Meeting the Demand for IT Employees: Can Career Choice be Managed?

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IT Employment as a Human Supply Chain

From a workforce perspective, there are generally two categories of people: those that are employed in the work force and those that are not. Those that are unemployed may have the skills to perform a job but for a given set of reasons are unable to obtain a job. While there are many factors that affect whether a person holds a job, a macroeconomic perspective suggests that the employment picture can be understood in part as an issue of supply (those workers seeking employment) and demand (the given need for workers in the marketplace).

Another perspective that may provide insight into the employment picture is to view employment in general as a supply chain. When the term "supply chain" is mentioned, the first thing that comes to most people's minds is the transformation of raw materials into finished goods as the work product moves through a series of linked suppliers and customers, ultimately ending with the finished product arriving at the end customer's location.[1] However, another way to view a supply chain is to view organizations that are linked as "suppliers" and "demanders" of each other, working together to maximize the efficiency and effectiveness of each organization while moving the "product" to the next link in the chain until the final product reaches the end customer.

The combination of the supply and demand of the workforce and the concept of a supply chain leads to some interesting ways of thinking of issues related to employment and unemployment (or underemployment), and gives rise to possibilities for companies to improve the way they work with employees and potential employees. The concept of applying supply chain analyses to the human capitol of an organization or industry is termed "Human Supply Chain Management."[2] Essentially, this perspective considers how the demand for workers is satisfied. Employees can be "sourced" or come from different places depending upon the job that needs to be filled. For example, job applicants may be found directly out of college, recruited from another company, or drawn from the unemployed labor force either domestically or internationally.

The sourcing side of the human supply chain includes attracting, training, and preparing employees for their jobs. This area covers

[1] Allen, D., Amini, M., Janz, B.D., & Nichols, E. L. (2008). *SCM discussion for use in the Navy HR SCM article development.* Working paper in progress. Memphis, Tennessee: The University of Memphis, The FedEx Center for Supply Chain Management.

[2] Allen, D. et al, op. cit.

initial orientation, continued education, and certifications. After sourcing, the tasks of retaining, developing, and advancing employees in the company can be considered. This stage encompasses compensation packages, benefits, and professional development and training. Finally, the last link of the human supply chain considers the exodus of employees from one organization to another, in the same or different industry, or complete separation from the workforce through retirements, termination, etc. In summary, the human supply chain covers the gamut of starting with untrained/uneducated workers-to-be, recruiting potential employees, through the education and training process of employed workers, and working with employees until they leave. The combination of the supply-demand model and the supply chain model leads to an investigation of the many employees in demand by companies juxtaposed with the supply of workers available to immediately join the workforce, as well as the many future employees in the education pipeline as students. The supply chain metaphor lends itself to considering if and how workforce demands ripple through the supply chain to drive interest in certain occupations, fields of study, etc. The economic metaphor works in concert with the supply chain metaphor to then help us consider how surplus supply or demand results in changes in career choice, compensation levels, and organizational workforce-related strategies.

In connection to the human supply chain the workforce can be broken down into employment type either by industry or by job type. This paper's focus is on the information systems/information technology sector. Recent discussion has occurred as to whether or not the IT workforce demand is on the rise, and in conjunction with this debate, whether or not there are enough people with IT training to fill the demand. We hypothesize that IT workforce demand is outstripping the supply of available trained IT workers.

