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Technically Competent Employees for the New Millennium: Recommendations by American Think Tanks

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TECHNICALLY COMPETENT EMPLOYEES FOR THE NEW MILLENNIUM:
RECOMMENDATIONS BY AMERICAN THINK TANKS

A RESEARCH PROJECT PRESENTED TO THE FACULTY OF
THE DEPARTMENT OF OCCUPATIONAL
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DEGREE MASTER OF SCIENCE IN EDUCATION

BY

CAROLYN L. TEBAULT

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APPROVAL PAGE

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CHAPTER I

INTRODUCTION

According to Alfred North Whitehead, education as a process of transmittal was only valid when the time span of major cultural change is longer than the life span of individuals – when the skills and knowledge people acquired as children are still useful in their later years of life. Up until the nineteenth century, major cultural changes, such as technological innovations, political and economic shifts, and vocational displacement, occurred over a period of many decades, even up to a century. Once educated, adults remained effectively employed in their respective vocations throughout their life span with little or no requirements for new skills and knowledge. (Knowles, pp. 40 – 41)

Today, the accelerating rate of technological change, and the economic shifts from local, state, and national economies toward a global economy have made it imperative that adults gain new skills and knowledge throughout their life to remain technically competent. This “life long learning” process however poses a great expense to business, and many companies find it difficult to provide the training they need to keep their technical employees up-to-date on the latest computer technologies. Another trend that compounds this problem is the increasingly short “shelf life” of technical skills and knowledge. Employees often become technically “obsolete” within a very short period of time (within a one to two year time span) due to the rapid acceleration of technological change.

To remain competitive in the current business market, companies will need to find ways to offer the technical skills and knowledge their employees require while
minimizing the cost. In this report, the researcher investigated the methods used by American think tanks to provide the necessary technical skills and knowledge to keep their employees competent in computer-related technologies. The results of the research were intended to advise other American companies on how they too can provide the training required to keep technical employees competent in computer-related technologies.

Statement of the Problem

The purpose of this study was to determine American think tank recommendations on how to keep employees technically competent in computer-related technologies.

Research Goals

To solve this problem, the following research goals will be answered:
1. What methods do American think tank companies use to keep their technical employees up-to-date on computer-related technologies?
2. Which recommendations are the most common ones cited by American think tanks?

Background and Significance

This study arose as a result of real life problems experienced by the researcher. She was responsible for locating and scheduling technical training classes for 197 computer system administrators and network engineers. The computer systems
environment consisted of multiple computer platforms and network configurations. Some of the individuals arrived at the work site with little or no technical skills and knowledge required to perform their duties. Other technical employees who had worked in this environment for extended periods of time (five to fifteen years) were rapidly losing their competency in computer-related technologies. It soon became apparent that both groups of workers required extensive technical training.

The commercial training costs were prohibitive for the number of individuals involved and the types of technical training that they required, and alternatives to the commercial-based training were extremely limited. Many other firms experienced similar training dilemmas. The 2000 American Society of Training & Development (ASTD) State of the Industry Report indicates that U.S. organizations will budget $54 billion for formal training this year, with almost 40 percent of it dedicated to teaching computer-related skills. (ASTD, 2000). These statistics suggested that companies needed to find alternative methods for technical training and/or ensure that the training dollars spent produce an equal or greater amount of return on investment (ROI) for the organization. To do otherwise would lead the company into insolvency.

Technical training, however, must be conducted despite its rising cost. Experts in the training field have begun to document the rate at which employees lose their technical competency. The ASTD Technical Skills Training Handbook states that “the half-life of knowledge in technology-intensive fields such as engineering and health care is now less than four years.” (Kelly, 1995, p. 39) Simply put, employers must begin to provide training for these professional workers the first day on the job in order to keep them technically competent. Failure to do so can lead to serious consequences for the
organization. To illustrate the point, technicians at the Labor Department's Bureau of Labor Statistics (BLS) inadvertently placed government data onto its Internet web site prior to its authorized release time, influencing financial markets worldwide, and compromising the integrity of the agency's internal computer procedures. The first problem arose when a technician pressed the wrong button. The second disclosure was the result of a computer programming error according to BLS Commissioner Katharine Abraham. (Bodipo-Memba, 1998, p. B9) Proper training for technical workers becomes more critical to business, government and industry as the rate of technological change continues to accelerate.

One possible solution to the technical training problem would be to simply hire personnel that already have the technical skills and knowledge needed to do the work. However this solution is not as viable as it sounds. There is a severe shortage of qualified technical workers in the United States, especially in the field of computer science. According to the Meta Group, an industry and research firm, there are more than 200,000 vacancies in computer-related jobs nationwide. In fact, the U.S. Department of Labor indicates that an average of 95,000 new computer scientists, systems analysts and programmers will be needed each year from now until the year 2005. This shortage is critical to the U.S. economy because the number of Computer Science degree graduates has fallen by 43 percent in the last ten years. In 1994, only 24,553 computer science graduates entered into the United States work force. Alarmed by these falling statistics, the U.S. government has joined forces with the Labor Department and technology industries to find effective ways to combat the critical shortage of technical workers. (Schedbauer, 1998, p. 16)
This research study was designed to reinforce these efforts by the U.S. government and industry. It identified what American think tank companies were doing to keep their technical employees up to date in computer-related technologies, and the most common approaches to this training problem.

**Limitations**

The limitations of this study were:

1) The population of this study was limited to information technology project managers and supervisors of American think tank companies.

2) The data collected was limited to methods of providing computer-related technology training to technical employees.

**Assumptions**

This study was conducted based on the following assumptions:

1) The American think tank employees surveyed would willingly discuss what methods were used to keep technical employees up-to-date on computer-related technologies.

2) The American think tank managers understood the current computer-related technology issues and trends, and how these issues affected training requirements for technical employees.
Procedures

In order to conduct this study, the researcher needed to identify American think tank managers that were responsible for keeping technical employees up-to-date on computer-related technologies. She identified twenty (20) U.S. think tank organizations using the Think Tank Directory (Helleburst, 1996). She then contacted the department training heads to ask for their assistance with a Delphi study. Each department training head was requested to identify one information technology project manager within their organization who met the following criteria:

- A full-time employee of the organization
- One or more years of computer-related experience
- Manages at least five or more employees working on high technology projects or programs.

Using the Delphi process, an open-ended survey was conducted to determine what methods were employed by these project managers to keep their technical employees up-to-date on computer-related technologies. These answers were collected and presented to an expert panel consisting of three members known for their expertise in information technology and technical training. A second questionnaire, using a Likert scale, was developed by the researcher in conjunction with the panel experts, and again distributed to the survey participants. The researcher then collected and analyzed the data, computing the means of the answers from the Likert scale. A third survey was distributed to the same managers, identifying their answers as compared to those of the group, allowing the research participant to change his or her answer as desired.
Definition of Terms

The following terminology and abbreviations were used in this study by the researcher. To help the reader fully understand these terms, the following definitions are presented:

1) Adult education – it refers to a post-public school program provided by schools, training centers and other related agencies. It is usually more adaptable than traditional educational programs. (Kelly, 1995, p. 581)

2) Business-education partnerships – an arrangement between businesses and educational institutions that integrates schools and the workplace. Educational institutions are employed to provide short-term or longer-term training for business’ training needs. (Kelly, 1995, p. 583)

3) Competency-based training – this training approach focuses on the learner’s capability for a specific job or task. This process of developing training includes a job analysis, identification of skill requirements and training needs, and assessment protocols. (Kelly, 1995, p. 583)

4) Computer-related training – education related to computer systems (hardware and software), associated peripheral devices (e.g., printers, scanners, etc.), and computer network services.

5) Core competencies – identifies skills that workers must obtain to perform effectively in their jobs. Also defined as the central or essential skills of a business or corporation. (Kelly, 1995, p. 584)
6) Downsized organizations – businesses and corporations that restructured and reduced their personnel in order to improve effectiveness and/or profit. (Kelly, 1995, p. 584)

7) Information technology (IT) – the acquisition, processing, storage, and dissemination of data contained on computer and telecommunications technology. (Kelly, 1995, p. 582)

8) Internet – a loose confederation of computer networks around the world that is connected through several primary networks. (Van Buren, 1998, p. 27)

9) Lifelong learning – a belief that adults should acquire formal and informal education throughout their lives and that everyone should continually improve oneself. (Kelly, 1995, p. 582)


12) Technical worker – employees who use or apply scientific or mathematical knowledge in their workplace. (Kelly, 1995, p. 585)

13) Technology transfer – the process of disseminating technical innovations from one culture to another. (Kelly, 1995, p. 583)

14) Think tank – “an institution or group involved in researching and solving difficult, interdisciplinary problems, the solutions to which often affect public policy.”
15) Vocational education - a type of training for an occupation or for entry into an occupation. (Kelly, 1995, p. 583)

Overview of Chapters

Chapter I of this research study provided the framework for the research problem. It identified the research goals, the assumptions used to conduct the research, and the limitations of the project. It also discussed the origin of the study and the importance of doing the research. Specific phrases and terminology used by the researcher in the report are defined for the reader.

The remaining chapters in this report will: (1) identify other studies that have been conducted by researchers, either directly or indirectly related to this research topic, and other literary works that discuss or describe the problem; (2) describe the methods and procedures used to collect the data for the study; (3) provide analysis of the findings; and (4) review the contents of the report and make suggestions for future research studies.
CHAPTER II

REVIEW OF LITERATURE

A review of the literature reveals significant changes in management and organization infrastructures brought about by the new information-based economy as well as major upheavals experienced in the global markets. The strong demand for information services, in conjunction with a significant decrease in the number of technical degrees being awarded by U.S. colleges and universities, has created a severe shortage of information technology (IT) workers in the United States. To address these shortfalls, businesses, primary and secondary schools, centers of higher learning, and the government (at the local, state and federal levels) have joined forces to establish business-education partnerships and consortiums to find ways to increase the number of IT workers. With the approach of the new millennium, the training and retraining methodologies used to keep America’s information service workers abreast of new technologies will be the topic of much discussion and concerted efforts. It is also the subject of this research study.

The Dawn of a New Era

Industrial training became more standardized in the early 1900s as Frederick Taylor’s concept of scientific management began to dominate the industry. New goals were set to extract as much work out of the employee as possible. Taylor believed that time-and-motion studies would yield more productive work methods. Although well
received at the time, these improvements in productivity soon became a thorn in the worker's side due to lack of concern for his physical and social needs. (Rieger, 1995, pp. 56-57)

About the same time, Mary Parker Follet began a counter movement to champion the importance of human relations in workplace productivity. Oddly enough, the parties from both camps were right. The Hawthorne studies revealed that worker productivity was as much of a social concern as an environmental one. In these studies, the researchers controlled a special work environment to maximize worker productivity. They found worker productivity not only improved due to controlled environmental factors but also because the workers felt a sense of importance, which resulted from being chosen to participate in the study. (Rieger, 1995, pp. 57-58)

Much of the findings of the Hawthorne Studies are still being employed in the workplace today. The current emphasis on team building, systems thinking, shared decision making and communication is derived from this study. These workplace philosophies and practices however sprang out of necessity to meet the demands of the Industrial Age. The question is now: "Can these same workplace philosophies and industrial training practices be effectively applied in the new business environments that produce information-based goods and services as opposed to manufactured products?"

