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In this issue:

A Value Chain Approach for Attracting, Educating, and Transitioning Students to the IT Profession

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A Value Chain Approach for Attracting, Educating, and Transitioning Students to the IT Profession

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Abstract

Economic conditions over the past year have brought most nations in the world to a state of flux. What once appeared to be a thriving economy has now been in one of the steepest recessions in decades. To get our economy back on track, organizations will need to seek IT investments and solutions that increase productivity, improve security and compliance, and support growth. It is critical that educators assume a long-term view in attracting, educating, and transitioning future IT professionals and focus on identifying future workplace needs and positioning their programs to prepare graduates to meet those needs. In this paper, the authors employ a modified value chain approach to attracting, educating, and transitioning future IT professionals into the workplace.

Keywords: CS programs, education strategies, educational model, value chain

1. INTRODUCTION

Although the USA, as well as countries around the globe, has been experiencing serious recessionary and financial crises, several forces should increase the demand for IT professionals. Hutchins (2009, 47) believes that the current economy is similar to the economy of the 1970's in which technological innovation prompted "a generation of company formation, job creation, productivity gain, wealth accumulation, and GDP growth." Consequently, innovation should increasingly be demanded as we seek recovery and growth; the skills and knowledge of IT professionals should prove invaluable in seeking and implementing innovations. In the short run, organizations may be willing to invest in technology solutions for solving their budgetary shortfalls and improving efficiency as they seek to maintain operations.

Surviving and newly created organizations will need to comply with increased regulations and demands for greater transparency and accountability as they seek growing revenue streams, efficient and effective operations, and positive cash flows. Global financial reporting and regulation, as well as demands for improved security and internal control, all have the potential for increasing

the demand for IT and IT-related professionals. For example, the mandatory requirement that organizations use XBRL in tagging financial information will require management, accounting, and IT professionals to work collaboratively.

Logically, one can anticipate that the need for skilled IT workers is present, albeit not to the degree expected prior to the economic downturn. Consequently, there is concern in the IT field that the number of skilled IT graduates is not what it should be and, will most assuredly, not meet future demand. The authors suggest educators consider a value-chain approach as they seek to attract, retain, and transition IT graduates with the appropriate skills, knowledge, and attitudes to areas in demand.

In the following sections, the authors review the employment opportunities for future graduates in the field of computing. In addition, the value chain is suggested as a means of providing a comprehensive framework to analyzing the educational process from the viewpoint of core and support activities. In section 3, an education program refinement model based upon the value chain framework is provided for analyzing activities in the core educational processes including: (1) Intake/Recruitment (inbound logistics), (2) Education and Retention (operations), (3) Graduation/Transition to Workplace (outbound logistics), (4) Affiliation (marketing and sales), and (5) Alumni Services (services). Strategies for enhancing enrollment and retention are then suggested.

2. BACKGROUND

In this section, the authors draw upon two literature streams. The first stream illustrates that educational programs are not producing the number of technology-oriented graduates that they have in previous years. The second stream provides support for the on-going need for graduates skilled in information technology oriented fields.

2.1 Technology Graduates

Generally, universities have been experiencing a downward trend in enrollment in academic programs in the computing field such as Computer Science (CS), Information Systems (IS), Software Engineering (SE), Computer Engineering (SE), and Information Technology (IT) as well as variants such as Computer Information Systems (CIS) and Management Information Systems (MIS) since the dot-com bubble burst. The recent 2006-07 Taulbee Survey (Zweben, 2008, p. 4) reports that, during that year, "the Bachelor's degree production (CS and CE) was down significantly (nearly 20%)." According to the survey, this trend followed the declining trends in the number of new Bachelor's students, reported widely in recent years (Zweben, 2008). The U.S. enrollment in MIS is only 25% of its 2001 level (Frankel, 2008). This trend is also observed at the authors' institution.

Several reasons are attributed to such an enrollment trend; some of which are facts (such as image of the discipline as established through interviews) and some of which are generated by media (such as the hype associated with offshore outsourcing). Job availability does not seem to be the issue. For example, Andriole and Roberts (2008) noted that the computing discipline graduate production meets only 25% of the job market requirement, while Biology graduates outnumber the job market demand by ten times.

