A GRADUATE EMPLOYMENT STUDY OF THE COMPUTER NETWORK SPECIALIST PROGRAM AT CHIPPEWA VALLEY TECHNICAL COLLEGE

By

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A Research Paper

Submitted in Partial Fulfillment of the
Requirements for the Degree of
Education Specialist
With a Major in

Industrial and Vocational Education

Approved: 6 Semester Credits

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ABSTRACT

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A Graduate Employment Study of the Computer Network Specialist Program at Chippewa Valley Technical College

Industrial & Vocational Education | Dr. Howard D. Lee | July/2002 | 204
(Graduate Major) | (Research Advisor) | (Month/Year) | (No. of Pages)

Publication Manual of the American Psychological Association, Fifth Edition
(Name of Style Manual Used in this Study)

The Computer Network Specialist (CNS) program at Chippewa Valley Technical College (CVTC) was launched in August 1999. CVTC is one of sixteen technical colleges in the Wisconsin Technical College System offering an associate degree-level computer networking program. CVTC's CNS program had experienced high enrollments during its first two years of existence. Consequently, a large number of trained networking professionals became available for employment within a relatively short time.

The main purposes of this study were to identify the degree of success that graduates of the CNS program at CVTC have had in securing program-related employment and to identify the types of duties graduates perform to fulfill their obligations in program-related jobs. To enable the creation of an employment opportunities profile for future CNS graduates, this research also discovered employer

names, job titles, salary information, and the degree to which CNS graduates have had to relocate to gain program-related employment. In addition, the research identified professional certifications that CNS graduates either currently hold or intend to obtain. Furthermore, this research determined what additional training needs CNS program graduates have, and if they would return to CVTC to receive that training.

The CNS department faculty agreed that a survey of CNS program graduates was an appropriate method of gathering the desired information. At the conclusion of a review of existing literature, a survey instrument was developed and pilot tested with the CNS faculty and the CNS advisory committee. A final survey instrument was developed utilizing the input from the pilot group. The survey was mailed during March 2002 to all 97 persons who had graduated from the CNS program between December 1999 and December 2001.

Slightly over half of responding graduates reported employment in jobs related to the CNS program at CVTC. Over 40% of respondents were earning salaries in the range of $30,000 to $40,000. They worked in many different industries; however, educational institutions employed the highest percentage of them. Most respondents were employed within the CVTC district and all reported employment within the upper mid-west region of the nation. The largest percentage of respondents worked under the job title of Computer Support Specialist, however, several other job titles were also identified.

The study revealed the duties that graduates were performing in program-related jobs. Respondents were performing duties in the areas of network operating systems/server components, network hardware configuration, network media, network

security and protection, client workstations, peripheral devices, help desk and troubleshooting, documentation, and computer usage. Duties related to client workstations and help desk and troubleshooting were performed at higher rates than those duties associated with the other classifications.

Cisco Certified Network Associate (CCNA) was the certification held most often, however, over 60% of respondents held no professional computer or networking related certifications. Sixty percent of respondents indicated an interest in testing for at least one professional certification in the near future.

The results of this research will help the CNS department maintain alignment with CVTC's mission statement by ensuring that the CNS program is serving the workforce needs of the information technology (IT) field. The information gathered will support the CNS department's continued efforts to maintain relevant curriculum offerings utilizing the latest networking technologies and aid the department's efforts to accurately assess student learning. The data gathered from program graduates will help support department requests for instructional hardware and software to facilitate industry-relevant training. Finally, the information gathered during this research will be used by CVTC counselors and faculty to better advise future CNS program students regarding employment options.

Acknowledgements

The completion of this research project and my graduate course work, in the midst of normal daily responsibilities, would not have been possible without the support and assistance of the following important people.

Dr. Howard Lee, research advisor and former program director, whose guidance and encouragement have been an enabling force in my academic pursuits.

Ms. Juli Taylor, program director, whose accomplishments and enthusiasm have been an inspiration to me.

Dr. John Burningham, associate professor, whose practical and flexible course delivery methods allowed me to complete career-relevant course work while I was teaching full-time.

The faculty and staff of the Computer Network Specialist Department at Chippewa Valley Technical College, who approved financial support for this study and shared their professional expertise in the development of the survey instrument.

Ms. Leesa Stack, Computer Network Specialist student, who asked me if I could use a work-study assistant. Your offer to help could not have come at a better time.

My wife, Kathleen, whose research skills helped me locate resource material for the literature review. Your love, support, and patience have always been a constant throughout my academic career.

Sam, my wonderful son, your interest in my study's progress has been an inspiration to me. Thank you for coming to check on me regularly while I was writing. Your visits enabled me to step back, refocus my thoughts, and renew my writing efforts.

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Chapter 1

Introduction

Background

"The rapid spread of computers and information technology has generated a need for highly trained workers to design and develop new hardware and software systems and to incorporate new technologies" (U.S. Department of Labor, 2000, p.109). One challenge associated with the increased use of computers in business is the need for different computer systems to communicate with each other. Primary goals of computer networking are to allow each user to share and retrieve information via a mainframe computer or a server for use on local workstation computers, send and receive electronic mail, conduct business transactions, and provide access to the Internet (U.S. Department of Labor, 2000).

Computer network specialists design, install, and maintain the interconnecting hardware systems that allow computers within an organization to communicate with each other or to communicate over the Internet to computer networks owned by other organizations. They also administer or control the level of access that system users have to various records and documents kept in network storage devices through the implementation of network operating system software.

Computer support specialists provide technical assistance, support, and advice to customers and users. These troubleshooters interpret problems and provide technical support for hardware, software, and systems. They answer phone calls, use automated diagnostic programs, and resolve recurrent problems. Support specialists may work

within an organization or directly for a computer or software vendor. Increasingly, these technical professionals work for help desk or support services firms, where they provide customer support on a contract basis to clients as more of this type of work is outsourced (U.S. Department of Labor, 2000).

The employment outlook for persons entering either of these fields is quite promising. According to 1998 statistics available in the *Occupational Outlook Handbook*, 1,046,000 people were employed in the computer networking and computer support occupations in the United States. These fields are expected to be among the fastest growing occupations through 2008. In 1998 the median annual salaries for network specialists (computer systems analysts) were $52,180. During the same year the median annual salaries for computer support specialists were $37,120.

Educational requirements for these occupations depend on the individual organization, specific job functions, and responsibilities. “A bachelor’s degree is a prerequisite for many jobs, however, some jobs may require only a two-year degree.” “Most community colleges … offer an associate degree in computer science or a related information technology (IT) field. Many of these programs may be more geared toward meeting the needs of local businesses and more occupation specific than those designed for a four-year degree. Computer support specialists, for example, usually need only an associate’s degree in a computer-related field, as well as significant hands on experience with computers” (U.S. Department of Labor, 2000, p.111).

In April, 1998, computer networking professionals from the Chippewa Valley Technical College (CVTC) district of west central Wisconsin were invited to a “Design A

Curriculum" (DACUM) meeting at CVTC's Clairemont campus in Eau Claire (DACUM: Computer and Network Hardware Technician, 1998). The aim of the DACUM was to ascertain the major competencies needed by computer network and computer support specialists in the Chippewa Valley. The identified competencies would then be used to create courses and curriculum for CVTC's new Computer Network Specialist (CNS) program. This two-day focus group activity involved several IT employers and employees. Their combined expertise provided the source of the new program's competency list. From that competency list, the CNS faculty developed the courses, curriculum, and scope and sequence of the program. It is worthwhile noting that many of the industry experts who participated in the DACUM became members of the advisory committee for the new program.

The CNS program at CVTC began with the fall semester of 1999. The program was offered at CVTC campuses in Eau Claire and River Falls. A program quota of 50 incoming students was originally established for the fall 1999 semester in Eau Claire. The program quota for River Falls was set at 20. Due to unexpected student demand, the Eau Claire quota was raised to 75 incoming students, and then raised again to 100 incoming students. Seventy-five new students were admitted in January 2000 to the Eau Claire offerings. The following year saw a repeat demand with 100 new fall enrollments and 75 new spring enrollments in Eau Claire and 20 new fall enrollments at River Falls.

The CNS program was launched as a cooperative effort between the Computer Information Systems and Electronics departments at CVTC. The Computer Information Systems faculty primarily teaches the core courses relating to computer software

programming, computer operating systems, and computer network operating system administration. The Electronics faculty teaches the core courses relating to basic electronics, computer hardware, and computer systems configuration and maintenance. Both departments' faculty teach a four-course series covering internetworking technologies and devices leading to the Cisco Certified Network Associate (CCNA) certification. This curriculum is provided through the Cisco Networking Academy Program. A general education component of math, communication skills, and sociology taught by the General Studies department rounds out the program.

The CNS program at CVTC is a 68-credit associate degree program that prepares individuals to design, install, maintain, manage, enhance, and troubleshoot the software and hardware components of computer networks. The program offered by CVTC has two tracks: Software and Hardware (Chippewa Valley Technical College Program Catalog 2000-2001, 1999).

The software track covers the following network operating systems: Windows NT, Novell NetWare, and Unix. Topics include managing system and client software, network security measures, user accounting, and monitoring event logs for problem resolution. Internet and Intranet administration is also covered. Program graduates are prepared to take one or more of the following certification exams: Certified NetWare Administrator (CNA) and Microsoft Certified Professional (MCP). Software track graduates are prepared to enter the following careers (examples): Network Specialist, Network Administrator, and PC Support Technician.

The hardware track emphasizes the installation, configuration, and troubleshooting of network hardware such as routers, switches, hubs, and network media. Students learn to configure and repair workstations, monitors, and printers. Through elective courses, students have the opportunity to learn to install, maintain, and troubleshoot voice, data, and video telecommunications equipment. Program graduates are prepared to take one or more of the following certification exams: A+, Cisco Certified Network Associate (CCNA), Network Cabling Specialist Certificate (NCSC), and Microsoft Certified Professional (MCP). Hardware track graduates are prepared to enter the following careers (examples): Network Specialist, Computer Repair Technician, and PC Support Technician (Chippewa Valley Technical College Program Catalog 2000-2001, 1999).

Both tracks are offered in Eau Claire in the aforementioned joint effort between the Computer Information Systems Department, located in the Clairemont campus of CVTC, and the Electronics Department, housed in the newly-built Manufacturing and Technology Center located in the Gateway Industrial Park on Eau Claire's northwest corner. Students commute the five miles between the two Eau Claire campuses to complete their course work. At this time only the software track of the program is offered at CVTC's River Falls campus.

Due to the unexpected demand for the new program, seven new faculty members were hired over the first year of the program's existence to help existing faculty teach the multiple sections of course offerings that were required for the higher-than-expected enrollment of students. To provide classroom and laboratory space for the program's

students, several Clairemont campus classrooms and laboratories vacated by the recent move of the electronics-based programs to the Manufacturing and Technology Center were remodeled and equipped to provide learning environments for the computer software and network administration courses. Additional furniture and equipment was purchased for the electronics laboratory at the Manufacturing and Technology Center to provide an appropriate environment for the computer hardware and Cisco Networking Academy Program courses. In River Falls, an empty, multi-purpose lab in the newly completed building was quickly furnished and equipped in time for the fall 1999 start of the program.

Statement of the Problem

The high level of student demand for the CNS program requires the program faculty to ensure that graduates are prepared to enter the IT workforce and that program-related employment opportunities exist. The broad problem that this study seeks to answer is two-fold: 1) Is the CNS program adequately preparing graduates for entry-level employment in the computer networking field, and 2) was CVTC correctly anticipating the industry need for computer network specialists when the program quota was raised to accommodate student demand for the program?

The CNS faculty members wish to evaluate the program to answer two fundamental questions:

1. To what extent are CNS program graduates finding employment related to the field of computer networking?

2. To what extent does the CNS program prepare graduates for entry-level computer networking jobs? (Bond, Boyd & Rapp, 1997).

Purpose of the Study

The main purposes of this study are to identify the degree of success that CNS graduates have had in securing program-related employment and the types of competencies they must possess to fulfill their duties in program-related jobs. This research will recommend enrollment quota and curriculum modifications to ensure that the CNS program is in alignment with the needs of the IT profession. To enable the creation of an employment opportunities profile for CNS graduates this research will also discover employer names, job titles, salary information, and the degree to which CNS graduates have had to relocate to gain program-related employment. CVTC counselors and faculty can use this information to better advise future CNS program students. In addition, the research will identify professional certifications that CNS graduates either currently hold or intend to obtain. Furthermore, this research will determine what additional training needs CNS program graduates have, and if they would return to CVTC to receive that training.

Research Questions

Outcomes.

1. What professional certifications do program graduates carry or plan to pursue three months to two years after graduation?
2. To what degree are program graduates employed in a job related to computer networking or computer maintenance?

3. Who are the employers hiring the program's graduates?
4. In what types of computer networking jobs are program graduates employed?
5. To what degree are program graduates finding employment within the Chippewa Valley Technical College district?
6. What is the salary range of program graduates after three months to two years in the work force? (CVTC Placement Report, 2000).

Needs.

1. To what degree do graduates perform the following job functions?
   A. Install, configure, or maintain major network operating systems.
   B. Install, troubleshoot, maintain, or repair various network components.
   C. Utilize various networking topologies, media, protocols and hardware.
   D. Troubleshoot client workstation computers.
   E. Install, troubleshoot, maintain, or repair various computer peripheral components.
   F. Create or maintain network documentation.
   G. Utilize computer application software.
2. Is there any additional education/training required for the position (CNS Program Outcomes, 2000)?

Justification for Research

This research is justified by the following reasons:

1. The program faculty members wish to measure the degree to which the CNS program meets the needs of the computer networking industry and the degree

of program-related employment graduates are finding. Currently, there is no single CNS department member assigned the responsibility to track whether or not the program objectives meet employers' needs. The college does conduct a six-month follow-up survey of all program graduates to gather basic employment data, however, that survey does not attempt to identify skills that graduates utilize in the performance of their jobs or any additional training that graduates are required to complete once they are employed.

2. It is anticipated that a survey instrument sent to graduates of the program, who have been in the work force for at least six months, will help to determine how well the program has met its primary goal of preparing people to work in the computer networking field. The DACUM conducted in 1999 set the educational goals for the program. Those goals, in turn, were used as the guiding influence for the development of program courses and competencies. It is time to measure how closely those competencies match the skills required in the computer networking industry.
3. The CNS program is relatively new. It has had high enrollments during its first two years. Has CVTC been accountable to the community if the college is enrolling and graduating individuals in the computer networking field when there may not be sufficient jobs available to graduates within the CVTC district? Saturation of the marketplace within the CVTC district with skilled individuals needs to be closely monitored. Saturation drives down salaries, breeds increased competition for available employment, and may cause

graduates' dissatisfaction with their educational choices.

4. All sixteen technical colleges in the Wisconsin Technical College System offer an associate degree-level computer networking program. Saturation of the marketplace within the state with skilled individuals also has the potential of driving down salaries and increasing employment competition within the field statewide.

Significance of the Study

This study is important to employers of CNS graduates, current and prospective students of the program, CVTC, and the Wisconsin Technical College System for the following reasons:

1. This study will help the CNS program continue to provide employers with a qualified, competent workforce.
2. Current and potential program students can be assured that the education they receive will prepare them for the job market.
3. This study will help CVTC continue to build its reputation for providing a skilled workforce for the community.
4. CNS faculty will be able to identify opportunities for professional development in a continuing effort to keep abreast of industry trends.
5. The colleges of the Wisconsin Technical College System can use the data gathered in this study to modify their programs.

Limitations of the Study

1. The population for the study is limited to graduates of the CNS program at CVTC. The population includes seven cohorts: December 1999, May 2000, August 2000, December 2000, May 2001, August 2001, and December 2001 graduates. Those persons who do not complete the educational program or who have not graduated from CVTC would not be participants in the study.
2. The study sample is limited to the 98 graduates of the CNS program.
3. The research will utilize a survey instrument that has been developed by the researcher. The presence of the human element indicates that the survey may contain errors, misinterpretations, misstatements, or omissions not intended by the researcher.
4. The research results are limited to the answers given by the respondents. Respondents' answers may be influenced by factors that are independent of this research and not disclosed to the researcher.
5. The research results are limited to the number of completed and returned surveys. It is unlikely that all graduates will respond to the survey. In some cases it may not be possible to obtain current mailing addresses for relocated graduates within the timeframe allotted for data collection.
6. This study does not intend to produce a competency-to-course correlation within the CNS program at CVTC. Upon completion of this research, the researcher will discuss recommendations for curriculum revision with the CNS faculty.

7. This research will not attempt to influence the CNS program's current assessment procedures.
8. The application of this research is intended only for the CNS program at CVTC (Hastings Taylor, 2001).

Definition of Terms

A+ - A CompTIA-sponsored testing program that certifies the competency of entry-level (six months experience) computer service technicians. (CompTIA, 2001).

Certified NetWare Administrator (CNA) - A certification for individuals who handle the day-to-day administration of an installed Novell networking product (Gocertify, 2001).

Cisco Certified Network Associate (CCNA) - A certification for individuals who install, configure, and operate simple routed and switched Local Area Networks and routed Wide Area Networks that utilize Cisco routers and switches (Gocertify, 2001).

Computer Repair Technician - Repairs computer hardware including monitors and printers. May also install and configure PC operating systems (Chippewa Valley Technical College Program Catalog 2000-2001, 1999).

Develop a Curriculum (DACUM) - A workshop approach to the identification of duties and tasks associated with a specific occupation or occupational cluster (O'Brien, 1989).

Duty – An act of course of action that is exacted of one by position, social custom, law, or religion. Function; work. (Morris, 1978)

Full-time Equivalent (FTE) - 1) A student who is carrying twelve semester

credits. 2) In the Wisconsin Technical College System, the total number of full-time equivalent students is calculated by dividing the total number of student-registered semester credits by twelve.

Hub - Hardware or software device that contains multiple independent but connected modules of network and internetwork equipment. Hubs can be active (where they repeat signals sent through them) or passive (where they do not repeat, but merely split, signals sent through them). The hub operates at the physical layer of the OSI model and serves as the center of a star-topology network. (Cisco Systems, Inc., 2001).

Information Technology (IT) - The broad subject concerned with all aspects of managing and processing information, especially within a large organization or company. Because computers are central to information management, computer departments within companies and universities are often called IT departments. Some companies refer to this department as IS (Information Services) or MIS (Management Information Services) (Webopedia, 2001).

Internet - A global network connecting millions of computers. As of 1999, the Internet has more than 200 million users worldwide, and that number is growing rapidly. More than 100 countries are linked into exchanges of data, news and opinions (Webopedia, 2001).

Intranet - A network based on Internet protocols belonging to an organization, usually a corporation, accessible only by the organization's members, employees, or others with authorization. An intranet's Web sites look and act just like any other Web

sites, but does not permit unauthorized access. Like the Internet itself, intranets are used to share information (Webopedia, 2001).

Local Area Network (LAN) - High-speed, low-error data network covering a relatively small geographic area (up to a few thousand meters). LANs connect workstations, peripherals, terminals, and other devices in a single building or other geographically limited area (Cisco Systems, Inc., 2001).

Media - Plural of medium. Various physical environments through which transmission signals pass. Common network media include twisted-pair, coaxial, and fiber-optic cable, and the atmosphere (through which microwave, laser, and infrared transmission occurs). Sometimes called physical media (Cisco Systems, Inc., 2001).

Microsoft Certified Professional (MCP) - A certification for individuals who would like to demonstrate their expertise with a particular Microsoft product. Microsoft Certified Professionals know about at least one Microsoft operating system, development tool, or desktop application (Microsoft, 2001).

Monitor - The most commonly used output device for displaying text and graphic output of a computer (Andrews, 2001).

Network - Collection of computers, printers, routers, switches, and other devices that are able to communicate with each other over some transmission medium (Cisco *Systems, Inc., 2001).*

Network+ - A vendor-neutral certification that measures the technical knowledge of networking professionals with 18 to 24 months of experience. Sponsored by CompTIA (Vaas, 2001).

Network Cabling Specialist Certificate (NCSC) - A certification for individuals who install, terminate, and test copper and fiber optic network cabling.

Network Administrator - Person responsible for the operation, maintenance, and management of a network (Cisco Systems, Inc., 2001).

Network Specialist - Also known as Network Operator. Person who routinely monitors and controls a network, performing such tasks as reviewing and responding to traps, monitoring throughput, configuring new circuits, and resolving problems (Cisco Systems, Inc., 2001).

Novell Netware - Popular distributed network operating system developed by Novell. Provides transparent remote file access and numerous other distributed network services (Cisco Systems, Inc., 2001).

PC Support Technician - Installs and maintains personal computers, both hardware and software. May provide user support and training. (Chippewa Valley Technical College Program Catalog 2000-2001, 1999).

Printer - A peripheral output device that produces printed output to paper. Different types include dot matrix, ink-jet, and laser printers (Andrews, 2001).

Router - Network layer device that uses one or more metrics to determine the optimal path along which network traffic should be forwarded. Routers forward packets from one network to another based on network layer information. Occasionally called a gateway (although this definition of gateway is becoming increasingly outdated) (Cisco Systems, Inc., 2001).

Switch - Network device that filters, forwards, and floods frames based on the destination address of each frame. The switch operates at the data link layer of the OSI model and serves as the center of a star-topology network. (Cisco Systems, Inc., 2001).

Telecommunications - Term referring to communications (usually involving computer systems) over the telephone network (Cisco Systems, Inc., 2001).

Unix - Operating system developed in 1969 at Bell Laboratories. Unix has gone through several iterations since its inception. These include Unix 4.3 BSD (Berkeley Standard Distribution), developed at the University of California at Berkeley, and Unix System V, Release 4.0, developed by AT&T (Cisco Systems, Inc., 2001).

Wide Area Network (WAN) - Data communications network that serves users across a broad geographic area and often uses transmission devices provided by common carriers (Cisco Systems, Inc., 2001).

Windows NT - A graphical computer operating system used for high-end personal computers on networks and to support applications used on the Internet (Andrews, 2001).

Workstation - A personal computer used by an employee or student.

Methodology

This quantitative research study will be conducted during the 2001-2002 academic year. Surveying is the technique that will be used to perform the research. The survey method will be a mailed questionnaire. This survey instrument will be developed and pilot tested during February 2002. The survey instrument will be sent to CNS program graduates in March 2002.

Chapter 2

Review of Literature

The main purposes of this study are to identify the degree of success that CNS graduates have had in securing program-related employment and to identify the types of duties they perform in program-related jobs. Research objectives include the creation of an employment opportunities profile for CNS graduates, such as, employer names, job titles, salary information, and the degree to which CNS graduates have had to relocate from the CVTC district to gain program-related employment; identify professional certifications that CNS graduates either currently hold or intend to obtain; determine what additional training needs CNS program graduates have, and if they would return to CVTC to receive that training.

In 1998 over one million people were employed in computer networking and computer support occupations in the United States. These fields are expected to be among the fastest growing occupations through 2008 (U.S. Department of Labor, 2000). Therefore, it is important for educational institutions to understand the direction in which the information technology profession is moving as we enter the 21st century so that information technology training programs meet the needs of the employers who hire information technology professionals. The following review of literature will review the information technology profession, current and future job related trends, responsibilities, competencies, professional certifications, and the impact of these areas on the information technology profession.

Background

"Information Technology is the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware. IT workers help to ensure that computers work well for people. Nearly every company, from a software design firm, to the biggest manufacturer, to the smallest 'mom & pop' store, needs IT workers to keep their business running smoothly" (Information Technology Association of America, no date).

The IT profession encompasses a wide range of job titles and associated duties. Job titles associated with the IT professions include computer scientist, computer engineer, systems analyst, computer programmer, database administration associate, information systems operator/analyst, network specialist, software engineer, and technical support representative.