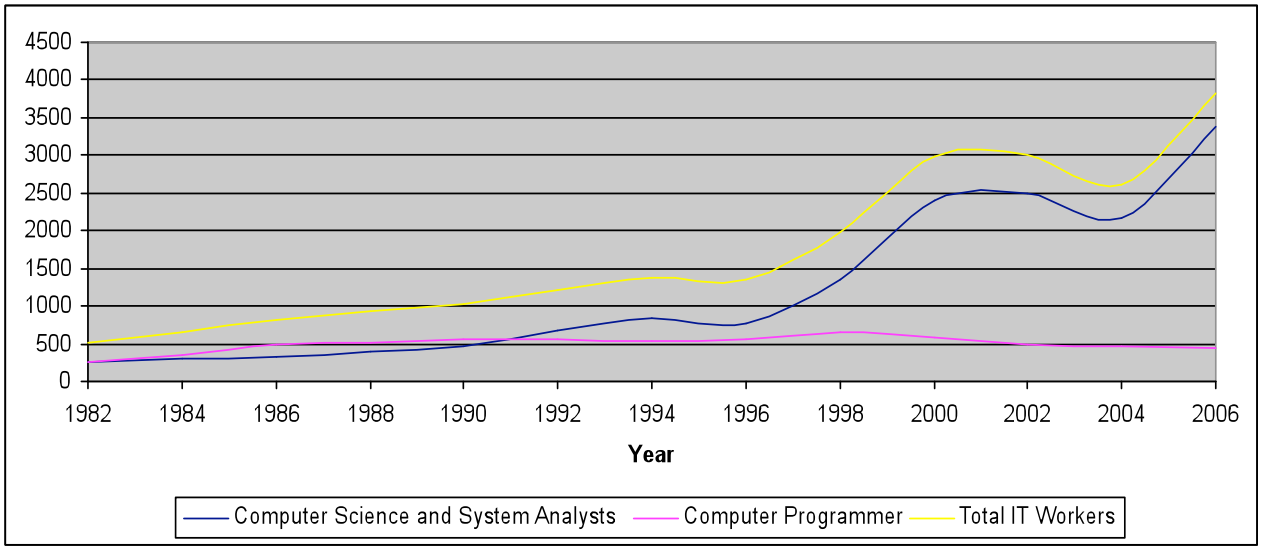
We are not the first to hypothesize that an IT workforce shortage currently exists. Many articles in trade journals, as well as anecdotal reports on this subject, make the assumption that the IT labor force demands are outstripping the supply. However, these reports typically do not provide hard data to substantiate their positions. This leaves a gap that must be filled and one goal of this paper is to find trustworthy data that supports or disproves that demand is outstripping supply. To that end, data is examined that was gathered from multiple publications by the Bureau of Labor Statistics (BLS). Supply data pertaining to the number of college graduates with IT related majors are acquired from Intuitional Research departments at universities and from the U.S. Government's National Center for Education.

If the hypothesis is indeed true, a search for solutions naturally follows. To that end, the final focus of the paper is to show different ways to increase student's interest in IT related majors and present one particular theory-driven solution that has been developed by an IT consultancy located in the southeastern U.S.

The Demand for IT Workers

The first major focus is to determine the trend in demand for IT positions. Data regarding the domestic workforce is published in the "Occupational Outlook Handbook" by the U.S. Bureau of Labor Statistics (BLS). This publication provides detailed descriptions of existing job types and the number of people employed in each.

Figure 1. Projected Growth in for Various Occupations (Ref Table 1, Appendix)



IT Workforce Trends: The History of Demand

Figure 1 compiles data from the "Occupational Outlook Handbook" for the years 1984-85 through 2008-09[3] (refer to the Table in the Appendix for numeric data).

The data presented is for two major categories: Computer Programmers and Computer Science and Systems Analysts. Computer Programmers "write, test, and maintain the detailed instructions, called programs, that computers follow to perform their functions. Programmers also conceive, design, and test logical structures for solving problems by computer."[4] According to the BLS, the Computer Science and Systems Analysts group includes the following job titles:

- Self Employed
- Computer Application Software Engineer
- Computer Systems Software Engineer
- Computer Support Specialist
- Network Administrator
- Computer Systems Administrator
- Computer Systems Analyst
- Network Systems and Data Communication Analyst
- Database Administrator
- Computer Information Scientist
- All Other Computer Specialists

The data reveals several interesting trends that correlate with the history of the IT workforce. Figure 1 presents a slow but

[3] Bureau of Labor Statistics, U. S. Department of Labor. (2007). *Employment Projections: 2006-16.* Retrieved February 5, 2008, from http://www/bls.gov/emp and Bureau of Labor Statistics, U. S. Department of Labor. (2008-2009). *Occupational Outlook Handbook (OOH) 2008-2009 edition.* Retrieved January 16, 2008, from http://www.stats.bls.gov/oco/home.htm

[4] Bureau of Labor Statistics, U. S. Department of Labor. (2008-2009). *Occupational Outlook Handbook (OOH) 2008-2009 edition.* Retrieved January 16, 2008, from http://www.stats.bls.gov/oco/home.htm

steady increase in IT employment from 1982 through 1996. During this time period, most businesses were either upgrading traditionally automated processes, e.g., HR, general ledger, accounts payable/receivable, payroll, etc., or automating those business processes that had yet to be automated, e.g., sales analysis, customer resource management, etc. The IT workforce then increased rapidly from 1996 through 2000. This ties directly to the rise of the Internet, the World-Wide Web, and early electronic commerce. This period is commonly referred to as the "Internet Boom" or "dot-com Bubble," and illustrates the exuberance with which all industries embraced the potential of IT. While these early electronic commerce business models were not well understood, and the metrics for measuring value in e-commerce were even less understood, Internet-based start-ups were securing large amounts of capitol from investors and the traditional "bricks and mortar" industries were investing heavily in the promise of "the Net."