To correctly answer this question, we must understand how the major products and services of this new era differ and compare to the ones of the Industrial Age.

In the article entitled "Management's New Paradigms," Peter Drucker asserts that the new knowledge workers own their own means of production, unlike the capital equipment and buildings that generated substantial corporate profits in former times. An
information-based product or service produced by technology workers can be sold a multiple number of times, unlike tangible products that are only sold once by the corporation. This same information can also be repackaged as a totally different product to meet the needs of different customers other than the customers first attracted to the product. Informational products and services also have more than one end use and are used by more than one industry, similar to the way plastic is used in the automobile, storage container and health care industries. (Drucker, 1998, pp. 166 – 174)

The technological walls separating American industries have fallen down, and information is not the eminent domain of any one specific business or industry. Information does not represent a product as much as it creates a whole new way of life, similar to the impact that the introduction of television had on the American family. The forces that have the most power to influence the products and services of an organization or business today come from outside the business entity, not from within. (Drucker, 1998, pp. 166 – 174)

Drucker is not alone in his assertions. Don Tapscott declares that companies are moving from cutting costs to creating value in order to increase profit margins. In a knowledge economy, which he defines in human capital and computer networks, almost 60% of the American workforce participates in information-related industries, and that eight (8) of every ten (10) new jobs are being created in information intensive sectors of the economy. As one manager he interviewed said “We’re in a risky business. Our key assets walk out of the door every night.” (Tapscott, 1997, p. 2)

The idea of human intellect and knowledge as an industrial asset is not new, but to view this knowledge as the most important asset to the company’s survival is. Mr.
Tapscott describes the human being as a “business unit of one” which clusters and regroups with other business units of one to form teams, divisions, and organizations whose boundaries inside and outside are both permeable and fluid. He describes the organization of the future as an “internetworked business” which is characterized by the inclusion of external business partners, the constant reconfiguration of business relationships, and a significant use of outsourcing. This new business structure will be known for a climate where the entrepreneur spirit is fostered, prized, and rewarded by upper management. As a result of the knowledge-based innovations, the emerging new media will be a unique combination of the current computing, telecommunications, and content industries. (Tapscott, 1997, pp. 3 - 5)

This new knowledge-based economy will also specialize in mass customization instead of the traditional mass production methods supported in the past. Rapid technological advancements will allow companies to easily customize consumer products and services to the unique wants and needs of the individual. High pay and high value will be associated with these new knowledge-based jobs, however there is little job mobility as the worker transitions from the old to the new world of employment. (Tapscott, 1997, pp. 6 - 7)

The task of changing from an industrial-based economy to a knowledge-based economy is not an easy one. New and existing American workers will require extensive training and retraining to perform these new jobs. It is important though that this training takes place due to the direct impact that these new technological advancements have upon the national economic productivity. Dr. Howard Rubin, a member of the Workforce and Education Informational Resources Task Force, states that the IT
workforce should be declared a national priority and resource. The use of technology to create information-based products and services is so important that the unfulfilled demand for additional IT workers “acts as a breaking force on the economy.” (Workforce and Education Information Resources Task Force, 1998) A recent study conducted by Information Technology Association of America (ITAA) indicates that American employers will create a demand for approximately 1.6 million IT-related positions this year. And because the demand far exceeds supply, one in every twelve IT jobs will be vacant. (Information Technology Association of America, 2000) These unfilled jobs translate into economic losses too large to ignore, setting off a strong public debate concerning the shortage of IT workers.

This controversy concerning IT employment figures has drawn the full attention of American government, industrial and educational leaders alike. But is there a true IT worker shortage in the U.S., or have other environmental influences, such as Year 2000 technology issues, distorted the true picture? Is the IT worker shortage an unexpected byproduct of current U.S. federal programs to promote rapid advancements in new American technologies, and the expanded use of the Internet for electronic commerce? A further investigation is warranted to ascertain the truth concerning the number of IT workers and job availability.

The New Digital World

Technological advancement in the computer industry has occurred at a faster rate than any other industry in the course of history. Major technical innovations, such as those developed by the health care and computer industries, have significantly changed
peoples' lives – both at home and at work. The development of these technical advances was accelerated by the introduction of knowledge-based products and services, such as the Internet that now supports millions of pages of information and the collective sharing of the scientific knowledge by like-minded individuals. (Gantz, 1998, p. 31) And there is still more significant advancement to be made.

The growth of IT services for home and office use is expanding rapidly in this knowledge-based economy. “The share of individuals using the Internet rose by a third, from 32.7% in December 1998 to 44.4% in August 2000. If growth continues at that rate, more than half of all Americans will be using the Internet by the middle of 2001.” (U.S. Department of Commerce, 2000, p. 14) “The number of households with Internet access soared by 58%, rising from 26.2% in December 1998 to 41.5% in August 2000.” (U.S. Department of Commerce, 2000, p. 14) By 2004, a billion devices are expected to be on the Internet, and the overall Internet economy shall represent almost 5% of the world’s gross domestic product. (Gantz, 1998, p. 31) “In 1998, Internet retailing was forecasted to reach $7 billion by 2000; current projections now forecast online retail sales in the range of $40 billion to $80 billion by 2002.” (U.S. Department of Commerce, 1999, p. 1)

The advent of these significant technological developments will require American workers to acquire new knowledge and skills in order to implement, operate, maintain and expand these new technologies as well as cause some well-established industries to become obsolete, forcing the workers to seek employment elsewhere.
Shortage of IT Workers: Fact or Fiction?

The rate at which these technological advancements occur will significantly affect the number of American workers needed to perform the jobs associated with these rapidly expanding technologies. And all workers, both new and existing employees, will require frequent training to update their skills and knowledge to keep pace with this ever expanding knowledge-based economy. "By 2006, almost half (49 percent) of the private workforce will be employed either by industries that produce IT equipment or services, or by industries that are heavy users of IT equipment or services, up from 44 percent in 1989." (U.S. Department of Commerce, 1999)

The Information Technology Association of America estimates that there are approximately 844,000 unfilled IT jobs in the U.S. (Information Technology Association of America, 2000, p.1) The 2000-01 Occupational Outlook Handbook predicts that the three fastest growing occupations in America will be that of computer scientist, computer engineer, and systems analyst from the years 1998 through 2008. During this time period, employment rates for computer engineers, computer systems analysts and database administrators are expected to increase 108%, 94% and 77% respectively. Growth in these knowledge-based professions will be driven by very rapid growth in computer and data processing services, which is projected to be the fastest growing industry in the U.S. economy. (2000-01 Occupational Outlook Handbook)

Proponents of the ITAA study believe these shortage statistics are reasonably accurate for several different reasons. Paul Kostek, president-elect of the Institute of Electrical and Electronic Engineers (IEEE-USA), insists that the extensive corporate
mergers of the early 1990's caused many engineers to seek jobs in other industries, such as marketing and real estate, because of the lack of employment in their respective field. (Ristelhueber, 1998, p. 2) Another factor often cited for the shortage of workers is the reported 42% drop in the number of computer science degrees awarded by colleges and universities between 1986 and 1994. During this time period, only 24,400 computer science graduates entered the American job market. (Steen, 1998, p. 4)

Still others believe that the shortage of IT workers in other countries, such as that of Western Europe, may be pulling qualified workers from the American employment pool. The Frankfurt-based European Information Technology Observatory states that Europe requires approximately 100,000 to 200,000 workers for its unfilled IT positions. (Wallace and Ouellette, 1998, p. 1) Workload demands created by the Year 2000 problem and the European currency conversion projects significantly increased the wages offered to highly qualified U.S. IT personnel to take these short-term work assignments. As other countries increase their use of knowledge-based systems, the number of IT worker requirements is expected to rise, making it even more difficult to fully staff the available IT positions within the U.S.

Despite these supporting arguments of a national IT labor shortage, there are others who believe that the upper management of many U.S. technology businesses is purposely inflating the number of IT worker requirements. These opponents assert that the labor shortage is a result of the numerous mergers that occurred in high-technology industries during the last decade, but for a different reason. They claim that the mergers allowed firms to raid the employees' talents and skills of other corporations, and treat the workers as disposable assets. As a result of this merger mania, company loyalty shown
by the employee has all but disappeared. Many employees have developed a "free agent" attitude that dictates they work for a specific period of time, then move on to "greener pastures." Consequently, the average turnover rate in many computer-related companies is estimated to be by some experts as high as 20%, but these figures represent temporary job vacancies, not permanently unfilled IT positions. (Ristelhueber, 1998, pp. 1 - 4)

Another argument used to refute the findings of IT-related surveys is that the studies are an extrapolation from the responses of a small number of U.S. companies of all types nationwide, and that the sample populations are too small. Mr. Ristelhueber, a writer for the "Electronic Business" magazine, cites this example: "If a baking company in Peoria, IL, needed an MIS executive, that opening would have been included in this study, which high-tech honchos have used to establish the purported shortfall in design and applications engineering professionals in high-tech manufacturing." (Ristelhueber, 1998, pp. 1 - 2) Hence, according to this argument, these IT studies do not accurately represent the national IT industry as a whole.

Still, critics argue that there are other reasons why the IT study estimates are inaccurate. They declare that some technology companies are overlooking or deliberately ignoring existing pools of talent in favor of hiring recent college graduates and foreign nationals at lower paying salaries. Workers who fall into these categories are usually single or separated from family and friends, and are able to work extended work hours to include nights and weekends, unlike their married counterparts. Mr. Norman Matloff, a computer science professor of the University of California at Davis, supports this view. He conducted a survey that found software producers hire as few as 2% of all job
applicants. His conclusion is that if there were a true IT labor shortage, these companies would not be so selective in their hiring processes. (Ristelhueber, 1998, p. 2)

Another possible reason for the shortage of IT workers is that many companies wish to hire only workers with previous experience in a specific technology. Since most of these technologies are so new, there is not a fully developed pool of qualified job candidates from which to chose, and many applicants despite some previous computer-related experiences, find themselves labeled as unqualified for the job. This highly selective process also applies to employment in "old" technology areas, such as that associated with the Year 2000 problem. The COBOL programming language has been out of use in the computer industry for so long ago that few of the today's programmers have the necessary job skills to perform the work. To acquire these unique skills, new and existing workers will require training supplied by the company to gain these needed skills, or they must seek out a college, university and some other center of learning with a technical skills program. Despite arguments, such as these, concerning the validity of a shortage of IT workers, many organizations have begun new initiatives to address the IT worker shortfall, to the degree they believe that the shortage exists.