The job titles used throughout the IT profession, as with most professions, do not define a specific, standardized set of skills and responsibilities. Overlapping responsibilities exist among the various titles. For example one organization may give the title computer support specialist to the individual responsible for the hardware maintenance of the organization's computers. Another organization may give the same title to someone who provides application software support. Similarly, professionals holding similar job titles, but working in different organizations may perform somewhat different duties dependent on the size of the organization, the size of the IT staff, and the range of responsibilities a particular organization associates with the job title. For example, in larger organizations, the network specialist may only be responsible for the

operation of the networking infrastructure – routers, switches, hubs, and cabling. Other members of the IT staff may be responsible for server administration and still others responsible for client workstation maintenance. However, in smaller organizations, one person with the title network specialist may be responsible for all of those areas.

This study will concentrate on identifying the duties, or job functions, for which the CNS program at CVTC prepares graduates and the job titles in which those duties are performed. Furthermore, duties associated with job titles commonly held by CNS graduates, but which are not currently part of the curriculum, will also be identified for the purpose of revising the program to bring it in line with the needs of employers.

Current Trends

Worker Shortage. The claim of a worker shortage in the IT industry depends on one's perspective. If an individual has skills that are not in demand in a particular locale, believing the claim of an IT worker shortage and a glut of job openings may be rather difficult. However, if that same individual were willing to relocate to where her skills are needed and jobs abound, the claim becomes more easily believed (Computing Research Association, 1999). Scannell (1999) reported that approximately 400,000 IT jobs in the United States were unfilled and that number was projected to increase by 25% each year. He stated that sectors particularly hard hit by the worker shortage or by expanded need included the "…financial, banking, utility, and insurance…" industries. He went on to report that part of the shortage, reaching fifteen percent in 1999, could be attributed to staff turnover. Companies have had to increase compensation to keep experienced IT

staffers on the payroll, who may be otherwise lured to competitors offering higher salaries and signing bonuses.

Societal and economic fluctuations have had an influence on employment trends in many sectors of the workforce and the IT profession is no exception. In the several months preceding the eve of January 1, 2000, the demand for computer programmers to fix the Y2K problem served as a boon for IT professionals holding the appropriate skills (Computing Research Association, 1999). In the last decade the growth in the number of businesses installing networking infrastructures and adding to the number of computers used by employees has created a demand for IT professionals with networking or computer maintenance skills.

Image. Often IT professionals are seen in unflattering representations. They are looked upon as "…geeky-nerdy individuals who wear bow ties, glasses, pocket protectors, pants that are too short and lab coats and who are typically bald males who are passive geniuses and work alone with their computers" (National IT Workforce Convocation, no date). Even ads for IT workers have used terms like nerd and pictures of individuals with taped glasses. Not exactly the image that attracts young people into the IT professions or encourages adults to seek training to prepare them for new roles at work.

Education and Training Programs. "Different kinds of jobs within the IT field require very different skill sets and levels of knowledge, and thus different IT jobs vary greatly in the kind and level of education they require" (Computing Research Association, 1999). Formal programs leading to associate's, bachelor's, master's and

doctoral degrees in IT-related fields all have their place in the supply system. An associate degree will train a person for certain kinds of entry-level positions that may involve maintaining or tending information technologies. A doctorate might prepare a person to create new aspects of information technology. There are no hard and fast relationships, however, between the degree program and the level of responsibility an IT worker may have. According to 1995 statistics reported by the Computer Research Association (1999) there were 727 two-year colleges and 1,068 four-year colleges offering programs in computer and information science across the United States. For the same year there were 339 master's and 119 doctoral computer science programs.

Degree-bound programs are not the only avenues of training for the IT professions. Even among post-secondary institutions, …less than one-third of those enrolled are traditional full-time students" (Computing Research Association, 1999). "Non-degree programs take many forms: certificate and enrichment courses taught by colleges and universities at every level; training provided by private educators, ranging from individual consultants to large commercial educational firms; training associated with specific IT products; businesses that train their own workforce; and courses offered via distance education" (Computing Research Association, 1999).

Job Titles and Descriptions

The Dictionary of Occupational Titles (1991) defines computer-related occupations as those concerned with the application of computers and computer languages and the utilization of the computer in the design and solution of business, scientific, engineering and other technical problems.

There are many job titles related to the computing/information technology career field. The Computing Research Association (1999) has categorized IT jobs as follows: Conceptualizers, Developers, Modifiers/Extenders, and Supporters/Tenders. The job categories and titles are classified by what the workers do on the job rather than by what they are called.

Conceptualizers - those who conceive of and sketch out the basic nature of a computer system artifact:

Entrepreneur

Product designer

Research engineer

Systems analyst

Computer science researcher

Requirements analyst

System architect

Developers – those who work on specifying, designing, constructing, and testing an information technology artifact:

System designer

Programmer

Software engineer

Tester

Computer engineer

Chip designer

Modifiers/Extenders – those who modify or add on to an information technology artifact:

Maintenance programmer

Programmer

Software engineer

Computer engineer

Database administrator

Supporters/Tenders – Those who deliver, install, operate, maintain, or repair and information technology artifact:

System consultant

Customer support specialist

Help desk specialist

Hardware maintenance specialist

Network installer

Network administrator

It is the last category, Supporters/Tenders, that contains the job titles that are of most interest to this study as they identify the types of jobs most often associated with graduates of two-year associate degree technical programs (Computing Research Association, 1999; Wisconsin Technical College System, 2001).

The following job titles and descriptions relating to careers in computer support and computer networking are a result of the literature review and will provide a foundation for this study. Job titles associated with upper management responsibilities or

those clearly requiring a minimum four-year post secondary education have not been included. Similarly, job titles associated with computer programming or Web development have not been included. The intent is to provide information pertaining to the types of jobs that relate to the competencies taught in the CNS program at CVTC. Similar job titles and descriptions have been combined.

The United States Department of Labor (2000) and The United States Bureau of Labor Statistics (2001) identify three job titles that fall within the category of Supporters/Tenders. The job titles listed below are defined by the Standard Occupational Classification (SOC) and are actually a distillation of common job titles (Computing Research Association, 1999). The SOC is used by all Federal statistical agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. These job titles will be used later in the literature review for the purpose of reporting salary and employment information.

Computer Support Specialists provide technical assistance to computer users. They troubleshoot computer hardware and software and related systems including printers, scanners, and monitors. They usually troubleshoot computers to the board or system level. They replace defective video cards, hard drives, network cards, and other computer subsystems rather than repair them to the component level. They answer client's concerning the use of computer hardware and software including printing, word processing, programming, electronic mail, and operating systems. They provide technical assistance to end users either in person or via the telephone.

Network Systems and Data Communication Analysts analyze, design, test, and evaluate network systems, such as LANs, WANs, Internet, intranet, and other data communications systems. They perform network modeling, analysis, and planning. They research and recommend network and data communication hardware and software. They may supervise computer programmers. This classification includes telecommunication specialists who deal with the interfacing of computer and communications equipment.

Network and Computer Systems Administrators design, install, and support an organization's LAN and WAN segments. They maintain the organization's Internet and intranet connectivity. They install and maintain the hardware and software systems of the network, analyze problems, and monitor network usage. Administrators may also plan, coordinate, and implement network security measures and supervise other network support and client server specialists.

Several of the duties and responsibilities associated with any one of the IT job titles may also be associated with or overlap into other job titles. Like many professions, there is no clear-cut definition of duties that can be associated with just one job title. The description of a particular job may be defined differently by each of several employers. The size of the organization to be served by IT professionals has much to do with the scope of their job responsibilities. For example, "larger companies often hire several network specialists, each of whom performs a different function. In smaller companies one or two people do everything relating to network administration and maintenance"

(The Computer Museum, 1998, p.1). Local, state, and national government agencies are often very specific regarding the duties of network specialists. Network specialists may be categorized into levels (Trainee, Level One, Level Two, etc.) by their experience and education. The associated responsibility and therefore the level of pay are commensurate with each level. Higher classification levels usually include supervisory duties in addition to the technical duties (Maryland Department of Budget and Management, 2001). The following job titles and descriptions are included in the literature review to illustrate the specificity certain organizations place on networking job titles and the overlap of duties among similar job titles.

Computer Operations Technician III (government agency classification) investigate and correct system malfunctions including telecommunications; install and troubleshoot local/remote terminal subsystems and related equipment; setup and install network equipment for LANs and WANs; setup, install and configure desktop workstations and peripheral equipment for customer departments; troubleshoot hardware errors; utilize network management software to troubleshoot network problems; staff departmental Help Desk which provides technical support to customer departments for hardware and software problems on all platforms; and orient or assist new or less experienced technicians and equipment users (County of Santa Cruz, CA, 2001).

Computer Operations Technician IV (government agency classification) are team leaders; research and correct the more complex system and auxiliary equipment malfunctions; oversee the operation of their section; and train new or

less experienced technicians and equipment users (County of Santa Cruz, CA, 2001).

Computer/Network Analysts provide technical support to the operations of a mainframe computer and network, analyze and resolve computer and network operational problems, and write computer and network operating manuals (Computer/Network Analyst, 1997).

Computer Network Specialist, Lead (government agency classification) assigns, reviews and approves the work of computer network specialists, trains computer network specialists, provides guidance in the resolution of network planning, integrating, and troubleshooting, consults with users to determine software and hardware needs, designs the structure of LAN and WAN segments, installs operating system and network communications software, prepares and assembles technical documentation, monitors network performance, diagnoses network hardware and software problems, and provides for network data backup (Maryland Department of Budget and Management, 1998)

Information Technician Managers transport equipment and software to user work sites; install and replace computers and related devices; provide information and basic training; identify technical training needs of staff; identify, isolate, and resolve operational problems related to user hardware and software; act as a liaison among users, vendors, and staff to resolve hardware and software problems; research and recommend viable system alternatives, products, and services for user configurations; research and maintain a working knowledge of a

variety of telecommunications and/or networking, information processing, and computer hardware, software, and procedures; and evaluate, test, and assist in maintaining, diagnosing and troubleshooting computer software, hardware, and operating systems (Community Housing Services, 2001).

Network Security Specialists regulate access to various computer files, monitor file use to assure that only appropriate users are gaining access, administer user passwords, maintain and ensure the confidentiality of employee information, backup files to guarantee their safety in the event of network server failure (The Computer Museum, 1998).

Network Specialists plan for and install the hardware and software that comprise the network, manage the network server, maintain printers and other peripheral devices, set up user accounts, train staff to use the network, troubleshoot network problems, and answer user questions (The Computer Museum, 1998).

Network Specialist III (government agency classification) performs advanced work overseeing activities associated with a LAN or WAN. Work involves network design and installation, policy development, training, monitoring, and analysis of existing hardware and software, and evaluation of potential network enhancements. May train or supervise network personnel. (State of Texas Human Resource Management, 1999).

Network Specialist V (government agency classification) performs highly advanced or supervisory work overseeing activities associated with a LAN or

> WAN and management functions in the selection and integration of system components for data telecommunications networks. Work involves project planning, designing, and integrating telecommunications networks, network design and installation, policy development, training, monitoring, and analysis of existing hardware and software, and evaluation of potential network enhancements. May train or supervise network personnel. (State of Texas Human Resource Management, 1999).

Salary and Employment Statistics

Salaries and employment opportunities for those individuals working in the IT career field are affected by the same factors that control salaries for most professions: locale, organization size, available workforce, and level of job responsibility.

The following salary and employment statistics were gathered in a 2000 study conducted by the United States Bureau of Labor Statistics (Bureau of Labor Statistics, 2001). The job titles are those used by the United States Department of Labor utilizing the Standard Occupational Classification (SOC) System. The job titles computer support specialist, network and computer systems administrator, and network systems and data communication analyst are used below for the purpose of salary and employment reporting. These titles have been used in the previous section of this chapter for the purpose of describing the jobs. Other job titles, previously described, but not listed below, relate to similar professions. It will be assumed that the following salary and employment statistics relate to the aggregate of similarly titled jobs. All annual salaries are calculated based on a 40-hour work week. Salary ranges are based between the 10%

percentile and the 90% percentile of salaries reported. The lowest and highest 10% of salaries reported were excluded to avoid skewing of the mean and median salaries by abnormally low or high salaries.

National Statistics

The United States national salary and employment estimates reported in Table 1, 2000 National Statistics, were calculated by the Bureau of Labor Statistics using data collected from employers in all industry divisions in metropolitan and non-metropolitan areas in every state and the District of Columbia. The salary range is quite wide for employees in each of the three jobs. The widest range is for the job of computer support specialist. The highest salary is nearly three times higher than the lowest salary in the range. The wide range in salaries is a result of job location. Employers in large cities tend to pay higher salaries than those in smaller communities. The widest variation between the mean and median salary values for the listed jobs is within $3,500. This indicates that there is a fairly equal distribution of the number of salaries greater than and less than the average salary. The final column of Table 1 indicates how many individuals were employed in the United States in each job. The highest salaries were reported for the job network systems and data communications analyst. This same job also had the lowest employment rate.

Table 1

2000 National Statistics

Job Title	Salary Range	Percentile	Median Annual Salary	Mean Annual Salary	Employment Rate
Computer Support Specialist	$21,260-63,480	10-90%	$36,460	$39,680	522,570
Network & Computer Systems Administrator	$32,450-81,150	10-90%	$51,280	$53,690	234,040
Network Systems & Data Communication Analyst	$33,360-88,620	10-90%	$54,510	$57,890	119,220

State Statistics

Salary information for the State of Wisconsin and the border states of Michigan, Minnesota, Illinois, and Iowa are reported in Table 2, 2000 State Statistics. The State of Wisconsin and its bordering states, especially Minnesota and Illinois, are of special interest because of the number of graduates from other CVTC programs who have found employment within this region (Chippewa Valley Technical College Placement Report, 2000). Salary ranges were not available from the Bureau of Labor Statistics report. Only median and mean wage information was available. Within the regional group, the State of Illinois ranked first in both salaries paid and individuals employed in the three jobs listed. Iowa ranked fifth in salaries paid and individuals employed in all cases except in salaries paid to network systems and data communications analysts where it ranked fourth. Wisconsin ranked third in salaries for computer support specialists, fourth in salaries for

network and computer systems administrators, and fifth in salaries for network systems and data communication analysts. Wisconsin ranked fourth in rate of employment for all three jobs.

Table 2

2000 State Statistics

Job Title	State	Median Annual Salary	Mean Annual Salary	Employment Rate
Computer Support Specialist				
	Michigan	$38,690	$40,110	13,350
	Minnesota	$37,360	$38,880	12,250
	Illinois	$38,970	$40,750	21,810
	Iowa	$34,360	$36,940	3,730
	Wisconsin	$38,540	$39,650	9,020
Network and Computer Systems Administrator				
	Michigan	$49,460	$50,440	6,800
	Minnesota	$50,440	$52,120	5,560
	Illinois	$53,500	$56,250	10,430
	Iowa	$42,600	$44,790	1,610
	Wisconsin	$46,280	$47,810	3,900
Network Systems and Data Communication Analyst				
	Michigan	$51,750	$53,910	2,710
	Minnesota	$52,370	$54,550	3,850
	Illinois	$54,140	$56,880	4,350
	Iowa	$52,400	$53,540	880
	Wisconsin	$44,140	$46,640	2,220

Metropolitan Area Statistics

The Eau Claire, Wisconsin and Minneapolis-St. Paul, Minnesota metropolitan areas, for which the Bureau of Labor Statistics (2001) provides information, are of interest to this study. The Eau Claire, Wisconsin area is of particular interest because of CVTC's major presence in that community. The CNS program is offered by CVTC in

Eau Claire and River Falls, Wisconsin; however, there are no metropolitan statistics available from the Bureau of Labor Statistics for any CVTC district community except Eau Claire. The Minneapolis-St. Paul, Minnesota metropolitan area is also of special interest because it is the closest major city to the CVTC district. Several past CVTC graduates have secured employment in the Minneapolis-St. Paul area (Chippewa Valley Technical College Placement Report, 2000). Table 3, 2000 Eau Claire-Minneapolis-St. Paul Metropolitan Area Statistics, summarizes the salary and employment statistics for the two metropolitan areas of interest. There is reasonable disparity between the salaries earned by computer support specialists and network systems and data communications analysts in each of the two metropolitan areas. However, there is a large gap between the salaries earned in each area by network and computer systems administrators. The rate of employment for computer support specialists is much higher in the larger Minneapolis-St. Paul area than it is in the Eau Claire metropolitan area. Employment statistics for the other two jobs was not released due to a high relative standard error in the employment data that was gathered.

Table 3

2000 Eau Claire-Minneapolis-St. Paul Metropolitan Area Statistics

Job Title	City	Median Annual Salary	Mean Annual Salary	Employment Rate
Computer Support Specialist				
	Eau Claire	$33,450	$37,070	300
	Minneapolis/ St. Paul	$38,810	$40,170	10,080
Network and Computer Systems Administrator				
	Eau Claire	$21,320	$26,340	-- (*)
	Minneapolis/ St. Paul	$51,590	$53,200	4,710
Network Systems and Data Communication Analyst				
	Eau Claire	$50,860	$49,780	-- (*)
	Minneapolis/ St. Paul	$53,930	$56,080	3,250

(*) Not released due to high a relative standard error.

West Central Region of Wisconsin Statistics

Employment information for the West Central Region of Wisconsin is available from the Wisconsin Department of Workforce Development (2001). The West Central Region is of particular importance to this study because it includes most of the CVTC district. Counties included in the West Central Region are Barron, Chippewa, Clark, Dunn, Eau Claire, Pepin, Pierce, Polk, and St. Croix. The statistics reported in Table 4, 2000 West Central Region of Wisconsin Statistics, reflect the results of the 1998 employment study conducted by the Department of Workforce Development. The report from the Wisconsin Department of Workforce Development did not contain occupation titles similar to network and computer systems administrators or network systems and

data communications analysts. Salary and employment data is available only for the job title computer support specialist.

Table 4

2000 West Central Region of Wisconsin Statistics

Job Title	Annual Salary Range	Median Annual Salary	Mean Annual Salary	Employment Rate
Computer Support Specialist	$24,170-39,710	$41,200	$32,390	620
Network & Computer Systems Administrators*				
Network Systems & Data Communication Analyst*				

(*) No similar occupational title listed.

Mean and median salaries earned by computer support specialists in the State of Wisconsin were very close to the national mean and median salaries for that same job. Wisconsin employees in the other two job areas ranked far behind the national averages. A comparison between salaries earned by workers in the Eau Claire metropolitan area and by workers nationwide shows that the salaries earned in the Eau Claire area are also lower than the national averages.

Education/Training

An effective IT worker needs a variety of skills, including technical knowledge about information technology, business knowledge and experience, and organizational and communication skills (Computing Research Association, 1999). A bachelor's degree is a prerequisite for many IT jobs; however, some jobs require only a two-year degree

(United States Department of Labor, 2000). Related work experience is also a benefit for those seeking IT jobs. Often work experience can be obtained through internships while the individual is attending college.

Two-year technical programs resulting in an associate degree prepare students for various kinds of IT work within the category of Supporters/Tenders such as network installation, Web development, or computer services. While graduates of two-year IT programs tend to be better prepared to immediately begin performing a job in the specific areas in which they were trained, they are less well prepared to transfer into other IT areas or into management positions without further education culminating, at minimum, in a bachelor's degree (Computing Research Association, 1999).

According to the Computing Research Association (1999) approximately one-third of the over 2000 two-year colleges nationwide offer programs in information technology. In Wisconsin, all sixteen of the two-year technical colleges offer an associate degree in at least one career field associated with information technology (Wisconsin Technical College System, 2001).

Wisconsin Technical College IT-related program offerings include:

Microcomputer Applications Software Specialist (one college)

Microcomputer Programmer Specialist (two colleges)

Microcomputer Specialist (ten colleges)

Microcomputer Technician (one college)

Network Communications Specialist (one college)

Network Specialist (fifteen colleges)

Programmer/Analyst (fourteen colleges)

Technical Support Specialist (one college)

Web Analyst/Programmer (one college)

User Support and Training Specialist (one college)

Web Development & Design Specialist (one college)

The listing indicates that the most common programs are Microcomputer Specialist, Network Specialist, and Programmer/Analyst. The other, less-common programs have unique titles which indicate either a specialty area or an area that is closely related to the more common program titles (i.e. Microcomputer Specialist and Microcomputer Technician).

The focus of this study is related to the Computer Network Specialist Program offered at Chippewa Valley Technical College and the IT jobs for which it prepares graduates, namely Computer Support Specialists, Network and Computer Systems Administrators, and Network Systems and Data Communication Analysts, as classified by the SOC. Therefore, the content of the programs Network Specialist and Microcomputer Specialist are pertinent to this study. Although CVTC does not offer a Microcomputer Specialist program, its Computer Network Specialist program does include separate hardware and software tracks that allow students to specialize in either computer and network hardware or network software (operating systems) or both, if students desire a double major.

Wisconsin technical colleges that offer either a Microcomputer Specialist degree or Network Specialist degree require students to complete coursework in the following areas (Wisconsin Technical College System, 2001):

Computer application software

Computer operating system software

Computer hardware systems and peripherals

Network infrastructure (cabling)

Network devices

Network operating system software

Introductory level computer programming

Data Acquisition

Telecommunication standards and technologies

Math

Written and oral communications

Psychology

Sociology

Economics

The IT industry needs qualified workers to fill any one of numerous job positions. The education that students receive must be relevant to the demands of the current job market. Educational institutions must review and update their course offerings and course content to keep up with changing technologies. Making sure that the skills students learn match those skills demanded by the jobs targeted by the educational programs will help

maintain a quality IT workforce (Task Force on Higher Education/Industry Responsiveness, no date). One of the goals of this study is determine the duties that CVTC's CNS graduates perform on the job. The results will then be used to recommend program and course content revisions to keep the program in line with industry needs (Skill Upgrading Task Force, no date).

Competencies

In April, 1998, computer networking professionals from the Chippewa Valley Technical College (CVTC) district of west central Wisconsin were invited to a "Design A Curriculum" (DACUM) meeting at CVTC's Clairemont campus in Eau Claire (DACUM: Computer and Network Hardware Technician, 1998). The aim of the DACUM was to ascertain the major competencies needed by computer network and computer support specialists in the Chippewa Valley. The identified competencies would then be used to create courses and curriculum for CVTC's new Computer Network Specialist (CNS) program. The competencies identified as a result of that DACUM are listed below.

Set up workstations/server

Install the peripherals

Install operating system

Install the applications

Set up users

Manage user passwords

Install local area network (LAN)

Install cable

- Terminate cable
- Test cable
- Label cable
- Set up hubs, switches, and routers
- Install network interface card
- Install network driver

Maintain network and attached devices

- Review log files
- Back up data
- Adjust network security
- Document network security
- Manage printing services
- Manage devices
- Monitor network
- Customize hardware and software
- Implement software update
- Modify network documentation
- Review licenses
- Review software updates
- Schedule software updates
- Maintain spare parts

Test network hardware and software

- Run diagnostics
- Test components
- Test backup plans (devices)
- Ascertain benchmarks
- Document test results
- Compare component function with standard
- Test security
- Simulate network performance

Manage the process

- Contact customer/vendor
- Prioritize tasks
- Respond to emergencies
- Monitor subcontractor work
- Train end users

Install wide area network (WAN)

- Set up routers and/or switches
- Terminate carrier
- Test transport
- Test data transfer
- Install network security

Maintain currency in industry trends

- Read journals

- Attend seminars
- Search the Internet

Design network LAN and/or WAN

- Determine needs via direct observation and/or questioning
- Research the job
- Determine performance and capacity requirements
- Evaluate existing hardware for compatibility
- Evaluate physical plant for hardware placement
- Specify standards
- Research the products
- Design network security
- Select hubs, switches, and routers
- Select carrier transport
- Select workstations
- Select servers

Troubleshoot devices

- Isolate problem
- Reproduce problem
- Replace failed part
- Repair failed part
- Retest part
- Monitor device/system

Certifications

Professional certifications from equipment manufacturers, software development companies, technical book publishers, and professional organizations proliferate the IT field. Companies such as Cisco Systems, Microsoft, Novell, Lotus, and Oracle offer certifications geared toward their products and the technologies they use. Publishing/training companies like Global Knowledge offer certifications based on the technologies covered in their books and training sessions. Organizations such as CompTIA offer non-manufacture-specific computer hardware and networking technical certifications (Global Knowledge Course Catalog, 2001-2002).