During the period 2000 – 2002, the increasing number of IT employees moderated slightly. The number of IT employees then dropped precipitously through 2004 as the validity of these new-found business models and the means to evaluate them, became better understood. The "bursting" of the dot-com bubble referred to the e-commerce markets in all industries underperforming compared to their over-inflated valuations.

The final portion of the chart shows that from 2004 through 2006, IT employment was on the rise. This short term turnaround in IT workforce numbers leads to the question, "What is expected in the years to come?"

Looking Ahead:
Future IT Workforce Demand Trends

The BLS also publishes the *Employment Outlook*, utilizing historical data and other information to forecast workforce trends. In the *Employment Outlook 2006-2016*, three of the top six fastest growing jobs, both in percentages as well as absolute numbers are Computer Software Engineer (44.6% projected growth); Computer Systems Analyst (29.0% projected growth); and Network Systems and Data Communication Analyst (53.4% projected growth)[5]. This publication also states, "Computer specialists in general, and especially the five occupations listed in Table 1, are expected to grow very rapidly as organizations continue to adopt and invest in increasingly sophisticated information technologies. Robust demand for efficient communication systems as well as new Internet and mobile technologies will spur strong growth in these areas, as will the need for more secure computer networks. The three fastest growing computer-related occupations—network systems and data communications analysts, computer systems analysts, and computer software applications engineers—also are among the occupations with growth."[6] These projections show that the number of IT jobs (demand) is expected to continue on an upward trend.
Given these trends, a critical question to consider is if there will be enough IT graduates to meet the growing demand.

IT Graduates: A Snapshot of Supply

Since statistical data shows the number of IT jobs increasing, it becomes imperative to determine if the supply of potential IT employees is adequate to meet the expected demand. The US government's National

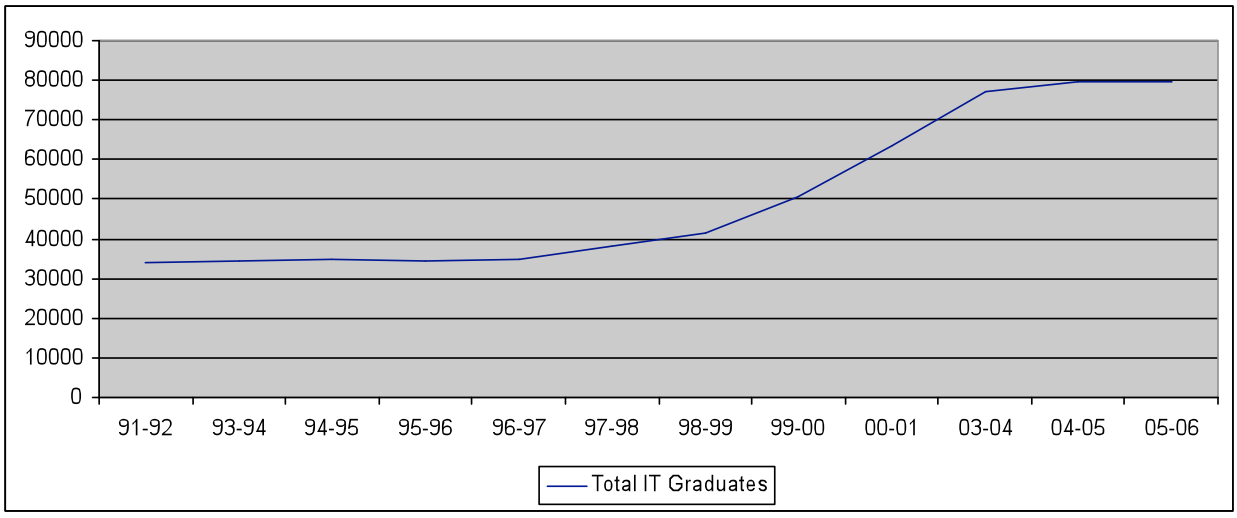
[5] U. S. Department of Labor, Bureau of Labor Statistics. (2007). *Employment Projections: 2006-16.* December 2007, p.8.
[6] U. S. Department of Labor, Bureau of Labor Statistics, op. cit. p.

Center for Education tracks the number of students that graduate by major and publishes this information in the *Digest of Educational Statistics*. Table 2 presents the total number of IT graduates and number of graduates by different IT related majors.