In examining the reason for low enrollment in the computing majors, a recent study indicated (Akbulut & Looney, 2007) that interest in the field of study (and self efficacy or salary) is the main antecedent to career choice goals. Walstrom, Schambach, Jones, and Crampton (2008) examined factors that influenced and impacted business students in selecting their major and why students were not majoring in information systems. Their results indicated that business students were not as knowledgeable about careers in information systems as they were in management, marketing, accounting, and finance. Students in their study indicated that they were seeking majors that were interesting, offered job security, and paid well. Information on college/department websites, brochures about the major, and Internet information were identified as important sources of information used in the students' selection of a major. An important observation is that, even though the millennial students are more confident than prior generations in using technology, they seem to lack the confidence to major in fields

(such as computing) that are crucial to inventing and building important technologies.

Professional institutions such as Association for Computing Machinery (ACM , http:// csta.acm.org/) and the Association for Information Systems (AIS - http:// enrollments.aisnet.org/) have initiated actions to address the issues along with high schools (to get the right message across to the high school graduates) and industries (to ensure the curricula focus on developing the right skills). The interaction with the industry is critical so as to avoid the skill gaps as well as the shortfall in the number of graduates entering the IT job market (Andriole & Roberts, 2008). Academicians in IT-related disciplines should work together and with academicians from other disciplines to initiate and participate in various activities to attract not only sufficient students to their disciplines, but also seek to retain the "best and brightest" to the IT-related professions and to ensure graduates possess not only technical skills and knowledge but also business knowledge and soft skills.

2.2 Continued Demand

In 2006, a group of 20 researchers, associated with the Society for Information Management Advocacy (SIM), collaborated on a study that examined IT workforce trends and implications among, primarily, Fortune 500 firms (Zweig, et al., 2006). Between May and October 2005, 81 senior level IT department executives were interviewed regarding their current and future workplace trends and requirements for IT skills. Zweig, et al. (2006) found that an increasing number of organizations were enlarging their in-house IT departments with employees having project management and business-oriented skills. Concerns were raised about the future need for mid-level managers who have both IT and business skills, while the number of new career entrants had been on the decline. The study found ". . . a shift in the mission of the information system function from delivering technology-based solutions to managing the process of delivering solutions. . . " (Zweig, et al., 2006, p. 102).

Simon, Kaiser, Beath, Goles, and Gallagher (2007) published an article in Information Systems Management entitled, *"Information Technology Workforce Skills: Does Size Matter?"* The article noted that, of the companies surveyed, the number of full-time equivalents was expected to increase in the IT departments of Fortune 500s (47%), large corporations (44%) and SMEs (67%). An increase was also expected in the number of third-party IT providers in Fortune 500's (59%), large corporations (56%) and SMEs (42%) (Simon, et al., 2007).

Several long term labor statistics were generated and published prior to the economic downturn. In the next section, the authors examine published labor projections from a holistic viewpoint realizing that the statistics, before the economic downturn, may have changed, but the general trends and directions may, in the opinion of the authors, remain relatively the same over the long run.

2.2.1 Labor Projections

The U.S. Bureau of Labor Statistics has projected that, over the next decade (2006-2016), most of the job growth would take place in service industries such as professional and business services, social services, health care, and retail (Table1).

Table 1 -U.S. Job Outlook (2006-16) – Employment (in 000's) by Major Industry Sector (including Information)

Industry	2006	2016	Percent
Professional & business services	17,552	21,644	23.3%
State and local government	19,262	20,696	7.4%
Retail Trade	15,319	16,005	4.5%
Health care and social assistance	14,920	18,954	27.0%
Leisure and hospitality	13,143	15,017	14.3%
Information	3,055	3,267	6.9%

Source: Bureau of Labor Statistics: http://www.bls.gov/news.release/ecopro.nr0.htm

Although the projected growth figures may no longer hold true, the industries with expectations for new jobs over the long run should still be considered.