**Public and Private Sector IT Initiatives**

Since the late '80s, the U.S. federal government has asserted that there is a critical need for highly qualified workers to sustain the tremendous growth of this emerging information-based economy. It declared that the current standards of learning found within the nation’s school districts would not prepare young people for these high technology jobs. To address this problem, the Secretary of Labor appointed the
Secretary’s Commission of Achieving Necessary Skills (SCANS) to determine the skills required by young people to succeed in the workplace. It decided upon five workplace competencies and a three-part foundation of skills and personal qualities that are needed to promote workforce excellence in this Age of Information. The Workplace competencies are defined as:

1. Know how to use resources (time, money, materials, space and staff)
2. Develop interpersonal skills (team work, negotiation, customer service, et al.)
3. Acquire, organize, analyze and evaluate data, and possess computer-related skills
4. Understand, monitor, and improve social, organizational and technological systems
5. Identify, maintain and troubleshoot technological tools, and apply the correct technology to complete specific tasks.

The Foundation skills are identified as:

1. Basic skills – reading, writing, arithmetic and mathematics, speaking and listening
2. Thinking skills – the ability to learn, to reason, to think creatively, to make decisions, and to solve problems
3. Personal qualities – individual responsibility, self-esteem and self-management, sociability, and integrity. (U.S. Department of Labor)

Since its initial report, SCANS has been a major influence in developing federal guidelines to ensure effective worker productivity in the workplace, and it continues to make recommendations as this new knowledge-based economy emerges.

Another federal agency responsible for nationwide employment and training programs is the U.S. Employment and Training Administration. This federal agency is best known for the One-Stop Career, Welfare-to-Work, and School-to-Work reform programs. The One-Stop Career Center is designed as a comprehensive employment and
training delivery system for job seekers and employers. The Welfare-to-Work program assists disadvantaged individuals to acquire the skills and knowledge they need to become economically self-sufficient. The School-to-Work program, administered in conjunction with the Department of Education, ensures that youth acquire the knowledge and skills they need to enter the workforce. (U.S. Employment and Training Administration, 1998) Although the U.S. Education and Training Administration sponsors many of the training development programs, it does not sponsor them all.

Other federal and state agencies and departments are addressing national labor needs too. For example, the U.S. Labor Department has distributed $3 million in grants to retrain laid-off workers as programmers and spent another $8 million to build an online recruiting site. The Commerce Department plans include providing $17 million to bring technology and training to disadvantaged individuals, and another $6 million in grants to industry groups that sponsor internships and vocational training. And, the state of Massachusetts under the Massachusetts Software Council Fellowship program provides software training for individuals who have been laid off from the defense and aerospace industries. (King, 1998, p. 1) Despite the success of these programs, IT workers are still in such demand that other alternatives are being considered to address the IT labor shortage.

Some federal initiatives focus not on training American workers but bringing qualified immigrants into the United States specifically for the purpose of filling high technology positions. An ITAA study revealed that 88% of the 543 companies surveyed retrain existing staff, 40% hire immigrants to the U.S. and 16% outsource to non-U.S. contractors. (King, 1998, p. 1) Consequently, the 1998 American Competitiveness Act
was passed to allow 90,000 foreign doctors, computer programmers, academics and other professionals to work in the U.S. for a maximum of five years under a company’s sponsorship. (Mottl, 1998, p. 31) It is apparent however despite all the efforts of the federal government, that more has to be done to meet the IT labor challenge.

A number of business and government groups have also banded together to address the IT worker shortage, forming task force and consortium partnerships. For example, the Workforce and Education Informational Resources Task Force released a report entitled “Image of the Information Technology Professions.” The task force members found that many youth do not think of IT professions as “cool,” and many adults fear computers because of the threat to their jobs. In this report, they express concern at the “geeky-nerdy” stereotype image often shown in popular children’s movies, such as “The Nutty Professor” and “Honey, I Shrunk the Kids,” and make recommendations about how to combat the negative image of the IT profession.

To encourage other groups to initiate their own IT programs, the task force also cites models for “best practices.” One such model is the Tech Corps - “a national organization dedicated to improving K-12 education at the grassroots level through effective integration of technology into the learning environment.” (Workforce and Educational Informational Resources Task Force, 1998) Another example is the Applied Information Management (AIM) Institute, a unique consortium comprised of 34 businesses, three local centers of higher education, the Greater Omaha Chamber of Commerce and the State of Nebraska. Its purpose is to support and promote business and community growth related to information technology.” (Workforce and Educational Informational Resources Task Force, 1998)
Although much of the federal government's efforts are concerned with only the education of adult workers, there are also new IT programs designed to encourage youth into an early IT career. Companies, such as CISCO Systems, International Business Machines (IBM), and Microsoft, are now donating time and money to high school recruitment programs. Mostly found in magnet schools, these curriculum programs now include classes to provide fiber optic, Microsoft Certified Systems Engineer (MCSE), and Novell LAN certifications. According to John Wittman, a magnet school administrator, he receives calls daily from local companies looking to hire qualified students from these programs. He also reflects how easily the curriculum for these programs can change because the companies provide the instructors, equipment and training materials. (Crowley, 1988, p. 69) Many of the students who graduate from these programs often continue to college, using these new IT skills to support themselves through school – reducing the number of unfilled IT positions.

At the college level however, there is more room for controversy concerning these types of industry-education partnerships. Some critics' point out that there may be conflict of interest concerns about financial or economic issues related to the use of funds, inappropriate influence, and the ownership of patents and licensing. Potential conflicts could arise over the blending of federal and private dollars to conduct company proprietary research. Still others question if it is appropriate for faculty to act as entrepreneurs, apply for patents, and become self-employed business owners themselves while employed by the college or university. There is also concern that this industry-education collaborative activity decreases the amount of time the instructor spends with
his students. (Campbell, 1997, pp. 357 - 359) As business and industry seek new ways to increase the number of IT workers, new guidelines for interactions between the government, industry and education will need to be established.

Summary

A review of the literature in Chapter II has revealed the controversial issues concerning the IT labor shortage in the United States. Proponents of the labor shortage believe there are not enough IT workers to support all the information-based initiatives being sponsored by the U.S. government, industry, business and education. They propose that along with increasing the amount of training offered to American workers, that a substantial number of non-U.S. citizens be allowed into the country to work in these unfilled IT positions for a short period of time. Still others believe that there is no IT labor shortage, and argue that business and industries are just searching for cheaper sources of labor. Despite the controversy, the federal government, industry and education have begun a number of new programs in order to increase the number of available IT workers. As the Information Age progresses, the truth about the IT labor shortage will surely be known.

Chapter III of this research study describes the population of the study, the design of the instrument used to conduct the study, and the methods of data collection and analysis.
CHAPTER III

METHODS AND PROCEDURES

The purpose of this chapter is to define the methods and procedures that were used to conduct this study. It identifies the population that was selected to participate in the study, describes the design of the study instrument and its use, states the methods used to collect the data, and defines the statistical analysis used to determine the findings. The details of each research method and procedure are stated in the following paragraphs.

Population

The sample population chosen for this study were twenty (20) information technology project and program managers employed by U.S. think tank organizations, both government and private sector, listed in the Think Tank Directory (Helleburst, 1996). The think tank organizations chosen for this Delphi study employed a minimum of eighteen (18) full time employees, and specialized in science and technology activities as stated in the 1996 Think Tank Directory. Department head training representatives were contacted initially by phone to ask for their assistance in identifying survey participants for a Delphi research study. Each department head was requested to recommend one (1) technology project manager or supervisor within their organization who met the following criteria and was willing to participate in this survey:
- A full-time employee of the organization
- One or more years of computer-related experience
- Manages at least five or more employees working on high technology projects or programs.

The researcher then contacted the twenty participants of the sample population to collect the survey data.

**Instrument Design**

The instrument used in this research study was a Delphi survey developed to determine the methods employed by American think tank managers to keep their technical employees up-to-date on computer-related technologies. The Delphi survey was conducted in three parts, and is shown in Appendices B, D and F. Using the Dephi process, an open-ended survey was developed by the researcher. The answers were collected from the initial survey and presented to an expert panel consisting of three members known for their expertise in information technology and technical training. A second survey, based on a Likert scale, was developed by the researcher in conjunction with the panel of experts, and again distributed to the survey participants. The researcher then collected and analyzed the data, computing the mean of the answers for each question, based on the Likert scale. A third survey was distributed to the same managers, identifying their answer as compared to the mean of the group's answer for each question, allowing the research participant to change his or her answer as desired.
Methods of Data Collection

To begin the study, the department training heads located in U.S. think tank organizations were contacted initially by phone to ask for their assistance with a Delphi research study. If they indicated a willingness to assist the researcher in the study, they were asked to recommend one (1) technology project manager to participate in a Delphi research study. An introductory letter describing the Delphi study methods, and the criteria for recommending the survey participants were promptly mailed to the training department head. The department training heads were requested to complete and return the requested information within ten days. The researcher's electronic mailing address was also provided if the department training head preferred to return the requested information in an electronic format.

Upon receipt of the manager's name and address, the initial round of the three-round survey along with an appropriate cover letter were immediately mailed to the survey participant. The participants were given ten days to complete and return the survey in the self-addressed, stamped envelope enclosed in the initial survey package or via electronic mail.

To ensure that a satisfactory data collection rate from the survey participants, a second follow-up correspondence was sent within ten days to remind them to complete the surveys. It reiterated the importance of the study and included another copy of the initial round of the survey sent in the first letter.
Once the data was collected from the original, open-ended survey, it was presented to a panel of three experts known for their expertise in information technology and technical training. The experts were asked to organize the answers into categories, and a second round of the survey, using a Likert scale, was developed and sent to the research participants along with an appropriate cover letter. Each participant was asked to answer the survey questions, then return the survey sheets to the researcher. Again, to ensure maximum participation, a follow-up correspondence was sent approximately ten days after the second round of the survey to each participant who failed to return the second survey within the specified time limit. The mean for each question was computed based on the answers received from the second iteration of the survey. Finally, a third round of the survey was sent to the same participants that reflected their answer to a specific question versus the mean of the answers for the group. Each participant was allowed to change his or her answer if desired. Copies of the research correspondence are found in Appendices A, B, D and F.

Statistical Analysis

An expert panel consisting of three members known for their expertise in information technology and technical training conducted the data analysis for the initial round of the survey. They were asked to review the survey answers, then group them into categories. The second round of the survey, developed by the researcher in conjunction with the panel of experts, used a Likert scale to collect the data. This data was analyzed by computing the mean of the answers for each question, based on the
Likert scale. A third round of the survey was distributed to the survey participants to let them compare their answers to the mean of the group's answers for each question, allowing the research participant to change his or her answer as desired. A final data analysis was conducted to calculate the group mean for each question, noting the change with respect to the group mean calculated for each question from the second round of the survey.