Table 1. U.S. Graduates in IT-Related Fields[7]

	91-92	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	02-03	03-04	04-05
Computer and Info. Science, Total	34097	34363	34730	34249	34866	38121	41595	50459	63412	76942	79631	79631
Computer and Info. Science, General	22989	23435	23008	22594	22571	24738	26049	31035	36164			
Computer Programming	446	160	249	255	262	306	324	489	742			
Data Processing Technology	364	287	196	177	127	140	214	210	259			
Info. Science and Systems	4759	4945	5391	5528	5953	6665	7755	9536	13100			
Computer Sys. Analysts	352	309	278	246	265	184	178	253	437			
Computer and Info. Science, Other	5177	5227	5608	5449	5688	6065	7075	8996	12710			

Figure 2. Total IT graduates



[7] U. S. Department of Education, National Center for Education Statistics. (2004-2005). *Integrated Postsecondary Education Data System (IPEDS)*. Fall 2005.

This data shows an upward trend in the number of IT students that correlates to the increase in IT related jobs from businesses automating in the early to mid-nineties and from the Internet boom. An interesting effect to notice is that the upward trend in IT graduates lags IT employment growth. There are several reasons for this, including the delay in reaction time between the realization that job prospects are improving in a particular field, and the actual decision to enter a field of study. A second, related reason is the four, or more, year delay necessary to complete an undergraduate degree. After IT jobs increase in a given year, the number of IT related graduates rises a few years later. Similarly, after the Internet bust, when the number of IT jobs decreased, the number of IT graduates leveled off as interest in IT careers moderated.

To explore IT trends at a more detailed level, data from three universities; the University of Memphis, the University of Louisville, and the University of Central Florida; for IT related majors was collected. This data comes from the Office of Institutional Research at each school. Tables 2-4 present data from each school pertaining to graduates in IT-related fields of study.

The University of Memphis is a metropolitan-based public university located in the city of Memphis. As can be seen in Table 2 and Figure 3, the University of Memphis shows an upward trend in the number of IT related graduates through 2002 and a rather precipitous drop closely following the dot-com bust. The number of IT-related graduates has continued on a downward trend, albeit slightly less negative.

Table 2. University of Memphis IT-Related Undergraduate Degrees[8]

UOM: Total Undergraduate IT Degrees		
Year	Number	% Change
1998	74	
1999	101	36.5%
2000	123	21.8%
2001	153	24.4%
2002	166	8.5%
2003	140	-15.7%
2004	109	-22.1%
2005	94	-13.8%
2006	70	-25.5%

The University of Louisville is also a metropolitan-based public university. The data presented in Table 3 and Figure 3 shows a similar upward trend shortly after the dot-com boom and a decline after the dot-com bust and is also similar to Memphis in the absolute number of graduates. One minor difference lies in the fact that the number of graduates from Louisville is not decreasing as quickly as the University of Memphis.

As can be seen from Table 4, the University of Central Florida (UCF) generally follows the same trend as Memphis and Louisville except for a drop in MIS graduates around 2001. The number of IT graduates also appears to be leveling off in recent years.

[8] University of Memphis, Office of Institutional Research. (2007). *All IT related degrees.* Retrieved March 5, 2008, from http://oir.memphis.edu/dtg/degree_table_frameset.html

Table 3. University of Louisville IT-Related Undergraduate Degrees[9]

UL: Total Undergraduate IT Degrees		
Year	Number	% Change
1999	47	
2000	127	170.2%
2001	168	32.3%
2002	183	8.9%
2003	165	-9.8%
2004	148	-10.3%
2005	125	-15 5%
2006	111	-11.2%

The more granular approach of gathering data for three specific schools allows us to see that, in general, the number of IT related graduates is on the decline, or at best, leveling out. Anecdotal evidence collected from colleagues at other institutions suggests that a similar profile exists in their schools.

Table 4. University of Central Florida MIS Undergraduate Degrees[10]

UCF: Total Undergraduate IT Degrees		
Year	Number	% Change
1996	104	
1997	107	2.9%
1998	116	8.4%
1999	217	87.1%
2000	412	89.9%
2001	354	-14.1%
2002	492	-39.0%
2003	441	-10.4%
2004	338	-23 4%
2005	252	-25.4%
2006	213	-15.5%

The overall picture suggests that the trend for IT graduates is clearly not in harmony with the trends in demand for IT professionals in the workforce.