The certification aspect of the IT industry is big business. Manufacturers reap financial rewards based on the revenue generated from the certification exams that are based on the products they sell. Manufacturers also offer multiple levels of certification based on education and experience level. Of course, each level requires another exam and exam fee. Many manufacturers require certified individuals to periodically retest to maintain their certifications by taking another exam every few years or when the company releases a new product or product revision (Cisco Systems, Inc., 2001, Microsoft, Corp, 2001). Certification exam providers such as Prometric and VUE are in the business of providing testing locations where interested individuals can take IT certification exams in a secure environment (Cisco Systems, 2001). Global Knowledge (2001-2002) is one company that specializes in “boot camps” or compressed training scenarios to prepare candidates for the certification exam they desire. These boot camps don’t come without a high price tag. A five-day boot camp to prepare for the CompTIA

A+ certification will cost the candidate $2,995. On the bright side, the cost of the exam is included in the price and if the candidate fails the exam, he will be given a free retake of the course and exam.

The IT industry has mixed views on the validity and necessity of the various professional certifications. The viewpoint varies as the perspective of the commentator. "James Kotwicki has an A+ … and a Network + certification. [He believes his certifications] say 'This person's committed to going out and doing everything required to get certified: reading books, studying, taking practice tests, taking the time out of our life to do that … I know what it takes to take tests. They may not be the hardest in the world, but it's definitely something you need to devote time to'". In an opposing view, "Steve Farr…thinks Kotwicki's certifications are, basically fluff. 'A+ is very easy to obtain,' Farr said. 'I don't think that's very respected. Neither is Network+'" (Vaas, 2001).

Certifications may prove that an individual has a certain skill level, but they will not necessarily guarantee employment. Hsin Feng was a network administrator for Porter Novelli International, a public relations company in San Jose, CA until his recent lay-off. Despite the fact he holds the Microsoft Certified Systems Engineer certification, he doesn't feel it will help him find new employment. "'I have an MCSE. So what?' Feng said. 'There's so many out there, anyway'" (Vaas, 2001).

Even the advisory committee members for CVTC's CNS program have mixed feelings about certifications. During the fall meeting (November 7, 2001) all members present agreed that an IT professional's work experience and educational background

were far more important as indicators of qualification than a certification. But, they also all agreed that in lieu of work experience, as would be the case for most graduates of the program, that at least one vendor certification may help graduates secure their first IT job.

Professional certifications that Computer Network Specialist programs in the Wisconsin Technical College System prepare students for include:

A+

Certified Novell Administrator

Cisco Certified Networking Associate

Microsoft Certified Professional

Network+

Network Cabling Specialist Certificate

(Chippewa Valley Technical College Program Catalog 2000-2001, 1999, Madison Area Technical College Program Catalog, 2001, Nicolet Area Technical College Program Catalog, 2001).

Future Trends

Some of the factors affecting the future of IT jobs are the same factors that affect the future lifestyles and business styles of most Americans. Advances in technology provide society with new opportunities for employment, increased productivity at work, efficiency in managing time, and more enjoyment from leisure time activities. Business deals and financial transactions can be conducted quickly and easily over the Internet from the comfort of offices and homes. The need to travel for business meetings, training seminars, or classes has been decreased by the advent of video conferencing and on-line

education. Historical events and societal changes have an impact on the IT professions as well as on the population at large. Sometimes these changes are not positive. The terrorist attacks on September 11, 2001 not only created a cautionary tone among the people of the United States, but also put IT professionals on alert to be on the defensive against possible attacks on the communications technology that ties our country together (Harreld and Fonseca, 2001).

Employment Outlook

The future of the IT profession looks bright. The employment of computing professionals is expected to grow much faster than average due to increased technological sophistication and the movement of organizations to adopt and integrate new technologies into the workplace. The growth of employment possibilities for IT professionals will vary by occupation, but is anticipated to be very strong for those in occupations related to computer networking and computer support. The employment of computer support technicians and network analysts is expected to rank among the fastest growing occupations through 2008 (U.S. Department of Labor, 2000). In a report from the Office of Technology Policy (1998) projections from the United States Bureau of Labor Statistics were cited which indicate that between 1996 and 2006, the United States will require more than 1.3 million new IT workers in the three core occupational classifications of computer scientists and engineers, systems analysts, and computer programmers to fill newly created jobs (1,134,000) and to replace workers who are leaving these fields (244,000) as a result of retirement, change of professions, or other reasons.

Ranked second and third among the fastest growing occupations for the period of 1998 to 2008 are the occupations computer support specialist and systems (network) analyst. The occupation of computer support specialist is projected to grow from 429,000 positions to 869,000 positions – an increase of 102 percent. The projected growth of systems (network) analyst jobs will be 94 percent – from 617,000 positions to 1,194,000 positions (Bureau of Labor Statistics, 2001).

Federal, state, and local government agencies may not immediately come to mind as employers of IT professionals and history has shown that often government bureaucracies are reluctant to embrace new technologies. However, … "governments are facing enormous pressure to exploit the Internet to improve customer service and cut administrative overhead. …The average organization spends about 5.5 percent of revenue on IT, but governments spend 9 percent of the overall operating budget on IT. On top of that, governments are forecasting more aggressive IT spending growth for 2002 than are most industries" (Gomolski, 2001).

Emerging Technologies

Technological advances change the way people work, play, and live. As new technologies for doing business over network connections evolve, network technicians will need to keep abreast of the changes so that they can provide their employers with sound advice and excellent technical support. Following is sampling of the emerging technologies and employment opportunities that future networking and computer support technicians need to be prepared to handle.

Operating systems. It seems that operating system and application software vendors release new versions of their products at an almost annual rate. In 2000 Microsoft released Windows ME for home users and Windows 2000 for professional users. On October 25, 2001 Microsoft released its latest operating system, Windows XP, in both home and professional versions. (Connolly, 2001). Not to be outdone, Novell also rolled out its latest network operating system, NetWare 6, in September 2001 (Moore, 2001). Software upgrades to match new user requirements and greater hardware capabilities will continue to push IT support personnel to learn how to configure the software for maximum benefit. Likewise, educators will need to keep abreast of the latest software releases to make sure their curriculum and the skill of their programs' graduates meets industry needs.

Testing and analysis tools. Along with the future evolution of application software requiring faster data transfers to remain useful to network users, networking devices providing faster data speeds will be implemented. To enable efficient troubleshooting of these faster networks, network technicians will need to utilize the latest analysis tools "Identifying network problems is critical in today's business environment. If the network goes down, many organizations can no longer function" (Andress, 2001). It becomes vital to make sure that network technicians are familiar with the latest monitoring and analysis software and troubleshooting tools to improve network performance and reliability (Lee, 2001).

Voice over IP (VoIP). Networking equipment manufacturers including Cisco Systems and 3COM are making inroads into the voice communications market.

Traditionally, businesses that did not want to subscribe to their local phone company for in-house telephone services such as voice mail, call forwarding, etc. purchased and maintained their own on-site telephone systems. As these telephone control centers approach replacement age, organizations are looking to their data network infrastructure to support their voice communications as well. Organizations can realize savings by using their existing network and Internet connections for voice communications. "Send interoffice calls over your WAN or the Net, and save toll charges" (Green and Jainschigg, 2001). Redundancy of connections to the local phone company for voice and data connections can be eliminated with the organization also realizing a savings for leased lines.

Videoconferencing. Organizations are finding that videoconferencing is an affordable alternative to face-to-face meetings. Productive employee time does not have to be spent traveling. Costly airline flights and hotel rooms for overnight travel can be avoided. The technology to deploy videoconferencing is now cheap enough for most organizations to afford, however the expensive, but necessary bandwidth of telecommunications connections may cause some organizations' reluctance to embrace the technology. In the future costs will decrease as newer videoconferencing technologies requiring less bandwidth become more prevalent. Network technicians will be called upon to install and maintain this additional load on their organizations' data pathways (Connolly, 2001, Moore, 2001).

Wireless networking. Wireless networking allows mobile or visiting users access to an organization's network services without the need for a hard wire connection.

Implementation of networking services within existing structures becomes less labor-intensive because the need for copper or fiber-optic cabling to each user's location is no longer needed. Networking professionals installing wireless systems must map the coverage area supported by each of the access points (communication transceivers) located throughout the organization's buildings to make sure all users have stable access to the network. Since the networking data signal is no longer contained within a copper or fiber-optic media, but in free-space radio waves, network security is of paramount importance. Wireless networking data speed has been an issue for users requiring wide network bandwidth. The Ethernet standard defines a data speed of ten megabits (millions of bits) per second. The most common installation over copper today for Ethernet connections relies on the Fast Ethernet standard of one hundred megabits per second. Common wireless speeds of eleven megabits per second do not meet the needs for power users; however, the newest standard for wireless networking is based on a speed of 54 megabits per second. With the increased speed of wireless networking and tighter security measures, pulling cable may become a thing of the past (Lee, 2001).

Fiber Optics. Using light to send a communications signal through a glass fiber is not a new technology. "While buildout of fiber in the public network has seen enormous strides, most of us aren't experiencing the benefits of optical because most of us aren't on a fiber network. According to Current Analysis, Inc., of U.S. businesses with 300 or more employees, approximately 30 percent are on a fiber network" (Nicoll, 2001). As network users demand more bandwidth from their networks, fiber optic technologies will be

incorporated increasingly, especially true since the cost of fiber installation continues to decrease.

Security. Organizations connected to the Internet have long known that they must protect valuable information and services from outside attacks. Data files stored on central servers must be backed-up regularly to safeguard information in the event of equipment failures or disasters such as fire, earthquakes, and floods. Since the terrorist attack of September 11, 2001, a new reality has come into view for many organizations. The latest questions calling IT security specialists to action are "What happens if the building is no longer standing? How can I duplicate and create redundancies in another location which will allow me to transfer not only my IT functions but my human resources, my employee records, my employees?" (Harreld & Fonseca, 2001). IT professionals are not only concerned with physical terrorist attacks, they must also contend with electronic attacks on their network services. "As one of the simpler forms of computer assaults to orchestrate, DDoS (distributed denial of service) attacks remain a major concern …. Fears of either becoming a victim of the traffic-clogging attack or being used [without knowledge] … to help launch an attack have users looking over their shoulder" (Harreld & Fonseca, 2001). IT professionals given the responsibility to defend their networks against attacks must utilize current anti-virus software and firewall software and hardware technologies to keep their organizations' data safe and communications flowing smoothly. Even with the current economical slowdown, companies that once may have cut IT security budgets to improve their financial bottom

line are investing in equipment and personnel to keep their valuable network and Internet operations functional.

E-business. Doing business over the Internet is not new, however, companies that wish to remain competitive will have to implement new strategies. Services performed by the e-business people and the IT staff must become more efficient. Businesses will have to place more emphasis on the background software and programming that allows customers effortless transactions rather than on flashy applications that may grab the customer's eye, but do little to complete the transaction (Gomolski, 2001).

E-learning. The on-line delivery of instruction increases educational opportunities for individuals who may not be able to attend class in the traditional brick and mortar environment. As the number of on-line courses delivered by an institution increases, so does the load on their delivery systems. Increased simulation, text, graphic, audio, and video content demand more powerful server engines and higher connection bandwidth to meet student needs. System downtime must be kept to a minimum for the benefit of student success (Sonwalkar, 2001).

Certification. As manufacturers deliver new products and as technologies continue to evolve, professional certifications will also evolve to keep pace. No certified professional will be able to sit back and relax after obtaining the latest vendor certification. Recertification may be just a few short years ahead or may be coincident with the next software release. The top level Cisco Certified Internetwork Expert and Cisco Qualified Specialist certifications from Cisco Systems, Inc. are valid for only two years. Lower level Cisco certifications are valid for three years (Cisco Systems, 2001).

"In a development that may dramatically change the ability of companies to get support for Window, more than half of all MCSEs (Microsoft Certified Software Engineers) worldwide seem likely to lose their certifications by the end of the year. This is due to a Microsoft requirement, announced last fall, that those who've passed its [Windows] NT exams must now complete new Windows 2000 exams by December 31, [2001]" (Livingston, 2001).

Training. Organizations must look for creative ways of maximizing the return for the training dollars they invest to keep their IT staff on the cutting edge of technology. Options available for keeping IT staff up to date on new technologies include:

Informal peer-to-peer learning sessions

Web-based training, free and fee-based

Books

Computer-based tutorials

Webinars (Web-based seminars)

Teleconference learning sessions

Online presentations

Skill-focused conferences (Biggs, 2001)

Examination of Similar Studies

Stated broadly, the main purposes of this study are to identify the degree of success that CNS graduates have had in securing program-related employment and to identify the types of competencies they must possess to fulfill their duties in program-related jobs. The goal of this research is to recommend enrollment quota and curriculum

modifications to ensure that the CNS program is in alignment with the needs of the IT profession. An examination of similar studies that focused on gathering employment data, for the purpose of enrollment or curriculum modification for other educational programs, was conducted. A synopsis of the findings follows.

Studies Conducted at CVTC

Moseng (1971) conducted a study to identify the competencies required of individuals who were employed in the field of data processing. A survey instrument for gathering employment information was constructed and mailed to the State Advisory Committee for Data Processing and nine local data processing advisory committees. Each member received two copies of the survey. One copy was completed by the advisory committee member and the second copy was given to a programmer who worked within the member's organization. The data compiled from the returned surveys was used to suggest curriculum changes in the associate degree program Data Processing – Programmer at District One Technical Institute (now known as Chippewa Valley Technical College).

Graduates of the Industrial Electronics Technology program completed a mailed survey which asked them to provide information concerning their employment status, duties performed in program-related jobs, test equipment they used, and any needs they had for further training. The sample population included program graduates from the previous five years. The results of the study were used to suggest program changes including new courses and revised curriculum within that associate degree program (Strong, 1979). Being a graduate of that program, this researcher was part of that sample

population. Upon returning to District One Technical Institute in 1985 as an instructor in that same program, this researcher was witness to the implementation of the program changes suggested by Strong's study.

Skamser (1981) researched the need for word processing skills among graduates of the Secretarial Science program at District One Technical Institute. Skamser gathered employment information and job competency data via a mailed survey instrument. Her study recommended changes to include word processing training within the existing program's curriculum.

A study was conducted by Crossman (1984) to determine the job competencies required by electronic technicians working in occupations related to the Electronic Servicing program at District One Technical Institute. Crossman mailed surveys to employers within the district to gather data pertaining to duties performed by their electronic technicians. The study suggested changes to the two-year vocational diploma Electronic Servicing program to keep it current with industry needs. This researcher was a graduate of this program before Crossman conducted his study and an instructor for the program after the completion of his study. Many of Crossman's recommendations for program and curriculum modification were successfully implemented.

Hastings Taylor (2001) conducted research to provide data for the Administrative Assistant associate degree program at Chippewa Valley Technical College. Hastings Taylor mailed surveys to administrative professionals within the Eau Claire region. Her study identified specific competencies performed by administrative professionals in west central Wisconsin, the types of technology used in their jobs, and the job titles associated

with this occupational field. The results of this study support the development of progressive, new curriculum and program changes within the department.

Other studies

Universities. Universities regularly conduct graduate follow-up studies to determine graduate success. Since 1973 the University of Illinois has conducted mailed surveys of graduates of the university. The results of the surveys have been used to review educational programs and for students' career and educational planning (University Office of Planning and Budgeting, 2002).

Technical colleges. CVTC and the other 15 technical colleges in the Wisconsin Technical College System conduct a graduate follow-up survey for each program delivered to gather data regarding the activities and perceptions of students approximately six months after their graduation. The primary objectives of the survey are to determine the extent to which graduates' current activities are related to the graduates' educational programs, to provide information to be used as tools in career awareness and planning efforts for those making or assisting in career decisions, and to provide data to facilitate program planning, evaluation, and development. The survey used by CVTC is not program specific and does not gather data regarding job duties performed by graduates (Chippewa Valley Technical College Placement Report, 2000; Wisconsin Technical College System Board, 2001).

High schools. The Parent Teacher Organization (PTO) at Southwest Allen County high school developed a survey to determine if this Indiana high school was adequately preparing its students, more that 80 percent of whom go on to college. The PTO received

feedback from 22 percent of the 2000 graduating class. Teachers and guidance counselors will use the results to support needed curriculum changes. “Evaluation by recent graduates is especially valuable.” “(Graduates) tend to take their high school preparation more seriously after they’ve left it behind and are more prepared to honestly assess their own skills compared to graduates of other high schools” (Editorial, 2002). In support of a comprehensive re-write of the Northampton Area Senior High School curriculum, the board of this Pennsylvania high school funded a survey of the school’s 1999 graduates to obtain their perspective on the quality and relevance of the education they received. Assistant Superintendent Linda Firestone hopes to conduct follow-up surveys with future graduating classes to measure the effectiveness of the revisions resulting from the 1999 study (Berg, 1999).

Conclusions

The examination of these previous studies supports the methodology of surveying program graduates as a proven means of gathering general employment and specific job duty data. Surveying graduates to obtain information important to the development of relevant curriculum has been conducted at the high school, technical college, and university level for many years. Faculty at CVTC have continued a long tradition of seeking input from those who know both the programs and the job market first hand – the graduates.

Research Rationale

The main purposes of this study are to identify the degree of success that CNS graduates have had in securing program-related employment and to identify the types of

competencies they must possess to fulfill their duties in program-related jobs. The review of literature has indicated that the need for trained computer support specialists and computer network specialists is projected to increase through 2008. The literature review also revealed that the skills needed by these professionals will continue to change as technology and the needs of business, industry, and education changes. A survey of CNS program graduates to identify their places of employment, job titles, duties performed, certifications required, and continuing education needs will encourage the implementation of program revisions, aid in efforts to assess student learning, defend budget requests for additional instructional and learning technologies for the purpose of keeping the CNS program at CVTC in step with the IT needs of district employers.

Summary

There are over one million IT workers in the United States and positions are available for approximately another 400,000. As the nation's businesses and industries continue to support the evolution of the information age, the need for trained professionals in the IT fields will continue to grow. Nationwide salaries for computer support specialist averaged nearly $40,000 in 2000. During that same year salaries for network systems and data communication analysts averaged nearly $58,000 and for network and computer systems administrators the average was approximately $54,000. There are many job titles associated with the IT profession. Several duties that are performed under any single job title may overlap into the set of duties performed by professionals holding similar job titles. Computer support specialist and computer network specialist are job titles consistent with the training provided by the CNS program

at CVTC. The number of organizations where IT professionals find employment opportunities and the number of IT positions will continue to grow. Likewise, the job-related responsibilities of IT professionals will continue to change as technology changes. Therefore, it is necessary to gather information regarding the employment of graduates of the CNS program at CVTC to ensure the program's relevance to the needs of area employers.

Chapter 3

Methodology

The quantitative methodology used to gather employment data on graduates of the CNS program was a mailed survey. This method was selected as a means of gathering actual employment data, including job titles and job duties, from CNS graduates as a means to evaluate the program's appropriateness to the needs of the IT industry. The initial CNS program competencies were identified through a DACUM conducted in April 1998. The CNS program enrolled its first students in August 1999. The program enjoyed high enrollments during its first two years and the program has had several graduating classes. New technologies have arisen since the DACUM was conducted, perhaps creating the need for modification of the program's outcomes. The time to assess the duties performed by program graduates against the competencies identified by the DACUM seemed appropriate.

The mail-out format for collecting survey data involves the dissemination of printed questionnaires through the mail to the target audience. Respondents are asked to complete the questionnaire on their own and return it by mail to the researcher. The mail-out survey format has the following advantages over other data gathering methods (Thomas, 1999):

- cost savings
- convenience for the respondent
- few time constraints for the respondent
- respondents remain anonymous

- reduced researcher induced bias
- researcher has the opportunity to adequately prepare the questionnaire

There are, of course, disadvantages to mail-out surveys as compared to other methods of data gathering that must be overcome or at least minimized by the researcher:

- lower response rate
- long time period for obtaining responses
- respondents may not answer all questions
- researcher does not have the opportunity to interact with subjects
- open-ended questions are generally avoided

Survey Development

The survey was constructed based on the research questions as illustrated in Tables 5 and 6 on the following pages.

Table 5

Research Questions Addressed in Survey: Outcomes

Research Question	Survey Item or Page
1. What professional certifications do program graduates carry or plan to pursue three months to two years after graduation?	Items 1 and 2
2. To what degree are program graduates employed in a job related to computer networking or computer maintenance?	Items 4 and 5
3. Who are the employers hiring the program's graduates?	Item 12
4. In what types of computer networking jobs are program graduates employed?	Items 6 and 9
5. To what degree are program graduates finding employment within the Chippewa Valley Technical College district?	Item 10
6. What is the salary range of program graduates after three months to two years in the work force?	Item 11

Table 6

Research Questions Addressed in Survey: Needs

Research Question	Survey Item or Page
1. To what degree do graduates perform the following job functions?	Pages 5 through 7
A. Install, configure, or maintain major network operating systems.	
B. Install, troubleshoot, maintain, or repair various network components.	
C. Utilize various networking topologies, media, protocols and hardware.	
D. Troubleshoot client workstation computers.	
E. Install, troubleshoot, maintain, or repair various computer peripheral components.	
F. Create or maintain network documentation.	
G. Utilize computer application software.	
2. Is there any additional education/training required for the position?	Items 3, 7, and 8

The questionnaire was designed to maintain respondent anonymity so that it would solicit the true and accurate opinions and situations of the respondents (Dillman, 2000). The first few questions were designed to elicit information concerning professional certifications and were intended to apply to all respondents. These first questions were also intended to improve the response rate by being easily answerable and interesting (Dillman, 2000). Questions four and five were filter questions (Rea, 1997). The intent was to use these questions to "filter out" graduates who did not work in jobs that related to the outcomes of the CNS program. Graduates who did not obtain program-

related employment were directed away from questions that pertained to employment in the IT field. Questions six through 12 sought to solicit specific demographic information regarding program-related employment (Dillman, 2000). Question 13 aimed to discover the importance that each of several duties holds for each graduate working in a program-related job. The final question was an open-ended "venting" question (Rea, 1997). Although it did not pertain to any of the research questions, it was added to allow respondents to voice an opinion regarding the survey or their educational experience in the CNS program at CVTC. While the responses to this question may not fit conveniently into table form, a listing of them, reviewed by CNS faculty, may prove insightful (Dillman, 2000, Thomas, 1999).

The job titles of network installer, network specialist, network administrator, network systems analyst, computer support specialist, computer repair technician, and help desk specialist were based on the job titles discovered during the literature review. Likewise, the same holds true for the range of salaries and the professional certifications that were identified.

The industry classifications of communications, construction, consulting/engineering, education, government, insurance/finance/real estate, manufacturing, medical, recreation, repair/service, retail/wholesale trade, and transportation/public utilities were based on divisions identified by the U.S. Department of Commerce, Technology Administration, Office of Technology Policy (1999).

The job duty section was compiled using the results discovered in the review of literature. Most of the items were derived from the DACUM (1998) results and from the

CNS Program Outcomes (2001). One of the purposes of this study was to identify the types of competencies graduates must possess to fulfill their duties in program-related jobs. Therefore, it was natural to build this survey item based on competencies graduates possess. Items discovered from other sources, which reflect changes in technology since the program's conception, were added to complete the compilation of duties.

Survey Design

The survey was designed for printing in booklet form "…on 11" x 17" paper so that when folded, individual pages are of conventional 8.5" x 11" dimensions" (Dillman, 2000, p. 83). The booklet format is familiar to most people and allows the respondent to easily move from page-to-page (Dillman, 2000; Rea, 1997).

The survey booklet begins with a cover page clearly stating the title of the survey, the sponsor of the survey, the date the survey was to be returned, and the name and address of the researcher. The logo of the sponsoring organization, CVTC, was included to help respondents identify the source of the survey. The cover page also served the purpose of making sure respondents could quickly relocate the survey if it was mislaid. The presence of the researcher's name and address further helped with source identification, since the researcher was also a program instructor for many of the study's subjects. In the event the postage-paid return envelope became separated from the survey instrument, respondents only need to refer to the cover page to identify where to send the completed survey (Dillman, 2000).

