], Gray [2005], and Willcocks and Lacity [2006], and the updating of existing ones to include sections on offshoring and globalization (e.g. Applegate *et al.*, 2007).

Many of the recommendations are more feasible for undergraduate programs or full-time and lock-step graduate programs. We recognize that part-time graduate students have some time and commitment constraints that undergraduates do not.

THE BUSINESS SCHOOL - ARCHIE'S BUNKER

IT curriculum preaches integration but do we practice it? A pressing need exists for greater integration of IT with other disciplines. Business schools still operate the way business did before

systems integration – in silos. Turf battles often create a hostile environment for interdisciplinary research and courses. Business process modeling and design is one of the key subject areas for our discipline. In the IT Workforce study, the second most critical skill for companies to keep in-house is functional process knowledge. How can we as IS faculty discuss CRM, ERP, and other enterprise systems when we tend to isolate ourselves in our own departments? Rather, we need to apply IT and frame it within marketing, finance, and operations functions. One approach would be for business schools to consider project-based models that pull together teams of interdisciplinary faculty and students to create new integrated courses.

IS classes often involve students in active as well as reflective learning. This is exemplified by requiring students to actively develop software applications, in addition to more reflective activities, such as analyzing a system's design. We also believe a student's development would benefit if the content and context of their course material were more concrete and less abstract. A more concrete approach is necessary to insure the development of students in ways that will help them to better understand the context into which IT is applied in businesses, for example, developing active learning exercises which require students to take the initiative and choose topics of interest, then apply research, writing, presentation, and listening skills to strengthen learning.

In this spirit, we offer several exemplars below, in hopes of encouraging educators to consider the adoption of new approaches to teaching IS classes. The ideas below are intended to promote a greater understanding of the application of IT, by incorporating greater integration of business domain knowledge, the implementation of project-oriented assignments, and the students' introduction to their chosen professions and industries.

INTERDISCIPLINARY TEAM TEACHING TO INTEGRATE FUNCTIONAL AREA PROCESS KNOWLEDGE

Integrated undergraduate capstone course. Undergraduates typically are required to take courses that focus on individual aspects of information systems and technology – the trees – without an opportunity to integrate and synthesize these components into the organization as a whole – the forest. An integrated capstone course would provide the students with an opportunity to develop an enterprise-wide perspective that employers find desirable. Such a course would go beyond systems or business process integration and address the interaction between technology, strategy, and organizational characteristics at the firm level.

Multi-course projects. Boston University [Brunel and Hibbard, 2006] students simultaneously enroll in operations management, finance, marketing, and IS courses in their junior year. In all four classes, they work with the same team to conceive and develop a new product or service.

Project competitions. The success of student competitions in enabling learning and enthusiasm for a subject area is well established in other fields. Some of the most famous of these are focused on innovation and result in funding for new ventures, e.g., at MIT [<http://www.mit50k.net/>]. One example of an effort that is related to IT is the West Point Project Capstone Conference [<http://www.se.usma.edu/CapstoneConference>]. This event is held yearly at West Point and includes the following areas: decision analysis, process modeling and analysis, modeling and simulation, project management, reengineering systems, and statistical analysis/stochastic processes. The competition is open to any students who have worked on a project with a real-world client. Another example is University of Texas' BizIT Challenge where student teams compete to solve business problems using IT. [<http://misbridge.mcombs.utexas.edu/events/bizit/default.asp>]

Globalization. The IT Workforce study data does not directly address globalization but hints at increasing importance of sourcing-related skills. The prevalence of nearshoring and offshoring calls for a global information systems course which combines IS and international business (IB) topics and provides students with a global business context. See Beise *et al.* [2005] for a detailed syllabus for such a course, covering the four broad topic areas of IB context, IS management,

global IS and functional area topics such as global accounting rules and just-in-time financing. In addition to integrating multidisciplinary concepts, this course provides an ideal setting for experiential learning, such as traveling abroad or participating in virtual team exercises. A project management course offering at Marquette University included U.S. teams delivering functional requirements to Indian students for development [Nath *et al.*, 2006; Gibson, 2005]. This curriculum incorporated experiential global, team, and project topics that surfaced cultural and time-zone differences simulating the students' future career environments.

