Information Technology Careers: Past, Present, and Future

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Executive Summary

Precisely when the information technology age started is a matter of conjecture. According to one source, it started when the first abacus was created nearly 2000 years ago (19). Many professors of introductory information technology courses place the beginning in 1890 when Herman Hollerith and James Powers created the first devices to process punched cards without human intervention. Still others might fix the beginning of the information technology age in 1942 when John P. Eckert and John W. Mauchly began constructing the Electrical Numerical Integrator and Calculator (ENIAC). Regardless of when the information technology age started, the machines used to process the information and the people who run those machines were very diverse. Not surprisingly, the careers in information technology that evolved over the years (however many years are included) are extremely diverse, too. This paper explores the past, present, and future careers in information technology. Through this exploration, the paper illustrates recent trends within the industry and the implications they hold for future members of the information technology profession.

Our research has shown us that more than just the size and speed of computers has changed since ENIAC was created in 1942. Many careers that were crucial to the information technology world when IBM announced the 360 in 1964 have completely disappeared. And job titles that would have seemed futuristic have now taken their place. But job titles aren’t the only changes that have transpired in the last forty years. Through interviews we will explore outsourcing and the impact it is making on the information technology industry. We will discuss some of the recent downturns in IT careers and the resurgence in the same industry over the last year. We will use research and interviews with IT executives and university educators to point out curriculum changes that are needed for information technology programs. Ultimately this paper will make some predictions about the future of careers in the industry through interviews with students, educators, professionals, and executives in information technology.
Information Technology Careers: Past, Present, and Future

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Data Processing 101

Early Occupations

The early job titles in the information technology world were anything but glamorous. Nobody had ever heard of a “software engineer” in the 1960s. There were no “web masters” or “database administrators”. Wait, that’s not quite true; there were database administrators but they were referred to as the “person holding that tray of cards”. All jobs in the early information technology (IT) shop revolved around the punched card. This was the storage medium of the age and processing this data was the *raison d’etre* for everyone in the IT department. By examining the key early occupations, we can begin to see how rapidly information technology has evolved and expanded in just a few decades. (5)
Card Editor

The individuals performing this function had to be extremely detail oriented. Card editors had the crucial but inglorious task of matching punched cards to their corresponding hard-copy documents. Every line item on an invoice or purchase order had to correspond exactly to the punched card that was generated by the computer. In addition, card editors were also required to collate the requisite customer information (also in the form of punched cards) to invoices and orders before the data was loaded into the computer. Inventory records, accounts receivable, accounts payable, and general ledger records were also stored on punched cards. The accuracy of the information was the responsibility of the card editor. While these individuals existed on the periphery of the IT shop, their function was critical to the daily operations of the IT department and to the general welfare of the business.

Keypunch Operator

Keypunch (or data entry) operators used keypunch machines to transcribe data into machine readable form. In the early years of information technology, the machine-readable form was the punched card. In large shops where the bulk of the punched card processing was done on the mainframe or tab machines, the keypunch operator might be required to punch card decks for programmers and make corrections to data. In small to medium shops, the keypunch operator might be responsible for all data entry. The role of keypunch operators has largely been replaced by more efficient methods of data entry or departmental computing.

Tab Machine Operator

These people were the jack-of-all-trades people in the early IT departments. They were responsible for running all the peripheral tabulating machines in the shop. One supervisor termed them the “hod carriers” of the department. Tab operators ran card sorters, collators, card interpreting machines, and gang punch machines. Their other duties might include restocking the card supplies and keeping the forms inventory. Tab machine operators spent the majority of their days sorting card decks and providing the hundreds of different card types used in the early data processing department. In some shops the tab operator was responsible for wiring boards for the various tab machines. In many companies, the tab machine operator position was the entry level position in the department. In other words, the tab machine operators were the computer operator and programmer “wannabes.” The photograph shows tab machine operators at work. The machine on the left is a gang-punch machine; it uses a wired board and a template card to reproduce large quantities of the same card. The machines in the center and on the right are card sorters. These machines use wire brushes to “read” the punches on the card and place them in the correct hoppers (which are shown on the front of the machine). Card sorting functions were replaced by electronic sorts on the computers.
Computer Operator