The second page included the informed consent statement and where questions regarding participation with the study should be directed (Dillman, 2000; Thomas, 1999).

Also included on the second page was a map outlining the CVTC district. This map was a reference for the question concerning a graduate's location of employment.

A two-column format was chosen to present all survey items except the job duties question and the open-ended question. The two-column format was chosen to keep line length to a minimum. Short lines of text are easier for the respondent to comprehend because the reader's eyes are able to remain focused of the question and follow the text more closely, thereby reducing uneven reading and misinterpretation (Dillman, 2000). The column format allows for vertical listing of item responses, making response comparison and selection easier for the respondent. The two-column format also allows for more efficient use of page space without the appearance of clutter or perception of difficulty (Dillman, 2000; Thomas, 1999).

All questions were printed in bold text and all answers in plain text to conveniently separate queries from answer choices. Additionally, words within questions that required emphasis were underlined (Dillman, 2000). Special instructions regarding progression through the survey were included after individual questions to which the instructions related. Bold, italic text was used to further identify these special instructions (Dillman, 2000). For items one through 11, underlined spaces preceded each answer to enable respondents to easily mark their choice(s) with a check mark. Placement of the check line to the left of each answer is supported by the recognition that the amount of space needed for writing answers varies considerably. This method also allows all answer spaces to be arranged easily in a vertical column, which helps avoid item nonresponse. (Dillman, 2000). In the case of close-ended items where an all-inclusive list of selections

was not feasible, a selection of "other" was made available to the respondents so as not to force them to select an inappropriate response or leave an item blank (Rea, 1997).

Question 12 asked for the identity of respondents' employers. Five blank lines provided space for each respondent to write his/her employer's name and address.

The job duties listed in question 13 were presented in a table format to efficiently arrange job duties by core ability category. The response alternatives, a five-point, Likert-type scale according to level of importance for each duty were presented in a series of rows of numbers for respondent circling (Dillman, 2000; Hayes, 1997; Rea, 1997; Thomas, 1999). Lines were included under each duty and associated responses to help guide respondents to the correct series of numbers for circling. The consistency in the direction of the scale throughout the listing helped avoid respondents' marking the incorrect choice (Dillman, 2000). A selection of "does not apply" was made available to the respondents so as not to force them to select an inappropriate response or leave an item blank (Rea, 1997).

The final question was of the open-ended type (Dillman, 2000; Rea, 1997; Thomas, 1999). Its purpose was to allow respondents an opportunity to express any opinions, feelings, or information that was not explicitly solicited within the close-ended questioning of the survey. A box was included to invite responses. The final question was printed on the back cover of the booklet along with the name and address of the researcher and the CVTC logo. In the event the survey was left lying face down, these identifying elements would help the respondent find it again (Dillman, 2000).

Pilot Study

Often a pilot test of a newly constructed survey instrument is in order to validate the construction and content of the survey (Dillman, 2000; Rea, 1997; Thomas, 1999). It was of particular interest in this study to make sure that the questions and given responses were in agreement with actual IT industry trends. Of particular interest was validation of the job duties gleaned from the DACUM (1998), the program competency listing (2001), and the review of literature.

A pilot test of the survey instrument was conducted using the members of the CNS faculty and the members of the CNS advisory committee. See Appendix A for a listing of the CNS faculty members and Appendix B for a listing of the CNS advisory committee members. During the fall advisory committee meeting of November 7, 2001, the faculty and advisory committee were informed of the upcoming study and the researcher's intention for their participation in the pilot testing of the survey instrument. Unique cover letters to accompany the surveys were sent to each pilot group. Refer to Appendix C for the cover letter sent to the CNS faculty and Appendix D for the cover letter sent to the advisory committee members. The pilot survey shown in Appendix E was mailed to committee members and distributed to the faculty members via inter-office mail on February 14, 2002. Faculty and members of the advisory committee were not only asked to complete the survey, as it pertained to their particular specialty, but were also charged with reviewing the format and content of the survey and then submitting their documented suggestions for revision.

Upon reception of the completed pilot surveys, the researcher compiled the suggestions for revision. Content and format revisions, as suggested by the pretest group and consistent with the objectives of the study, were incorporated into the final version of the survey instrument.

Selection of Subjects

The population for the study was limited to graduates of the CNS program at CVTC. The population included seven cohorts: December 1999, May 2000, August 2000, December 2000, May 2001, August 2001, and December 2001 graduates. Those persons who did not complete the educational program or who had not graduated from CVTC were not participants in the study. A total of 98 names and addresses, sorted by graduation date were obtained from the Admissions Office at CVTC. One graduate was listed as deceased. Consequently, that graduate's name was removed from the mailing list. Considering the limited size of the total population (97 graduates), it was decided to survey all CNS graduates rather than select a sample population (Hayes, 1999; Rea, 1997).

Implementation

There is no single "magic bullet" that will, by itself, guarantee a high survey response rate. Dillman (2000) suggests that there are five essential elements for achieving high survey response rates. "These elements include: (1) a respondent-friendly questionnaire, (2) up to five contacts with the questionnaire recipient, (3) inclusion, of stamped return envelopes, (4) personalized correspondence, and (5) a token financial incentive that is sent with the survey request." Each element adds, in varying degrees, to

the overall success of a survey study. When the elements are combined, a high response rate results.

Multiple contacts are essential for maximizing response to mail surveys. According to Dillman (2000), the five contacts between researcher and subject that lead to high response rates include: (1) a brief prenotice letter, (2) the questionnaire itself, (3) a thank you postcard, (4) a replacement questionnaire, and (5) a final contact.

Following Dillman's (2000) guidelines, a brief prenotice postcard was developed in lieu of formal letter. Since the questionnaire was to be sent enclosed in a CVTC envelope marked with the college logo, the researcher wished the prenotice mailing to have a different look from the forthcoming questionnaire to generate interest among recipients (Dillman, 2000). The postcards were duplicated on yellow cardstock paper and cut to a 3.5" by 5" card size to adhere to United States postal regulations (Hastings Taylor, 2001). The first paragraph explained that the recipients would be receiving the questionnaire within the next several days and briefly detailed the purpose and usefulness of the survey. The second paragraph was a thank you in advance to the recipient for completing and returning the questionnaire. The researcher personally signed each postcard with blue, ballpoint pen so that the recipients knew that each signature was real (Dillman, 2000; Rea, 1997). Recipient addresses were printed directly on the postcards by use of a word processing program's mail merge utility. The CVTC logo and address was used for the return address on the mailing label side of the postcards. The secondary purpose of the prenotice postcards was to obtain address correction for those graduates who had moved from the address that the CVTC Admissions Office had on file. The

request for return service address correction was printed on the mailing label side of the postcards. The initial first-class mailing of the prenotice postcards on February 22, 2002 was timed so that they would arrive approximately two weeks before the questionnaire (Dillman, 2000). This timeframe allowed for address correction and a new prenotice postcard mailed to the corrected addresses timed to arrive within a few days of the questionnaire. Refer to Appendix F for a sample of the prenotice postcard.

Cover letters, mailed with the questionnaires, were constructed following Dillman's (2000) guidelines and printed on CVTC letterhead paper. An address merge enabled the inclusion of the recipients' name and address at the top of the letter for a personalized effect. The first paragraph made the request for participation. The second paragraph explained why the recipient was selected to participate in the study. The third paragraph detailed the main purpose of the study and how the recipient's responses will be used. The fourth paragraph assured the confidentiality of participants' responses and that the encoding of the questionnaires was only used to track returned surveys. The remainder of the letter mentioned the enclosed token of appreciation, how to contact the researcher with questions related to the survey, and a thank you for participation. As with the prenotice postcards, all cover letters were personally signed in blue ink. All of the cover letters were dated and mailed on March 8, 2002. A copy of the survey cover letter may be found in Appendix G.

Questionnaires were printed back-to-back booklet-style on 8.5" by 17" ivory-colored paper, folded and center-stapled (Dillman, 2000; Rea, 1997). Black printing was used on the light-colored paper to provide high contrast and easy readability. Black

printing also afforded the advantage of lower cost as compared to color printing. Each questionnaire included a consent statement informing the recipients that their participation was voluntary, that their answers would be confidential, and whom they could contact in case they had questions or complaints regarding the study (Dillman, 2000; Rea, 1997). Participants were assigned a numerical code based on their graduation date and the alphabetical sequence of their names within their graduating classes. The code numbers were printed on clear labels and attached to the last page of each questionnaire (Rea, 1997). The questionnaires were tri-folded face-out for insertion into standard 4.5" by 9.5" business size envelopes. See Appendix H for a copy of the final questionnaire.

Token financial incentives of just two dollars have been shown to increase response rates by 19 to 31 percent (Dillman, 2000). Dillman (2000) found that a small token reward included with the questionnaire was more effective in producing high response rates than the promise of a larger reward given after the survey's return. He also found that whether the reward was in the form of two one-dollar bills, a two-dollar bill, or a check had little effect on the improvement of the response rate. The researcher consulted with CVTC administration as to the appropriateness of the inclusion of a cash incentive in a college-sponsored mailing. It was decided that a custom-designed, prepaid long distance telephone credit card, similar to the one used by Hastings Taylor (2001) would be a more appropriate incentive. Each phone card was worth 10 minutes of long distance calling time. The cost to the CNS department was approximately two dollars per card for a quantity of 250 cards. Extra phone cards, not used for this study, were kept by

the department for use during future promotional events. Refer to Appendix I for a sample of the phone card design.

A business reply envelope was included with each questionnaire mailing to improve the response rate. Dillman (2000) found that a return envelope with a real stamp improved response rates an average of only one to two percent over the use of preprinted business reply envelopes. The researcher decided that this marginal improvement did not warrant the increased cost associated with creating reply envelopes with a real stamp applied.

Each first-class mailing included the personalized cover letter, an encoded questionnaire, a business reply envelope, the researcher's business card, and the phone card token incentive enclosed in an envelope preprinted with the CVTC logo, CVTC return address, and participant's name and mailing address. Participants' names and addresses were directly printed onto each envelope instead of using an attached mailing label to add personalization (Dillman, 2000; Rea, 1997). To ensure that all enclosures came out of the envelope at once when received by the recipient, the following format was used to assemble the mailing: The questionnaire was folded vertically with the front cover on the outside. The phone card and business card were placed on top of the questionnaire and the reply envelope was placed beneath it. Then, all components were placed within the cover letter. The cover letter was folded face-out around the other materials. The entire package was inserted into the mailing envelope. This method has the advantage that all materials are removed from the envelope at once. When the packet is unfolded the respondent will simultaneously see the letter personally addressed to

them, the questionnaire, the business card, the phone card, and the reply envelope (Dillman, 2000).

The survey was sent on March 8, 2002 via United States mail. Participants were allowed approximately two weeks to complete and return the questionnaire. The deadline for response was March 25, 2002.

Responses were tracked by means of a spreadsheet listing participants' names and their associated code numbers (Hastings Taylor, 2001). As questionnaires were returned, respondents' names were checked off.

A thank you postcard was sent to all participants two weeks after the survey mailing. This third contact served to thank those who had already completed and returned their questionnaires and also gently remind those who hadn't that their response would be greatly appreciated (Dillman, 2000; Rea, 1997). To make this third contact look different from the previous two mailings, and thereby draw attention, bright green cardstock was selected for the postcards (Hastings Taylor, 2001). As before, the cardstock was cut to conform to United States postal regulations. The mailing label side of the card once again displayed the CVTC logo and return address. The first paragraph simply stated that a questionnaire had been sent to the respondent and reiterated the purpose of the questionnaire. Although this may seem a bit redundant, the researcher wished to be sensitive to the fact that this may be the first time that respondents learn that a survey was sent to them (Dillman, 2000). The questionnaire may have been lost in the mail or mislaid by the respondent and forgotten. The second paragraph contained the main message of the mailing. People who had already responded to the questionnaire were

thanked and those who had not yet responded were asked to do so "today" to convey the importance of the study. The second paragraph finished with an invitation for the recipient to call for a replacement questionnaire if the first one was not received or was lost. As with the first two mailings, this postcard was also personally signed with blue ballpoint pen by the researcher and sent via first class mail on March 22, 2002. Refer to Appendix J for a sample of the follow-up post card.

Four weeks after the survey was mailed to the participants, a fourth contact was made with non-respondents. A replacement questionnaire and accompanying cover letter were sent to all participants who had not responded. This fourth contact had a marked difference in tone from the three preceding contacts. The level of personalization communicated to recipients that they were receiving individual attention (Dillman, 2000). In the first paragraph recipients were reminded that they had received the first questionnaire about four weeks earlier, but that they had not been heard from. The second paragraph told them that many others had already responded and that the input received was going to provide important information for the CNS program. Most of the rest of the cover letter reiterates the importance of the recipient's participation in the study and that maintaining confidentiality of their responses is very important to the researcher. The final paragraph reminded the recipient that participation was voluntary and if non-participation was the recipient's choice, to please return the blank questionnaire. The cover letter was personally signed with blue ballpoint pen by the researcher. A sample of the second cover letter may be found in Appendix K. The mailing, sent on April 9, 2002, consisted of a replacement questionnaire, a reply envelope, the researcher's business

card, and the cover letter enclosed in a CVTC business envelope. A second token incentive was not included (Dillman, 2000).

By May 8, 2002, the response rate had exceeded 60%, therefore a fifth contact with non-respondents was deemed unnecessary. Data tabulation began on June 3, 2002. Surveys received after June 3, 2002 were not included this study. This date was over 12 weeks after the original graduate survey was sent and eight weeks after the replacement survey was sent to the non-respondents. Table 7 includes a summary timeline of the major dates and events connected with the data-gathering element of the CNS graduate follow-up study.

Table 7

Data-gathering Timeline

Date	Event
February 14, 2002	Mailed pilot surveys to advisory committee members and faculty.
February 22, 2002	Mailed prenotice postcards to CNS graduates.
March 8, 2002	Mailed surveys to CNS graduates.
March 22, 2002	Mailed follow-up postcards to CNS graduates.
April 9, 2002	Mailed replacement surveys to non-respondents.
June 3, 2002	Cut-off date for the inclusion of returned surveys. Data tabulation began.

Data Analysis

Returned surveys were recorded by means of a spreadsheet program according to the code number attached to each questionnaire. Responses to the open-ended "venting"

question were compiled into a categorized list. Likewise, a report listing employers' names and addresses was generated. The survey data from the closed-ended questions was analyzed using SPSS computer software. A report of frequency counts and percentages was generated for respondents' demographic information and cross-tabulated by the interval since the respondents' graduation dates. A report of frequency counts, percentages, mean, and standard deviation was generated for the job duty section of the survey. Results were cross-tabulated by job title and industry category.

Limitations

1. Graduates who were not employed in a program-related job may not have responded.
2. Many of the respondents were familiar with the researcher through classes taught by him.
3. Some of the graduates may have moved without leaving a forwarding address, therefore, some of the addresses used for mailings may have been incorrect.
4. Return service address correction from the USPS may not have caught all address changes, thereby preventing the researcher from discovering correct addresses.
5. Participants may have had negative experiences with either the CNS program or with CVTC.
6. The length of the questionnaire may have had a negative effect on the response rate.

Chapter 4

Results and Discussion

In order to measure the degree of success CNS program graduates have had in securing program-related employment and to identify duties that are performed in program-related occupations, a survey of CNS program graduates was conducted. The survey was mailed to all persons who had graduated from the CNS program at CVTC since it began in August 1999.

Survey Returns

Out of the 97 surveys that were mailed to program graduates, a total of 61 completed surveys were returned. One blank survey was returned.

A detailed description of survey returns, based on graduation date, is shown in Table 8 on the following page. The response rate typically ranged from 61.4% to 71.4%, when analyzed by graduating class. The exceptions being the classes of December 1999 and July 2001, where there was a 100% response rate from each class's single graduate and the class of July 2000 where the response rate was 0% from the class's three graduates. The combined response rate from all graduating classes was 62.9%.

Table 8

Survey Return Detail

Graduation Date	Number	Number Returned	Percent Returned
December 1999	1	1	100.0
May 2000	3	2	66.7
July 2000	3	0	0.0
December 2000	21	15	71.4
May 2001	44	27	61.4
July 2001	1	1	100.0
December 2001	24	15	62.5
Total	97	61	62.9

Because of the small number of respondents by graduating class, the responding graduates were grouped into three categories based on time intervals since their graduation, thus enabling better cross tabulation of results. The intervals chosen were over one year, over three months to one year, and three months since graduation. The category of over one year from graduation includes the classes of December 1999, May 2000, July 2000, and December 2000. The category of over three months to one year from graduation includes the graduating classes of May 2001 and July 2001. The class of December 2001 makes up the category of three months since graduation. Table 9 details the number and percentage of responding graduates in each category.

Table 9

Respondents by Interval Since Graduation

Interval	Number	Percent
Over one year	18	29.5
Over three months to one year	28	45.9
Three months	15	24.6
Total	61	100.0

Employment Status

The survey asked graduates to indicate their present employment status. Fifty-two or 85.2% of respondents were employed. Forty-one or 67.2% of respondents were employed in full-time jobs and 11 or 18.0% of respondents were employed in part-time jobs. Three (4.6%) respondents were unavailable for employment because they were a student, had a disability, or other reason. The other reason given was a position of substitute teacher assistant. Fifteen or 83.3% of respondents who graduated over one year before the study were employed full-time. Respondents who graduated three months before the survey had a full-time employment rate of 33.3%. Table 10 summarizes the employment status of responding graduates.

Table 10

Employment Status

			Interval Since Graduation					
			Three Months		Over Three Months to One Year		Over One Year	
Employment Status	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Full-time	41	67.2	5	33.3	21	75.0	15	83.3
Part-time	11	18.0	7	46.7	3	10.7	1	5.6
Not employed, but seeking	6	9.8	3	20.0	2	7.1	1	5.6
Not available for employment, student	1	1.6	0	0.0	0	0.0	1	5.6
Not available for employment, disabled	1	1.6	0	0.0	1	3.6	0	0.0
Not available for employment, other	1	1.6	0	0.0	1	3.6	0	0.0
Total	61	100.0	15	100.0	28	100.0	18	100.0

CNS Program-related Employment

The survey asked employed respondents to indicate whether or not their present employment was related to the education they received while enrolled in the CNS program at CVTC. The rate of program-related employment for all respondents was 31 out of 61 or 50.8%. Thirty-one or 59.6% of the 52 employed respondents were employed in program-related jobs. Respondents who graduated over one year before the survey

were employed in program related jobs at a rate of 75% while those who graduated just three months before the survey were employed at a rate of 41.7%. Twenty-six (83.9%) of the 31 program-related jobs held by respondents were full-time and five (16.1%) were part-time. Program-related employment rates based on interval since graduation are detailed in Table 11.

Table 11

CNS Program-related Employment

			Interval Since Graduation					
			Three Months		Over Three Months to One Year		Over One Year	
Employment Related to CNS Program	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Related	31	59.6	5	41.7	14	58.3	12	75.0
Not related	21	40.4	7	58.3	10	41.7	4	25.0
Total	52	100.0	12	100.0	24	100.0	16	100.0

Certifications

Respondents were asked to identify professional computer and networking certifications they currently held, planned to test for within the next year, and those for which they would consider returning to CVTC to receive preparation training. In all three questions, respondents were asked to choose all certifications that applied, therefore, response totals exceeded 100%. Tables 12 through 14 summarize the responses given by

all respondents (61) and each table is discussed separately. In addition, comparisons are made between the demographic groups of those respondents employed in program-related jobs (31) versus those who were not (30). Furthermore, comparisons are drawn between the demographic groupings based on the time intervals of three months (15), over three months to one year (28) and over one year (18) since graduation.

Currently-held Certifications

Table 12 on the following page provides summary information regarding currently-held professional computer and network certifications. Respondents were asked to identify all currently-held certifications; therefore, column totals exceed 100%. CCNA certification was most-held by all respondents (18.0%). CCNA was held by 25.8% of the respondents who held program-related employment as compared to 10.0% of those who did not. CCNA was held by 38.9% of those respondents who graduated over one year before the study, but by only 10.7% of those over three months to one year past graduation and by only 6.7% of those just three months beyond graduation.

Table 12

Currently-held Certifications

			Program-related Employment				Interval Since Graduation					
			Yes		No		Three Months		Over Three Months to One Year		Over One Year	
Certification Held	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
A+	7	11.5	5	16.1	2	6.7	3	20.0	3	10.7	1	5.6
CCNA	11	18.0	8	25.8	3	10.0	1	6.7	3	10.7	7	38.9
CNA	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
MCP	2	3.3	2	6.5	0	0.0	0	0.0	0	0.0	2	11.1
NCSC	8	13.1	4	12.9	4	13.3	4	26.7	4	14.3	0	0.0
Network+	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Other	5	8.2	2	6.5	3	10.0	1	6.7	3	10.7	1	5.6
None	37	60.7	18	58.1	19	63.3	9	60.0	17	60.7	11	61.1
Total	70	114.8	39	125.9	31	103.3	18	120.1	30	107.1	22	122.3

NCSC and A+ were the next most-commonly held certifications at 13.1% and 11.5% of all respondents. There was no significant difference between the program-related employment demographic groups (approximately 13%) for NCSC certification. More respondents with program-related employment (16.1%) held A+ than those who were not employed in a program-related job (6.7%). Most of the NCSC and A+ certifications were held by those respondents who were three months beyond graduation (26.7% and 20%, respectively) and those who were over three months to one year past graduation (14.3% and 10.7%, respectively).

Five or 8.2% of all respondents indicated that they held some other certification. One respondent reported holding CFOT and another reported holding NACC.

The largest percentage of all respondents, 60.7%, held no professional computer or network certifications. There is also no significant variation from this percentage across all demographic groups.

Future Certifications

Table 13 on the following pages provides summary information regarding those professional computer and network certifications that respondents planned to test for within the next year. Respondents were asked to identify all intended future certifications; therefore, column totals exceed 100%. All respondents chose CCNA and A+ certifications most often at 32.8% and 26.2%, respectively. There was no significant difference in future preference for CCNA between the respondents who held program-related employment (32.3%) and those who did not (33.3%).

Table 13

Future Certifications

			Program-related Employment				Interval Since Graduation					
			Yes		No		Three Months		Over Three Months to One Year		Over One Year	
Certification	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
A+	16	26.2	11	35.5	5	16.7	3	20.0	8	28.6	5	27.8
CCNA	20	32.8	10	32.3	10	33.3	8	53.3	9	32.1	3	16.7
CCNP	3	4.9	3	9.7	0	0.0	1	6.7	1	3.6	1	5.6
CNA	2	3.3	1	3.2	1	3.3	2	13.3	0	0.0	0	0.0
CNE	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
LPIC	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
MCP	11	18.0	7	22.6	4	13.3	4	26.7	5	17.9	2	11.1
MCSE	3	4.9	2	6.5	1	3.3	1	6.7	0	0.0	2	11.1

(table continues)

			Program-related Employment				Interval Since Graduation					
			Yes		No		Three Months		Over Three Months to One Year		Over One Year	
Certification Held	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
NCSC	2	3.3	2	6.5	0	0.0	2	13.3	0	0.0	0	0.0
Network+	7	11.5	4	12.9	3	10.0	3	20.0	2	7.1	2	11.1
SAIR Linux	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Other	7	11.5	5	16.1	2	6.7	2	13.3	2	7.1	3	16.7
None	24	39.3	9	29.0	15	50.0	4	26.7	14	50.0	6	33.3
Total	95	155.7	54	174.3	41	136.6	30	200.0	41	146.4	24	133.4

Prediction of pursuit of CCNA certification was significantly higher among those respondents who graduated three months (53.3%) and over three months to one year (32.1%) than it was for those respondents who graduated over one year (16.7%) before the study. The predication rate for taking the A+ certification exam was higher (35.5%) for those respondents who held program-related employment than for those respondents who were not employed in program-related jobs (16.7%). Prediction rates for respondents in pursuit of A+ certification were 20%, 28.6%, and 27.8%, respectively, for those respondents who graduated three months, over three months to one year, and over one year before the study.