IT in Functional Area Courses. IT faculty could team with non-IT faculty to present IT-related material in functional area courses. For example, a human resources course could integrate issues related to human resource information systems such as how they are developed, the nature of the data, privacy issues, pervasive packages, and so forth. Similar topics generalize to marketing, finance and supply chain management.

PROJECT-BASED LEARNING

Project Management for Undergraduates. Some IS departments have begun to offer a project management course for undergraduates. Marquette University and the University of Memphis introduced project management courses in fall 2005 and spring 2006, respectively. If a department's curriculum cannot be expanded to accommodate a new course, project management coverage can be expanded by embedding it in human resource and management courses in addition to systems analysis and design (SAD) classes [Reif and Mitri, 2005]. Similarly, embedding team projects and presentations in most courses can strengthen interpersonal and communication skills.

Integrating Comprehensive Learning. Multi-semester projects, which combine and extend certain courses across semesters, essentially become two-semester courses that include both technical and soft skills. For example, a programming course and a systems analysis and design course could be combined and extended, with a two-semester team project included. This would help students develop and use soft skills and project management skills as part of the project. One model is a systems analysis class as prerequisite for a systems design and implementation class using one client over two semesters.

Renewable Projects. Another approach is the use of renewable projects which cover the whole project life cycle and use teams and open source software [Bennett and Watson, 2006]. Students can work on "real world" projects with diverse, distributed teams over multiple semesters. Since the projects are large and complex, future classes and new teams continue to develop and refine the work so that the product is usable and can benefit the community.

Service Learning. Projects in the community offer a real-world organizational problem for students to address. For example, the University of Houston's College of Technology has in the past offered a course that gets students actively involved in meaningful team projects that serve the community by helping build technology capacity in Houston area community technology centers, which help bring technology to underserved segments of the community. An important aspect of the learning experience is the opportunity for students to gain experience in applying communication and project management skills taught in the classroom to a "real world" project. [<http://www.comtechreview.org/spring-2003/000043.html>] This could be particularly promising if a university adopts a two-semester approach to certain courses.

Virtual Teams. IS faculty can use ISWorld or other venues to develop and facilitate team projects that span universities. This would give the students experience working with virtual teams. See Nath *et al.* [2006].

Universities need to provide additional institutional support for new curriculum and teaching initiatives. But universities cannot implement these initiatives alone. Providing greater context and interactions with industry will require greater industry alliances. We believe these alliances could be initiated and sustained through several mechanisms, as outlined below.

V. INDUSTRY ALLIANCES

STUDENT INTERNSHIPS

We define internships as pertinent work experience. It could be full-time in summer, part-time during the school year, and may or may not earn credit toward an IS major. It need not be as structured as the engineering co-operative model where students rotate between class and work full-time over several semesters.

Internships are a win-win for both companies and students. The placement of students in organizations is often met with skepticism by supervisors new to internships. They fear that students will require a great deal of supervision and have inadequate skills. Faculty internship directors need to market successes and testimonials to allay these fears. What supervisors do not realize is that students are apprehensive and strongly desire to be treated like a coworker. Therefore, they are often reluctant to bother their supervisors and work more on their own than expected. Management is more often impressed. The sidebar describes an exemplar model used by a large organization.

INTERNSHIP EXAMPLAR

Encouraging internships is one way to promote industry knowledge and experience. One study [Sandvig *et al.*, 2005] showed that internship experience is the single most influential factor for predicting starting salary for IS graduates, much more important than either GPA or the strength of the job market. The study found that internship experience is particularly important during weak job markets. An example presented at SIMposium [Zwieg, 2005] and the SIM Academic Workshop [Kaiser, 2005] describes a highly successful internship program with a company that works with eight area universities. Students begin as freshmen or sophomores in summer but may continue during the school year if distance/transportation is feasible. The CIO requests that 20% of his staff be working with interns at any one time. The program was so popular that other functional areas duplicated it.