One industry that is obviously absent in Table 1 is the "Federal Government." In light of President Obama's Roadmap to Recovery initiative, one can assume that several of these areas, including the Federal Government, will experience job growth. For example, in a statement released by the Office of the White House Press Secretary on June 8, 2009, job creation initiatives were spotlighted in several areas, including the following:

- Service expansion by 1,129 Health Centers in 50 states and territories
- Work on 107 National Parks
- Rehabilitation and improvement projects at 98 airports and over 1,500 highway locations
- Fund 135,000 education related jobs
- Improvements to 90 Veterans' Medical Centers
- Start 200 New Waste and Water systems in Rural America
- Initiate 2,300 construction and rehabilitation projects at 359 military facilities

Although none of these individual projects specifically mentions technology development, one can anticipate that an IT infrastructure will be needed to support and provide these ongoing services. President Obama has also advocated the need for technical workers and, with the anticipated job growth expected to be generated by the Recovery Act, some of those IT jobs should result from oversight needs for the individual initiatives.

2.3 The Value Chain

For years, business organizations have sought various tools and techniques for continuously improving operations to maximize customer satisfaction, reduce costs, increase revenue, and maximize profits. As these organizations have undertaken strategic planning and cost management, many have adopted a value chain approach to improvement. The value chain (Porter and Millar, 1985) involves linking primary and support activities together in an organization with a focus on increasing the value of the product as it passes through the chain. An organization's value chain includes five primary activities consisting of: 1) inbound logistics, 2) operations, 3) outbound logistics, 4) marketing and sales, and 5) service. Support activities for business organizations promote efficient and effective performance of the primary activities and include the four categories: 1) firm infrastructure, 2) human resources, 3) technology, and 4) purchasing.

The authors suggest that educators at the university level adopt a similar educational value chain approach to attracting students to academic programs, educating and retaining those students, and transitioning those students to the workplace successfully. Several strategies and pedagogies are integrated into a modified value chain approach suggested by the authors (Appendix).

3. A VALUE CHAIN FOR EDUCATING AND TRANSITIONING IT PROFESSION

The authors propose use of an Education Value Chain model patterned after the work of Porter and Millar (1985), as a technique to organize various activities in a meaningful way. The value chain shown in the Appendix is suggested as a strategic framework for displaying conventional and enhanced activities that may be used for attracting, educating, and transitioning IT professionals.

The primary activities of the model consist of (1) Intake/Recruitment (inbound logistics), drawing students into the program, (2) Education and Retention (operations), providing students with a well-rounded MIS/CS/CIS education and keeping them engaged, (3) Graduation/Transition to Workplace (outbound logistics), providing opportunities for industrial experience, (4) Affiliation (marketing and sales), developing a feeling of ownership in their education and program, and (5) Alumni Services (services), developing a lasting relationship with program graduates.

3.1 Intake/Recruitment

The inbound logistics for our value chain involves conventional and enhanced activities for recruiting and enrolling students. This area is supported by the secondary research and development activities that, for example, involve identifying trends in supply and demand for IT professionals, industry requirements and future expectations, and development of profiles of students most likely to be attracted to the profession and

to experience long-term success in the workplace. Educators should consult various sources and research to acquire this knowledge and then share this information with prospective students.

Examples of research would include studies such as the 2005 study by Frinking, Ligtvoet, Lundin, and Oortwijn on supply and demand of information and communication technology in the EU. Frinking, et al. (2005) suggested that supply-demand studies should examine data pertaining to occupational profiles, skill profiles, and formal education (and training). They also suggest a framework involving a shortage (lack of skilled people), a gap (competence shortfall), and a mismatch (difference between the competence of graduate and employers' expectations).

Educators also must be aware of the potential for outsourcing of labor. When a skill becomes globally ubiquitous, cost becomes a significant issue in determining from where that skill should be sourced (BCS, 2004). IT industries have followed suit with what the manufacturing industries attempted in the 1970's. In the software development life cycle, analysis, design (in particular, user interface design), and acceptance testing activities require a recurrent working relationship with the customer; however, coding and maintenance may not be subject to such proximity constraints. Thus, for the most part, coding and support related jobs may be outsourced offshore. In the IT sector, demand for customization, infrastructure maintenance, and project management is growing. Some of these jobs require excellent oral and written communication skills, interpersonal skills, a broad knowledge in business operations, and knowledge of system-wide concepts.