Summary

This chapter defined the modified Delphi survey methods and procedures used to conduct this research study. Information technology managers of U.S. think tank organizations were selected as the sample population, and follow-up correspondence was used to encourage increased participation in the study. A panel of experts categorized the responses from the initial round of the survey, and the researcher developed the second round of the survey based on the initial responses. A third round of the survey was conducted to derive a group consensus to answer the research goals, the results of which are discussed in Chapter IV, Findings.
CHAPTER IV

FINDINGS

A three-round Delphi study was conducted to determine how American think tank managers would keep employees technically competent in computer-related technologies. Round 1 of the survey was distributed to 20 technology managers and resulted in eight (8) completed surveys. Round 2 of the survey was sent to the original eight (8) participants of Round 1 with additional Round 2 surveys sent to the six (6) managers who did not return the original survey in the hope that they would choose to participate in Round 2 and 3 of the study. Seven (7) participants who completed Round 1 returned the surveys. The eighth person declined to participate in the remainder of the survey. Round 3 of the survey was sent to seven (7) participants, with six (6) participants completing the third round of survey. To increase the number of completed surveys, a second reminder (and sometimes a third reminder) for each round of the survey was sent via hardcopy, phone, and electronic mail to ensure maximum survey participation. A total of six (6) participants completed all three rounds of the Delphi study.

First Round Results

The intent of the first round of the survey was to determine: (a) if these survey participants believe that a shortage of IT workers exists in the United States; and (b) what methods will they use in the next five to ten years to keep the IT skills of their employees current. To conduct this study, the initial round of the survey was sent to 20 technology
managers of American think tank corporations and organizations. To encourage survey participation, a second reminder was sent to the remaining participants via hardcopy and electronic mail as well as personal phone calls. In total, eight (8) of the recipients completed and returned the initial round of the survey. Six (6) survey recipients declined in writing to participate further in the survey, and six (6) recipients did not respond to further survey inquiries. In an attempt to increase the number of survey participants, the researcher also contacted four directors (or presidents) from the organizations that failed to answer the initial inquiries via hardcopy and electronic mail to request their participation in this Delphi study. No additional survey responses were received as a result of this action.

The initial eight responses obtained from Round 1 of the survey were analyzed by a panel of three IT experts: a state university computer-technologies instructor, a government contractor IT analyst, and an e-government analyst (and former Chief Information Officer (CIO) of a Navy command). The findings of the panel were inconclusive. After a thorough review of the data, the panelists agreed that most input could not be easily categorized – that the answers to the majority of the survey questions reflected a very diverse range of opinions, and there were not enough responses to offset the diversity of the answers. The panelists determined that survey participants (all except for one person) agreed that there is a shortage of IT workers, but there was no agreement as to a common cause of the shortage. The panelists also asserted that the inputs to the remaining questions could not be assigned common themes or categories. Appendix C, Round 1 Inputs, provides a list of responses to each survey question. Because of the differences noted in the participant responses, the researcher reviewed the remarks by the
panel of experts, the research goals of the Delphi study and the responses of the survey participants to create the second survey found in Appendix D, Round 2 Correspondence and Survey. It was designed to extract additional information to answer the research goals.

Second Round Results

Round 2 of the survey was sent to the eight (8) participants who answered the initial survey – again, using hardcopy and electronic mail services. Round 2 surveys were also mailed to managers who did not respond to the initial survey in the hope they would agree to participate in Rounds 2 and 3 of the survey. Participants in Round 2 of the survey were requested to rate ten questions related to technology training and future technology advancements based on the following criteria:

1. Strongly Disagree – Statement is not true
2. Mildly Disagree – Statement is probably not true
3. Neutral – Neither agree or disagree with statement
4. Agree – Statement is probably true
5. Strongly Agree – Statement is definitely true

Seven (7) of the eight original participants returned their Round 2 answers promptly while the eighth participant declined to participate in the remainder of the survey. No responses were received from the six (6) organizations that did not respond to the first round. Based on the inputs from the seven original participants, a group mean was
calculated for each survey question. All group means were rounded to the nearest tenth, one decimal point beyond the whole integer. Table 1 presents the mean scores for each of the training survey statements.

Table 1

Second Round Group Mean Score for Training Survey

<table>
<thead>
<tr>
<th>Survey Question</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The shortage of IT workers will gradually decrease as computers and related IT technology becomes more common in the home, education institutions and workplace.</td>
<td>2.6</td>
</tr>
<tr>
<td>2. Instructor-led training (as compared to computer-based training (CBT)) is the most effective training method at the present time.</td>
<td>3.6</td>
</tr>
<tr>
<td>3. Advances in network technology will gradually shift training activities on-line vice traditional training methods, such as classroom instruction and on-the-job training.</td>
<td>4.1</td>
</tr>
<tr>
<td>4. IT workers should acquire at least some of the required IT skills and knowledge utilizing personal time and resources (e.g., IT trade magazines and books; college courses; software applications; etc.)</td>
<td>4.0</td>
</tr>
<tr>
<td>5. Recent advances in on-line training technologies will reduce the amount of time required to adequately train IT workers.</td>
<td>3.3</td>
</tr>
</tbody>
</table>
Survey Question

6. Advances in software applications, such as artificial intelligence and "smart" agents (advanced software applications to include automated employee performance support programs) will reduce the depth of technical knowledge and skills required by the IT worker to perform the job.

7. IT skills and knowledge should be emphasized more strongly in high school level curriculum.

8. "On-the-job" IT training (peer-to-peer learning) will become less prevalent in the future.

9. There will be a gradual increase in the need for IT certification(s) to prove adequate technical skills and proficiency.

10. It is difficult to predict IT training needs beyond a three-to-five year time range.

Survey participants gave ratings ranging from 1 to 5 on the 5 point Likert scale. In total, group mean scores ranged from 2.0 to 4.4. The "On-the-job" IT training statement received the lowest mean score, 2.0, while the "It is difficult to predict IT training needs" statement received the highest mean score, 4.4. The data collected for Round 2 is listed in Appendix E, Round 2 Inputs.

Third Round Results

Round 3 of the survey was sent to the seven (7) participants who answered Round 2 of the survey using phone, fax and electronic mail services. The Participants in Round 3 of the survey were requested to rate ten questions in light of their response and the
group mean calculated using the inputs from Round 2. Again, they were to rate the statements based on the following criteria:

1. Strongly Disagree – Statement is not true
2. Mildly Disagree – Statement is probably not true
3. Neutral – Neither agree or disagree with statement
4. Agree – Statement is probably true
5. Strongly Agree – Statement is definitely true

Six (6) of the original seven participants returned their Round 3 inputs. Round 3 of the survey is found in Appendix F, Round 3 Correspondence and Survey. Based on these inputs, a group mean was calculated for each survey question. All group means were rounded to the nearest tenth, one decimal point beyond the whole integer. Table 2 presents the mean scores for Round 3, and the associated change between the group means for Rounds 2 and 3 for each of the training survey statements.

Table 2

<table>
<thead>
<tr>
<th>Survey Question</th>
<th>Mean</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The shortage of IT workers will gradually decrease as computers and related IT technology becomes more common in the home, education institutions and workplace.</td>
<td>2.7</td>
<td>+0.1</td>
</tr>
<tr>
<td>2. Instructor-led training (as compared to computer-based training (CBT)) is the most effective training method at the present time.</td>
<td>3.7</td>
<td>+0.1</td>
</tr>
</tbody>
</table>
Survey Question  | Mean | Change  
--- | --- | ---  
3. Advances in network technology will gradually shift training activities on-line vice traditional training methods, such as classroom instruction and on-the-job training. | 4.3 | +0.2  
4. IT workers should acquire at least some of the required IT skills and knowledge utilizing personal time and resources (e.g., IT trade magazines and books; college courses; software applications; etc.) | 3.8 | -0.2  
5. Recent advances in on-line training technologies will reduce the amount of time required to adequately train IT workers. | 3.5 | +0.2  
6. Advances in software applications, such as artificial intelligence and “smart” agents (advanced software applications to include automated employee performance support programs), will reduce the depth of technical knowledge and skills required by the IT worker to perform the job. | 3.0 | +0.3  
7. IT skills and knowledge should be emphasized more strongly in high school level curriculum. | 4.0 | - 0.3  
8. “On-the-job” IT training (peer-to-peer learning) will become less prevalent in the future. | 1.3 | - 0.7  
9. There will be a gradual increase in the need for IT certification(s) to prove adequate technical skills and proficiency. | 3.8 | - 0.2  
10. It is difficult to predict IT training needs beyond a three-to-five year time range. | 4.2 | - 0.2
Survey participants provided ratings ranging from 1 to 5 on the 5 point Likert scale. Mean scores ranged from 1.3 to 4.3. The “On-the-job” IT training statement received the lowest mean score, 1.3, while the “Advanced in network technology will gradually shift training activities online…” statement had the highest mean score, 4.3. To enhance the results of the research, each participant whose final rating was one integer above (or below) the group mean was asked to provide a brief comment concerning the difference between their input and the group as a whole (based on the group mean). A rating that is one integer (or greater) from the group mean is considered significantly different from the consensus of the group. Round 3 data and comments are found in Appendix G, Round 3 Inputs.

Summary

The purpose of this Delphi survey was to determine American think tank recommendations on how to keep employees technically competent in computer-related technologies. To obtain this information, a three-round survey was conducted using an initial sample of 20 technology managers of American think tank corporations and agencies derived from the 1996 Think Tank Directory.

The initial round of the survey included an open-ended questionnaire. Survey participants were asked to answer each question. The inputs to Round 1 were reviewed by a panel of experts that concluded that the inputs could not be easily categorized.

Based on the responses to Round 1 and a review of the research goals, the researcher developed a Likert-scale questionnaire for Round 2 which was sent to the eight (8) original participants of Round 1, and to six (6) individuals from the original
contact list who provided no response to the Round 1 survey in the hope that they would agree to participate in Rounds 2 and 3. Participants were asked to rate each statement using a five point Likert style scale. Based on the inputs from seven (7) participants in Round 2, the group means were calculated for each statement.

A third round of the survey was sent to seven participants who had responded to Rounds 1 and 2 of the survey. Each participant was asked to rate the statements from Round 2 again in light of the group means and their current rating. From this round, six (6) participants returned their surveys, and the group means were recalculated to determine changes in the Round 2 versus Round 3 group consensus. Participants whose answers were one integer greater than that of the group mean were asked to provide a brief comment to explain their differing viewpoint. A total of six (6) participants completed all three rounds of this Delphi study.

The Chapter V of this study will summarize the research, provide conclusions based on the findings, and provide recommendations on areas of extended research based on this study.
CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this chapter is to summarize the research study, draw conclusions based on the survey inputs, and make recommendations concerning additional areas of research. The final analysis of the research study is provided in the following paragraphs.