Colleges can offer the incentive of having internships count toward the major requirements. This may involve working with other college departments to standardize an internship course. A faculty internship director can approve duties before the internship begins to assure that the activities are meaningful work from which students will learn. Other requirements for credit are a minimum number of hours monitored by an internship/placement director with the students' supervisors and tangible outcome such as a presentation to introductory classes to market the program. Internships could be full time in summer or part-time during the school year. Vehicles to help market and encourage internships could be an e-mail distribution list where job postings focused on IT are sent out by the internship director to IT majors.

An important institutional support for internships is recognition and compensation for faculty involvement. Some schools offer a course reduction each year to internship directors. Others offer course reduction or merit increase by the number of students enrolled in a formal internship class. The internship director can play the vital role of rainmaker in networking to promote the program among regional businesses. Internships need not be local to the university. Some directors have supervised internships in other cities (usually summer) or even other countries (summer or as part of a study-abroad program).

Student qualifications for internship applications should be carefully thought out. For example, one school has a 2.5 GPA requirement before a student can enroll for internship credit. Although well-intentioned to encourage students to apply themselves to their studies before undertaking an internship, this requirement may have the opposite effect. Students with internships see the value of the classroom concepts and principles based on their internship experience, which often motivates them to improve their grades. Some become more engaged in discussing the application of their work in class, which can stimulate other students.

The approaches presented above can encourage students to think more concretely about the systems they are analyzing and the implications of various design choices. An existing system with implications for a business and its users will present a more realistic challenge to students than the abstract problems that are often used. Furthermore, projects that force students to integrate concepts with their knowledge of business practices and processes that they learn in other classes will help them to understand the difficulties of designing and implementing information systems.

Replacing interns after their graduation could result in more positions to incoming interns.

One author uses the Godfather approach in insuring the rotation. She tells students who thank her for facilitating their internships that they owe the school a favor someday. When students become supervisors, they initiate and perpetuate the internship model where they work. It is important to note that the key industry alliance is between the internship director and the supervisor. It takes time to nurture the relationship and build trust. For this reason, the faculty intern director should be someone who is very practitioner-oriented and remains in the position over time to insure consistency. Reward and recognition can be valued as a teaching assignment.

Requiring internships can establish a school's reputation for insuring business domain skills. Students would receive one to three credits toward their major for working a minimum number of hours anytime from freshmen year to graduation. Although many schools encourage internships, formal processes are often not in place. Administrators raise objections for foreign students and those students obliged to work in a family business. Foreign students could work on campus depending on visa restrictions. Family businesses have IT needs that could qualify for valid IT experience.

PRACTITIONER MENTORS

Some schools have mentor programs where practitioners volunteer to mentor a student through several years. They may invite students to their workplaces, meet them for lunch, review their résumés, etc. Another approach is to have students interview an IT professional about what they do in their job. At Boston College, consultants from a global firm cooperate with faculty to develop cases and then play the role of client-managers in a simulated competition [Heim *et al.*, 2005]. The object of the competition is for student teams to develop a proposal for a CRM system, and the best one wins a consulting contract.

PROFESSIONAL SCHOOL MODELS

IS programs should emphasize more active and concrete learning experiences. IS programs could learn much from other professional schools, such as law, engineering, and medicine. An example of a more concrete approach to learning is the use of case studies taken from real-world examples, as used in law schools. Students learn to apply theoretical concepts in a variety of applications, as opposed to learning theoretical concepts in isolation. Similarly, engineering schools have encouraged, if not required, students to participate in internships and cooperative learning programs with industry, to insure that they learn the application of theory.

A model that IS can draw from is the teaching hospital model, which provides faculty and students with a business context. A teaching hospital has ties to a medical school. Practice is combined with theory as students take their 'rounds' in a teaching hospital. Faculty in the medical school often practice medicine in the hospital and train their students in a real medical context. Private physicians are often invited to teach a class in exchange for attending privileges. Faculty can conduct and publish research based on their practical experiences.