University faculty and admissions personnel should seek ways to get involved in the process of motivating high school students to consider computer related fields as their intended career choice through recruitment activities and communications. As evidenced in research published by Kelleher and Pausch (2007), it appears that this process could effectively start at the middle school level. The faculty could promote the teaching of computer science and other computing disciplines by either working with the teachers in the high schools themselves or volunteering in the efforts of the Computer Science Teachers Association that ". . . *provides opportunities for K-12 teachers and students to better understand the computing disciplines and to more successfully prepare themselves to teach and learn" (acm.org).* Following this strategy, the faculty and admission personnel could identify those students who have the potential to succeed in IT related fields and guide them in selecting their field of learning. Once identified, these students should be provided with materials and contact information, utilizing Web 2.0 tools such as Twitter, Facebook, YouTube, Skype and Second Life. Students, teachers, counselors, and parents can use these tools to learn more about what IT professionals do, communicate with university admission counselors, and learn more about the programs of study offered at the institution.

3.2 Education & Retention

The next component of the educational value chain involves the education and retention of IT students to graduation. To educate and retain future IT professionals, educators should seek to understand the characteristics and learning styles of each new pool of learners, undertake effective teaching strategies, and provide a challenging and supportive learning environment. There are a number of resources that can be utilized in identifying and implementing instructional strategies and activities to motivate students to stay in our programs and to prepare them for the workplace. For example, Beard, Schwieger, and Surendran (2007) offered teaching strategies that focused on the integration of technology, group projects and interaction, and flexible and experiential learning opportunities to bridge the academic/industrial chasm for the millennial generation.

Providing support to the Education and Retention component are model curricula (for instance, IS2002). These guidelines, along with accreditation standards, can provide important assistance in the design and assessment of educational programs. As indicated in Figure 1, it is necessary to refine programs from time to time to consider changing characteristics of the students and the changing nature of the jobs in the profession.

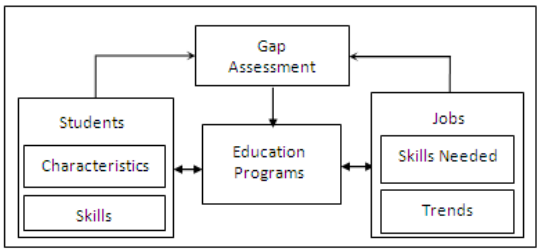

Figure 1: Education Program Refinement Model

The characteristics of the current generation of students were summarized, for example, in Beard, Schwieger, and Surendran (2007). Research on workplace trends and the skills and knowledge demanded, as indicated earlier, should be used in the refinement of educational programs. The activities presented in the Appendix can be used to bridge the gap in the educational process arising from job information on one end and changing characteristics of the students on the other end as indicated in Figure 1.

Also, important in this phase of the value chain is advising and professional consultation. Effective advising, both face-to-face and online, as well as career exploration and insights are critical activities. Technology can provide important support in this area. Students and faculty, for example, should have real-time access to degree audit information and to enrollment opportunities. At the authors' institution, students and advisors have online access to student records which can be used to ensure that students make progress in meeting program requirements, leaving more time for professional career discussions.

Attracting, retaining, and developing faculty who stay abreast of student and workplace expectations, develop and assess academic programs, provide high quality educational experiences, and create and maintain ongoing professional contacts with graduates are essential. These are important steps to managing the gap.

3.2.1 Flexible CIS Program

The following quote regarding the need to broaden CS/IS programs was included in a report published by the British Computing Society on offshore outsourcing, "A narrow focus on technical skills and their application will not enhance career prospects for tomorrow's professionals" (BCS, 2004, p 24). The report provides an example in which a SQL developer with pharmaceutical expertise, after losing his job due to offshore outsourcing, takes on a new role with a company supplying hospital technology because of his domain knowledge.

At the authors' institution, the requirements for the CIS (undergraduate) program were recently revised. In this revision, the students majoring in CIS are required to take a minor outside the department as part of the degree requirements. To complete this program, students take 53 credit hours of core CS and IS courses, 8 credit hours of mathematics, 45 hours of general education requirements, and select either a minor (18 hours) or another major (optional, requiring additional credit hours over and above the 124 needed for CIS) (Duben, et al, 2004). In such programs, students are able to choose an area of interest for applying their IT skills which may enhance their scope for future employment.