Being a computer operator in the early information technology department meant that you had reached the pinnacle of your career; at least as far as the operations section of the business was concerned. Computer operators ran the “big iron,” the euphemistic name for the main computer. Operators were responsible for overseeing all the peripherals attached to the mainframe. These peripherals were card readers, card punches, paper tape readers (paper tapes read by these machines contained data that was usually punched into cards), and tape drives. Changing removable disk drives was also the job of the operator. In addition, they monitored the printers attached to the mainframe. Computer operators often were responsible for the distribution of the various output media generated by the mainframe. The computer operator’s primary function, however, was to oversee the control console and respond to all system and program messages. The computer operator job is gradually being phased out because users can submit and run their own applications either on their desktops or through the main computer.

Computer Programmer

According to Alter Information Systems (1), the programmer is the person who designs the logic, codes, debugs, tests, and documents computer programs. The definition is nearly perfect except for the part regarding documentation. Documentation is to programmers what garlic is to vampires. Regardless, these are the individuals who use the specifications created by the systems analyst to create applications for the computer to run. The languages used by programmers are
heard now about as frequently as Latin. The earliest business computers usually used the Assembler programming language. Other languages were PL1, Pascal, and Autocoder. Gradually COBOL (Common Business Oriented Language) and RPG (Report Programmer Generator), both of which are still used today, became the mainstays of business computing in the early years. A good programmer, according to Alter Information Systems, is perceptive, persistent, picky, patient, and productive – the “five Ps”. As with anything else in the early computer shop, the programmer’s output was in the form of cards that issued instructions to the computer.

*Systems Analyst*

This individual is the liaison between the user community and the programmers. Analysts meet with users to develop the requirements that are needed to build applications. Analysts then create the specifications that programmers use to build computer applications. The systems analyst is still an integral part of most large IT shops. Smaller shops generally combine the role of the analyst and the programmer into a programmer / analyst position.

*Tape Librarian*

The tape librarian records the location of all tapes that are created on the computer system. These tapes can be for inventory, invoicing, accounts payables, and system backups. This role is extremely important in shops where several dozen tapes are created daily. The tape librarian has a highly critical job when an IT department has a catastrophe. This individual is the keeper of the backup media. If tapes are stored off-site, the tape librarian is the person who oversees the logistics. Regular maintenance of the recording media, tape cleaning, is also the responsibility of the tape librarian. In many IT shops the tape librarian’s job has been taken over by discovery recovery specialists.

It is readily apparent that some of the early career opportunities have disappeared while others have managed to accommodate changes in the information technology world.

*Early Computer Systems*

Discussing early IT careers without a brief examination of the pioneer systems would be remiss. The common ancestor of all modern computing systems is arguably ENIAC (Electronic Numerical Integrator and Calculator. In 1942, John P. Eckert and John W. Mauchly, both of the Moore School of Electrical Engineering at the University of Pennsylvania set out to create a high-speed electronic computer to calculate trajectory tables for the military (19). The slide below provides the basic specifications of their computer. Their system was operational from 1946 until 1955 and also was responsible for giving the IT industry the term “bug.” Allegedly, Lieutenant (later Admiral) Grace M. Hopper taped an electrocuted moth to the daily log after a system crash along with the phrase, “There was a bug in the system.”(21)
International Business Machines (IBM) made several important contributions to early general-purpose computers. IBM’s 1401 has been termed the first affordable general-purpose computer. It was announced in 1959 and IBM’s intent was that this machine would replace all accounting machines and calculators in use at that time. IBM 1401s were found running in 2000. These systems were running on simulators (the IBM 1401). Perhaps the most important computing system announcement came in April, 1964 when the IBM 360 was rolled out. The IBM 360 revolutionized the IT industry because each model in the line was compatible with all other models in the line. The 360 “family” permitted owners to upgrade models without purchasing new programs or peripherals. The higher end Model 50 had an eight megabytes central processing unit capacity. The current iPod minis have four gigabytes of memory (roughly 500 times more). The Model 50 could also support up to 248 terminals – moving input away from punched cards to on-line, real-time data entry with the data being stored on tape or disk. (25) Both the IBM 1401 and the IBM 360 are shown below.
Since many of the early information technology careers focused on processing punched cards, it wouldn’t be right to leave this section without including a picture of the industry’s first input, output, and storage medium. Most punched cards were 80 column cards although IBM’s System 3 employed a 96 column card. The picture below is a standard 80 column punched card.
The disappearance of punched cards has brought about some sociological changes as well. The aesthetically horrible red, green, silver, or gold Christmas wreaths made from discarded cards are seldom seen any more. And very few people at local parades or football games are pelted by confetti made from punched card chaff.