[9] University of Louisville, Office of Institutional Research. (2007). *All IT related degrees.* Retrieved March 4, 2008, from http://coldfusion.louisville.edu/webs/ir/index.cfm?method=degree.QueryBuilderResults

[10] Includes both MIS and Computer Science degrees. University of Central Florida, Orlando, Office of Institutional Research. (2007). *All degrees conferred.* Retrieved March 3, 2008, from http://www.iroffice.ucf.edu/degrees/degrees.conferred.html

Figure 3. Total IT Graduates Earning Undergraduate Degrees.

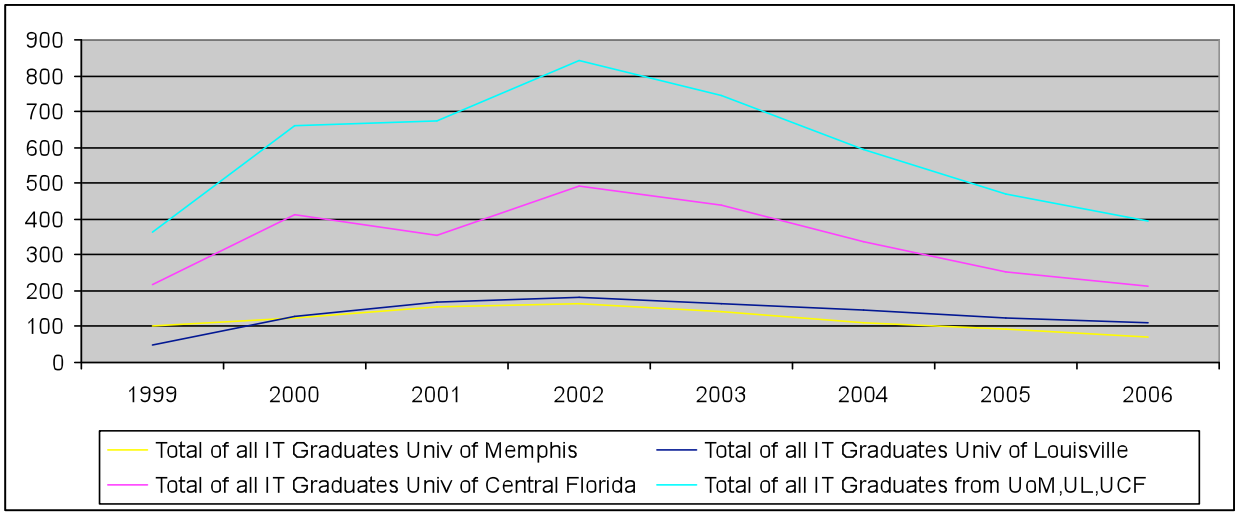


Figure 3 also shows the aforementioned time lag between demand and changes in enrollment. One reason for this may be that, in addition to the previously discussed lag between demand and supply for workers, an additional perception exists that even though the demand for IT jobs has more than recovered since the dot-com bubble burst, demand is still low. Whatever the reason, the hypothesis that demand for IT jobs has indeed outstripped the supply of IT workers, and that the gap will continue to get worse, seems well-founded. These facts are troubling and lead to the question, "Given the current supply-demand imbalance, what can be done to close the gap?"

Prospects for Narrowing the IT Employment Gap

A shortage of IT workers can be addressed within organizations by two primary means: 1utilize existing human resources, or 2) find the needed human resources. While the first alternative may work for the short term, the growing ubiquity of IT in organizations today necessitates that organizations seek out workers to design, develop, implement, and support the systems required for them to remain viable. One solution is outsourcing IT functions to companies in the U.S. or overseas. This alternative brings with it both advantages and disadvantages. While the IT work ultimately gets done (in a potentially cost effective manner), risk is often introduced through the loss of control and the loss of proprietary knowledge of mission-critical applications. In the case of offshore providers, there are added hidden costs associated with coordinating IT efforts across geographical distances, as well as dealing with time, language, and cultural barriers.

Ultimately, however, the biggest issue related to the skills gap in outsourcing is that, while perhaps providing the needed IT resources, outsourcing does not address the larger skills gap, and in fact, passes the skills gap burden to the outsourcing partner. A good example at the macro-economic level can currently be found between the U.S. and India. While the skills gap in the U.S. has recently been addressed by outsourcing IT needs to countries with inexpensive labor markets like India, it is now India that is

facing an "IT staff drought"[11]. This Indian skills gap has resulted in increased labor costs (the disappearance of one of outsourcing's biggest advantages for Indian companies), and the search for lower-priced labor markets. This in part helps to explain how outsourcing, which originally took place in the U.S., has migrated to countries like Ireland, then India, and now China, and also explains how rather than fixing the IT skills gap, has forced outsourcing from a U.S. problem to one international in scope. Thus, we return to the only other alternative: developing a "home-grown" supply of IT workers by increasing the number of students graduating with IT related majors. The question then becomes, "How can the U.S. attract more students to IT-related degrees?"