Summary

The purpose of this study was to determine American think tank recommendations on how to keep employees technically competent in computer-related technologies. To define this problem, research goals were established to determine: (a) what methods American think tank companies use to keep their technical employees up-to-date on computer-related technologies; and (b) which recommendations are the most common ones cited by American think tanks. A review of current literature related to this study was conducted to establish the significance of the problem and to establish the context from where the problem arose. To conduct this study, a sample population of 20 think tank companies was identified to participate in a Delphi research study. Department training heads were asked to identify one technology manager within the organization to participate in the research. A three round survey was sent to each participant. Round 1 was an open text questionnaire. A panel of information technology experts reviewed eight inputs from the initial round. Based on the Round 1 inputs, a review of the research goals, and remarks by the panel of experts, the second round of the survey was developed as a five point Likert style scale. Seven participants returned their
inputs, and the group mean was calculated for each question. In Round 3 of the survey, participants were asked to rate the statements again in light of their current response and the group means. To enhance the research findings, participants were also asked to provide brief comments if their ratings were greater than one integer from the group mean. Six (6) participants returned their Round 3 ratings along with their comments. From these inputs, the group means for Round 3 were calculated, and then compared to the group means derived from Round 2 of the survey.

Conclusions

The data collected for this research study indicated that there was a general agreement among the survey participants concerning Questions 2, 3, 4, 5, 7, 9, and 10, while the group means calculated for Questions 1, 6 and 8 indicated that a group consensus could not be reached. Specifically, the conclusions for this research with regard to the survey inputs and the research goals are stated below.

Research Goal 1: What methods do American think tank companies use to keep their technical employees up-to-date on computer-related technologies?

In support of Research Goal 1, the following conclusions were derived as a result of this study:

- Instructor-led training (as compared to computer-based training (CBT)) is the most effective training method at the present time. (Group mean = 3.7)
• As network technology advances, there will be a gradual shift from traditional training methods, such as classroom instruction and on-the-job training to on-line training activities. (Group mean = 4.3)

• IT workers should be prepared to acquire at least some of the required IT skills and knowledge used in the workplace by utilizing personal time and resources (e.g., IT trade magazines and books; college courses; software applications; etc.) (Group mean = 3.8)

• The time required to adequately train IT workers is expected to decrease based on recent advances in on-line training technologies. (Group mean = 3.5)

• Some IT skills and knowledge should be acquired through an increased emphasis in high school level curriculum. (Group mean = 4.0)

• A gradual increase is anticipated for the need for IT certification(s) to prove adequate technical skills and proficiency. (Group mean = 3.8)

• IT training needs are difficult to predict beyond a three-to-five year time range. (Group mean = 4.2)

Research Goal 2: Which recommendations are the most common ones cited by American think tanks?

In support of Research Goal 2, the results of this study indicate that the following conclusions are the most common methods:

• As network technology advances, there will be a gradual shift from traditional training methods, such as classroom instruction and on-the-job training to on-line training activities. (Group mean = 4.3)
• Some IT skills and knowledge should be acquired through an increased emphasis in high school level curriculum. (Group mean = 4.0)

Recommendations

The following recommendations were submitted based on the results of this survey, and for research studies related to this topic to be conducted in the future.

1. Rephrase Round 1 survey questions with a clearer emphasis on “training within your organization” versus training activities for the IT worker population at large.

2. Increase the size of the sample population (suggest a minimum of N=20) to improve the validity of the survey results.

3. Use electronic or technological means to communicate with survey participants. IT-related workers seem to generally respond better (based on time constraints and the number of completed surveys) to electronic mail and/or facsimile services as compared to the traditional hardcopy mail services.

4. Additional research should be undertaken to examine how perceived IT training needs are: (a) influenced by political or social factors within the organizations of the sample population; and (b) affected by the size of the think tank organization (e.g., the IT training needs of a small organization vs. those of a large organization).

5. Based on user comments from this study, research should be conducted to determine whether technology managers support an increased emphasis on IT skill acquisition in high school curriculum.
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http://www.itaa.org/workforce/studies/quality.htm


APPENDIX A

DEPARTMENT TRAINING HEAD CORRESPONDENCE
August 30, 2000

XYZ Corporation
Street Address
City, State Zip code

Dear {Name of Department Training Head}:

Research is defined as "a systematic search for facts" [Webster's]. Since the foundation of your job is based on "fact" and not assumption nor speculation, I know you appreciate knowing the truth of a matter. Recently, there have been several reports concerning a severe shortage of information technology (IT) workers in America. The Bureau of Labor Statistics estimates that an additional two million people will be needed to fill technology-related jobs in the United States between 1996 to 2006. This significant figure is a cause for your concern as well as mine if it is indeed true.

After reading these reports, I decided to investigate how American think tank corporations are preparing their technology workers for the new millennium. Do they plan to retrain existing workers for new technology jobs? How will they keep IT skills and knowledge of the employees current given the rapid rate of technological change? What challenges need to be anticipated concerning IT employees? In order to collect this data, I need to ask for your assistance.

Please recommend one (1) information technology project manager within your organization who is willing to participate in a three-round Delphi survey and meets the following criteria:

- A full-time employee of the organization
- One or more years of computer-related experience
- Manages at least five or more employees working on information technology projects or programs.

Please write the manager's full name, job title, and mailing address on the enclosed form, and return it within ten days. Or if you prefer, you may email this information to CLTEBAULT@AOL.COM. It is not my intent to release any personal information (e.g., participant names), only gather the data as a whole and report it. Your cooperation in this matter is greatly appreciated.
Respectfully,
Carolyn L. Tebault
Technical Training Specialist
3541 Sir Wilfred Place
Virginia Beach, VA 23452

CLT
Attachment

Please return this information no later than September 20, 2000.

PLEASE PRINT THE FOLLOWING PROJECT MANAGER INFORMATION:
Name (e.g., J.L Smith) and or Job Title (e.g., XYZ Project Manager)

________________________________________________________________________

Mailing Address:
________________________________________________________________________
________________________________________________________________________

Would you like a free copy of the results from this research study once it is completed (estimated date: winter of 2000)? Yes ________ No ________

SEND THE RESEARCH RESULTS TO:
Name (e.g., J.L Smith) and or Job Title (e.g., XYZ Project Manager)

________________________________________________________________________

Mailing Address:
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Dear {Name of Survey Participant},

Research is defined as "a systematic search for facts" [Webster's]. Since the foundation of your job is based on "fact" and not assumption nor speculation, I know you appreciate knowing the truth of a matter. Recently, there have been several reports concerning a severe shortage of information technology (IT) workers in America. The Bureau of Labor Statistics estimates that an additional two million people will be needed to fill technology-related jobs in the United States between 1996 to 2006. This significant figure is a cause for your concern as well as mine if it is indeed true.

After reading these reports, I decided to investigate how American think tank organizations are preparing their technology workers for the new millennium. Do they plan to retrain existing workers for new technology jobs? How will they keep IT skills and knowledge of the employees current given the rapid rate of technological change? What challenges need to be anticipated concerning IT employees?

I have enclosed the initial round of a three-part Delphi survey that will help me gather data to answer these important questions. Please take just a few moments to complete the enclosed survey and return it by September 20, 2000. The initial round will require the most time (up to 20 – 25 minutes); the second and third rounds will be Likert scale questionnaires and should take no more than 10 to 15 minutes each.
The intent of this study is to collect sufficient data to report generalized statements concerning the training of IT workers for the new millennium. Why are the results of this research study important to you? Keeping your employees current on new technologies:

- Increases the productivity of your work group
- Upholds employee morale
- Promotes a sense of personal accomplishment among your employees

No one likes to feel that his or her job skills are obsolete or outdated. By participating in this study, you will see how your training ideas match up with the training plans for technical employees of similar organizations, and this research information may even be able save you time when planning your next training program.

I want to assure you that specific information about individual study participants and other personalized data will not be made available to the public. I have my electronic mail address for your convenience. Your cooperation in this matter is greatly appreciated.

Respectfully,
Carolyn L. Tebault
Technical Training Specialist
Virginia Beach, VA
cltebault@aol.com
Would you like a free copy of the results from this research study once it is completed (estimated date: winter of 2000)? Yes ________ No ________

SEND THE RESEARCH RESULTS TO:

Name (e.g., J.L Smith) and or Job Title (e.g., XYZ Project Manager)

Preferred Mailing Address:
Purpose: The intent of this survey is to report a group consensus of how information technology workers will be trained in the future.

Directions: Please complete the following questions, and return this survey in the enclosed stamped envelope no later than September 20, 2000. Your input is vital to this survey! All participant identities will be kept strictly confidential.

1. Do you believe that there is a shortage of Information Technology workers in the United States? Yes or No (circle one).

2. Based on your answer to Question 1, why do you believe this is true?

3. What existing standard training technologies (e.g., computer-based training (CBT), instructor-led classes) do you believe will still be in use by the year 2005? By the year 2010?
4. What new training technologies can you foresee being implemented by the year 2005? By the year 2010?

________________________________________

________________________________________

________________________________________

5. What major technological advancements do you believe will occur within the next ten years, and how will they affect the structure of your organization?

________________________________________

________________________________________

________________________________________

________________________________________

6. How will these new technologies affect training activities conducted within your organization?

________________________________________

________________________________________

________________________________________

________________________________________
Thank you for your cooperation in completing Round 1 of this survey. Using this information, I will invite a panel of three information technology experts to categorize all inputs from Round 1 of this three-part survey (minus the personal information on this page to protect the identities of study participants). Based on this categorized information, the second round of this survey (a Likert-scale questionnaire) will be developed, and mailed to you using the information you have indicated below.

PLEASE PRINT THE FOLLOWING INFORMATION:

Name (e.g., J.L Smith) and or Job Title (e.g., XYZ Project Manager)

__________________________________________________________

Mailing Address:

__________________________________________________________

__________________________________________________________

__________________________________________________________

Would you like a free copy of the results from this research study once it is completed (estimated date: winter of 2000)? Yes ________ No ________

If you desire to have it mailed to a different address than the one indicated above, please complete the following information.

Mailing Address:

__________________________________________________________

__________________________________________________________

__________________________________________________________
APPENDIX C

ROUND 1 INPUTS
1. Do you believe that there is a shortage of Information Technology workers in the United States? Yes or No (circle one).