No future professional computer or network certifications were in the next year's plans of 39.5% of all respondents. Just 29% of those respondents employed program-related jobs did not plan to pursue further certification while 50% of those who did not hold program-related employment showed a similar inclination. Prediction rates for non-pursuit of certifications were 26.4%, 50%, and 33.3%, respectively, for those respondents who graduated three months, over three months to one year, and over one year before the study.

Seven or 11.5% of all respondents indicated that they planned to test for other certifications within the next year. Other certifications specified included CCDA, Server+, and MCSA (four occurrences).

Advanced Certification Preparation

Respondents were asked to identify any professional certifications for which they would consider returning to CVTC to receive training. Table 14 on the next page provides a summarization of the findings. Since respondents were asked to identify all future certifications for which they would consider returning to CVTC to receive training, column totals exceed 100%. All respondents chose CCNP (21.3%) and MCSE (18%) most often as the certifications for which they would return to CVTC to receive preparation training. Other was selected by 11.5% of all respondents. Specified training included NCSC, Server+, Network+, and programming.

The division between the yes and no program-related employment groups was different for CCNP training at 22.6% and 20%, respectively, as it was for MCSE training at 16.1% and 20%, respectively. Returning for CCNP training received response rates of 26.7%, 21.4%, and 16.7%, respectively, for those respondents who graduated three months, over three months to one year, and over one year before the study. The response rates for the same three groups concerning returning to CVTC for future MCSE training were 20%, 14.3%, and 22.2%, respectively.

Table 14

Advanced Certification Preparation

			Program-related Employment				Interval Since Graduation					
			Yes		No		Three Months		Over Three Months to One Year		Over One Year	
Certification	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
CCNP	13	21.3	7	22.6	6	20.0	4	26.7	6	21.4	3	16.7
CNE	8	13.1	5	16.1	3	10.0	5	33.3	3	10.7	0	0.0
LPIC	5	8.2	5	16.1	0	0.0	2	13.3	2	7.1	1	5.6
MCSE	11	18.0	5	16.1	6	20.0	3	20.0	4	14.3	4	22.2
SAIR Linux	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Other	7	11.5	4	12.9	3	10.0	1	6.7	4	14.3	2	11.1
None	31	50.8	13	41.9	18	60.0	7	46.7	14	50.0	10	55.6
Total	75	122.9	39	125.7	36	120.0	22	146.7	33	117.8	20	111.2

A slight majority (50.8%) of all respondents indicated that they would not consider returning to CVTC for any advanced certification preparation. Those respondents employed in program-related jobs showed a more favorable interest with a 41.9% negative response rate, while those not employed in program-related jobs responded negatively at a 60% rate. Negative response rates of 46.7%, 50%, and 55.6% were received from those respondents who graduated three months, over three months to one year, and over one year before the study, respectively.

Job Titles

The respondents who held program-related jobs were asked to identify their job title. Eleven or 35.5% of the 31 respondents held the job title of Computer Support Specialist. None of the respondents chose the job title of Computer Systems Administrator, Network Installer, or Network Systems Analyst. Three (9.7%) respondents indicated other titles for their jobs. Other job titles included were Computer Trainer, Web Site Maintenance, and Technical Data Assistant/Computer Information Technician. Table 15 on the next page provides a listing of job titles chosen by respondents employed in program-related jobs.

Table 15

Job Titles

Job Title	Number	Percent
Consultant	3	9.7
Contractor	1	3.2
Computer Repair Technician	4	12.9
Computer Support Specialist	11	35.5
Computer Systems Administrator	0	0.0
Help Desk Specialist	2	6.5
Network Administrator	4	12.9
Network Installer	0	0.0
Network Specialist	3	9.7
Network Systems Analyst	0	0.0
Other	3	9.7
Total	31	100.0

In order to categorize these 31 respondents for better cross tabulation, the job titles were organized into three groups based on job title commonalities. The job titles Consultant and Contractor were combined into one group entitled Consultant/Contractor (12.9%). The job titles Computer Repair Technician, Computer Support Specialist, Help Desk Specialist, Computer Trainer, Web Site Maintenance, and Technical Data Assistant/Computer Information Technician formed a second group entitled Computer

Support Specialist (64.5%). The job titles Network Administrator and Network Specialist were combined into the third group entitled Network Specialist (22.6%).

Additional Training for Current Employment

Respondents who were employed in program-related jobs were asked to identify the methods by which they received any additional training for their current job. Respondents were allowed to select all methods of training that applied to them, therefore, the number of responses totals more than 31 and likewise the percentages total more than 100%. Self-study was selected by 17 or 54.8% and coworker/supervisor-led training was chosen by 10 or 32.8% of the respondents. The training methods indicated by those two (6.5%) respondents who selected other are Internet Techweb and Benchmark Learning Center. Eight or 25.8% of the respondents indicated that they needed no additional training for their current employment. Table 16 on the next page provides detailed information regarding additional training methods used by respondents.

Table 16

Additional Training for Current Employment

Method of Training	Number	Percent
Self-study	17	54.8
Coworker/supervisor-led training	10	32.8
Workshops/seminars	6	19.4
Two-year college	1	3.2
Four-year college	3	9.7
Other	2	6.5
No additional training required	8	25.8
Total	47	152.2

Additional Training or Experience for Career Advancement

Respondents with program-related employment were asked to identify any areas of additional training or experience that would help them advance in their career. Respondents were allowed to select all areas of training that applied to them, therefore, the number of responses totals more than 31 and likewise the percentages total more than 100%. Table 17 on the next page details respondents' training/experience selections. Network operating systems was chosen by 15 or 48.4% of respondents as an area where more training was needed for their career advancement. Firewall configuration and network security techniques were selected by 13 (41.9%) and 11 (35.5%) of the

respondents, respectively. Two or 6.5% of the respondents indicated advanced disaster recovery and VPN (virtual private network) as their other areas of needed training. Six or 19.4% of the respondents indicated that they needed no further training to advance in their careers.

Table 17

Additional Training or Experience for Career Advancement

Type of Training or Experience	Number	Percent
Advanced router configuration	9	29.0
Advanced LAN switch configuration	8	25.8
Firewall configuration	13	41.9
Network operating systems	15	48.4
Network security techniques	11	35.5
Streaming audio and video	4	12.9
Video conferencing	5	16.1
Voice over Internet Protocol (VoIP)	9	29.0
WAN carrier technologies	10	32.0
Other	2	6.5
No additional training needed	6	19.4
Total	92	296.5

Industry Category

Respondents, who were worked in program-related jobs, were asked to identify the industry category that best describes the organization for which they work. Education was selected by 9 or 29.0% of the respondents and five or 16.1% chose consulting or engineering and retail or wholesale trade. No respondents chose the categories construction, insurance, finance or real estate, recreation, or transportation or public utilities. Three (9.7%) respondents indicated a preference for other and specified the industry categories of rehabilitation center, veterinarian, and accounting. Table 18 on the following page details the responses chosen to describe the industries where respondents, who held program-related employment, work.

Table 18

Industry Category

Industry Category	Number	Percent
Communications	1	3.2
Construction	0	0.0
Consulting or Engineering	5	16.1
Education	9	29.0
Government	2	6.5
Insurance, finance or real estate	0	0.0
Manufacturing	3	9.7
Medical	1	3.2
Recreation	0	0.0
Repair or service	2	6.5
Retail or wholesale trade	5	16.1
Transportation or public utilities	0	0.0
Other	3	9.7
Total	31	100.0

Location of Employment

Respondents, who worked in program-related jobs, were asked to identify the geographic area that best describes the location of the organization for which they work. Twenty-two or 71.0% of the 31 respondents worked in program-related jobs within the CVTC district. Nine or 37% of the respondents found program-related employment

elsewhere within the State of Wisconsin or in the four states bordering Wisconsin. No respondents worked in program-related employment outside the local region defined by the study. Examination of the location of employment by interval since graduation shows similar trends. Respondents three months from graduation were placed within the CVTC district at an 80% rate. Those who graduated over three months to one year before the study were employed at a 78.6% rate and those respondents who graduated over one year before the study were placed within the CVTC district at a rate of 58.3% in jobs related to the CNS program. Table 19 on the following page provides further detail regarding of the locations where graduates were employed in program-related jobs.

Table 19

Location of Employment

			Interval Since Graduation					
			Three Months		Over Three Months to One Year		Over One Year	
Location	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Within the CVTC district	22	71.0	4	80.0	11	78.6	7	58.3
Within the State of Wisconsin	4	12.9	0	0.0	1	7.1	3	25.0
Within the region (Minnesota, Illinois, Iowa and Michigan)	5	16.1	1	20.0	2	14.3	2	16.7
Within the United States	0	0.0	0	0.0	0	0.0	0	0.0
Outside the United States	0	0.0	0	0.0	0	0.0	0	0.0
Total	31	100.0	5	100.0	14	100.0	12	100.0

Salaries

Salary information was reported by 30 of the 31 respondents who were employed in program-related jobs. The reported salaries excluded benefits and overtime pay. Table 20 on the next page shows that no respondents indicated a yearly salary above $50,000. The highest concentration of responses was in the $20,000 to $29,999 (10 or 33.3%) and $30,000 to $39,999 ranges (13 or 43.3%). Table 20 also shows that the time interval since a respondent's graduation had an effect on salary. Eighty percent of respondents only

three months from graduation were earning less than $20,000. Fifty percent of respondents who had graduated over three months to one year before the study were earning between $20,000 and $29,999 and 63.6% of respondents were earning up to $39,999 after more than one year past graduation.

Table 20

Salary Report

			Interval Since Graduation					
			Three Months		Over Three Months to One Year		Over One Year	
Salary Range in U.S. Dollars	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Up to 19,999	6	20	4	80.0	2	14.3	0	0.0
20,000 – 29,999	10	33.3	0	0.0	7	50.0	3	27.3
30,000 – 39,999	13	43.3	1	20.0	5	35.7	7	63.6
40,000 – 49,999	1	3.3	0	0.0	0	0.0	1	9.1
50,000 – 59,999	0	0.0	0	0.0	0	0.0	0	0.0
60,000 – 69,999	0	0.0	0	0.0	0	0.0	0	0.0
70,000 – 79,999	0	0.0	0	0.0	0	0.0	0	0.0
80,000 and above	0	0.0	0	0.0	0	0.0	0	0.0
Total	30	100.0	5	100.0	14	100.0	11	100.0

Cross-tabulation reports of salaries versus employment status and salaries versus employment location were generated. Table 21 on the next page carries over the reported salary information of the entire group of respondents and displays salary information for those respondents who held part-time and full-time jobs. It also shows salary information based on the location of the respondents' program-related employment. The locations of employment selected by respondents included within the CVTC district, elsewhere within the State of Wisconsin (outside the CVTC district), and within the region, which includes the States of Minnesota, Illinois, Iowa, and Michigan, but excludes the State of Wisconsin. Five of the six (83.3%) respondents who reported salaries of less than $20,000 were employed part-time. All 24 respondents who indicated a salary between $20,000 and $49,999 were employed full-time. All six respondents who reported a salary of less than $20,000 were employed within the CVTC district. This fact is not surprising since five of the six positions were part-time and it is unlikely that respondents would travel outside the district for part-time employment. Those respondents who had secured employment outside the CVTC district did trend toward the higher ranges of $20,000 to $29,999 and $30,000 to $39,999, however in-district employment numbers for these two salary ranges are higher (15) than the numbers for out-of-district employment (8). The highest reported salary, which was in the range of $40,000 to $49,999, was also within the CVTC district.

Table 21

Salary Comparisons

			Program-related Employment Status				Program-related Employment Location					
			Full-time		Part-time		Within the CVTC District		Elsewhere within the State of Wisconsin		Within the region (excluding Wisconsin)	
Salary Range in U.S. Dollars	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Up to 19,999	6	20	1	4.0	5	100.0	6	27.3	0	0.0	0	0.0
20,000 – 29,999	10	33.3	10	40.0	0	0.0	9	40.9	1	25.0	0	0.0
30,000 – 39,999	13	43.3	13	52.0	0	0.0	6	27.3	3	75.0	4	100.0
40,000 – 49,999	1	3.3	1	4.0	0	0.0	1	4.5	0	0.0	0	0.0
Total	30	100.0	25	100.0	5	100.0	22	100.0	4	100.0	4	100.0

Employers

Fourteen of the 31 respondents, who were employed in a CNS program-related job, chose to identify their employers. A list of the identified employers is included in Appendix L.

Job Duties

CNS program graduates, who were employed in program-related jobs, were asked to identify job duties according to the level of importance they held (Low, Below Average, Average, Above Average, or High) or their non-importance (Does Not Apply). For analysis purposes and application of research results, the survey importance categories of Low, Below Average, Average, Above Average, and High are considered an indicator of job duty performance. The percentage of respondents, who indicated a duty's importance level, and therefore, performance, are summarized in this chapter.

Additionally, importance categories were assigned a numerical rating for the purpose of calculating mean and standard deviation. The scale of numerical rating of importance is as follows: 1 = Low, 2 = Below Average, 3 = Average, 4 = Above Average, 5 = High. The calculation of mean is the average of the responses in those five importance categories for each duty. The calculation of standard deviation is an indication of how closely all of the responses for a specific duty are grouped around the mean. A higher standard deviation equates to a larger variance in the responses and indicates disagreement. A lower standard deviation equates to a tighter grouping of responses and indicates higher validity. The mean and standard deviation for each duty are presented in this chapter (see Tables 22 – 30).

Based on the review of literature, job duties were grouped into several distinct categories including Network Operating Systems/Server Components, Network Hardware Configuration, Network Media, Network Security and Protection, Client Workstations, Peripherals, Help Desk and Troubleshooting, Documentation, and Computer Usage. The results will be presented and discussed separately by those category classifications.

Twenty-eight of the 31 respondents who held program-related jobs responded to the survey question regarding job duties. Therefore, N = 28 = 100% of the valid population.

An analysis of job duty performance based on job title is included in this chapter. The job titles of network specialist, computer support specialist, and consultant/contractor included populations of seven, 18, and three respondents, respectively.

Also, an analysis of job duty performance based on interval since graduation is included in this chapter. The intervals of three months, over three months to one year, and over one year since graduation had respective populations of five, 13, and 10 respondents.

Network Operating Systems/Server Components. The results of respondents indicating importance to duties associated with network operating systems and server components are summarized in Table 22 on the following pages.

Table 22

Network Operating Systems/Server Components

Job Duty	Percent Who Perform	Mean	Standard Deviation	Percent Who Perform Based on Job Title			Percent Who Perform Based on Interval Since Graduation		
				Network Specialist	Computer Support Specialist	Con-sultant/ Con-tractor	Three Months	Over Three Months to One Year	Over One Year
Specify network server requirements	78.6	3.18	1.14	100.0	66.7	100.0	80.0	76.9	80.0
Configure network server hardware	82.1	3.48	1.12	100.0	72.2	100.0	80.0	76.9	90.0
Configure Linux network operating systems	53.6	2.07	1.33	71.4	44.4	66.7	80.0	38.5	60.0
Configure Unix network operating systems	57.1	2.00	1.26	71.4	50.0	66.7	80.0	53.8	50.0
Configure Microsoft network operating systems	85.7	3.67	1.37	100.0	77.8	100.0	80.0	84.6	90.0
Configure Novell network operating systems	50.0	2.93	1.59	71.4	38.9	100.0	80.0	46.2	40.0
Configure DNS and/or DHCP	75.0	2.90	1.34	85.7	66.7	100.0	80.0	69.2	80.0
Create and maintain network user accounts	82.1	3.74	1.21	100.0	72.2	100.0	80.0	76.9	90.0

(table continues)

Job Duty	Percent Who Perform	Mean	Standard Deviation	Percent Who Perform Based on Job Title			Percent Who Perform Based on Interval Since Graduation		
				Network Specialist	Computer Support Specialist	Con-sultant/ Con-tractor	Three Months	Over Three Months to One Year	Over One Year
Write or implement network administration scripts	64.3	2.83	1.29	100.0	44.4	100.0	60.0	61.5	70.0
Install or configure RAID storage	64.3	2.61	1.42	85.7	50.0	100.0	80.0	53.8	70.0
Implement or maintain network print services	82.1	3.87	1.22	100.0	72.2	100.0	80.0	76.9	90.0
Resolve hardware, software, or data migration issues	89.3	4.24	1.13	100.0	83.3	100.0	80.0	92.3	90.0
Plan for server hardware upgrades	75.0	3.14	1.28	100.0	61.1	100.0	80.0	69.2	80.0
Plan for server software upgrades	78.6	3.27	1.32	100.0	66.7	100.0	80.0	76.9	80.0
Other	10.7	3.33	1.53	14.3	11.1	0.0	0.0	0.0	30.0

In this category resolving hardware, software, or data migration issues was the duty performed by respondents the most (89.3%), followed by configuring Microsoft network operating systems (85.7%). These duties also have high mean scores of 4.24 and 3.67, respectively, which indicates that these duties are important to job performance. The standard deviations were a bit on the high side (1.13 and 1.37, respectively) though, meaning a relatively wide variation in the scores awarded by individual respondents. The duties performed the least in this category are configuring Novell network operating systems at a 50.0% performance rate and 2.93 mean score and configuring Linux network operating systems with a 53.6% performance rate and 2.07 mean score. Once again the standard deviations are high at 1.59 and 1.33, respectively, which indicates that the importance level for these two duties depends greatly on the particular job held by the respondent. Other was selected by 10.7% of the respondents. One respondent specified the additional job duty of SAN storage and backup.

The performance percentages for the demographic groups based on job title were consistent with the results from the total population. The percentages of Network Specialists, Computer Support Specialists, and Consultants/Contractors resolving hardware, software, or data migration issues was 100%, 83.3%, and 100%, respectively. For the duty of configuring Microsoft network operating systems, the performance percentages for the same three groups were 100%, 77.8%, and 100%, respectively. For the duty of configuring Novell network operating systems the percentages from the Network Specialists and Computer Support Specialists groups were at 71.4% and 38.9% respectively with the exception being the Consultants/Contractors group who performed

this duty at a 100% rate. The duty of configuring Linux network operating systems was performed less often by all three groups (71.4%, 44.4%, and 66.7%, respectively). Since all of the duties in this category relate to jobs in networking, it is not surprising that the performance percentages for all duties are higher for the Network Specialists group than they are for the Computer Support Specialists group.

The performance percentages for the demographic groups based on interval since graduation were also consistent with the results from the total population with the exception being the three month group who performed the lowest rated duties at a higher rate of 80%.

Network Hardware Configuration. The results of respondents indicating importance to duties associated with network hardware configuration are summarized in Table 23 on the following pages.

Table 23

Network Hardware Configuration

Job Duty	Percent Who Perform	Mean	Standard Deviation	Percent Who Perform Based on Job Title			Percent Who Perform Based on Interval Since Graduation		
				Network Specialist	Computer Support Specialist	Con-sultant/ Con-tractor	Three Months	Over Three Months to One Year	Over One Year
Configure routers	67.9	2.16	1.17	85.7	55.6	100.0	80.0	53.8	80.0
Create or maintain sub-networks	64.3	2.17	1.15	85.7	50.0	100.0	60.0	61.5	70.0
Configure NAT	57.1	2.06	0.93	85.7	38.9	100.0	60.0	46.2	70.0
Configure LAN switches	64.3	2.56	1.46	85.7	50.0	100.0	60.0	53.8	80.0
Create or maintain VLANs	46.4	2.23	1.01	57.1	33.3	100.0	40.0	46.2	50.0
Specify WAN carriers	50.0	1.71	0.99	85.7	27.8	100.0	40.0	46.2	60.0
Configure modems or CSU/DSUs	64.3	2.61	1.38	85.7	55.6	66.7	60.0	61.5	70.0
Configure ISDN equipment	50.0	1.93	0.92	57.1	44.4	66.7	60.0	53.8	40.0

(table continues)

Job Duty	Percent Who Perform	Mean	Standard Deviation	Percent Who Perform Based on Job Title			Percent Who Perform Based on Interval Since Graduation		
				Network Specialist	Computer Support Specialist	Con-sultant/ Con-tractor	Three Months	Over Three Months to One Year	Over One Year
Plan for network hardware upgrades	75.0	3.19	1.47	100.0	61.1	100.0	80.0	69.2	80.0
Configure voice over IP (VoIP) equipment	35.7	1.80	1.32	42.9	27.8	66.7	80.0	30.8	20.0
Configure videoconferencing equipment	46.4	1.77	1.24	71.4	27.8	100.0	80.0	38.5	40.0
Other	10.7	2.33	1.15	14.3	11.1	0.0	20.0	0.0	20.0

All duties in this category are related to networking jobs. The low overall performance percentages were caused by the influence of the low performance ratings given them by the Computer Support Specialists group. The duty performed at the highest rate was planning for network hardware upgrades (75%) with a mean score of 3.19, which indicates slightly above average importance, and a wide standard deviation of 1.47. The Network Specialists and Consultants/Contractors group both performed this duty at a 100%, however the Computer Support Specialists group performed it at only a 61.1% rate. Analyzing this same duty by interval since graduation, it can be seen that the three months after graduation and the over one year since graduation groups both performed it at an 80% rate while those in the over three months to one year since graduation group performed it at a 69.2% rate.

The duties of configuring voice over Internet Protocol (VoIP) equipment and configuring videoconferencing equipment ranked the lowest at 35.7% and 46.4%, respectively. Not surprisingly, their mean scores are also low at 1.80 and 1.77, respectively. Their respective high standard deviations of 1.32 and 1.24 indicate a wide spread of importance ratings awarded by individual respondents. The Network Specialists, Computer Support Specialists, and Consultants/Contractors groups performed the duty of configuring VoIP equipment at 42.9%, 27.8%, and 66.7% rates, respectively. The same three groups configure videoconferencing equipment at 71.4%, 27.8%, and 100% rates, respectively. The interval since graduation group of three months after graduation performed these two duties at low rates of 30.8% and 35.8%, respectively. A similar response was given by the over one year since graduation group for the same two

duties (20% and 40%, respectively). The exception was the three months since graduation group who indicated an 80% performance rate for both duties.

Respondents indicated a 10.7% performance rating for other, however, no specific duties were noted.

Network Media. The results of respondents indicating importance to duties associated with network media are revealed in Table 24 on the following page. Respondents reported that they test or certify cable (82.1%) most often. A mean score of 2.87 gives this duty slightly below average importance and the standard deviation of 1.18 indicates an inconsistency among respondents' rankings. The Network Specialists and Consultants/Contractors groups each performed this duty most often at a 100% rate. Computer Support Specialists performed this duty at a 72.2% rate. The interval since graduation groups of three months (60%), over three months to one year (84.6%), and over one year (90%) showed increasing performance as the interval since graduation increased.