Education and Training

Universities and Institutions

Top Schools

Since we are discussing careers, the education one receives is just as important as landing the big job. Based on the most recent U.S. News and World Report (26), the top undergraduate computer engineering programs are:

- Rose-Hulman Institute of Technology (Indiana)  Website: www.rose-hulman.edu
- Cal-Poly (San Louis Obispo, California)  Website: www.calpoly.edu
- Cooper Union (New York)  Website: www.cooper.edu

These top institutions were selected by deans and senior faculty members based on comparison to programs with which they were familiar.

Rose-Hulman provides some illuminating anecdotal information regarding the importance of a quality education. One particular story from Rose-Hulman involves three alumni who, in 2000, created an anti-spam company from a dream derived during an entrepreneurship class. “Corvigo created patent-pending Intent-Based Filtering artificially intelligence technology that eliminates
junk e-mail.” The three partners sold the company, Corvigo, in March 2004 for $41.5 million. (10)

Rose-Hulman has also been recognized in the 2003 National Survey of Student Engagement as a leader in challenging its students academically, creating an active and collaborative learning environment, and providing a supportive campus environment.

**Adjustments in Curriculum**

In our research, we found a continuing string of values and skills that are going to be needed in one’s career path in Information Technology. Articles from *Computerworld*, personal interviews with Dick Navarro and Jerry Siegel, and the 2005 Robert Half Technology survey (22) signal changes that need to be made in curriculum to better prepare IT students for their career. A survey by *Computerworld*, which polled 244 IT professionals along with CIOs, indicated that academia had the following shortfalls in preparing graduates for today’s IT jobs. (7) Some of the skills that graduates are going to need are the following:

- Communication/people skills
- Business skills
- Real-world/hands-on experience
- Troubleshooting
- Project management
- Analytical skills
- Integration

Based on the survey’s findings, academia will need to move from what was a strict programming and systems development attitude to one of preparing students to be more like a businessperson with strong communications skills. Schools are now partnering with local businesses to find a better way of educating and getting the skills needed out in the workforce. Local CIOs are getting involved with proposing curriculum for elective IT courses at colleges and universities. Employers want students with more real-world or hands-on experiences. Companies are getting involved by providing projects for teams of students to address. A quote signifies this importance; “employers tell me they would rather have a student with a lower GPA and more work experience than someone with a perfect GPA and no work experience who has had their nose in a book for four years.” With internships and co-op programs, students gain an understanding of and appreciation for job performance and expectations. This translates into better job performance in their business careers.

**Certifications**

Hot areas of Certification:
It is important to find the right certification for the career you wish to pursue. We recommend looking at the market to find out what certifications are needed for specific jobs to prepare for the interview process. Increased knowledge following training in a specific area often yields a corresponding increase in salary.
IT’s Hottest Skills

When looking for the current hottest skills in the market, we turned to the Robert Half Technology 2005 Guide which contains interviews with 1,650 CIOs. Eighty percent of those interviewed responded that Windows administration was the hottest specialty in demand. Other skills mentioned in the survey included: Visual Basic development, Check Point Firewall administration, Cisco Network administration, and SQL Server management.