Priming the Pump: Attracting Students to Enter the IT Supply Chain

There are several alternatives to increase would-be student awareness and interest in IT. For example, MIS Departments can provide informational materials to high school guidance counselors to increase their awareness of IT careers and the demand for IT workers. The counselors can then relay the needs and the career opportunities to graduating high school seniors (and their parents) as they contemplate their choice of colleges and majors. Similarly, MIS Departments can offer events for high school students that give them a better understanding of what IT is, and what career choices in IT exist. Activities of this nature can help to adjust students' perceptions.

Once in college, students who are undecided in their choice of major can be targeted by putting the top IT teachers in entry-level or required IT classes to more effectively interest students in the IT field[12]. Similarly, by involvement in career fairs so that students learn more about IT; by making the materials in introductory IT classes relevant and applicable to what is occurring in business today; and by getting students involved in IT internships will help to dispel the myth that "IT Doesn't Matter,"[13] and that, in fact, IT related jobs are on the rise and are projected to continue increasing for at least a decade.

Social Cognitive Career Theory: Understanding Career Choice

The methods described above, as well as several other tactics to attract students to majors in IT are being employed in universities across the U.S.[14] The efficacy of these tactics is usually reported anecdotally and, at times, reported in published papers[15]. However, it would be useful to have a unifying framework to better understand how career choices are made. Fortunately, Social Cognitive Career Theory (SCCT) provides this organizing framework.

SCCT is a derivative of Social Cognitive Theory (SCT), a more generalized and rigorously tested theory proposed by Albert Bandura in 1986[16]. SCCT "focuses on the connection of self-efficacy, outcome

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11 Yong-Young, K. (2003). India could face IT staff drought. *CNET News.com.* February 19, 2003. Retrieved January 16, 2008, from http://www.news.com/India-could-face-IT-staff-drought/2100-1001_3-985118.html.

12 Looney, C. A. & Akbulut, A. Y. (2007). Combating the IS enrollment crisis: the role of effective teachers in introductory IS courses. *Communications of the Association for Information Systems* (Vol. 19, pp. 781-805). This paper was presented at the 2007 Association for Information Systems Americas Conference in Keystone, Colorado.

13 Carr, N. G. (2003, May). IT Doesn't Matter. *Harvard Business Review,* 41-49.

14 In fact, at the 2007 Association for Information Systems Conference, several panel sessions and paper presentations discussed the strategies that MIS departments across the country were employing to attract students to major in MIS.

15 Looney and Abulut, 2007, op. cit.

16 Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive Theory.* Englewood Cliffs, NJ: Prentice-Hall. This book established the original concept of the Social Cognitive Theory, and from this theory the Social Cognitive Career Theory was formed.

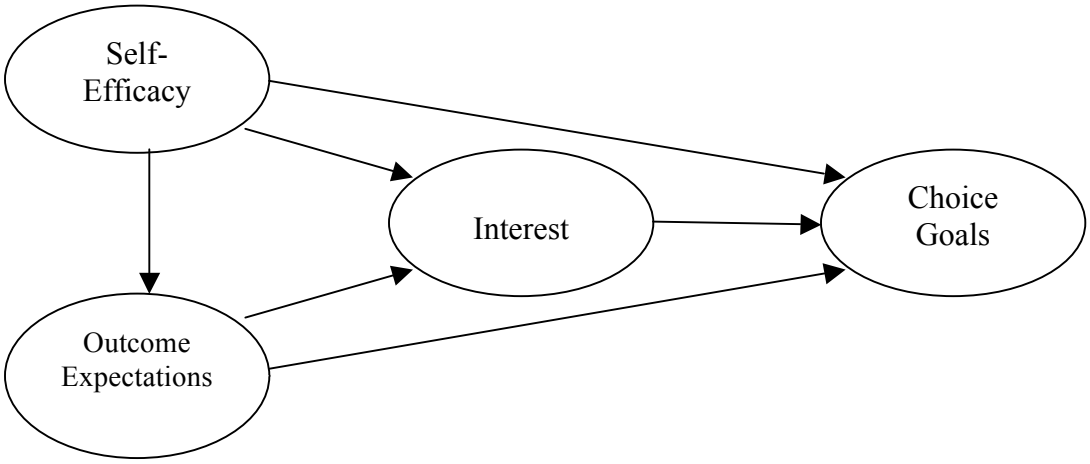
expectations and personal goals that influence an individual's career choice."[17] The SCCT research model is depicted in Figure 8, and is referred to as the Choice Goals Model.