3.2.2 Minor in CS/IS

In addition to such flexible CS/IS curricula, the departments could promote minors in CS/IS/MIS to adequately prepare students for acquiring jobs in their own disciplines that require some IT skills. Such initiatives should broaden students' marketability and could help regain faculty workload lost due to reduced enrollment.

3.2.3 Open Source Software Development

In order to perform well in higher-level jobs, graduates still need the technical experience required by some entry-level jobs. Even if students acquire the softer skill sets needed in higher level jobs through revised programs, they would still lack the technical experience provided by entry-level positions (since these jobs are decreasing in number). To make up for this deficiency, students could be exposed to activities in open source software development which will enhance their programming skills while involving them in a development community.

3.2.4 Experiential Learning Opportunities

Simulated real-world experiences such as those described in the above cannot match the benefits available to students through

internships and apprenticeships (Surendran, et al, 2002). During internships and apprenticeships, students are guided by mentors, interact with people in different disciplines, and obtain a broader exposure to business. The different roles they play during an apprenticeship program help them hone both their technical and soft skills.

3.2.5 Broadening Skill-Sets

Most studies, dealing with skill sets, stress the need for students to acquire soft skills and knowledge in business areas. In this regard, MIS students have an edge over others because their programs include a few business courses. However, acquiring soft skills remains somewhat elusive. Making the students work in teams on system development or database projects helps the students, to some extent, hone their soft skills. The students are able to assume different roles and responsibilities in such assignments. In these roles, students are able to recognize deficiencies in their soft skills and learn from their mistakes. Further, in these group projects, the instructor usually lets the team leader manage the project and provides the necessary guidance and coaching for resolving conflicts and handling delegation. Such assignments help students develop oral and written communication skills as well as provide opportunities for students to gain skills in leadership, project management and conflict resolution.

3.3 Graduation/ Transition to Workplace

The outbound logistics of the educational value chain model focus on transitioning students to the workplace. The following section examines those conventional and enhanced strategies and activities.

3.3.1 Career Development

Career development strategies and activities should be integrated throughout the students' university experience. Opportunities for career exploration and self assessment should be provided early in the students' academic program with assistance in resume preparation, interviewing, and placement provided as the student prepares to exit the program. Students should also be introduced to online resources such as job and internship boards as well as be reminded that recruiters use Web 2.0 tools for first impressions and evaluations. Through the Career Linkages program at our university, students are required to undertake a structured supplemental program focused upon career preparation and job search skill development. In this program, students must complete skill and career-interest self-assessments, career exploration and planning guides, and job search activities throughout their four-year academic program. Faculty participate in this program through the integration of these activities and requirements into various courses.

Job shadowing, internships, and other experiential learning experiences provide opportunities to network and identify mentors from IT professions. Strong and effective student organizations that provide activities supporting the development of leadership, teamwork, and time management skills should be supported.

3.3.2 Additional Opportunities

Taking the initiative to organize and promote a college interview day at a location in close proximity to the greatest number of employers is a great way to take prospective graduates to employers. Collecting and organizing the students' resumes into a resume book for distribution prior to the interview day will also facilitate the interview process. In addition, faculty who attend these events have the opportunity to visit informally with recruiters to gain insights into current and changing workplace expectations.

3.4 Affiliation

The marketing and sales component focuses both inside and outside the university. This portion of the value chain involves conventional and enhanced strategies and activities for developing affiliations and connections with industry professionals.

3.4.1 Marketing of IT Programs and Graduates

Faculty should make connections with students as early as possible in the academic experience and should provide on-going opportunities to stay connected. A national campaign, similar to that commenced by the Institute of Management Accountants (IMA) and the American Institute of Certified Public Accountants (AICPA), should be undertaken to help students better understand the challenges and opportunities of their chosen pro-

fession and career path. Students need to be informed of the importance of IT for business, not-for-profit, and governmental entities and the vast career paths available in these areas.

3.4.2 Marketing to Secondary Educators

Already, there are several well thought out initiatives to support interaction with high school students and revamp the curricula such as ACM's formation of the Computer Science Teachers' Association. Universities need to be innovative and extend their links between their supplier (high schools) and their significant customer (industries). For instance, when enrollments are low, faculty members could be encouraged to consider industrial sabbaticals or assignments in high schools. Such a proactive approach could help strengthen ties between both industries and secondary schools.