Robert Half Technology 2005 Salary Guide, survey of 1,650 CIO’s with more than 100 employees
What’s Hot and What’s Not

IT Jobs in Jeopardy

According to industry analysts, the jobs most likely to be targeted by outsourcing initiatives are the non-core competencies. These jobs can be removed from an information technology (IT) department without unduly impacting crucial functions. The following list of jobs falls into the non-core group:

- Legacy / custom application development
- Legacy application maintenance
- Web application development
- Customer care, services / call centers
- Management of IT infrastructure / IT outsourcing
- Packaged application implementation

In fact, many firms already have outsourced jobs in these categories to provide better service and lower costs.

CURRENT IT JOB STATUS
Number of IT Jobs

Although the number of IT jobs can be construed many different ways, the Information Technology Association of America (13) 2004 Survey results show that the number of jobs is still rising after the 2002 drop off. ITAA conducts an annual survey to “monitor, assess, and communicate market conditions for IT employers and employees”. ITAA also provides other interesting factors from this year’s survey including:

- Almost 80% of the IT workforce is in a non-IT related company (e.g., financial services, pharmaceuticals)
- Programmers represent the largest single group of workers
- The largest increase in new jobs from 2003 to 2004 was in the technical support and network systems design categories. These categories also are in high demand for future trends.
- In terms of advancing a career, 71% of the respondents said either certification or continuing education is important.

(13)

Competitiveness in the marketplace, for both employers and employees, is showing what needs to be addressed to attain an edge. Increased competition is making the employers look a deeper into what the candidate could offer. Potential employees are working harder to get an edge over other job candidates. By understanding the trends and hot skills needed now, you just might be able to win someone over!
Jobs by Region

![Jobs by Region Pie Chart]

Job Category as a Percentage of Total IT workforce

![Job Category Pie Chart]

(12)
SALARIES IN INFORMATION TECHNOLOGY

2005 Salary Projections

Salaries are just a piece of the pie when it comes to choosing a career. For some, it is the whole pie; for others, doing something they love is half of the pie while salary is just one slice. Many resources are available to review salary information. Robert Half Technology provides a salary guide. The 2005 guide was released in October 2004 and we included data from their research. The U.S. Department of Labor website also has information regarding salaries. Dice.com is another useful website. The downside to Dice.com is that the data is derived from the responses of those who have visited the website and given their information. Salary.com is a good site to reference for articles about salary negotiations and career planning.

For our purposes, we used the Robert Half Technology 2005 Salary Guide (22). It is an easy document to review and gives a description of each category with regional adjustments based on the cost of living indexes around the country. The Robert Half guide also shows a 5-7% increase in salary if an individual has certifications or skills that are in need.

Administration:

<table>
<thead>
<tr>
<th>Title</th>
<th>2004</th>
<th>2005 (projected)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIO</td>
<td>$115,500-$195,250</td>
<td>$114,000-$191,250</td>
<td>-1.8</td>
</tr>
<tr>
<td>VP Info Systems</td>
<td>$108,000-$155,500</td>
<td>$104,250-$154,000</td>
<td>-2.0</td>
</tr>
<tr>
<td>IS Manager</td>
<td>$81,500-$113,750</td>
<td>$80,250-$112,250</td>
<td>-1.4</td>
</tr>
</tbody>
</table>

A key issue with the top administrative positions shows that, on average, the salary ranges associated with those positions are staying static or even dropping slightly.