At SUNY-Albany this approach was applied to the field of information security [Berg, 2004]. They set up a Center for Information Forensics and Assurance (CIFA), a partnership between the University, the Office of Cyber Security and Critical Infrastructure Coordination (CSCIC), the State

Police Computer Crime Laboratory (CCL) and many state agencies. CIFA's goals include promoting best practices in information security and providing a center for information security research and teaching at the University. This model can be adapted to the business school in general and the IS discipline in particular. One university is proposing a consulting organization housed in an urban development center. The university would behave as a service provider. Nonprofits and small businesses could engage IT services delivered by faculty and students. This differs from the course project model by not having the constraints of a semester time period where students earn a grade. Practitioners from IT professional organizations will donate time and expertise to assist the students.

FACULTY INTERNSHIPS

Faculty internships develop opportunities for faculty to work closely with industry. One way for industry to support a context-based education is for companies to provide faculty with 2-3 month summer internships. Faculty could consult on a specific project and use that experience to develop a case study or other industry-specific teaching materials. They could also use the opportunity to develop a student internship program with the organization.

IS SELF-PROMOTION

In conjunction with an industry or professional organization (e.g., AIS, SIM), the IS field could benefit from a marketing campaign similar to operations research's "Science of Better" [<http://lionhrtpub.com/orms/orms-12-03/frmarketing.html>]. Possible points of emphasis could include:

- Current pessimistic reports regarding the IT job market are inaccurate, as discussed in the next section.
- Pending baby boomer retirements will open up a number of jobs. It is estimated that there will be 21 million new IT jobs by 2012, and only 17 million new IT workers [People3, 2005].
- IT/IS (business) graduates have the desired mix of technical and soft skills for client firms (especially compared to CS graduates)
- An example of a vendor, practitioner, and academic partnership model to address anticipated IT shortages is how Microsoft, SIM, and universities have collaborated to market IT careers. Microsoft and SIM have partnered to address IT career awareness and misperceptions about the field. They are reaching out to college freshmen and sophomores to interest them in IT-related majors [McGee and Whiting, 2005]. Plans include outreach to high school students and guidance counselors.

PROFESSIONAL ORGANIZATION INVOLVEMENT WITH ACADEMIA

In 2005, SIM formalized the role of Academic Liaison and asked each chapter to add this role to a Board position. With Microsoft, SIM is sponsoring half-day events for freshmen and sophomores on a campus to entice them to IT careers. This effort involves a national team and local chapter and university collaboration [McGee and Whiting, 2005]. Some universities use the local SIM chapter board for curriculum review. Many SIM chapters offer scholarships to area universities. The Memphis chapter has endowed scholarships at two area schools because they earmarked proceeds of their annual full-day conference.

EXEMPLAR ROLE MODEL

Practitioners who connect to universities as adjuncts, integrate internship programs, serve on advisory boards, or through associations prove to be valuable allies and resources to promote curricular exchange. For example, one Vice President of Information Systems facilitated research projects by suggesting contacts. He serves on a Global Sourcing Advisory Board through which he is exposed to university bureaucracy in implementing curricular change was willing to meet with university administration to emphasize the need for change. Teaching MBA classes, he

brings in current topics and influences full-time faculty in curriculum design. Many practitioners make time and would like to be tapped for their expertise to influence curriculum.

VI. ENROLLMENT ISSUES

REPORTS OF THE DEMISE OF IS ARE GREATLY EXAGGERATED

Collectively, the IT field is facing the threat of a self-fulfilling prophecy. As media reports of IT job shortages persist, incoming students have begun to turn away from the IT career path. University enrollments are down, affected by the specter of jobs moving offshore. The reality, however, is just the opposite. An increasing number of indications point to a growing demand for IT workers. U.S. IT employment in 2004 was 17% higher than 1999, the year before Y2K [ACM, 2006]. The U.S. Bureau of Labor Statistics predicts that IT jobs will be among the ten fastest growing occupations between 2004 and 2014 [BLS 2005]. A survey of CIOs indicated that they are more optimistic about increasing headcount in 2006 than at any time since 2001 [CIO 2006]. In fact, IT employment in the U.S. recently reached a record high level, surpassing the zenith of the dot-com boom [Chabrow, 2006].