Table 24

Network Media

Job Duty	Percent Who Perform	Mean	Standard Deviation	Percent Who Perform Based on Job Title			Percent Who Perform Based on Interval Since Graduation		
				Network Specialist	Computer Support Specialist	Con-sultant/ Con-tractor	Three Months	Over Three Months to One Year	Over One Year
Select appropriate network media	71.4	2.80	1.24	85.7	61.1	100.0	80.0	61.5	80.0
Design or build wiring closets	60.7	2.65	1.41	85.7	44.4	100.0	60.0	46.2	80.0
Install equipment racks and patch panels	57.1	2.50	1.32	71.4	44.4	100.0	60.0	53.8	60.0
Install copper-based network cabling and connectors	67.9	2.89	1.24	100.0	50.0	100.0	60.0	69.2	70.0
Install fiber optic network cabling and connectors	53.6	1.67	1.18	71.4	38.9	100.0	100.0	38.5	50.0
Test or certify network cabling	82.1	2.87	1.18	100.0	72.2	100.0	60.0	84.6	90.0
Configure wireless networking components	64.3	2.89	1.32	85.7	55.6	66.7	100.0	46.2	70.0
Other	17.9	3.40	1.52	28.6	16.7	0.0	0.0	15.4	20.0

Respondents revealed that they install fiber optic cabling and connectors (53.6%) and equipment racks and patch panels (57.1%) least often. Mean scores of 1.67 and 2.50, respectively, give these duties below average importance and their respective standard deviations of 1.18 and 1.32 indicate inconsistencies among respondents' rankings. The Network Specialists group performed both duties at a 71.4% rate, which exceeded the Computer Support Specialists group ratings of 38.9% and 44.4%, respectively. Both groups lagged behind the Consultants/Contractors group, which performed both these duties at a 100% rate. The installation of fiber optic cabling and connectors was performed most often (100%) by the three months since graduation group. The over three months to one year and over one year groups performed the same duty at much lower 38.5% and 50% rates. The installation of equipment racks and patch panels was performed more consistently at rates of 60% for the three months and over one year since graduation groups and 53.8% for the over three months to one year group.

Respondents indicated a 17.9% performance rating for other duties, however no specific duties were noted.

Network Security and Protection. Graduates who worked in program-related jobs performed duties associated with network security and protection as described in Table 25 on the following page.

Table 25

Network Security and Protection

Job Duty	Percent Who Perform	Mean	Standard Deviation	Percent Who Perform Based on Job Title			Percent Who Perform Based on Interval Since Graduation		
				Network Specialist	Computer Support Specialist	Con-sultant/ Con-tractor	Three Months	Over Three Months to One Year	Over One Year
Configure anti-virus software	85.7	4.13	1.19	100.0	77.8	100.0	80.0	84.6	90.0
Configure firewall hardware and software	64.3	2.89	1.18	85.7	50.0	100.0	60.0	61.5	70.0
Create or install security policies and procedures	71.4	3.50	1.28	85.7	61.1	100.0	80.0	53.8	90.0
Utilize security intrusion devices or software	57.1	2.94	1.18	85.7	38.9	100.0	60.0	46.2	70.0
Create and place router access control lists	50.0	2.07	1.21	71.4	33.3	100.0	60.0	46.2	50.0
Design, implement, or oversee network data backup, archival, or disaster recovery procedures	71.4	3.85	1.46	100.0	55.6	100.0	60.0	69.2	80.0
Install uninterruptible power supplies	71.4	3.85	1.27	85.7	61.1	100.0	80.0	53.8	90.0
Other	14.3	3.25	1.26	14.3	16.7	0.0	20.0	7.7	20.0

Once again, all duties in this category are related to networking jobs. The low overall performance percentages were caused by the influence of the low performance ratings given them by the Computer Support Specialists group. The duty performed at the highest rate was configuring anti-virus software (85.7%) with a mean score of 4.13, which indicates above average importance, and a standard deviation of 1.19. The Network Specialists and Consultants/Contractors group both performed this duty at a 100%, however the Computer Support Specialists group performed it at only a 77.8% rate. There is no significant different in the performance rates for this duty among the three interval since graduation groups. Configuring anti-virus software was performed at rates of 80%, 84.6%, and 90% by the three months after graduation, over three months to one year since graduation, and over one year since graduation groups, respectively.

The duties of designing, implementing, or overseeing, network data backup, archival, or disaster recovery procedures and installing uninterruptible power supplies each received performance ratings of only 71.4% by the whole population, however, those respondents who performed these duties ranked them as being above average importance, as the mean score of 3.85 for each duty would indicate. The high standard deviations of 1.46 and 1.27 for the two duties, respectively, however, do indicate a wide disparity among individual responses. The Network Specialists performed these two duties at 100% and 85.7% rates and the Consultants/Contractors group performed these same duties each at a 100% rate, however the Computer Support Specialists group performed them at only 55.6% and 61.1% rates, respectively.

The duties of creating and placing router access control lists and utilizing security intrusion devices or software were performed at the lowest rates of 50% and 57.1%, respectively. Not surprisingly, their mean scores of 2.07 and 2.94, respectively, indicate below average to average importance ratings. Their respective high standard deviations of 1.21 and 1.18 indicate a wide spread of importance ratings awarded by individual respondents. The Network Specialists, Computer Support Specialists, and Consultants/Contractors groups performed the duty of creating and placing router access control lists at 71.4%, 33.3%, and 100% rates, respectively. The same three groups utilize security intrusion devices or software at 85.7%, 38.9%, and 100% rates, respectively. The interval since graduation group of three months after graduation performed these two duties at rates of 60%. The performance response given by the over one year since graduation group for the same two duties was 50% and 70%, respectively. The lowest performance rating was given by the three months to one year since graduation group who indicated a 46.2% performance rate for both duties.

Respondents indicated a 14.3% performance rating for other, however no specific duties were noted.

Client Workstations. The results of respondents indicating importance to duties associated with client workstations are summarized in Table 26 on the next page.

Table 26

Client Workstations

Job Duty	Percent Who Perform	Mean	Standard Deviation	Percent Who Perform Based on Job Title			Percent Who Perform Based on Interval Since Graduation		
				Network Specialist	Computer Support Specialist	Con-sultant/ Con-tractor	Three Months	Over Three Months to One Year	Over One Year
Specify workstation hardware requirements	75.0	3.76	1.14	85.7	66.7	100.0	80.0	69.2	80.0
Install or configure operating system software	89.3	4.46	0.81	85.7	94.4	100.0	80.0	100.0	80.0
Install application software	96.4	4.36	0.99	100.0	100.0	100.0	100.0	100.0	90.0
Install software patches and upgrades	92.9	4.58	0.70	100.0	88.9	100.0	100.0	92.3	90.0
Install hardware drivers	92.9	4.33	0.88	100.0	94.4	100.0	100.0	100.0	90.0
Install hardware upgrades or replacement devices	92.9	4.26	1.20	100.0	94.4	100.0	100.0	100.0	90.0
Configure computer BIOS settings	89.3	4.28	1.02	100.0	83.3	100.0	100.0	84.6	90.0
Perform repairs on computers	92.9	3.92	1.20	100.0	94.4	66.7	100.0	92.3	90.0
Other	21.4	4.17	1.33	14.3	22.2	33.3	40.0	15.4	20.0

All duties in this category relate to computer support jobs. They were performed at high rates and received high mean scores by the total population and by the job title and interval since graduation demographic groups. The lowest performance rating (75%) was received by the duty specify workstation hardware requirements, but its importance score of 3.76 indicates that this duty carries above average importance for those respondents who performed it. It is surprising to note that this duty received a performance rating of only 66.7% by the Computer Support Specialists group, while the Network Specialists and Consultants/Contractors groups performed it at 85.7% and 100% rates, respectively. The performance response given by the three months and the over one year since graduation groups for the same duty was 80%, but the over three months to one year group performed this duty at just 69.2%.

Other was selected by 21.4% of all respondents and was awarded an above average mean score of 4.17, however, no specific duties were noted.

Peripherals. The results of respondents indicating importance to duties associated with peripheral devices are summarized in Table 27 on the following page. Installing or configuring printers was the duty performed by all respondents the most (92.9%) in this category, followed by performing periodic maintenance or repairs on printers (89.3%). These duties also have above average importance mean scores of 4.08 and 3.36, respectively. The standard deviations were high at 1.23 and 1.55, respectively, though, meaning a relatively wide variation in the scores awarded by individual respondents.

Table 27

Peripherals

Job Duty	Percent Who Perform	Mean	Standard Deviation	Percent Who Perform Based on Job Title			Percent Who Perform Based on Interval Since Graduation		
				Network Specialist	Computer Support Specialist	Con-sultant/ Con-tractor	Three Months	Over Three Months to One Year	Over One Year
Install or configure printers	92.9	4.08	1.23	100.0	88.9	100.0	100.0	92.3	90.0
Perform periodic maintenance or repairs on printers	89.3	3.36	1.55	100.0	83.3	100.0	100.0	84.6	90.0
Install or configure video displays	89.3	3.48	1.42	100.0	83.3	100.0	80.0	92.3	90.0
Perform repairs on video displays	71.4	2.80	1.67	100.0	55.6	100.0	80.0	69.2	70.0
Install or configure scanners	71.4	2.95	1.36	57.1	72.2	100.0	100.0	69.2	60.0
Perform repairs on scanners	71.4	2.90	1.59	57.1	72.2	100.0	100.0	69.2	60.0
Other	17.9	2.60	1.14	28.6	16.7	0.0	20.0	7.7	30.0

The duties performed the least in this category were performing repairs on video displays, installing or configuring scanners, and performing repairs on scanners all of which received a 71.4% performance rating and average importance mean scores of 2.80, 2.95, and 2.90, respectively. Once again the standard deviations are high at 1.67, 1.36, and 1.33, respectively, which indicates that the importance level for these three duties depends greatly on the particular job held by the respondent. Other was selected by 17.9% of the respondents, but no specific duties were designated.

One hundred percent of Network Specialists and Consultants/Contractors reported installing or configuring printers and performing periodic maintenance or repairs on printers. Computer Support Specialists performed these duties at 88.9%, and 83.3% rates, respectively.

For the duty of performing repairs on video displays, the percentages from the Network Specialists and Consultants/Contractors demographic groups were both at 100%. The Computer Support Specialists group performed this duty at a low 55.6% rate. The duties of installing or configuring scanners and performing repairs on scanners were performed less often by Network Specialists and Computer Support Specialists (57.1% and 72.2% for each duty, respectively), but the Consultants/Contractors group performed both duties at 100% rates.

The performance percentages for the demographic groups based on interval since graduation trended toward either a relatively consistent or slightly declining performance rate as the interval since graduation increased.

Respondents chose other at a 17.9% rate and ranked those other duties at slightly below average importance (2.60), however, no specific duties were identified.

Help Desk and Troubleshooting. Respondents, who worked in program-related jobs, performed duties associated with help desk and troubleshooting as described in Table 28 on the following pages. The duties performed at the highest rate (96.4%) were troubleshooting client problems and instructing clients on the proper use of network/computer/peripheral equipment, both of which had high mean scores of 4.52 and 4.33, respectively. The standard deviations for both duties were low (0.80 and 0.83, respectively) indicating that respondents' importance ratings for these duties were closely grouped. Analyzing these same duties by interval since graduation, it can be seen that the three months after graduation group performed them at an 80% rate while those in the over three months to one year since graduation and the over one year since graduation groups both performed them at 100%.

It is somewhat surprising to note that the Computer Support Specialists group performed all duties in this category at rates lower than the Network Specialists and Consultants/Contractors groups, which performed almost all of these duties at a rate of 100%.

Table 28

Help Desk and Troubleshooting

Job Duty	Percent Who Perform	Mean	Standard Deviation	Percent Who Perform Based on Job Title			Percent Who Perform Based on Interval Since Graduation		
				Network Specialist	Computer Support Specialist	Con-sultant/ Con-tractor	Three Months	Over Three Months to One Year	Over One Year
Follow safety precautions and procedures	78.6	3.95	1.00	85.7	72.2	100.0	100.0	76.9	70.0
Refer to manufacturer service manuals/schematics	85.7	3.54	1.22	100.0	77.8	100.0	80.0	84.6	90.0
Contact manufacturers' technical support	92.9	3.58	1.33	100.0	88.9	100.0	80.0	92.3	100.0
Refer to Internet help sites	85.7	4.08	1.02	100.0	77.8	100.0	60.0	84.6	100.0
Download and use test programs	89.3	3.64	1.22	100.0	83.3	100.0	80.0	92.3	90.0
Download and install software patches	92.9	3.88	1.11	100.0	88.9	100.0	100.0	92.3	90.0
Troubleshoot client problems	96.4	4.52	0.80	100.0	94.4	100.0	80.0	100.0	100.0

(table continues)

Job Duty	Percent Who Perform	Mean	Standard Deviation	Percent Who Perform Based on Job Title			Percent Who Perform Based on Interval Since Graduation		
				Network Specialist	Computer Support Specialist	Con-sultant/ Con-tractor	Three Months	Over Three Months to One Year	Over One Year
Instruct clients on the proper use of network/computer/peripheral equipment	96.4	4.33	0.83	100.0	94.4	100.0	80.0	100.0	100.0
Maintain spare parts inventory	82.1	3.74	1.39	85.7	77.8	100.0	60.0	84.6	90.0
Other	28.6	3.88	0.99	28.6	33.3	0.0	20.0	15.4	50.0

It is also somewhat surprising to observe that the duty of following safety precautions and procedures was performed at the lowest rate of 78.6%, although it was rated above average (3.95) in importance by those who reported its performance. This same duty received diminished performance as the interval since graduation increased from three months (100%) to over three months to one year (76.9%) to over one year (70%).

Respondents indicated a 28.6% performance rating for other and ranked those other duties at above average importance (3.88). A single respondent identified one additional duty, preparing help desk resources.

Documentation. The results of respondents indicating importance to duties associated with documentation are summarized in Table 29 on the following page. All duties received low overall performance ratings of 78.6% or less. The low overall performance percentages were influenced by the low performance ratings given all duties in this category by the Computer Support Specialists group.

Table 29

Documentation

Job Duty	Percent Who Perform	Mean	Standard Deviation	Percent Who Perform Based on Job Title			Percent Who Perform Based on Interval Since Graduation		
				Network Specialist	Computer Support Specialist	Con-sultant/ Con-tractor	Three Months	Over Three Months to One Year	Over One Year
Document network security measures and procedures	60.7	3.59	1.37	100.0	38.9	100.0	60.0	53.8	70.0
Prepare procedure guides for network users	71.4	3.05	1.47	100.0	55.6	100.0	60.0	69.2	80.0
Prepare network procedure manual for IT staff	67.9	2.84	1.57	85.7	55.6	100.0	60.0	61.5	80.0
Document hardware or software inventory	78.6	3.59	1.53	100.0	66.7	100.0	80.0	76.9	80.0
Maintain service call records	75.0	3.95	1.32	85.7	66.7	100.0	100.0	69.2	70.0
Document software licenses	75.0	3.57	1.60	100.0	61.1	100.0	60.0	84.6	70.0
Other	17.9	2.60	1.50	14.3	22.2	0.0	20.0	15.4	20.0

The duty performed at the highest rate was documenting hardware or software inventory (78.6%) with an above average mean score of 3.59 for duty importance and a wide standard deviation of 1.53. The Network Specialists and Consultants/Contractors group both performed this duty at a 100%, however the Computer Support Specialists group performed it at only a 66.7% rate. There is no significant different in the performance rates for this duty among the three interval since graduation groups. Documenting hardware or software inventory was performed at rates of 80%, 76.9%, and 80% by the three months, the over three months to one year, and the over one year since graduation groups, respectively.

The duty of documenting network security measures and procedures received a performance rating of only 60.7% by the whole population, however, those respondents who performed these duties ranked them as being above average importance, as the mean importance score of 3.59 would imply. The high standard deviation of 1.37 for this duty does indicate a wide disparity among individual responses. The Network Specialists and the Consultants/Contractors groups both performed this duty at a 100% rate, however the Computer Support Specialists group performed it at a rate of only 38.9%. The interval since graduation group of three months after graduation performed this duty at a rate of 60%. The performance response given by the over one year since graduation group was 70% and the lowest performance rating was given by the three months to one year since graduation group who indicated a 53.8% performance rate.

Respondents indicated a 17.9% performance rating for other, however, no specific duties were noted.

Computer Usage. The results of respondents indicating importance to duties associated with computer usage are summarized in Table 30 on the next page. Downloading or uploading Internet files and developing electronic spreadsheets, databases, documents, or presentations were the duties performed by all respondents the most (85.7% each) in this category. These duties also have above average importance mean scores of 3.53 and 3.08, respectively. The standard deviations were high at 1.36 and 1.41, respectively, though, meaning a relatively wide variation in the scores awarded by individual respondents. The duty of managing files, folders, and disks was performed at a lower rate (78.6%), but it had the highest mean importance rating (3.91) of all duties in this category.

Maintaining an Internet Web site was the duty performed the least in this category (67.9%). It received an above average importance rank of 3.17, but once again the standard deviation was high at 1.38, which indicates that the importance level for this duty depends greatly on the particular job held by the respondent.

Other was selected by 21.4% of all respondents with a mean importance score of 3.17. A single respondent identified one additional duty, database management.

One hundred percent of Network Specialists and Consultants/Contractors reported performance of the highest performance-ranked duty, downloading or uploading Internet files. Computer Support Specialists performed this duty at an 83.3% rate. This same duty was awarded decreasing performance rates of 100%, 92.3%, and 80% by the three months, the over three months to one year, and the over one year since graduation groups, respectively.

Table 30

Computer Usage

Job Duty	Percent Who Perform	Mean	Standard Deviation	Percent Who Perform Based on Job Title			Percent Who Perform Based on Interval Since Graduation		
				Network Specialist	Computer Support Specialist	Con-sultant/ Con-tractor	Three Months	Over Three Months to One Year	Over One Year
Manage files, folders, and disks	78.6	3.91	1.31	85.7	77.8	100.0	100.0	76.9	80.0
Develop electronic spreadsheets, databases, documents, or presentations	85.7	3.08	1.41	85.7	88.9	100.0	100.0	84.6	90.0
Download or upload Internet files	85.7	3.52	1.36	100.0	83.3	100.0	100.0	92.3	80.0
Maintain an Internet Web site	67.9	3.16	1.38	85.7	55.6	100.0	80.0	61.5	70.0
Other	21.4	3.17	0.98	14.3	27.8	0.0	20.0	15.4	20.0

For the lowest performance-ranked duty of maintaining an Internet Web site, the performance percentages from the Network Specialists (85.7%) and Consultants/Contractors (100%) groups were both much higher than from the Computer Support Specialists group (55.6%). This same duty was awarded performance rates of 80%, 61.5%, and 70% by the three months after graduation, the over three months to one year since graduation, and the over one year since graduation groups, respectively.

Open-ended Responses

Twenty-three of the 61 total survey respondents chose to answer the open-ended question at the end of the survey. Respondents voiced opinions on the quality and content of the CNS program, availability of program-related employment, the importance of internships, and their reaction to the survey itself. Respondents' comments are included in Appendix M, where they are arranged in three categories: Program Content, Internships and Employment, and Other Comments. The largest of the three categories was Internships and Employment. Nine of the 23 submitted comments indicated that graduates felt the college should have expended more effort assisting them with securing internships and employment. While some students' comments were not limited to just one category, their comments were categorized by the main idea conveyed in each.

Chapter 5

Summary, Conclusions, and Recommendations

In this chapter, the study will be summarized and conclusions will be drawn based on the results. Recommendations based on the study's outcomes will be discussed at the end.

Summary

The purpose of this research was to provide data for the Computer Network Specialist associate degree program at Chippewa Valley Technical College.

Restatement of the Problem

This study sought to identify the degree of success that CNS graduates have had in securing program-related employment and the types of competencies graduates must possess to fulfill their duties in program-related jobs. To achieve the goals of this research the following questions were developed to guide the course of the study. The research questions were organized into two categories, outcomes and needs.

Outcomes.

1. What professional certifications do program graduates carry or plan to pursue three months to two years after graduation?
2. To what degree are program graduates employed in a job related to computer networking or computer maintenance?
3. Who are the employers hiring the program's graduates?
4. In what types of computer networking jobs are program graduates employed?

5. To what degree are program graduates finding employment within the Chippewa Valley Technical College district?
6. What is the salary range of program graduates after three months to two years in the work force?

Needs.

1. To what degree do graduates perform the following job functions?
   A. Install, configure, or maintain major network operating systems.
   B. Install, troubleshoot, maintain, or repair various network components.
   C. Utilize various networking topologies, media, protocols and hardware.
   D. Troubleshoot client workstation computers.
   E. Install, troubleshoot, maintain, or repair various computer peripheral components.
   F. Create or maintain network documentation.
   G. Utilize computer application software.
2. Is there any additional education/training required for the position?

Methods and Procedures

The CNS department faculty agreed that a survey of CNS program graduates would be an appropriate method of gathering the desired information. At the conclusion of a review of existing literature, a survey instrument was developed and pilot tested with the CNS faculty and the CNS advisory committee. A final survey instrument was developed utilizing the input from the pilot group. During March 2002 the survey was mailed to all 97 persons who had graduated from the CNS program since its inception in August 1999.

The goal of the survey was to identify the degree of success that CNS graduates have had in securing program-related employment, the types of duties they performed in program-related jobs, employer names, job titles, salary information, professional certifications that CNS graduates either currently held or intended to obtain, what type of additional training needs they had, and if they would consider returning to CVTC to receive that training.

Survey data was analyzed using SPSS software. A report of frequency counts and percentages was generated based on the graduates' demographic information. A report of frequency counts, percentages, mean, and standard deviation was generated for the job duties performed by graduates employed in program-related jobs. Cross tabulation reports of frequency counts and percentages between different demographic populations within the study were also created. The resulting data was presented and discussed.

Major Findings

Over 60% of all respondents held no professional computer or networking certification. Of those certifications graduates currently held, CCNA was held most often (18%) followed by NCSC (13.1%) and A+ (11.5%). Over 60% of all respondents indicated that they planned to test for a professional certification within the following year. CCNA was indicated most often (32.8%) followed by A+ (26.2%) and MCP (18%). Respondents listed CCNP (21.3%), MCSE (18%), and CNE (13.1%) most often as the certifications for which they would consider returning to CVTC to receive preparation training.

Slightly over 85% of respondents were employed either full-time or part-time, but just over 50% of respondents had found employment related to the CNS program at CVTC. Over 70% of the respondents employed in program-related jobs were working within the CVTC district and none reported working outside the immediate upper Midwest region of the nation. The largest percentage (29%) reported working for educational institutions. The majority (64.5%) of those working in program-related jobs reported that their employment related to computer support. Just 22.6% were working as network specialists. Over 43% of respondents who worked full-time in program-related jobs reported annual salaries between $30,000 and $39,999 while another 33% of full-time workers were earning between $20,000 and $29,999 annually.

At least 50% of respondents employed in program-related occupations reported performing the computer support and network support duties identified in the questionnaire. The only exceptions were configuring voice over IP (VoIP) equipment

(35.7%) and configuring videoconferencing equipment (46.4%). Over 90% of respondents working in an IT profession reported some level of importance for the duties listed below.

install application software

install software patches and upgrades

install hardware drivers

install hardware upgrades or replacement devices

perform repairs on computers

install or configure printers

download and install software patches

troubleshoot client problems

instruct clients on the proper use of network/computer/peripheral equipment

Over half of respondents with program-related employment indicated that they study on their own for any additional job-related training they may need and almost one third reported receiving training from a coworker or supervisor. Over 30% stated that they needed training related to WAN carrier technologies, network security techniques, firewall configuration, and network operating systems to advance in their careers.

Conclusions

There were six research questions related to program outcomes and two research questions related to the professional skill needs of graduates employed in program-related jobs. Each research question will be restated and conclusions drawn for each.

Research Questions: Outcomes

1. What professional certifications do program graduates carry or plan to pursue three months to two years after graduation?

   Graduates of the CNS program reported holding CCNA, NCSC, and A+ certifications more often than the other professional certifications. This outcome is not surprising considering the promotional value of the program courses that naturally lead to these certifications. The four semesters of the Cisco Networking Academy Program lead to the CCNA certification. The courses Computer Hardware, Hardware Configuration of Operating Systems, and A+ Review naturally lead to the A+ certification. Students prepare for the NCSC exam in the course Cable Certification. CCNA and A+ were cited as being the certifications most sought after by respondents not already holding them. The negative news is that over 60% of all respondents held no professional computer or networking certification and that nearly 40% of all respondents do not intend to test for any of these certifications. Refer to Tables 12 and 13 on pages 84 and 86, respectively, for detailed certification information.

2. To what degree are program graduates employed in a job related to computer networking or computer maintenance?

   As reported in Tables 10 and 11 on pages 81 and 82, respectively, just over 50% of all respondents had found employment related to the CNS program at CVTC. It would seem that the number of program graduates

exceeded the employment demand for workers with computer networking skills. Most graduates working in program-related jobs found employment within the CVTC district (see number 5 below). If graduates have an unwillingness to relocate, a saturation of the local computer networking workforce is likely to follow resulting in many program graduates having a difficult time finding employment that matches their skills.