Applications Development:

<table>
<thead>
<tr>
<th>Title</th>
<th>2004</th>
<th>2005 (projected)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems Analyst</td>
<td>$61,000-$84,750</td>
<td>$61,500-$81,500</td>
<td>-1.2</td>
</tr>
<tr>
<td>Programmer Analyst</td>
<td>$50,750-$80,250</td>
<td>$52,500-$83,250</td>
<td>3.6</td>
</tr>
<tr>
<td>Business Sys Analyst</td>
<td>$54,750-$79,250</td>
<td>$56,000-$80,500</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Quality Assurance & Testing:

<table>
<thead>
<tr>
<th>Title</th>
<th>2004</th>
<th>2005 (projected)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>QA Testing Manager</td>
<td>$63,250-$85,000</td>
<td>$64,750-$86,750</td>
<td>2.2</td>
</tr>
<tr>
<td>Systems Auditor</td>
<td>$60,750-$77,250</td>
<td>$63,250-$81,750</td>
<td>5.1</td>
</tr>
</tbody>
</table>

With the new regulatory requirements, mainly the Sarbanes-Oxley Act of 2002, technology departments must have built-in controls that audit the codes of the Act. This explains why there is a 5% change in salary from 2004 to 2005 for the Auditor position.
Internet & E-Commerce:

<table>
<thead>
<tr>
<th>Title</th>
<th>2004</th>
<th>2005 (projected)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet Developer</td>
<td>$51,000-$72,500</td>
<td>$51,750-$74,250</td>
<td>2.0</td>
</tr>
<tr>
<td>E-Commerce Analyst</td>
<td>$57,000-$84,000</td>
<td>$58,250-$82,750</td>
<td>0.0</td>
</tr>
</tbody>
</table>

E-Commerce is a vibrant source of business, and it is important to have qualified personnel overseeing any possible issues that the site might encounter. The threat of hackers and the corresponding need for an increase in security for web transactions intensifies the importance of the analyst’s position.

Security:

<table>
<thead>
<tr>
<th>Title</th>
<th>2004</th>
<th>2005 (projected)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Security Analyst</td>
<td>$67,000-$90,750</td>
<td>$68,250-$93,000</td>
<td>2.2</td>
</tr>
<tr>
<td>Systems Security Administrator</td>
<td>$66,000-$91,500</td>
<td>$67,500-$92,750</td>
<td>1.7</td>
</tr>
</tbody>
</table>

It is no surprise that the increase in terrorism and the ingenuity of hackers will create the largest growth potential in the security area over the next three to five years.

Software Development:

<table>
<thead>
<tr>
<th>Title</th>
<th>2004</th>
<th>2005 (projected)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre- Post- Sales Consultant</td>
<td>$51,750-$75,000</td>
<td>$53,500-$78,250</td>
<td>3.9</td>
</tr>
<tr>
<td>Software Engineer</td>
<td>$62,500-$94,750</td>
<td>$63,250-$92,750</td>
<td>-0.8</td>
</tr>
<tr>
<td>Product Manager</td>
<td>$76,500-$102,750</td>
<td>$77,000-$104,250</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Technical Services, Help Desk, Tech Support:

<table>
<thead>
<tr>
<th>Title</th>
<th>2004</th>
<th>2005 (projected)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop Support Analyst</td>
<td>$47,000-$65,000</td>
<td>$44,500-$63,250</td>
<td>-3.8</td>
</tr>
<tr>
<td>Instructor/Trainer</td>
<td>$43,750-$62,250</td>
<td>$43,250-$65,500</td>
<td>2.6</td>
</tr>
<tr>
<td>Disaster Recovery Specialist</td>
<td>$59,000-$89,000</td>
<td>$60,500-$90,750</td>
<td>2.2</td>
</tr>
</tbody>
</table>

The preceding charts are all courtesy of the ITAA Annual Workforce Development Survey. (12)

More desktop support services are being supplied offshore or outsourced through another firm that can provide a cost savings. The Instructor/Trainer is always needed to teach the technology to new hires or to retrain current employees. A disaster recovery specialist is needed to respond to acts of terror or natural disasters. Should something extraordinary happen to a business’ data, backups and disaster recovery technologies will be needed.
Compensation is also viewed as a means for firms to keep valuable employees. As noted in the ITAA Annual Workforce Development Survey, the importance of keeping quality IT employees in their jobs meant “better performance, fewer service and support discontinuities, lower recruitment costs, and better employee morale generally.” (12)