It is the nature of the desired skills that is changing, not the demand. Nevertheless, if this is not made clear to incoming students, we will indeed see a substantial migration of jobs from domestic to offshore locations. However, this will be driven by a misperception of the job market, resulting in a shortage of qualified workers that further feeds the loss of jobs. This cycle will be repeated until the current prophecy of the demise of the domestic IT industry is realized.

The answer to the question "Is there a future in pursuing a career in IT?" is "yes," but the individual must have the right balance of technical and managerial skills. Other research has supported this conclusion (see also ITAA, 2004 and Litecky, *et al.*, 2004). However the impact of sourcing strategies on how the mix of full-time equivalents (FTEs) is changing between in-house and external service providers has intensified the need for a good balance of skills. It is very clear from this research that IT management sees the undergraduates entering the workforce as lacking key managerial skills and experience.

Television, parents, and guidance counselors misleadingly advise potential college students about the lack of career opportunities in IT in client organizations (as opposed to IT organizations like Microsoft and service providers like IBM). The students have seen the dot-com bust so they are no longer tempted to get rich quickly with IT. They hear about jobs being lost to sourcing and how IT is moving offshore. They avoid "hard" majors like computer science. Because of all this negative influence, it is becoming critical for universities and organizations to broadcast a different message. Young people entering today's workforce need to understand the critical role that IT plays in the competitive success of organizations.

DIVERSITY – WHITHER THE FEMININE MYSTIQUE?

One area that continues to persist as an issue in the IT workforce is the low percentage of women in the field. The impact for the profession reflects on organizations' performance as stated by Catalyst, which found that American companies with more women in senior management jobs earned a higher return on equity than those with fewer women at the top. Women hold only 10% of the top IT positions, and their rise to the top has been slowing. Researchers pose that heterogeneous teams fare better than single-sex ones at problem solving, and that women are better at team building and communications [Economist, 2006]. ITAA [2003] indicates that women make up only 35% of the IT workforce in the U.S. while representing 46.6% of the U.S. workforce overall. More alarmingly, this number is declining. A model by Adya and Kaiser [2005] identifies some of the decision factors affecting girls and contrasts them across ethnic cultures. The model indicates that perceptions start as early as middle school. The paper notes that the emphasis of IT in developing Asian economies encourages more women into IT than one finds in developed nations.

Some research finds that young girls in the age range of 11-17 have already decided on career directions without really having the knowledge of the possibilities before them [Barltrop, 1988; Marso and Pigge, 1994]. The American Association of University Women has conducted a series of studies of the specific courses that girls pursue and found that they avoid math, science and technology [AAUW, 1990; AAUW, 2000]. These early choices may be steering girls away from careers in IT.

Other factors that are important to understand include social influences such as gender stereotypes and role models, the influence of teachers and counselors, and personal access to technology. Ongoing research needs to shed light on how to motivate and excite young people toward IT-related careers.

SUPPLIERS IN K -12 - ALL I REALLY NEED TO KNOW I LEARNED IN KINDERGARTEN

Emotional intelligence, social skills, communication skills, and problem-solving skills cannot be developed when a student arrives at college. Clearly in the U.S., primary education issues must be addressed. In a knowledge economy, it is an axiom that the larger the pool of literate citizens, the larger the comparative advantage. Universities and industry in the U.S. need to work closely with general education and K-12 to ensure that most high school students have the necessary skills and are excited about careers in technology. How can we project the excitement and passion of IT careers?

Governments in industrialized nations like the U.S., Canada, Japan, and the countries of Western Europe must consider some of the strategies that we see in the industrializing countries like India where financial support is provided to students who study computer science and IT, and income tax holidays are enacted for individuals entering the IT fields.