3.4.3 Building Relationships

Relationships with individuals in diverse organizations should be maintained and enhanced through interactions among faculty, career development and placement personnel, and prospective employers. Contacts made through these relationships can be shared with students, potentially leading to internships and full-time employment.

3.5 Services

The final element of the value chain is both outward and inward focused. This component includes services to alumni and continued interactions with them for their professional development as well as continued program improvement.

3.5.1 Alumni Services

Developing ongoing relationships with alumni is crucial in building associations with industry and strengthening academic programs. Soliciting feedback regarding their academic experience, inviting alumni back to campus to speak in classes, and creating connections that can lead to possible internships and job opportunities are all ways to involve alumni in building successful programs.

3.5.2 Research and Development

It is imperative that faculty remain current in their instructional fields and interact with leading edge practitioners. Alumni can be an excellent resource for faculty in gaining insight into the characteristics and preferences of successful IT professionals. Workplace expectations and needs among practitioners and students should be collected and communicated in efficient and effective ways.

4. CONCLUSION

As noted in the literature, the demand for skilled IT employees was expected to grow in the US prior to the economic downturn of 2008. Although those projections may have changed in the short run, the areas of IT need identified by the research may still hold true in the future. In addition, we may see an increased need for IT skills and knowledge as Federal initiatives are enacted. The challenges and opportunities that may develop as a result of the renewed demand for IT workers cannot be ignored.

The declining enrollments in computing disciplines remain a major concern. Attracting and retaining students must be addressed through a variety of strategies and activities, many of which are suggested by the authors. By examining economic projections provided by corporations and research institutions, faculty can get a better feel for the employment trends, future required skills, and possible changes to programs of study and academic courses.

We offer a value-chain approach for researching the workplace expectations and student characteristics, designing value-added programs and activities, developing students with the requisite knowledge, skills, and professional attributes, marketing to and distributing those students to the workplace, and finally, maintaining communication with our students and practitioners to continue to improve our processes. By developing and providing a structured approach for examining the end to end educational process, programs are better prepared to: identify areas of improvements; address the needs of students, employers, the educational process, and the institution; and essentially, bridge the educational gap.

The objective of this paper is to provide a framework for addressing the educational process as well as a comprehensive list of suggestions aimed at improving recruitment and retention. Our most valuable addition to

the value chain that we propose is the focus on career development from the freshmen level and integration of career building issues throughout the curricula.

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APPENDIX: THE VALUE CHAIN FOR ATTRACTING, EDUCATING, AND TRANSITIONING STUDENTS TO THE IT PROFESSION

	Intake/ Recruitment (Inbound Logistics)	**Education & Retention (Operations)**	**Graduation/ Transition to Workplace (Outbound Logistics)**	**Affiliation (Marketing & Sales)**	**Alumni Services (Services)**
Primary Activities	*Conventional* * High School Recruitment * H.S. Campus Visits *Brochures *Letters *Web sites	*Conventional* *Programming *Advising *Majors *Minors *Experiential Projects *Extracurricular Activities *Educational Certification in Technology *Continuing Ed.	*Conventional* * Career Development *Networking Opportunities *Resume Book *Interview Days	*Conventional* * Connections with students & scholars * Celebrate Achievements * Job Boards * Alumni Monday	*Conventional* *Networking *Presentations *Alumni Achievements *Alumni Socials
	Enhanced * Twitter * Social Net Sites * Virtual Worlds (Second Life) * Middle School Programming	*Enhanced* * Flexible CIS * Integrated Classes *Open Source Development	*Enhanced* * Online Job Boards * Online Internship Boards	*Enhanced* *Industry Internship Kits	*Enhanced* * Online Alumni Services *Alumni Services Networking Site *Alumni Visits in Industry
Secondary Activities	**Infrastructure Development** * Technology * Accreditation Standards * Curriculum Standards/Model Curriculum * Attracting/Retaining/Developing Faculty and Staff **Marketing Program to Potential Students**			**Research & Development** *Trend Identification *Enrollment Analysis *Enrollment Projections	