Marketing Trends

Consulting Services
There are many ways to research the trends in the IT world. A very reliable source of information is the people who provide consulting services for the IT industry. We interviewed two marketing managers for our research. Kenneth Koboldt of Analysts International shared his perspective of the changes that have occurred in the last five years. Mr. Koboldt says that the desired skill sets have changed. There are fewer requirements for mainframe and mid-range personnel and the skills needed for those platforms. He sees far more demand for Java as a technical skill. Additionally, Mr. Koboldt pointed out that the placement process has changed substantially. Marketing managers do not deal with IT managers now. The process is handled by the procurement departments because IT skills are now considered a commodity. Some firms have gone so far as to use on-line auctions to meet their staff augmentation needs. (13)

Mitchell Loder of Daugherty Business Systems also sees the commoditization of IT development positions and further adds that developers are being chosen on a cost, rather than a skill, basis. Mr. Loder’s is a proponent of the theory that in order to survive, management consulting firms must move away from the staff augmentation model and shift to a business model that partners firms with a client to provide business solutions. This means that developers need to transform themselves into roles that lie beyond the scope of traditional development functions. Developers need to possess communication skills (both oral and written) and presentation skills. According to Mr. Loder, developers must be knowledge matter experts also. (16)

Careers of the Future – What to Look Forward to

How Do IT Leaders See the Future?

To gain a perspective for the next two segments of the paper, we interviewed several high-level executives, knowledgeable educators with research ties to the IT industry, and information technology students. The interviews yielded very interesting perspectives.

- “Coding will largely go away…with the growth in outsourcing of routine tasks. (20)
- Opportunities will continue to exist in both the management and technical areas of the industry. Purely technical skills are going to be more prone to outsourcing. (4)
- A computer science degree does not necessarily prepare students for the IT job market. (6)
- The increased pace of business, industry consolidation, and globalization mean that many IT professionals will work for many companies during their careers. (6)
- “Future job seekers will need to do more than study computer science at a reputable school to succeed.” (6)
Management vs. Technical (Is it one or the other?)

We asked this question in an attempt to determine whether students and educators felt the two career paths were mutually exclusive. Is it possible to train for a managerial role without acquiring technical skills as part of the curriculum? This is in opposition to the normal pattern of promoting the brightest technicians to management positions. Dr. Mary C. Lacity answers the question this way,” The issue here is entry level positions…most project managers, subject matter experts, and governance people get trained via the programming ranks. In the future, maybe this expertise will be groomed in the subject areas that embed the IT bit within the curriculum, like a major in supply chain may also be an expert in B2B.” (14.) Students had mixed responses to this question. One student viewed it this way,” I would like to do both. Hoping to be able to become middle management to do both managerial and hands on in 5 years and be a full time manager in 10 years.” (3) A graduate student viewed it differently, “I have already been moved from technical to managerial. Not sure it’s a great move yet, but that’s where I currently am. I have been out of college since 1996, so I have a bit of experience that forced me up…I am a development group leader in a telecommunications software provider.” (3)

Professional Prognostications

What Will IT Look Like?

Very few people can resist the temptation to take a look into the future when given the opportunity. We couldn’t either. Research provided us with several writers who have contemplated what the IT professional might be doing on a daily basis ten years in the future. Additionally, one of UMSL’s leading IT professors shared his thoughts on the preparation an IT professional might require for the future. According to Dr. Jerry Siegel (Professor Emeritus, University of Missouri – St. Louis), “IT professionals in the future will be more grounded in engineering skills. Software engineers and architecture developers will need a deeper understanding of math modeling languages and data access languages. IT developers will require expertise in the legalities of the business environment. Curriculum will need to include instruction in HIPA, OSHA, and Sarbanes-Oxley.” (23)

Barbara Gomolski of Computerworld defines future IT careers by the new opportunities she sees (and the old opportunities she sees declining). Ms. Gomolski’s predictions include the following:

- Traditional IT jobs are not going away but there may be fewer of them
- New IT opportunities:
  - Business process design and management
    - New competency rising from the opportunity to see entire business process while designing IT systems
  - Information management
    - Customer Relations Management, Business Intelligence, and Search Technologies
  - Relationship and vendor management
- Negotiate and manage contracts
- Select and manage IT service provider partners (6):

Other computer industry analysts base their speculations upon the impact that the global economy is having on the IT industry. Steve Alexander of *Computerworld* looks at the experience afforded to information technology professionals whose companies are engaged in the global economy. Mr. Alexander says that global IT operations offer more opportunities with a broader range of responsibilities for employees working for American companies outside the United States. He believes that the cultural and legal differences provide a learning experience that simply is not available in an IT environment that operates only in the U.S. Companies that expand operations in foreign countries create job opportunities. This expansion builds new career paths and improves IT morale. (2)

**What Are the New Skills?**

So what will it take to be a successful IT professional in the future? Do these new skills involve learning new languages or working with microscopic-sized hardware platforms? Perhaps, but our research indicates that success may lie in areas that many IT students and professionals have previously ignored. Experts now believe that the so-called “soft” skills and content knowledge are becoming infinitely more critical as the global economy expands.

In her book, *International Journal of Human Resources Development and Management*, B. Dawn Medlin explains that IT professionals must have a variety of skills. These skills are not just technical skills but include business acumen as well as managerial abilities. Ms. Medlin goes on to say that “the global business environment requires oral and written communication skills.” Furthermore, it is crucial that “IT professionals must comprehend the interlacing of roles of IT within a business organization.” (15)

Mike Biffignani, CIO of LMI Aerospace, summarizes the new skills this way, “a good career path lies in being both business and technical. It’s about providing value to the business.” Mr. Biffignani believes that content knowledge, technical skills, and business acumen will provide an edge for IT professionals. (4)

Our interview with Dick Navarro (20), Director of Information Technology at Boeing, Inc. provided yet another set of skills that need to be acquired by aspiring IT professionals. Mr. Navarro’s list includes these skills:
- Interpersonal and communication skills
- Ability to work with teams
- Leadership abilities
- Organizational skills
- Analysis and more analysis
- Desire to undertake new assignments even in the face of risk and uncertainty

One can see that IT professionals no longer view technical proficiency as being sufficient to excel it the IT world of the future. Consequently, colleges and universities will need to modify
curriculum to ensure that their graduates have the requisite skill set to meet their employers’ expectations.

**What Did We Learn?**

For starters, we aren’t in the world of punched cards and wired boards anymore. Actually, we knew that before we started, but this was graphically pointed out to us through the research and interviews that make up this paper. Information technology has changed substantially since ENIAC and the IBM 360 were the premier systems. Many jobs that revolved around the punched card process are memories. The machines of that era are museum pieces. Teenagers have more memory in their iPods than the largest computer systems of the 1960s.

We learned that the IT job market is very cyclical. The downturns of the past four years are relatively typical of the industry. The upswing of the cycle is slower than some of the other cycles but we are moving toward a stronger job market.

Other things we have learned: The technical skills that many students and professionals learned are not sufficient to advance their careers beyond the technical ranks. Our research indicates that professionals of the future need to be articulate and possess the ability to present information to a variety of audiences using a large array of media. The new IT professional must possess leadership capabilities while simultaneously being capable of performing well in a collaborative or team environment. Business and content knowledge are also going to be essential for success.

We’ve learned that security is a crucial success area. Security, in terms of Sarbanes-Oxley compliance as well as business espionage, is fast becoming a growth business in the IT world.

But mostly we’ve learned that the information technology world has changed for the better over the last forty years. The hardware is smaller, the software is better and faster, and the opportunities are limited only by an individual’s imagination. If IT professionals were intrigued by the last forty years, all indications are that they are going to be challenged for the next forty years.
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