<table>
<thead>
<tr>
<th>Survey ID</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>Yes</td>
</tr>
<tr>
<td>11</td>
<td>&quot;Yes, although I really don't believe that the shortage is as severe as the various groups of IT people want us to believe. Nearly all jobs now and into the future will require a certain level of computer literacy, but computers are becoming so commonplace that this level of competence will develop naturally. We'll need a smaller number of &quot;real&quot; IT people – software developers, etc., and at least for now, there is a real shortage of those people.”</td>
</tr>
<tr>
<td>12</td>
<td>No</td>
</tr>
<tr>
<td>14</td>
<td>Yes</td>
</tr>
<tr>
<td>16</td>
<td>Yes</td>
</tr>
<tr>
<td>18</td>
<td>Yes</td>
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<tr>
<td>19</td>
<td>&quot;Yes, but I would like to qualify this statement. I believe that there is an abundance of people interested in the Information Technology field, yet the number of skilled people able to match the needs of our facility/operation is few. Therefore, there is an appearance that there is a shortage of Information Technology workers, although it would be better to say that there is a shortage of properly skilled Information Technology workers.&quot;</td>
</tr>
</tbody>
</table>
2. Based on your answer to Question 1, why do you believe this is true?

<table>
<thead>
<tr>
<th>Survey ID</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“There is a lack of information technology workers in the US. I believe this is true because when the information technology boom hit, a whole generation of workers had never used computers. They lacked the skills and training necessary to accomplish their jobs.”</td>
</tr>
<tr>
<td>9</td>
<td>“Very difficult to find and keep talent.”</td>
</tr>
<tr>
<td>11</td>
<td>“I’m not sure our education system is keeping up with the need for “real” IT professionals (as opposed to users of IT systems.”</td>
</tr>
<tr>
<td>12</td>
<td>“Things seem to be moving along rapidly – quicker than we can keep up.”</td>
</tr>
<tr>
<td>14</td>
<td>“Answer: The application of computer technology is approximately 25% of where we’re going to be in the next ten years. Currently there is a significant shortage of network/computer hardware personnel, let alone computer applications programmers. So I expect a tremendous increase in technology-related job openings over the next ten years.”</td>
</tr>
</tbody>
</table>
| 16        | “a. There is a limited pool of potential candidates. IT careers are perceived as, and in fact are, intellectually challenging. The percentage of the population that is motivated, capable, and willing to accept any challenging career path is inherently limited.  
b. IT job performance expectations are high. While any industry is always short on smart motivated people, the IT community feels this most acutely because IT job performance is generally Boolean. You can do the job, or you can’t. While there may be room in other job categories for marginal performers, IT personnel prove their worth every day, and marginal/non-performers are weeded out of the workforce more rapidly than most jobs.  
c. There is no accurate method of forecasting IT personnel need. The conventional thinking is that the supply of IT workers is unable
to keep up with the growing demand. While this is true, it misses an important point. The demand (industry) has little idea what it will need in the near, mid or long term. If this point is in doubt, remember that virtually no one foresaw the need for Web programmers seven or eight years ago. Hence, the sources of supply for IT workers (colleges, technical schools, etc.) are relegated to guessing what the target technologies are going to be when their latest crop of graduates enter the job market. They are shooting at a moving target, and they generally won’t know their results for 2 to 4 years after the student starts a program."

"The number of qualified Information Technology workers pales in comparison to the ever-growing technology needs of today’s industries and corporations."

"In the past year, when posting job openings for our position we have received significantly less resumes for the same job posted 2 years ago. We are also experiencing a decrease in response to our "on-campus" recruiting program. Further, staff retention is more and more difficult because the number of positions open in other companies has greatly increased. In a sense, one can pick and choose amongst many different job opportunities. Most often we lose folks to higher paying positions. "

Continued

to keep up with the growing demand. While this is true, it misses an important point. The demand (industry) has little idea what it will need in the near, mid or long term. If this point is in doubt, remember that virtually no one foresaw the need for Web programmers seven or eight years ago. Hence, the sources of supply for IT workers (colleges, technical schools, etc.) are relegated to guessing what the target technologies are going to be when their latest crop of graduates enter the job market. They are shooting at a moving target, and they generally won't know their results for 2 to 4 years after the student starts a program."

"The number of qualified Information Technology workers pales in comparison to the ever-growing technology needs of today's industries and corporations."

"In the past year, when posting job openings for our position we have received significantly less resumes for the same job posted 2 years ago. We are also experiencing a decrease in response to our "on-campus" recruiting program. Further, staff retention is more and more difficult because the number of positions open in other companies has greatly increased. In a sense, one can pick and choose amongst many different job opportunities. Most often we lose folks to higher paying positions. “
3. What existing standard training technologies (e.g., computer-based training (CBT), instructor-led classes) do you believe will still be in use by the year 2005? By the year 2010?

<table>
<thead>
<tr>
<th>Survey ID</th>
<th>Response</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>“I don’t believe by 2005 or 2010 we will be able to abandon instructor led class. However CBT’s seem to making real headway where I am working. I don’t know how good they are yet but, they have the capability of taking over traditional based classes.”</td>
</tr>
<tr>
<td>9</td>
<td>“Instructor led is and will remain the most effective means of training staff. It will be delivered via the web for portions of the course but 1 for 1 training is still important.”</td>
</tr>
<tr>
<td>11</td>
<td>“Clearly CBT will continue to grow, however I don’t believe that instructor led classes will disappear. Different people learn in different ways, and I think some people will always need the help of another person for learning. I also think that future generations will learn to use computers as easily as current generations learned to use telephones and televisions. Computers are becoming so ingrained in our culture that using them will become second-nature.”</td>
</tr>
<tr>
<td>12</td>
<td>“Always instructor-led -- more than now there will be internet ways to get training.”</td>
</tr>
<tr>
<td>14</td>
<td>“Answer: I believe that there will be a lot more instructor-led classes than people think due to student motivational factors. Online CBT is too consuming and students do not have the “stick-to-itness” required to complete these courses. There will be a steady increase in the use of CBT and distance education classes but traditional instructor-led training will still be around.”</td>
</tr>
</tbody>
</table>
"I believe all existing training technologies will still be in use by the year 2005 to 2010 and beyond. At best, you may see a shift into more internet based training. However, teaching tools and methodologies tend to die a very hard and protracted death – there are always champions for obsolete and ineffective training methods."

"In my estimation, 2005 will still utilize on-line training with a higher, more reliable degree of interactivity. The year 2010 will more than likely introduce a higher dependency on the web and web-based training."

"I foresee that CBT would still be in existence, although most certainly not in its current format. Most likely we’ll see a more mature deployment of CBT over the web. IL training will still be around – although it too will see a transformation where we will have something like virtual classrooms, multi-locational distance learning. Bandwidth is the single most important limiting factor at this time. Mentoring and face-to-face peer instruction will always exist, although newer technologies will streamline the delivery method. Other existing technologies that will still be around include Soft skills (i.e., customer service) training and video course training."
4. What new training technologies can you foresee being implemented by the year 2005? By the year 2010?

<table>
<thead>
<tr>
<th>Survey ID</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“I believe distance learning will be the future of training and educating the future. We already seeing this type of instruction over the web, I believe it is here to stay. In the next ten years you will be able to complete a typical degree from most universities via Distance Learning. This will be accomplished by having a home P.C.”</td>
</tr>
<tr>
<td>9</td>
<td>“More real time, on-line training. But I still believe some face to face training will still be necessary.”</td>
</tr>
<tr>
<td>11</td>
<td>“My crystal ball doesn’t work well enough to give a good answer to this question.”</td>
</tr>
<tr>
<td>12</td>
<td>Internet training ways. ie. Def. Driving through the internet etc..”</td>
</tr>
<tr>
<td>14</td>
<td>“Answer: I believe two things are needed: (1) The web-based training must be more interactive (more real time interaction between instructor-to-student and student-to-student); (2) Training must be broken down into much smaller learning modules (instead of a 500 page text book to be read during the course of a semester), and learning by topic instead of whole concepts. Instead of a single history course, classes should be broken down into a series of one hour study activities featuring a specific topic (e.g., a one hour study on Christopher Columbus; next class would feature a one hour topic on George Washington – short topics that are specifically tailored to meet the specific training needs of an individual student.)”</td>
</tr>
</tbody>
</table>
"I don’t know. Technology has a way of catching even the knowledgeable by surprise. While the technologies are an unknown, I do believe we will see a gradual increase in the need for certification(s) to prove updated technical training and proficiency. By certifications, I mean being tested against a set of standards not simply a certification for course completion. By 2010, I can easily see a job posting asking for a bachelors degree with “X”, “Y” and “Z” certifications.”

"I foresee more credible, comprehensive internet training.”

"As bandwidth and delivery methods increase (web and otherwise), we’ll see more use of white boarding, shared applications (i.e., net meeting), simulation-training that approximates the real-life experience not just theory (along the lines of airplane pilot simulation training), smart applications/testing that adapts to students’ skill-set weaknesses during the course. Use of plain speech voice recognition software, knowledge bases/knowledge management tools in training. With better video compression we’ll see much more use of this arena for taped as as well as real-time video conferencing training. PDAs will become the standard for training tools in the field and in the classroom so that a support person can pull up training courses/ smart knowledge bases right in the field and “learn real-time”. Customized skills based training will allow for individual profiles to be assessed and customized curriculum set for a student.”
5. What major technological advancements do you believe will occur within the next ten years, and how will they affect the structure of your organization?

<table>
<thead>
<tr>
<th>Survey ID</th>
<th>Response</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>“On-line training will be the next major explosion in the next ten years. This training will affect all organizations. One, the training will be cheaper. Two, you will not lose man hours due to this training.”</td>
</tr>
<tr>
<td>9</td>
<td>“Faster, stronger networks allowing for more computer based training.”</td>
</tr>
<tr>
<td>11</td>
<td>“I think that use of laptop or other small, portable computers along with teleconferencing and other on-line means of communicating will make it less and less necessary for people to be physically located in the same place to conduct business. I foresee more telecommuting of various sorts. My organization is very resistant to this movement for 2 reasons: one, a lot of our work is classified and must be done on site, and two, we are primarily a research organization, and there is a strong sense that researchers need face-to-face time to collaborate effectively.”</td>
</tr>
<tr>
<td>12</td>
<td>No answer</td>
</tr>
<tr>
<td>14</td>
<td>“Answer: A continued emphasis on increasing speed – things that formerly took 60 seconds now can be done in 10 seconds, then that same activity will be done in 2 seconds in the near future. This increase in speed will result in increased productivity expectations that in turn will result in a significant increase in employee burnout rates. Because of this increased speed, management will set employee productivity goals that will become increasingly harder to meet. Therefore, employees may leave larger corporate organizations, such as IBM and Hewlett-Packard, and migrate to smaller mom-and-pop type businesses that require less of them...”</td>
</tr>
</tbody>
</table>
(goal-wise), or encourage these people to start their own businesses and be their own boss! Instead of being everything to everybody (like corporate America), special niche companies will appear and these employees formerly working for large corporations will use that same increased technology knowledge to boost the productivity of their own businesses.”

A trend toward centralized processing (server based, and client/server, applications) and distributed work locations. While these are not new technologies, they are advancements and greater acceptance of current practice. By 2010, I expect to see virtual software companies where no brick & mortar facility exists. Software programmers will become “hired guns” working for more than one company/client at a time. Additionally or alternatively, there will be much greater connectivity between geographically separate work sites within a traditional company setting – joining geographically distant teams to work on a single effort.