Governor Scott McCallum's recent announcement of the I-94 Corridor Technology Zone, which includes much of the CVTC district, offers potential for growth in the computer, electronic technologies, and telecommunications industries. The influx of $5 million in income tax incentives may help provide sources of employment for CNS program graduates (Wisconsin Department of Commerce, 2002).

3. Who are the employers hiring the program's graduates?

There seems to be no clear-cut division of industry that hires computer network specialists. Table 18 identifies education as the industry category selected most often (29%) by respondents. Retail or wholesale trade and consulting or engineering were tied for second place with 16.1% of respondents each. There seems to be no single industry that specifically hires computer network specialists. On the contrary, practically every industry that relies on data communication is a potential employer. A list of identified employers is included in Appendix L.

4. In what types of computer networking jobs are program graduates employed?

   Organizations will have many computer workstations for each piece of networking equipment. Networking equipment is primarily the responsibility of networking professionals only and that equipment usually requires little attention once it is in place. Conversely, individuals with a wide range of technical expertise use computer workstations, resulting in a larger need for technical support. Add numerous operating system and application upgrades and it is easy to understand why more graduates were employed in jobs related to computer support than in jobs related to networking, as outlined in Table 15 on page 92.

5. To what degree are program graduates finding employment within the Chippewa Valley Technical College district?

   Just over 50% of all 61 respondents found program-related employment. Twenty-two or 36.1% of all respondents found program-related employment within the CVTC district. Another four or 6.6% work elsewhere in Wisconsin and 5 or 8.2% work in one of the four states surrounding Wisconsin. No respondents reported program-related employment outside this area. Clearly, students who enroll in CVTC's CNS program desire to find work and live within the immediate area. Refer to Tables 10, 11, and 19 on pages 81, 82, and 99, respectively, for more information.

6. What is the salary range of program graduates after three months to two years in the workforce?

   Over 43% of respondents who worked full-time in program-related jobs reported annual salaries between $30,000 and $39,999 while another 33% of full-time workers were earning between $20,000 and $29,999 annually. Table 20 on page 100 shows a trend that relates higher salaries with experience. More respondents, who were over three months to one year past graduation, were making salaries between $20,000 and $29,999 annually. As the interval since graduation increased to over one year, so too did the majority of earned salaries increase to the $30,000 to $39,999 range. Salary comparisons in Table 21 on page 102 indicate that the Chippewa Valley offers salaries comparable to those of the other geographic areas in which graduates work. It is also shown, however, that graduates who did move away from the Chippewa Valley were earning salaries in the higher, $30,000 to $39,999 range. Furthermore, the ranges of salaries reported by graduates were typically in the lower half of the range of salaries reported nation-wide for similar occupations (Bureau of Labor Statistics, 2001). See Table 1 on page 31 for national salary statistics.

Research Questions: Needs

1. To what degree do graduates perform the following job functions?
   A. Install, configure, or maintain major network operating systems.
   B. Install, troubleshoot, maintain, or repair various network components.

C. Utilize various networking topologies, media, protocols and hardware.
D. Troubleshoot client workstation computers.
E. Install, troubleshoot, maintain, or repair various computer peripheral components.
F. Create or maintain network documentation.
G. Utilize computer application software.

The study revealed that graduates perform all duties related to the listed job functions to some degree. Tables 22 through 30 (see pages 105 – 129) provide detailed information regarding the duties performed under each of the job functions listed above. The duties that were typically performed most often and held the highest importance ratings included those duties related to the support of client computer workstations. This result is not surprising considering that most graduates (64.5%) employed in program-related jobs were working in some realm of computer support.

On average, graduates do not perform networking duties such as router or switch configuration very often nor do they set up IP telephone systems or videoconferences on a regular basis. Router and switch configuration, although not done often, is still an important skill for network specialists, as indicated by the high importance and performance ratings those duties received from that demographic group of graduates. The review of literature revealed that IP telephony and videoconferencing are technologies that will experience widespread utilization in the future (Green and Jainschigg, 2001;

Connolly, 2001; Moore, 2001). Although graduates are not currently performing these duties often now, they most certainly will be performing them in years to come as the technologies become more pervasive and as graduates' experience levels increase.

2. Is there any additional education/training required for the position?

Less than 20% of graduates working in program-related jobs indicated that they had no need for additional training for career advancement. Most often the graduates identified network operating systems, firewall configuration, network security techniques, and WAN carrier technologies as the areas where they felt they could use additional training or experience. Table 17 on page 95 lists all of the areas of additional training that graduates felt could help them with career advancement.

In a related finding, graduates indicated that they would be most likely to return to CVTC to receive preparation training for CCNP and MCSE certifications. See Table 14 on page 90 for the complete listing.

It is apparent that the technology of the IT field is continuously evolving and those individuals working in this field will need to constantly upgrade their skills to remain employable or advance to opportunities of higher responsibility and pay.

Recommendations Related to This Study

The results of this study present several suggested responses for the CNS faculty and CVTC leadership to consider.

1. Although there are mixed reviews concerning the validity of professional certifications, the review of literature and the members of the CNS program advisory committee agreed that in lieu of work experience, professional certification is the next best way for program graduates to successfully compete in the IT job market (Vaas, 2001). Efforts to encourage CNS program students to prepare for, take, and pass entry-level certification exams prior to graduation need to be improved. The faculty may wish to consider requiring at least one professional certification as a condition of program completion. The presence of an on-campus VUE testing center since December 2001 and available discount vouchers for CCNA and A+ exams should act to stimulate certification testing.
2. Employment rates and salaries of IT professionals can vary widely across the career field and across geographic location (Bureau of Labor Statistics, 2001). Many of the comments received from CNS program graduates revealed the difficulty they have had in finding employment related to the education they received. Perhaps CVTC should examine its career counseling procedures to include information to increase student awareness of the job market and salary potential in the IT field. Students need to be aware that relocation may be necessary for them to be able to secure employment related to their training. Program enrollment caps that more accurately match the employment market could be considered.

3. CVTC leadership and faculty should work together to foster partnerships with any new and/or expanding high-tech industries which may be attracted to the Chippewa Valley because of Governor McCallum's recent announcement of the I-94 Corridor Technology Zone (Wisconsin Department of Commerce, 2002). Partnerships with new industries should include program advisement from industry leaders, internship sites for current CNS program students, and employment opportunities for graduates.
4. There are many job titles associated with the IT professions and, comparably, many industries employing IT professionals. Potential and current students of the CNS program need to be made aware of the types of careers available and the skill sets needed, including general education skills, for successful employment in such a diverse field (Computing Research Association, 1999).
5. The CNS program curriculum must continue to provide the wide base of training opportunities it currently offers. However, the program curriculum must adapt to keep pace with the continual technological evolution of the IT field. As software manufacturers roll out new versions of workstation and network operating systems, the program's curriculum will need to incorporate instruction in the use of the latest versions (Connolly, 2001).
6. Network testing and analysis software and hardware is also changing in function and form. Faculty will need to meet the challenge of incorporating the latest techniques for identifying and solving network problems into the curriculum (Andress, 2001; Lee, 2001).

7. The inclusion of the latest applications of network utilization including videoconferencing and voice over Internet Protocol (VoIP) telephony into the CNS curriculum will be a monetary and content challenge that CVTC leadership and faculty will need to address in the very near future (Green and Jainschigg, 2001; Connolly, 2001; Moore, 2001).
8. Program faculty will also face curriculum implementation of the latest network media solutions – fiber optic cabling and wireless networking. The bandwidth and/or mobility requirements of modern networking applications has necessitated the migration to higher bandwidth media or media that is not tied to physical connections (Lee, 2001; Nicoll, 2001).
9. As organizations depend more heavily on network resources and storage capabilities and as the threat of intrusion into private networks has increased, the need to improve data and network security has led to numerous security solutions. The CNS program should incorporate curriculum modifications to keep current on the latest security software and hardware technologies (Harreld & Fonseca, 2001).
10. Several graduates commented on the importance of work experience and the important role that internships play in allowing students to get that important initial experience. The department needs to look at ways of recruiting more local employers into the internship program to expand the base of internship opportunities for students.

11. There are opportunities to bring program graduates back to CVTC for further training. Potential training opportunities include firewall configuration, network operating systems, and network security techniques. Graduates also indicated an interest in pursuing CCNP and MCSE certifications. Methods of developing, promoting, and offering additional training opportunities for our graduates and other IT professionals should be explored.
12. The department should continue to seek opportunities to write articulation agreements with four-year universities, such as the agreement between CVTC's CNS program and the B.S. in Telecommunication Systems program at University of Wisconsin-Stout (University of Wisconsin-Stout and Chippewa Valley Technical College, 2002). These articulation agreements allow CNS program graduates to apply earned associate degree credits toward further educational opportunities.

Recommendations for Further Study

Information Technology educators should also consider a few additional recommendations associated with this study.

1. Initiate efforts toward professionalism of IT occupations. The CNS faculty at CVTC and the other technical colleges in the Wisconsin Technical College System can begin to foster a focus on professional conduct and attitude within the existing technical curriculum (National IT Workforce Convocation, no date).

2. Investigate methods of attracting women into IT professions. Attention should be focused on ways to encourage female middle school and high school students to take computer, electronics, and other technology-based course work.
3. Conduct a needs assessment of organizations that employ computer support specialists and network specialists to determine the skill sets they require for these types of employees.
4. Survey employers of computer support specialists and network specialists to determine if an applicant's possession of a professional certification is considered during the hiring process. Also, discover which certifications, if any, employers hold in high regard.
5. Determine why a large percentage of CNS program graduates did not find program-related employment and why no graduates were employed outside the upper Midwest region.
6. The study should be replicated often. The review of literature suggests that this is a changing field. New technology will lead to a revised skill set for future IT professionals. Therefore, this study should be replicated on a regular basis to determine program-related job placement rates and the occupational skill sets that future CNS graduates will have to hold to be marketable in the workforce. The CNS program curriculum will have to be updated regularly to keep abreast of the changes to come.

7. This study could be replicated for all CNS programs of the Wisconsin Technical College System. The employment rates of graduates and skill sets graduates need for program-related occupations may vary based on each district's demographics. Replication of this study statewide will help each technical college maintain a curriculum consistent with industry needs.
8. If this study were replicated, the ordering of survey questions should be examined to determine if a better sequence of the questions could be developed. The question regarding salaries should be modified. Based on the results of this study, salary ranges in excess of $70,000 could be eliminated. In addition, to facilitate more meaningful salary information, either the range of each of the possible salary responses should be narrowed or respondents should be asked to simply state their annual salary.

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APPENDIX A

Computer Network Specialist Faculty

Paul Almquist
Jon Brutlag
Jon Cooley
John Creaser (technician)
Karen Derks (lab assistant)
Timothy Fawcett
Brian Goodman
Gary Johnson
Gerald Koehler
Robert Pagel
Mark Puig
Brian Schwahn
James Severson (program counselor)
Kelly Svoma
Terrence Truesdell

APPENDIX B

Computer Network Specialist Advisory Committee Members

Name	Company
Mark Adams	student representative
Ray Bailey	Berquist Company
Jim Embke	Luther Hospital
J.B. Grangaard	student representative
Randy Hammer	Chippewa Valley Technical College
Mel Jahnke	Imagineering, Inc.
Dale Johnson	UWEC
Mark Larsen	Xcel Energy
Richard Long	Wipfli Ullrich Bertelson, LLP
Bruce Lubinski	Royal Credit Union
James Maloney	Chippewa Valley Technical College
Pete Nohelty	Cisco Systems
Cindy Truesdell	Truesdell Technologies

APPENDIX C

Pilot Survey Cover Letter to CNS faculty

February 14, 2002

«FirstName» «LastName»
«Address1»
«City», «State» «PostalCode»

Pilot of the Computer Network Specialist Graduate Follow-up Survey

I am conducting an employment follow-up study of the graduates of the Computer Network Specialist program. In an effort to update the curriculum of the Computer Network Specialist Program, I am asking for your input. You can assist with the improvement of the Computer Network Specialist Program by completing the enclosed survey.

As a member of the faculty of the Computer Network Specialist Program, you have been instrumental in setting the course for the program. In its final form, the survey that is enclosed will be sent to graduates of the program to gain information about their place of employment, the job duties they are currently performing, any certifications they hold, and any need of further training.

I am asking for your assistance with the editing and content improvement of the survey instrument. Please complete the enclosed survey as it relates to your particular specialty. More importantly, please feel free to add comments, suggest additional survey items, or suggest wording changes as you complete the survey. Your input, as a computer networking professional, will be helpful as I finalize the format and content of this survey instrument.

Your answers are completely confidential and will be used only to improve the survey instrument or as summaries in which no individual's answers can be identified. Identifying numbers on the survey are merely used to indicate who has responded for follow-up purposes. If you receive a duplicate survey in error, please return the blank questionnaire indicating that fact. The survey is voluntary. However, you can help me greatly by taking a few minutes to share your expertise about the computer-networking field. If for some reason you prefer not to respond, please let me know by returning the blank questionnaire in the enclosed business reply envelope.

Please return the survey to me in the enclosed business reply envelope by February 25, 2002. The results of the graduate follow-up study will help us make positive, progressive and relevant changes in the Computer Network Specialist Program at Chippewa Valley Technical College. If you would like to be notified about the results of this research, send an email to me at bgoodman@chippewa.tec.wi.us.

Thank you for helping to shape this important study.

Sincerely,

Brian M. Goodman
Instructor, Computer Network Specialist Program

Enclosures

APPENDIX D

Pilot Survey Cover Letter to Advisory Committee Members

February 14, 2002

«FirstName» «LastName»
«Company»
«Address1»
«City», «State» «PostalCode»

Pilot of the Computer Network Specialist Graduate Follow-up Survey

I am an instructor in the Computer Network Specialist Department at Chippewa Valley Technical College in Eau Claire, Wisconsin. In an effort to update the curriculum of the Computer Network Specialist Program, I am asking for your input. You can assist with the improvement of the Computer Network Specialist Program by completing the enclosed survey.

As a member of the Advisory Committee for the Computer Network Specialist Program, your input has always been important in setting the course for the program. In its final form, the survey that is enclosed will be sent to graduates of the program to gain information about their place of employment, the job duties they are currently performing, any certifications they hold, and any need of further training.

I am asking for your assistance with the editing and content improvement of the survey instrument. Please complete the enclosed survey as it relates to your particular field. More importantly, please feel free to add comments, suggest additional survey items, or suggest wording changes as you complete the survey. Your input, as a computer networking professional, will be helpful as I finalize the format and content of this survey instrument.

Your answers are completely confidential and will be used only to improve the survey instrument or as summaries in which no individual's answers can be identified. Identifying numbers on the survey are merely used to indicate who has responded for follow-up purposes. If you receive a duplicate survey in error, please return the blank questionnaire indicating that fact. The survey is voluntary. However, you can help me greatly by taking a few minutes to share your expertise about the computer networking field. If for some reason you prefer not to respond, please let me know by returning the blank questionnaire in the enclosed business reply envelope.

Please return the survey to me in the enclosed business reply envelope by February 25, 2002. The results of the graduate follow-up study will help us make positive, progressive and relevant changes in the Computer Network Specialist Program at Chippewa Valley Technical College. If you would like to be notified about the results of this research, send an email to me at bgoodman@chippewa.tec.wi.us.

Thank you for helping to shape this important study.

Sincerely,

Brian M. Goodman
Instructor, Computer Network Specialist Program

Enclosures

APPENDIX E

Pilot Survey Instrument

Graduate Employment Survey 2002

Chippewa Valley Technical College
Computer Network Specialist Department

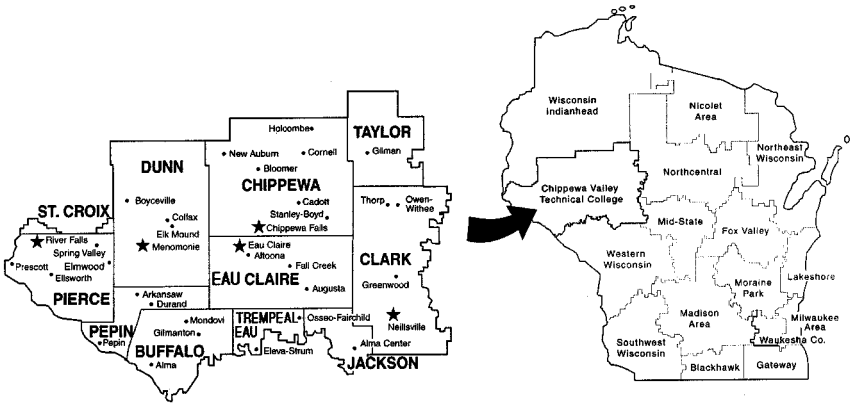
Chippewa Valley Technical College

Please return your completed survey by *February 25, 2002,* in the enclosed postage-paid envelope to:

Brian Goodman, CNS Instructor
Chippewa Valley Technical College
620 W. Clairemont Avenue
Eau Claire, WI 54701-6162

CONSENT STATEMENT: I understand that by returning this questionnaire, I am giving informed consent as a participating volunteer in this study. I understand that the purpose of this study is to investigate job competencies of information technology professionals and agree that any potential risks are exceedingly small. I also understand there are potential benefits that might be realized from the successful completion of this study. I am aware that the information is being sought in a specific manner so that no identifiers are needed and so that confidentiality is guaranteed. I realize that I have the right to refuse to participate and that my right to withdraw from participation at any time during the study will be respected with no coercion or prejudice.

NOTE: Questions or concerns about participation in the research or subsequent complaints should be addressed first to the researcher, Brian Goodman, or research advisor, Dr. Howard Lee, UW-Stout, Menomonie, WI 54751, and second to Susan Foxwell, Human Protections Administrator, UW-Stout Institutional Review Board for the Protection of Human Subjects in Research, 11 HH, UW-Stout, Menomonie, WI 54751, phone 715-232-2477.



Map of the Chippewa Valley Technical College District

Chippewa Valley Technical College
Computer Network Specialist Department
Graduate Employment Survey

PLEASE BEGIN HERE:

1. **What certifications do you currently hold? Check all items that apply.**

   _____ 1. No certifications held
   _____ 2. A+
   _____ 3. CCNA
   _____ 4. CCNP
   _____ 5. CNA
   _____ 6. MCP
   _____ 7. MCSE
   _____ 8. NCSC
   _____ 9. Network+
   _____ 10. Other (specify) _____

2. **What certifications do you plan to test for within the next six months? Check all items that apply.**

   _____ 1. None
   _____ 2. A+
   _____ 3. CCNA
   _____ 4. CCNP
   _____ 5. CNA
   _____ 6. MCP
   _____ 7. MCSE
   _____ 8. NCSC
   _____ 9. Network+
   _____ 10. Other (specify) _____

3. **For which of the following advanced certifications would you return to Chippewa Valley Technical College to receive preparation training? Check all items that apply.**

   _____ 1. None
   _____ 2. CCNP
   _____ 3. CNP
   _____ 4. MCSE
   _____ 5. Other (specify) _____

4. **Which one of the following best describes your present employment status? Check the best answer.**

   _____ 1. Employed full time
   _____ 2. Employed part time
   _____ 3. Not employed, but seeking
   _____ 4. Not available for employment, student
   _____ 5. Not available for employment, disabled
   _____ 6. Not available for employment, other
   (specify) _____

   If you are currently employed, please continue with Question 5. If not employed, please turn directly to Page 8.

5. **Is your current job related to the education you received in the Computer Network Specialist program at Chippewa Valley Technical College? Check your answer.**

   _____ 1. No

   If no, please turn directly to Page 8.

   _____ 2. Yes

   If yes, please continue with Question 6.

6. **Which one of the following titles best describes your job position in the information technology field? Check the best answer.**

   _____ 1. Network Installer
   _____ 2. Network Specialist
   _____ 3. Network Administrator
   _____ 4. Network Systems Analyst
   _____ 5. Computer Support Specialist
   _____ 6. Computer Repair Technician
   _____ 7. Help Desk Specialist
   _____ 8. Other (specify) _____

7. **If you have had to complete additional training for your current job, beyond the training you received at CVTC, how did you receive that training? Check all items that apply.**

_____ 1. No additional training required
_____ 2. Self-study
_____ 3. Coworker/Supervisor-led training
_____ 4. Workshops/Seminars
_____ 5. Two-year college
_____ 6. Four-year college
_____ 7. Other (specify) _____

8. **What additional training or experience do you need to help you advance in your career? Check all items that apply.**

_____ 1. WAN carrier technologies
_____ 2. Voice over Internet Protocol (VoIP)
_____ 3. Video conferencing
_____ 4. Server Operating systems
_____ 5. Advanced router/switch configuration
_____ 6. Network security techniques
_____ 7. Other (specify) _____

9. **What industry category <u>best</u> describes the organization for which you work. Check the best answer.**

_____ 1. Communications
_____ 2. Construction
_____ 3. Consulting or Engineering
_____ 4. Education
_____ 5. Government
_____ 6. Insurance, Finance, or Real Estate
_____ 7. Manufacturing
_____ 8. Medical
_____ 9. Recreation
_____ 10. Repair or Service
_____ 11. Retail or Wholesale Trade
_____ 12. Transportation or Public Utilities
_____ 13. Other (specify) _____

10. **Which <u>one</u> of the following <u>best</u> describes the location of the organization for which you work? Check the best answer.**

_____ 1. Within the CVTC District
(see map on page 2)
_____ 2. Within the State of Wisconsin
_____ 3. Within the region
(including Minnesota, Illinois, Iowa and Michigan)
_____ 4. Within the United States
_____ 5. Outside the United States

11. **Check the range that includes your current gross annual salary, excluding overtime and benefits package.**

_____ 1. Up to $19,999
_____ 2. $20,000 - $29,999
_____ 3. $30,000 - $39,999
_____ 4. $40,000 - $49,999
_____ 5. $50,000 - $59,999
_____ 6. $60,000 - $69,999
_____ 7. $70,000 - $79,999
_____ 8. $80,000 and above

12. **What is the name and address of the organization for which you work? (Employers will be contacted only as potential advisors for the program or as potential employers of future program graduates.)**

_____
_____
_____
_____
_____

13. The table below lists duties normally associated with jobs that are related to the Computer Network Specialist program. Rank the level of importance each duty has in your current job by circling the number in the appropriate column. You may add duties that are not listed next to "Other" at the end of each category.