Until organizations, universities, and governments begin cooperating to change the trend of low IT enrollments, the field of IT is in danger of a severe shortage of qualified staff. This is becoming apparent now through university enrollments, and it will become strikingly clear as the baby boomer retirements begin to have an impact on the existing workforce. It is important for the future of the IT field that more research be focused on the fundamental K-12 pipeline to understand the factors, trends and motivational needs.

VII. DISCUSSION

THE BUSINESS AND TECHNOLOGY DUALITY - THE PIT AND THE PENDULUM

Our findings led us to analyze several issues related to IS education. First, there is the question of how best to integrate the right mix of skills. This is related to a long-standing question for the field of IS: Are we managers or engineers? The IS discipline has struggled to find a balance within its dual nature. The pendulum has swung from one side to the other over 35 years. With each technology breakthrough, we scramble to master its intricacies. A decade ago, most of us had to retrain ourselves on object-oriented and Internet technologies. Once the technology matures, however, it becomes more of a management challenge.

The new factor of globalization, providing a seemingly bottomless pit of foreign talent, however, may mean that the pendulum may not swing so predictably anymore. The new MSIS curriculum hints that the day of the "Renaissance IT Professional" may be passing. While graduates will have a core understanding of both technology and business, they may choose to emphasize one more than the other, depending on work assignments and how much choice they have in determining a career path. Tracks often separate along business analysis and technical expertise. The business emphasis usually leads to management positions more than a technical emphasis does. Technical career paths may find more reception at IT service providers. Both IT and their client firms will need managers with solid technical foundations.

The classic career path of programmer-analyst-manager is being replaced at most organizations. A model for this already exists at many firms that outsourced IT years ago. At Sony-BMG, each department has designated "super-users" who join those departments in a variety of entry-level positions but are selected as liaisons with the IT service providers. At L'Oreal, promising IS students are recruited and rotated through several jobs at several departments before becoming business analysts assigned to one area. GE's Information Management Leadership Program (IMLP) places graduates in rotations of user areas for 3-4 months over two years to learn the business. The new career path for our students may well be trainee, liaison, business analyst, and project manager.

Secondly, support for a more experiential education in IS will require an increased effort to develop alliances with industry. Secondary education and graduate education are key suppliers to industry. Enlightened self-interest would dictate that business invest in developing this supply chain. Our findings show that IT executives are looking for employees with significant business domain knowledge and project management skills. Yet they still appear to be using the earlier paradigm of the programmer for entry-level hires. It is time for these executives to articulate a clear career path for IT professionals and to invest in creating ongoing alliances with academia.

WHO MOVED MY CHEESE?

Students and faculty will also need to learn and adapt to this changing industry. For example, one of the authors began his IT career by leaving the sleepy town in which he grew up, in search of a big (blue) mainframe to program. He traveled far and wide and eventually landed in Silicon Alley, where he pursued a fulfilling dual career as academic and consultant. One day he arrived at the consulting firm to find that the development work had been outsourced, so he now has plenty of time to travel back to his hometown to visit. The town is not so sleepy anymore but it is still called Bangalore. The point of this little tale is that students and faculty may have to accept the fact that they will have to follow the work. Settings are Shanghai and Sofia as much as the classroom. An increasing number of students are passing on Wall Street to intern at Infosys [Rai, 2005]. Recruiters indicate that foreign experience demonstrates entrepreneurship, resourcefulness and independence. Many IS faculty, too, have traveled to India to gather data and develop research collaborations.

Our survival will also depend on our ability to increase enrollments, so as to insure an IT workforce in the future. The trend towards increased sourcing, coupled with the finding that technical skill sets such as programming are emphasized less at non-IT organizations, at least over time in a career path, indicates that the IT career path may be evolving toward more segmented or delineated skill tracks. As the IT function at non-IT firms evolves into arranging for the provision of IT services, rather than actually providing those services, their needs become more focused on skills related to managing the process of obtaining IT services, and managing the relationship with those service providers. Service providers and software vendors, on the other hand, may experience an increasing need for the technical skills necessary to deliver IT services [Morello, 2005]. The question of how the mix of skills desired by service providers matches the skills we identified as needed in non-IT organizations will require a future study.