Organizationally, the structure of my company will not be impacted if this should come to fruition. MRI is, at its base, a scientific concern that has much capital and effort placed on (big and expensive) physical instrumentation. I do see a possibility that there will be a greater reliance on outsourcing/subcontracting certain technical activities (software development, IT network management, and others?). However, even thinking well outside the box, I cannot see a radically different work environment by 2010 in practice – only in theory.”

“Each household will have a greater need to use and be a part of the internet, therefore more information will available to a greater number of people. The number of telecommuting positions will more than likely increase, making it necessary for organizations to provide on-line learning for their employees for both internal and external applications.”
"There are three areas in which technology will advance significantly within the next ten years and have broad affects, not just in our organization, but the world over. These areas are in computer science, physics and biology and they are discussed below respectively.

We have for some time been building increasingly more automated systems for handling a variety of work. At the simplest level, we have spell-checkers that check our spelling and grammar checkers that check our grammar. At the more complex level, we have aircraft that can land themselves fully automated. Within the next year, there will be breakthroughs in artificial intelligence that will revolutionize automation ways that we have not yet seen. Intelligent "agents" will act in the same capacity as personal assistants or secretaries do today. These software-generated intelligences will be able to answer our phones, take messages, hold simple, yet useful, conversations, take dictation, identify and report problems instructions--even order out for lunch. Of course, they will not replace the need for human beings and human insight, but as time goes on they will become increasingly complex and be capable of developing insights of their own. This has obvious affects on the structure of an organization. While human assistants will still be required and necessary, everyone will have, at their disposal, the use of an intelligent "agent". This will allow people to concentrate on the meat of their work and allow something else to worry about the busy work: filing, returning phone calls, writing up reports, etc. Two things follow from this change at once: an eight hour work day will become eight hours of real work and no time wasted on "paperwork". Organizations will be able to get more out of their workers and workers will get more out of their work because they will be able to work constantly on the "fun" stuff. Or, workdays can be reduced in length to four or six hours. This frees up leisure time
and allows a society to focus its efforts in a more creative capacity. This could lead to revolutionary changes in culture and science.

We use more energy than ever before. With increasing pressure for more renewable sources of energy, and an increasing drain of oil reserves, the next ten years will see additional pressure put on groups investigating nuclear energy, in particular, cold fusion. In ten years, although we may not yet have cold fusion, the "fuel cell" will certainly be, by and large, the standard source of energy for both homes and businesses. Automobiles will be powered by fuel cells making them cleaner burning; companies and residences will be powered by cheaper, cleaner fuel cells. The benefits of cheaper, cleaner-burning fuel sources are obvious to the environment as well as to business who depend on energy for their production, whether that production is of something material (such as cars) or abstract (such as research).

Finally, there is biology. With the mapping of the human genome complete, we will see, within the next ten years, a significant extension to the average human life span. Theoretically, this extension could be unlimited but in the next ten years, the practical limit will probably be somewhere between 150-200 years. How does this technical advancement affect the workplace? For one thing, it allows the retention of experience. For another, it allows the broadening of experience. It also introduces complications to things like retirement, pensions, and training. For instance a 65-year-old retiree might choose to spend another 30 years on the job (a retention of experience). Or they might choose to leave the company and start anew elsewhere. Or they might choose to go back to school and be trained in a new field, yet continue to work at the company. Organizations must be prepared for these types of changes and have reasonable ways of dealing with these choices.

Technology is often looked upon as a lurking evil—a kind of
| 19 (Continued) | temptation that traps us in a gloomy outlook of the future. This is not so. Technology is an extension of human nature. It is an extension of ourselves and of the jobs we do, and it is a reflection of the tenacity and resolve of the human race. Technology has sped along at fantastic speeds over the past 150 years, accelerating each year. For those that doubt the possibilities, the following should be pointed out: 30 years ago, although computers existed and were in use, something as simple as a spelling checker was the nothing more than science fiction. “ |
6. How will these new technologies affect training activities conducted within your organization?

<table>
<thead>
<tr>
<th>Survey ID</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“It is going to make training and work easier. We will no longer lose man hours or loose work hours due to travel time.”</td>
</tr>
<tr>
<td>9</td>
<td>“Training will be more accessible.”</td>
</tr>
<tr>
<td>11</td>
<td>“Our organization does only minimal in-house training. We tend to send people out to seminars and courses as needed. I think that trend will continue for us.”</td>
</tr>
<tr>
<td>12</td>
<td>“People will need to be more aware and have access to the internet. More people will get their training on-line but I don’t believe classroom will be eliminated.”</td>
</tr>
<tr>
<td>14</td>
<td>“Answer: Training activities will convert to mostly in-house programs, reviving the full-time presence of an internal training department tailored to meet specific organizational training requirements. One to two person training consultant shops may also be hired to address specific needs vice hiring a large corporate training organization (e.g., Andersen) which specialize in broad-based training activities.”</td>
</tr>
<tr>
<td>16</td>
<td>“I hope to see a greater reliance on internet based training that provides tangible (certification?) results. I also hope to see less reliance on costly remote location seminars (ex., for ONLY a mere $1995.00 you can send someone to San Francisco to attend a three day Windows NT training seminar – i.e., total bill &gt; $3500 including travel &amp; lodging with unknown results), and much less reliance on high-priced training consultants (of whom, I have very little nice to say).”</td>
</tr>
</tbody>
</table>
"It will probably minimize the need to have vendors send instructors to our site as training would be available anywhere the internet is accessible."

"The above answer can be represented in three categories. Artificial Intelligence (AI), Energy Sources and Biological Advances. I see AI and Biological Advances as having the most impact on training. With regard to AI, immersion and concentrated training may need not be as critical for a new employee because they will be able to rely upon an AI device to "assist" them and orient them. Therefore training periods will be shorter and thus an employee will be operational and contributing at a much earlier point after their date of hire. The ability of AI to learn about the person it is assisting could also be utilized for custom training. (Along the lines of customized curriculum, adaptive learning, etc.) With biological advances, as stated previously, it allows the retention of experience, and broadening of experience. Mentoring/teaching will play a significant role. Taking advantage of someone's life/job experiences will continue to be as important as it is today. Yet as life spans increase, these life/job experiences will be longer in duration and much more rich with knowledge. Training will need to deal with individuals who are loyal to the company but decide that after 30 years they desire a change to a new field of work. It is difficult to imagine what lies ahead, but it is most exciting... isn’t it? “
APPENDIX D

ROUND 2 CORRESPONDENCE AND SURVEY
Dear {Survey Participant Name},

Thank you so much for answering the first round of this study. I apologize for the delay... some of the participants have been a bit slow returning the initial survey. The attached second round should only take 10 minutes (or less). We have one more round to go after this one... basically, by Round Three, you'll see how the majority voted and to change your answer if you wish. Please take just a few minutes and return this part as soon as possible. I promise you it will not take long, and it will help me tremendously with meeting my early December deadline.

Thank you for your cooperation and assistance.

Respectfully,
Carolyn Tebault
ODU Graduate Student
Dear {Survey Participant Name}:

Thank you for recently completing Round 1 of my Delphi study on training technology workers for the new millennium. Your comments were very helpful to my research. It is now time to complete Round 2. Please take just a few moments to complete the enclosed survey and return it no later than November 23, 2000. The initial round required the most time (up to 20 – 25 minutes); the second and third rounds are Likert scale questionnaires and will require no more than 10 minutes to complete. Please circle the appropriate answer for each statement.

To refresh your memory, the intent of this study is to collect sufficient data to report generalized statements concerning the training of IT workers for the new millennium. Why are the results of this research study important to you? Keeping your employees current on new technologies will:

- Increase the productivity of your work group
- Uphold employee morale
- Promote a sense of personal accomplishment among your employees

By the final round of this survey, you will see how your training ideas match up with the training plans for technical employees of similar organizations, and this research information may even be able save you time when planning your next training program.

I want to reassure you that specific information about individual study participants and other personalized data will not be made available to the public. I have enclosed my electronic mail address for your convenience. Your cooperation in this matter is greatly appreciated.
Purpose: The intent of this survey is to report a group consensus of how information technology workers will be trained in the future.

Directions: Please rank the following ten statements concerning IT training on a scale of one to five, and return this survey no later than November 23, 2000. Your input is vital to this survey! All participant identities will be kept strictly confidential.

Rating Scale:
1 Strongly Disagree – Statement is not true
2 Mildly Disagree – Statement is probably not true
3 Neutral – Neither agree or disagree with statement
4 Agree – Statement is probably true
5 Strongly Agree – Statement is definitely true

1. The shortage of IT workers will gradually decrease as computers and related IT technology becomes more common in the home, education institutions and workplace.

2. Instructor-led training (as compared to computer-based training (CBT)) is the most effective training method at the present time.

3. Advances in network technology will gradually shift training activities on-line vice traditional training methods, such as classroom instruction and on-the-job training.
4. IT workers should acquire at least some of the required IT skills and knowledge utilizing personal time and resources (e.g., IT trade magazines and books; college courses; software applications; etc.)

5. Recent advances in on-line training technologies will reduce the amount of time required to adequately train IT workers.

6. Advances in software applications, such as artificial intelligence and “smart” agents (advanced software applications to include automated employee performance support programs), will reduce the depth of technical knowledge and skills required by the IT worker to perform the job.

7. IT skills and knowledge should be emphasized more strongly in high school level curriculum.

8. “On-the-job” IT training (peer-to-peer learning) will become less prevalent in the future.

9. There will be a gradual increase in the need for IT certification(s) to prove adequate technical skills and proficiency.

10. It is difficult to predict IT training needs beyond a three-to-five year time range.
IF YOUR ADDRESS INFORMATION HAS CHANGED, PLEASE UPDATE:

**Name** (e.g., J.L Smith) and or **Job Title** (e.g., XYZ Project Manager)

________________________________________________________________________

**Mailing Address:**

________________________________________________________________________

________________________________________________________________________
APPENDIX E

ROUND 2 INPUTS


<table>
<thead>
<tr>
<th>Survey ID</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
<th>Q6</th>
<th>Q7</th>
<th>Q8</th>
<th>Q9</th>
<th>Q10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>4</td>
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<td>4</td>
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<td>19</td>
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<td>3</td>
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</tr>
<tr>
<td>Total Sum</td>
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<td>29</td>
<td>28</td>
<td>23</td>
<td>19</td>
<td>30</td>
<td>14</td>
<td>25</td>
<td>31</td>
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<td>Group Mean</td>
<td>2.6</td>
<td>3.6</td>
<td>4.1</td>
<td>4.0</td>
<td>3.3</td>
<td>2.7</td>
<td>4.3</td>
<td>2.0</td>
<td>3.6</td>
<td>4.4</td>
</tr>
</tbody>
</table>

**NOTE:** Questions are identified by "Q#" (e.g., Q1 denotes Question #1)
APPENDIX F

ROUND 3 CORRESPONDENCE AND SURVEY
Dear {Survey Participant Name},

Thank you so much for answering the second round of this study. The Round 3 round should only take 10 minutes (or less), and you’ll be finished! Please take just a few minutes and return this part as soon as possible. I promise you it will not take long, and with your help, I’ll meet my December graduation date. After the holidays, I’ll send you a copy of my completed thesis.