The four major elements of the Choice Goals Model are Self-Efficacy, Outcome Expectations, Interest, and Choice Goals. *Self-Efficacy* is defined as a person's belief that he or she can plan and execute the steps necessary to successfully accomplish a task. For our discussion, self-efficacy relates to creating the belief in students that they indeed have the wherewithal to successfully major in IT and accomplish IT-related job tasks. *Outcome Expectations* refers to a person's belief that a positive, favorable, consequence will occur because of their actions. This factor is important to our discussion in that students must see the linkage between majoring in IT and ultimately securing a fulfilling and well-compensated job in the IT field. *Interest* is defined as the emotion of curiosity and a related positive reaction. In the case of this discussion, the positive feelings are related to students developing an *interest* in IT tasks and the field of IT in general. Finally, *Choice Goals* relate to the decision to choose or not choose a goal. In the present discussion, there are two choices that students face: the first is whether or not to major in an IT-related field of study; the second is whether the student chooses a job in the IT industry. Overall, the Choice Goals Model helps us to understand the mechanisms inherent in how career choices are made. These mechanisms have been tested and are supported in academic literature.

The Choice Goals Model suggests that self-efficacy has a direct affect on outcome expectations, interest, and choice goals. That is, if a person feels that they can complete an IT major and succeed at IT job responsibilities, then they will most likely be more interested in the domain of IT. It is important to also note that increased interest in IT also encourages the choice to major and work in IT.

[17] Savickes, M. & Lent, R. (1994). *Convergence in Career Development Theories.* Palo Alto, California: Consulting Psychologists Press, Inc. and Stitt-Gohdes, W. (1997). *Career Development*. Columbus, Ohio: ERIC Clearinghouse on Adult, Career and Vocational Education., page 2.

Figure 4. The Social Cognitive Career Theory's Choice Goals Model



The Choice Goal mechanisms just described have been researched in academic circles, and journals have reported how each of the factors affects the different variables that lead to ultimate major and/or career choices. For example, Looney and Abulut[18] investigated whether the added factor of the teaching ability of the instructor in introductory IT courses had any effect on whether or not more students chose IT-related majors. Their findings showed that a strong teacher does increase a student's choice of an IT related major. Another example reported by Compeau, Higgins, and Huff[19] investigated how anxiety levels in a person performing computer tasks related to the components of the Goal Choice model. As one might intuitively expect, this study showed that higher levels of reported self-efficacy and outcome expectations coincided with lower levels of task-related anxiety. This finding can be applied to students choosing an IT-related major. By giving students the opportunity to perform computer-related tasks, their confidence in their abilities to perform (feelings of self-efficacy) and lowered levels of related anxiety, will contribute to making IT-related choices.

An additional factor potentially increasing students' interest in making the Choice Goal of selecting an IT-related major is internships. Internships provide real-world job experience with a company (the "sponsor"). Through this interaction both the students and companies benefit. Self-Efficacy is improved by allowing students to perform IT tasks and increase confidence through their successes. Outcome Expectations are increased through interaction with IT professionals, allowing students to observe successful IT career paths and improve confidence in securing a position in IT. Finally, interest is increased by the improvement of Outcome Expectations. In the end, internships increase the number of students choosing IT-related majors and increase the likelihood that the IT workforce will be positively impacted. In essence, the experience and

[18] Looney, C. A. & Akbulut, A. Y. (2007). Combating the IS enrollment crisis: the role of effective teachers in introductory IS courses. *Communications of the Association for Information Systems* (Vol. 19, pp. 781-805).

[19] Compeau, D., Higgins, C. A., & Huff, S. (1999, June). Social Cognitive Theory and Individual Reactions to Computing Technology: A Longitudinal Study. *MIS Quarterly* (Vol.23, No. 2, pp. 145-158).

interaction provided through a meaningful IT internship may be the deciding factor in whether students choose an IT-related major.

The sponsoring organization also benefits from the internship model. With a relatively low amount of investment – in both time and money – organizations are able to bring students into their workplace and observe how they fit into the company's environment and culture. They can then use the performance of the intern as a gauge by which to judge capabilities and to later decide if a job offer should be extended to an intern following graduation.