Understanding needs of both types of firms helps us to design curriculum because our graduates desire and receive offers from both types of firms.

VIII. CONCLUSION

The IT Workforce study dispels the myth of catastrophic job loss in the IT discipline. We found that the number of IT jobs is likely to remain stable from 2005 through 2008, with a small increase in the proportion of offshore third-party providers. In the longer term (2011 and beyond), the retirement of the baby boom generation will create a fairly rapid growth in IT-related jobs. This news needs to be broadcast to students and counselors.

In the study, participants identified skills and capabilities critical for their organizations to keep in-house today and in the future. The results indicate that business domain skills, in general, and knowledge-based skills, in particular (functional area knowledge, company specific knowledge, industry knowledge, and business process knowledge), are the most critical skills to keep in-house today. A second set of skills critical to keep in-house relates to managing projects. The skills and capabilities identified as critical to keep in-house in the future further highlight the increasing importance of business domain knowledge. Skills identified as growing in importance in the future also include emerging skills associated with managing entities outside the traditional IS department, such as managing third-party service providers. Taken as a whole, these results signify a shift in the mission of the IS function from providing technology-based solutions to *managing the process* of delivering and providing them, a subtle but telling distinction.

The skills identified by our participants as those most desired in entry-level employees were primarily technical. While the emphasis on technical skills fits with the conventional wisdom that technical skills are a prerequisite to a career in IT, this finding presents a striking disconnect with the list of skills identified as most critical to keep in-house. These findings raise interesting questions regarding the career path that entry-level hires must follow in order to develop the skills that our participants identified as critical to their organizations and desired in their more senior personnel.

The primary dilemma for academia is to determine how to develop entry-level candidates who are (1) sought for their technical skills and (2) prepared to move into the pipeline as desirable mid-level candidates. IS programs may be best served by integrating business functional knowledge and teaching through experiential learning models. We discussed several approaches to creating concrete experiences for students in a business setting. These included service learning, internships, and a teaching hospital model. We also discussed mechanisms for better integrating functional process knowledge which include team-teaching, multi-course projects and a matrix organizational structure for business schools. While the IT Workforce research presents an overview of skills primarily for firms based in the United States, each global and local region may have influences that dictate how IT faculty customize their curriculum for area organizations that recruit regularly or those firms that the faculty would like to recruit regularly. How well do these findings and suggestions resonate for faculty in their setting?

Technology and the business environment continue to evolve, which necessitates that IS as a field must evolve as well, or else become irrelevant and extinct. Through this paper we hope to stimulate thoughtful discussion and, more importantly, meaningful change. Towards that end we have raised what we believe are pertinent issues and offered pertinent suggestions. The next step is up to members of the IS community, both individually and collectively, practitioner and academic.

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that

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APPENDIX I. SKILLS AND CAPABILITIES CATEGORIES

TECHNICAL

- Systems Analysis
- Systems Design
- Programming
- System Testing
- Database Design / Management
- IT Architecture/Standards
- Voice/Data Telecommunications
- Operating Systems
- Server Hosting
- Security
- Mainframe/Legacy
- Operations
- Continuity/Disaster Recovery
- Desktop Support/Help Desk

PROJECT MANAGEMENT

- Project Planning, Budgeting and Scheduling
- Project Risk Management
- Negotiation
- Project Leadership
- User Relationship Management
- Working with Virtual Teams
- Working Globally
- Capability Maturity Model Utilization

BUSINESS DOMAIN

- Industry Knowledge
- Company Specific Knowledge
- Functional Area Process Knowledge

Business Process Design and Reengineering
Change Management/Organizational Readiness
Managing Stakeholder Expectations
Communication

SOURCING

Sourcing Strategy
Third-party Provider Selection
Contracting and Legal
Managing Third-party Providers

IT ADMINISTRATION

Financial Management
Internal IT HR Management
IT Governance

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