Thank you for your cooperation and assistance.

Respectfully,

Carolyn Tebault
ODU Graduate Student
November 30, 2000

Dear {Survey Participant Name}:

Thank you for recently completing Round 2 of my Delphi study on training technology workers for the new millennium. It is now time to complete Round 3. Please take just a few moments to complete the enclosed survey and return it no later than December 5, 2000. I cannot proceed with the data analysis until the surveys have been returned from each participant, so please do not wait until the deadline if possible. Your answers are very important to the findings of this research.

The last round gives you the opportunity to change your answer in light of the overall ratings of the group. If your current and new rating is significantly different than that of the group, please add a few comments concerning your answer. This will help me with my research. Round 3 will require no more than 10 minutes to complete. Please circle the appropriate answer for each statement.

I want to reassure you that specific information about individual study participants and other personalized data will not be made available to the public. I have enclosed my electronic mail address and fax number for your convenience. Your cooperation in this matter is greatly appreciated.

Respectfully,
Carolyn L. Tebault
Technical Training Specialist
Virginia Beach, VA
Purpose: The intent of this survey is to report a group consensus of how information technology workers will be trained in the future.

Directions: Please rate the following ten statements again in light of the group and your response. If your new rating is greater than one integer away from the group mean, please include a brief explanation below the statement. Please return this survey no later than December 5, 2000. Your input is vital to this survey! All participant identities will be kept strictly confidential.

Rating Scale:
1. Strongly Disagree – Statement is not true
2. Mildly Disagree – Statement is probably not true
3. Neutral – Neither agree or disagree with statement
4. Agree – Statement is probably true
5. Strongly Agree – Statement is definitely true

1. The shortage of IT workers will gradually decrease as computers and related IT technology becomes more common in the home, education institutions and workplace.

Your Ranking = N                  Group Ranking (mean) = 2.6
2. Instructor-led training (as compared to computer-based training (CBT)) is the most effective training method at the present time.

Your Ranking = N  Group Ranking (mean) = 3.6

3. Advances in network technology will gradually shift training activities on-line vice traditional training methods, such as classroom instruction and on-the-job training.

Your Ranking = N  Group Ranking (mean) = 4.1

4. IT workers should acquire at least some of the required IT skills and knowledge utilizing personal time and resources (e.g., IT trade magazines and books; college courses; software applications; etc.)

Your Ranking = N  Group Ranking (mean) = 4.0

5. Recent advances in on-line training technologies will reduce the amount of time required to adequately train IT workers.

Your Ranking = N  Group Ranking (mean) = 3.3
6. Advances in software applications, such as artificial intelligence and “smart” agents (advanced software applications to include automated employee performance support programs), will reduce the depth of technical knowledge and skills required by the IT worker to perform the job.

Your Ranking = N  
Group Ranking (mean) = 2.7

7. IT skills and knowledge should be emphasized more strongly in high school level curriculum.

Your Ranking = N  
Group Ranking (mean) = 4.3

8. “On-the-job” IT training (peer-to-peer learning) will become less prevalent in the future.

Your Ranking = N  
Group Ranking (mean) = 2.0

9. There will be a gradual increase in the need for IT certification(s) to prove adequate technical skills and proficiency.

Your Ranking = N  
Group Ranking (mean) = 3.6
10. It is difficult to predict IT training needs beyond a three-to-five year time range.

Your Ranking = N

Group Ranking (mean) = 4.4

IF YOUR ADDRESS INFORMATION HAS CHANGED, PLEASE UPDATE:

Name (e.g., J.L Smith) and or Job Title (e.g., XYZ Project Manager)

Mailing Address:
APPENDIX G

ROUND 3 INPUTS
<table>
<thead>
<tr>
<th>Survey ID</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
<th>Q6</th>
<th>Q7</th>
<th>Q8</th>
<th>Q9</th>
<th>Q10</th>
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<td>23</td>
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<td>18</td>
<td>24</td>
<td>8</td>
<td>23</td>
<td>25</td>
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<tr>
<td>Group Mean (R 3)</td>
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<td>3.7</td>
<td>4.3</td>
<td>3.8</td>
<td>3.5</td>
<td>3.0</td>
<td>4.0</td>
<td>1.3</td>
<td>3.8</td>
<td>4.2</td>
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<tr>
<td>Group Mean (R 2)</td>
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<td>3.6</td>
<td>4.1</td>
<td>4.0</td>
<td>3.3</td>
<td>2.7</td>
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<td>2.0</td>
<td>3.6</td>
<td>4.4</td>
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<td>+0.1</td>
<td>+0.2</td>
<td>-0.2</td>
<td>+0.2</td>
<td>+0.3</td>
<td>-0.3</td>
<td>-0.7</td>
<td>+0.2</td>
<td>-0.2</td>
</tr>
</tbody>
</table>

**NOTE:** Questions are identified by "Q#" (e.g., Q1 denotes Question #1)
Rationales Supporting Divergent Views

1. The shortage of IT workers will gradually decrease as computers and related IT technology becomes more common in the home, education institutions and workplace.

   a. Greater than one integer above the Group Mean:

      | Survey Participant | Comment |
      |--------------------|---------|
      | 1                  | "I am totally in agreement with this statement. It is a fact! The more people use something they continue to become more comfortable with the product. Additionally, more people will go into this field because this is where the high paying jobs are going to be in the future." |
      | 11                 | "While I believe that there will still be a demand for IT workers, the nature of what is needed will change. The "super techies" who work at places like MicroSoft and actually develop the applications will be hard as ever to find, but normal users of computers will become more knowledgeable and the software will continue to become more user-friendly. This should reduce the need for a lot of computer support people that are in such high demand right now." |

   b. Within one integer above or below the Group Mean: No comments

   c. Greater than one integer below the Group Mean:

      | Survey Participant | Comment |
      |--------------------|---------|
      | 16                 | "I believe that there will almost always be a shortage of qualified IT workers." |
2. Instructor-led training (as compared to computer-based training (CBT)) is the most effective training method at the present time.
   a. Greater than one integer above the Group Mean: No comments
   b. Within one integer above or below the Group Mean: No comments
   c. Greater than one integer below the Group Mean: No comments

3. Advanced in network technology will gradually shift training activities on-line vice traditional training methods, such as classroom instruction and on-the-job training.
   a. Greater than one integer above the Group Mean: No comments
   b. Within one integer above or below the Group Mean: No comments
   c. Greater than one integer below the Group Mean: No comments

4. IT workers should acquire at least some of the required IT skills and knowledge utilizing personal time and resources (e.g., IT trade magazines and books; college courses; software applications, etc.)
   a. Greater than one integer above the Group Mean:
      
      | Survey Participant | Comment                                               |
      |--------------------|--------------------------------------------------------|
      | 11                 | “I believe that everyone should take at least some responsibility for his or her own professional development.” |
      
   b. Within one integer above or below the Group Mean: No comments
   c. Greater than one integer below the Group Mean: No comments
5. Recent advances in on-line training technologies will reduce the amount of time required to adequately train IT workers.

a. Greater than one integer above the Group Mean: **No comments**

b. Within one integer above or below the Group Mean: **No comments**

c. Greater than one integer below the Group Mean: **No comments**

6. Advances in software applications, such as artificial intelligence and “smart” agents (advanced software applications to include automated employee performance support programs), will reduce the depth of technical knowledge and skills required by the IT worker to perform the job.

a. Greater than one integer above the Group Mean:

<table>
<thead>
<tr>
<th>Survey Participant</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>“I believe that these ‘smart agents’ or AI technology would allow for the IT person to not necessarily need such depth of knowledge since they would have these agents at their disposal more readily. Now, that is not to say that the depth of knowledge is not required, or to say that it will <strong>drastically</strong> reduce the requirement, but it certainly will affect it, and therefore I ‘strongly agree’ – statement is definitely true.”</td>
</tr>
</tbody>
</table>

b. Within one integer above or below the Group Mean: **No comments**

c. Greater than one integer below the Group Mean: **No comments**
7. IT skills and knowledge should be emphasized more strongly in high school level curriculum.
   a. Greater than one integer above the Group Mean: No comments
   b. Within one integer above or below the Group Mean:
      
      | Survey Participant | Comment |
      |---------------------|---------|
      | 11                  | "Those skills are rapidly becoming absolutely necessary to function in our society." |
      
   c. Greater than one integer below the Group Mean:
      
      | Survey Participant | Comment |
      |---------------------|---------|
      | 16                  | "IT skills such as programming, networks and hardware are not appropriate at the High School level." |
      
8. "On-the-job" IT training (peer-to-peer learning) will become less prevalent in the future.
   a. Greater than one integer above the Group Mean: No comments
   b. Within one integer above or below the Group Mean: No comments
c. Greater than one integer below the Group Mean:

<table>
<thead>
<tr>
<th>Survey Participant</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>“I can’t imagine a workplace where some amount of ‘OJT’ doesn’t occur. At the very least, each company has it’s own procedures that have to be passed on to new employees.”</td>
</tr>
<tr>
<td>16</td>
<td>“I believe it will become more important.”</td>
</tr>
</tbody>
</table>

9. There will be a gradual increase in the need for IT certification(s) to prove adequate technical skills and proficiency.

a. Greater than one integer above the Group Mean:

<table>
<thead>
<tr>
<th>Survey Participant</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“There will always be a need for certifications. (i.e. I don’t think doctors and other professional groups are going to stop certifying personnel just because they have enough). This is a means to exist!”</td>
</tr>
<tr>
<td>16</td>
<td>“I believe that widely recognized “certification” programs will eventually equal, and then surpass traditional 2 &amp; 4 year degree programs in the IT arena.”</td>
</tr>
<tr>
<td>18</td>
<td>“IT Certification exams are loosely based on how well a student can apply the knowledge and be an asset to the organization. As demands for technology increase, businesses and organizations will become more familiar with the capabilities that the technology industry provides and will become more dependent on the need for certification.”</td>
</tr>
</tbody>
</table>
b. Within one integer above or below the Group Mean: No comments

c. Greater than one integer below the Group Mean: No comments

10. It is difficult to predict IT training needs beyond a three-to-five year time range.

a. Greater than one integer above the Group Mean: No comments

b. Within one integer above or below the Group Mean:

<table>
<thead>
<tr>
<th>Survey Participant</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>“In 3 to 5 years, the technology can be totally changed.”</td>
</tr>
</tbody>
</table>

c. Greater than one integer below the Group Mean: No comments