The CollegeCareerCorps: An Innovation in the Traditional Internship to Affect Career Choice

In this section we provide an overview of the CollegeCareerCorps (CCC) model, as well as discuss how the Goal Choice model shows that the CCC can have a positive impact on IT enrollment and career choices. Cook Systems International (CSI), a U.S. based consulting and IT outsourcing firm, has developed an apprenticeship model – an extended internship of sorts – called the CollegeCareerCorps, which seeks to further enhance the internship experience for students and sponsoring organizations. In essence, CSI serves as an intermediary between the student, their university, and a client organizations in need of IT services and support. CSI provides apprenticeships to students and, in turn, CSI markets the apprentices to organizations seeking to reduce their IT costs through outsourcing with an "onshore" model.

The benefits of the CCC extend to all stakeholders in the relationship. For students, the benefits include having a real-world apprenticeship opportunity with an experienced organization doing meaningful work in the systems development arena. CSI also provides mentoring through a team approach, each team being led by experienced CSI IT consultants. Students also benefit by observing not only CSI's organization, but also the client organization where the project team is placed. Apprenticeships are structured to be part-time during the school year and can be extended to full-time hours during the summers.

For client organizations, CSI's CCC model serves as a compelling alternative to traditional offshore outsourcing efforts, in that project costs are typically lower, the work product meets or exceeds customer expectations, and the work effort remains on-shore. This avoids the hidden costs associated with travel and complexities related to differences in language, culture, time zones and long-distance work coordination efforts. In addition, CSI assumes the responsibility for training and managing the apprentices. The client benefits by having access to a future workforce, should they decide to hire a CCC apprentice upon graduation.

For universities, the benefits include having CSI as a ready sponsor for IT apprenticeships, which in turn improves the attractiveness of the university in the eyes of potential students, their parents, and guidance counselors, resulting in improved enrollments in IT-related majors. Universities also improve their relationships with the local business community and enjoy increased access to community partners.

Several Fortune 500 companies have already begun using this program as a manner of reducing offshoring (outsourcing to a company that is located overseas) and improving their future base of possible

employees. CCC supports the theory that apprenticeships have a positive effect on the Choice Goal Model and will increase the number of students that select IT-related majors. (For additional information on the CCC, visit collegecareercorps.com)

In terms of the Goal Choice model, the CCC can impact all of the model's elements. First, CSI provides a chance to participate in real-world systems development efforts, From the model's perspective, the creation of self-efficacy should then improve the student's sense of outcome expectations (majoring in IT has led to the IT apprenticeship and can lead to a full-time job in IT) as well as lead to enhanced levels of interest in IT-related activities through real-world participation in IT activities (as opposed to classroom theory) and determine actual interest in a future in IT. All of these enhanced elements should then lead to the increased probability that students will choose: 1) to successfully finish their IT major course of study; and 2) to set full-time employment in the IT industry as a career goal.

Conclusion

In terms of the human supply chain, significant increases in demand for IT professionals for the foreseeable future, coupled with the limited growth in enrollment of future workers in colleges and universities across the country, suggest that the supply of future IT workers will not satisfy the growing need for IT professionals. In addition, by factoring in the growing levels of retirements from the IT ranks, the picture begins to look even more dire.

To satisfy the demand, industry may be forced to continue searching for IT-related skills in other parts of the world, or look to U.S. based colleges and universities for strategies designed to increase IT-related enrollments. Social Cognitive Theory, along with its variant Social Cognitive Career Theory's Choice Goals Model were presented as frameworks for better understanding why people make choices.

These models suggest that by instilling a feeling of self-efficacy, an awareness of how today's decisions in selecting a major relate to future work opportunities, can have a positive impact on choosing to major in IT and subsequently enter the IT labor market. We introduced the notion of student internships as an effective means to provide this insight, and highlighted Cook Systems International's CollegeCareerCorps as an innovative apprenticeship model to increase students' interest in IT-related majors and create a link with businesses to more easily fill the increasing demand with capable employees.

Acknowledgements

The authors would like to acknowledge the FedEx Center for Supply Chain Management at the University of Memphis and Cook Systems International for their support of this research.

Appendix

Table 1. IT Workforce Employment for the Years 1982-2006 (in thousands).

Job Type	1982	1984	1986	1988	1990	1992	1994	1996	1998	2000	2002	2004	2006
Computer Science and System Analysts	254	308	331	403	463	666	828	776	1344	2390	2501	2157	3386
Computer Programmer	266	341	479	519	565	555	537	568	648	585	499	455	435
Total IT Jobs	520	649	810	922	1028	1221	1365	1344	1992	2975	3000	2612	3821