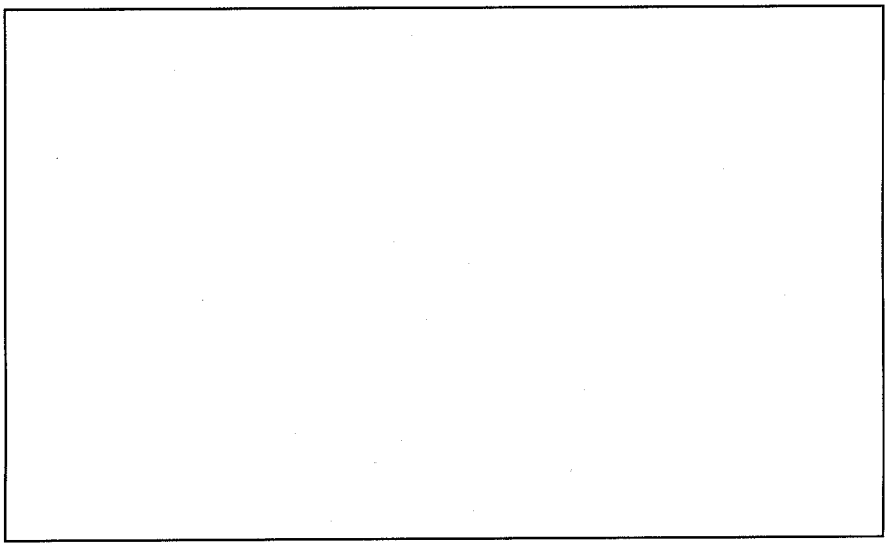
	Category / Job Duty	Low Importance	Below Average Importance	Average Importance	Above Average Importance	High Importance
	Network Operating Systems/Server Components					
N01	Specify network server requirements	1	2	3	4	5
N02	Configure network server hardware	1	2	3	4	5
N03	Configure UNIX operating systems	1	2	3	4	5
N04	Configure Windows operating systems	1	2	3	4	5
N05	Configure Novell operating systems	1	2	3	4	5
N06	Create and maintain network user accounts	1	2	3	4	5
N07	Write or implement network administration scripts	1	2	3	4	5
N08	Design, implement, or oversee network data backup, archival, or disaster recovery procedures	1	2	3	4	5
N09	Implement or maintain network print services	1	2	3	4	5
N10	Resolve hardware, software, or data migration issues	1	2	3	4	5
N11	Plan for server hardware upgrades	1	2	3	4	5
N12	Plan for server software upgrades	1	2	3	4	5
N13	Other:	1	2	3	4	5
	Network Hardware Configuration					
H01	Configure routers	1	2	3	4	5
H02	Create or maintain sub-networks	1	2	3	4	5
H03	Configure network address translation (NAT)	1	2	3	4	5
H04	Configure LAN switches	1	2	3	4	5
H05	Create or maintain VLANs	1	2	3	4	5
H06	Specify WAN carriers	1	2	3	4	5
H07	Configure modems or CSU/DSUs	1	2	3	4	5
H08	Configure ISDN equipment	1	2	3	4	5
H09	Plan for network hardware upgrades	1	2	3	4	5
H10	Configure voice over IP equipment	1	2	3	4	5
H11	Configure videoconferencing equipment	1	2	3	4	5
H12	Other:	1	2	3	4	5

	Category / Job Duty	Low Importance	Below Average Importance	Average Importance	Above Average Importance	High Importance
	Network Media					
M01	Select appropriate network media	1	2	3	4	5
M02	Design or build wiring closets	1	2	3	4	5
M03	Install equipment racks and patch panels	1	2	3	4	5
M04	Install copper-based network cabling and connectors	1	2	3	4	5
M05	Install fiber optic network cabling and connectors	1	2	3	4	5
M06	Test or troubleshoot cables	1	2	3	4	5
M07	Configure wireless networking components	1	2	3	4	5
M08	Other:	1	2	3	4	5
	Network Security and Protection					
S01	Configure anti-virus software	1	2	3	4	5
S02	Configure firewall hardware and software	1	2	3	4	5
S03	Utilize software to control user access rights	1	2	3	4	5
S04	Create and place router access control lists	1	2	3	4	5
S05	Install uninterruptible power supplies	1	2	3	4	5
S06	Other:	1	2	3	4	5
	Client Workstations					
C01	Specify workstation hardware requirements	1	2	3	4	5
C02	Install or configure operating system software	1	2	3	4	5
C03	Install application software	1	2	3	4	5
C04	Install hardware drivers	1	2	3	4	5
C05	Install hardware upgrades or replacement devices	1	2	3	4	5
C06	Configure computer BIOS settings	1	2	3	4	5
C07	Perform repairs on computers	1	2	3	4	5
C08	Other:	1	2	3	4	5
	Peripherals					
P01	Install or configure printers	1	2	3	4	5
P02	Perform periodic maintenance or repairs on printers	1	2	3	4	5
P03	Install or configure video displays	1	2	3	4	5

	Category / Job Duty	Low Importance	Below Average Importance	Average Importance	Above Average Importance	High Importance
P04	Perform repairs on video displays	1	2	3	4	5
P05	Install, or configure scanners	1	2	3	4	5
P06	Perform repairs on scanners	1	2	3	4	5
P07	Other:	1	2	3	4	5
	Help desk and Troubleshooting					
T01	Follow safety precautions and procedures	1	2	3	4	5
T02	Refer to manufacturer service manuals/schematics	1	2	3	4	5
T03	Contact manufacturers' technical support	1	2	3	4	5
T04	Refer to Internet help sites	1	2	3	4	5
T05	Download and use test programs	1	2	3	4	5
T06	Download and install software patches	1	2	3	4	5
T07	Troubleshoot client problems	1	2	3	4	5
T08	Instruct clients on the proper use of network/computer/peripheral equipment	1	2	3	4	5
T09	Maintain spare parts inventory	1	2	3	4	5
T10	Other:	1	2	3	4	5
	Documentation					
D01	Prepare procedure guides or manuals	1	2	3	4	5
D02	Prepare network procedure manuals for IT staff	1	2	3	4	5
D03	Document hardware or software inventory	1	2	3	4	5
D04	Maintain service call records	1	2	3	4	5
D05	Document software licenses	1	2	3	4	5
D06	Other:	1	2	3	4	5
	Computer Usage					
U01	Manage files, folders, and disks	1	2	3	4	5
U02	Develop electronic spreadsheets, databases, documents, or presentations	1	2	3	4	5
U03	Download or upload Internet files	1	2	3	4	5
U04	Maintain an Internet Web site	1	2	3	4	5
U05	Other:	1	2	3	4	5

Continue →

Thank you for taking the time to complete this questionnaire. Your assistance in providing this information is very much appreciated. If there is anything else you would like to tell us about this survey, or the educational experience you had while enrolled in the Computer Network Specialist Program at Chippewa Valley Technical College, please do so in the space provided below.



Thank you for your valuable input!

Please return your completed survey by *February 25, 2002,* in the enclosed postage-paid envelope to:

Brian Goodman, CNS Instructor
Chippewa Valley Technical College
620 W. Clairemont Avenue
Eau Claire, WI 54701-6162

APPENDIX F

Prenotice Postcard

Approximately two weeks from now you will receive in the mail a request to fill out a questionnaire for an important research project I am conducting for the Computer Network Specialist program at Chippewa Valley Technical College. It concerns the employment experiences of graduates of the program. The study is an important one that will help the Computer Network Specialist Department modify and update the content and structure of the program to meets the needs of employers and future students.

Thank you, in advance for your time and consideration. With your help, this research can be successful.

Brian Goodman
Instructor, Computer Network Specialist Department
Chippewa Valley Technical College

APPENDIX G

Graduate Survey Cover Letter

March 8, 2002

«FirstName» «MiddleName» «LastName»
«Address1»
«City», «State» «PostalCode»

Computer Network Specialist Graduate Follow-up Survey

You may recall me as one of the instructors in the Computer Network Specialist Department at Chippewa Valley Technical College, Eau Claire, Wisconsin. In an effort to update the curriculum of the Computer Networking Specialist Program, I am asking for your input. You can assist with the improvement of the Computer Networking Specialist Program by completing the enclosed survey.

You have been chosen to participate in this study because you are identified as a graduate of the Computer Network Specialist program. I am contacting program graduates to gain information about current or future professional certifications, needs for further training, employment status, and program-related job duties currently performed.

Results from the survey will be used by the Computer Network Specialist Department to update the program. The information gathered is critical to support program changes and the development of progressive technical curriculum to support the workforce needs of the region. By understanding the job duties that are performed and the networking technology that is used, the department can also budget for updated and additional equipment to aid the delivery of relevant instruction.

Your answers are completely confidential and will be released only as summaries in which no individual's answers can be identified. Identifying numbers on the survey will be used only for follow-up purposes and general graduating class statistics. When you return your completed questionnaire, your name will be deleted from the mailing list and never directly connected to your answers in any way. The survey is voluntary. However, you can help me greatly by taking a few minutes to share your experiences about your job. At your option, you may elect to not respond to questions that make you feel uncomfortable. If for some reason you prefer not to respond to any of the questions, please let me know by returning the blank questionnaire in the enclosed business reply envelope. If you receive a duplicate survey in error, please return the blank questionnaire indicating that fact.

I have enclosed a small token of appreciation as a way of saying thanks for your help.

Please return the survey to me in the enclosed, business reply envelope, as soon as possible. If you would like to be notified about the results of this research, send an email to me at bgoodman@chippewa.tec.wi.us.

Thank you for helping with this important study.

Sincerely,

Brian Goodman
Instructor, Computer Network Specialist Program

Enclosures

APPENDIX H

Survey Instrument

Graduate Employment Survey 2002

Chippewa Valley Technical College
Computer Network Specialist Department

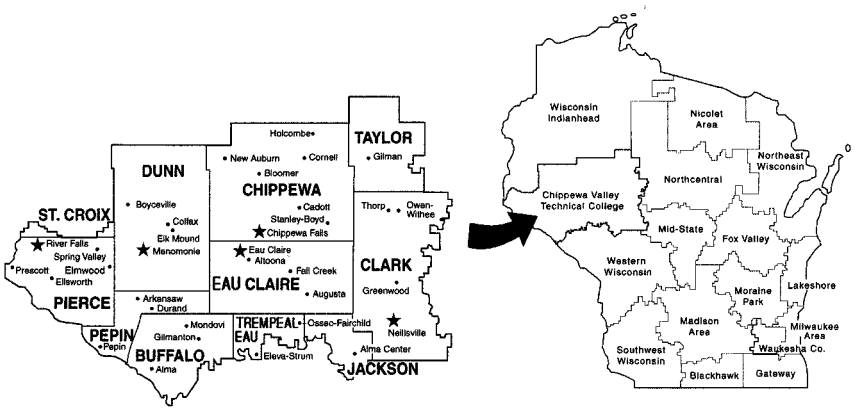
Chippewa Valley Technical College

Please return your completed survey by *March 25, 2002,* in the enclosed postage-paid envelope to:

Brian Goodman, CNS Instructor
Chippewa Valley Technical College
620 W. Clairemont Avenue
Eau Claire, WI 54701-6162

CONSENT STATEMENT: I understand that by returning this questionnaire, I am giving informed consent as a participating volunteer in this study. I understand that the purpose of this study is to investigate job competencies of information technology professionals and agree that any potential risks are exceedingly small. I also understand there are potential benefits that might be realized from the successful completion of this study. I am aware that the information is being sought in a specific manner so that no identifiers are needed and so that confidentiality is guaranteed. I realize that I have the right to refuse to participate and that my right to withdraw from participation at any time during the study will be respected with no coercion or prejudice.

NOTE: Questions or concerns about participation in the research or subsequent complaints should be addressed first to the researcher, Brian Goodman, or research advisor, Dr. Howard Lee, UW-Stout, Menomonie, WI 54751, and second to Susan Foxwell, Human Protections Administrator, UW-Stout Institutional Review Board for the Protection of Human Subjects in Research, 11 HH, UW-Stout, Menomonie, WI 54751, phone 715-232-2477.



Map of the Chippewa Valley Technical College District

Chippewa Valley Technical College
Computer Network Specialist Department
Graduate Employment Survey

PLEASE BEGIN HERE:

1. **What computer/networking certifications do you currently hold? Check all items that apply.**

   _____ 1. A+ (CompTIA computer technician certification)
   _____ 2. CCNA (Cisco Certified Network Associate)
   _____ 3. CNA (Certified Novell Administrator)
   _____ 4. MCP (Microsoft Certified Professional)
   _____ 5. NCSC (Network Cabling Specialist Certificate)
   _____ 6. Network+ (CompTIA network certification)
   _____ 7. Other (specify) _____
   _____ 8. No computer/networking certifications held

2. **What computer/networking certifications do you plan to test for within the next year? Check all items that apply.**

   _____ 1. A+ (CompTIA computer technician certification)
   _____ 2. CCNA (Cisco Certified Network Associate)
   _____ 3. CCNP (Cisco Certified Network Professional)
   _____ 4. CNA (Certified Novell Administrator)
   _____ 5. CNE (Certified Novell Engineer)
   _____ 6. LPIC (Linux Professional Institute Certification)
   _____ 7. MCP (Microsoft Certified Professional)
   _____ 8. MCSE (Microsoft Certified Systems Engineer)
   _____ 9. NCSC (Network Cabling Specialist Certificate)
   _____ 10. Network+ (CompTIA network certification)
   _____ 11. SAIR Linux
   _____ 12. Other (specify) _____
   _____ 13. None

3. **For which of the following advanced certifications would you return to Chippewa Valley Technical College to receive preparation training? Check all items that apply.**

   _____ 1. CCNP (Cisco Certified Network Professional)
   _____ 2. CNE (Certified Novell Engineer)
   _____ 3. LPIC (Linux Professional Institute Certification)
   _____ 4. MCSE (Microsoft Certified Systems Engineer)
   _____ 5. SAIR Linux
   _____ 6. Other (specify) _____
   _____ 7. None

4. **Which <u>one</u> of the following <u>best</u> describes your <u>present</u> employment status? Check the best answer.**

   _____ 1. Employed full time
   _____ 2. Employed part time
   _____ 3. Not employed, but seeking
   _____ 4. Not available for employment, student
   _____ 5. Not available for employment, disabled
   _____ 6. Not available for employment, other (specify) _____

   If you are currently employed, please continue with Question 5. If not employed, please turn directly to the final question on Page 8.

5. **Is your current job <u>related</u> to the education you received in the <u>Computer Network Specialist</u> program at Chippewa Valley Technical College? Check your answer.**

   _____ 1. No

   If no, please go to the final question on Page 8.

   _____ 2. Yes

   If yes, please continue with Question 6 below.

6. **Which <u>one</u> of the following titles <u>best</u> describes your job position in the information technology field? Check the best answer.**

   _____ 1. Consultant
   _____ 2. Contractor
   _____ 3. Computer Repair Technician
   _____ 4. Computer Support Specialist
   _____ 5. Computer Systems Administrator
   _____ 6. Help Desk Specialist
   _____ 7. Network Administrator
   _____ 8. Network Installer
   _____ 9. Network Specialist
   _____ 10. Network Systems Analyst
   _____ 11. Other (specify) _____

7. **If you have had to complete additional job-specific training, beyond the training you received at CVTC, how did you receive that training? Check all items that apply.**

_____ 1. Self-study
_____ 2. Coworker/Supervisor-led training
_____ 3. Workshops/Seminars
_____ 4. Two-year college
_____ 5. Four-year college
_____ 6. Other (specify) _____
_____ 7. No additional training required

8. **What additional training or experience do you need to help you advance in your career? Check all items that apply.**

_____ 1. Advanced router configuration
_____ 2. Advanced LAN switch configuration
_____ 3. Firewall configuration
_____ 4. Network operating systems
_____ 5. Network security techniques
_____ 6. Streaming audio and video
_____ 7. Video conferencing
_____ 8. Voice over Internet Protocol (VoIP)
_____ 9. WAN carrier technologies
_____ 10. Other (specify) _____
_____ 11. No additional training/experience needed

9. **What industry category <u>best</u> describes the organization for which you work. Check the best answer.**

_____ 1. Communications
_____ 2. Construction
_____ 3. Consulting or Engineering
_____ 4. Education
_____ 5. Government
_____ 6. Insurance, Finance, or Real Estate
_____ 7. Manufacturing
_____ 8. Medical
_____ 9. Recreation
_____ 10. Repair or Service
_____ 11. Retail or Wholesale Trade
_____ 12. Transportation or Public Utilities
_____ 13. Other (specify) _____

10. **Which <u>one</u> of the following <u>best</u> describes the location of the organization for which you work? Check the best answer.**

_____ 1. Within the CVTC District
(see map on page 2)
_____ 2. Within the State of Wisconsin
_____ 3. Within the region
(including Minnesota, Illinois, Iowa and Michigan)
_____ 4. Within the United States
_____ 5. Outside the United States

11. **Check the range that includes your current gross annual salary, excluding overtime and benefits package.**

_____ 1. Up to $19,999
_____ 2. $20,000 - $29,999
_____ 3. $30,000 - $39,999
_____ 4. $40,000 - $49,999
_____ 5. $50,000 - $59,999
_____ 6. $60,000 - $69,999
_____ 7. $70,000 - $79,999
_____ 8. $80,000 and above

12. **Optional: What is the name and address of the organization for which you work? (Employers will be contacted only as potential advisors for the program or as potential employers of future program graduates.)**

_____
_____
_____
_____
_____

13. The table below lists duties normally associated with jobs that are related to the Computer Network Specialist program. Rank the level of importance each duty has in your current job by circling the number in the appropriate column. You may add duties that are not listed next to "Other" at the end of each category.

	Category / Job Duty	Level of Importance					
		Low	Below Average	Average	Above Average	High	Does Not Apply
	Network Operating Systems/Server Components						
N01	Specify network server requirements	1	2	3	4	5	N/A
N02	Configure network server hardware	1	2	3	4	5	N/A
N03	Configure Linux network operating systems	1	2	3	4	5	N/A
N04	Configure UNIX network operating systems	1	2	3	4	5	N/A
N05	Configure Microsoft network operating systems	1	2	3	4	5	N/A
N06	Configure Novell network operating systems	1	2	3	4	5	N/A
N07	Configure DNS and/or DHCP services	1	2	3	4	5	N/A
N08	Create and maintain network user accounts	1	2	3	4	5	N/A
N09	Write or implement network administration scripts	1	2	3	4	5	N/A
N10	Install or configure RAID storage	1	2	3	4	5	N/A
N11	Implement or maintain network print services	1	2	3	4	5	N/A
N12	Resolve hardware, software, or data migration issues	1	2	3	4	5	N/A
N13	Plan for server hardware upgrades	1	2	3	4	5	N/A
N14	Plan for server software upgrades	1	2	3	4	5	N/A
N15	Other:	1	2	3	4	5	N/A
	Network Hardware Configuration						
H01	Configure routers	1	2	3	4	5	N/A
H02	Create or maintain sub-networks	1	2	3	4	5	N/A
H03	Configure network address translation (NAT)	1	2	3	4	5	N/A
H04	Configure LAN switches	1	2	3	4	5	N/A
H05	Create or maintain VLANs	1	2	3	4	5	N/A
H06	Specify WAN carriers	1	2	3	4	5	N/A
H07	Configure modems or CSU/DSUs	1	2	3	4	5	N/A
H08	Configure ISDN equipment	1	2	3	4	5	N/A
H09	Plan for network hardware upgrades	1	2	3	4	5	N/A
H10	Configure voice over IP equipment	1	2	3	4	5	N/A
H11	Configure videoconferencing equipment	1	2	3	4	5	N/A
H12	Other:	1	2	3	4	5	N/A

	Category / Job Duty	Level of Importance					
		Low	Below Average	Average	Above Average	High	Does Not Apply
	Network Media						
M01	Select appropriate network media	1	2	3	4	5	N/A
M02	Design or build wiring closets	1	2	3	4	5	N/A
M03	Install equipment racks and patch panels	1	2	3	4	5	N/A
M04	Install copper-based network cabling and connectors	1	2	3	4	5	N/A
M05	Install fiber optic network cabling and connectors	1	2	3	4	5	N/A
M06	Test or certify network cabling	1	2	3	4	5	N/A
M07	Configure wireless networking components	1	2	3	4	5	N/A
M08	Other:	1	2	3	4	5	N/A
	Network Security and Protection						
S01	Configure anti-virus software	1	2	3	4	5	N/A
S02	Configure firewall hardware and software	1	2	3	4	5	N/A
S03	Create or install security policies and procedures	1	2	3	4	5	N/A
S04	Utilize security intrusion devices or software	1	2	3	4	5	N/A
S05	Create and place router access control lists	1	2	3	4	5	N/A
S06	Design, implement, or oversee network data backup, archival, or disaster recovery procedures	1	2	3	4	5	N/A
S07	Install uninterruptible power supplies	1	2	3	4	5	N/A
S08	Other:	1	2	3	4	5	N/A
	Client Workstations						
C01	Specify workstation hardware requirements	1	2	3	4	5	N/A
C02	Install or configure operating system software	1	2	3	4	5	N/A
C03	Install application software	1	2	3	4	5	N/A
C04	Install software patches and upgrades	1	2	3	4	5	N/A
C05	Install hardware drivers	1	2	3	4	5	N/A
C06	Install hardware upgrades or replacement devices	1	2	3	4	5	N/A
C07	Configure computer BIOS settings	1	2	3	4	5	N/A
C08	Perform repairs on computers	1	2	3	4	5	N/A
C09	Other:	1	2	3	4	5	N/A
	Peripherals						
P01	Install or configure printers	1	2	3	4	5	N/A
P02	Perform periodic maintenance or repairs on printers	1	2	3	4	5	N/A
P03	Install or configure video displays	1	2	3	4	5	N/A

	Category / Job Duty	Level of Importance					
		Low	Below Average	Average	Above Average	High	Does Not Apply
P04	Perform repairs on video displays	1	2	3	4	5	N/A
P05	Install, or configure scanners	1	2	3	4	5	N/A
P06	Perform repairs on scanners	1	2	3	4	5	N/A
P07	Other:	1	2	3	4	5	N/A
	Help desk and Troubleshooting						
T01	Follow safety precautions and procedures	1	2	3	4	5	N/A
T02	Refer to manufacturer service manuals/schematics	1	2	3	4	5	N/A
T03	Contact manufacturers' technical support	1	2	3	4	5	N/A
T04	Refer to Internet help sites	1	2	3	4	5	N/A
T05	Download and use test programs	1	2	3	4	5	N/A
T06	Download and install software patches	1	2	3	4	5	N/A
T07	Troubleshoot client problems	1	2	3	4	5	N/A
T08	Instruct clients on the proper use of network/computer/peripheral equipment	1	2	3	4	5	N/A
T09	Maintain spare parts inventory	1	2	3	4	5	N/A
T10	Other:	1	2	3	4	5	N/A
	Documentation						
D01	Document network security measures and procedures	1	2	3	4	5	N/A
D02	Prepare procedure guides or manuals for network users	1	2	3	4	5	N/A
D03	Prepare network procedure manuals for IT staff	1	2	3	4	5	N/A
D04	Document hardware or software inventory	1	2	3	4	5	N/A
D05	Maintain service call records	1	2	3	4	5	N/A
D06	Document software licenses	1	2	3	4	5	N/A
D07	Other:	1	2	3	4	5	N/A
	Computer Usage						
U01	Manage files, folders, and disks	1	2	3	4	5	N/A
U02	Develop electronic spreadsheets, databases, documents, or presentations	1	2	3	4	5	N/A
U03	Download or upload Internet files	1	2	3	4	5	N/A
U04	Maintain an Internet Web site	1	2	3	4	5	N/A
U05	Other:	1	2	3	4	5	N/A

Continue →

Thank you for taking the time to complete this questionnaire. Your assistance is very much appreciated. If there is anything else you would like to tell us about this survey, or the educational experience you had while enrolled in the Computer Network Specialist Program at Chippewa Valley Technical College, please do so in the space provided below.

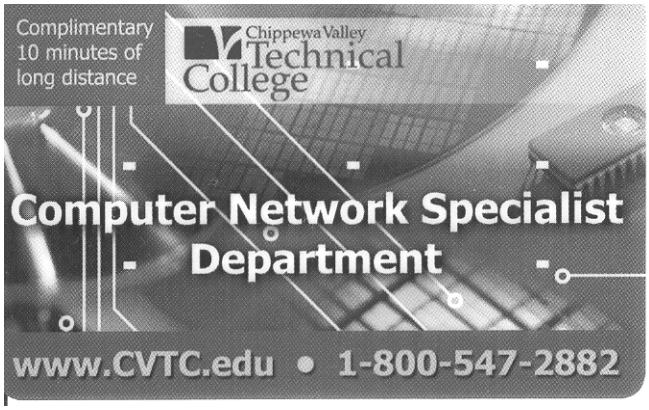
Thank you for your valuable input!

Please return your completed survey by March *25, 2002,* in the enclosed postage-paid envelope to:

Brian Goodman, CNS Instructor
Chippewa Valley Technical College
620 W. Clairemont Avenue
Eau Claire, WI 54701-6162

APPENDIX I

Token Phone Card



APPENDIX J

Follow-Up Postcard

Approximately two weeks ago a questionnaire concerning the employment of graduates of the Computer Network Specialist was mailed to you. You were selected to participate because Chippewa Valley Technical College records identify you as a program graduate.

If you have already completed and returned the questionnaire, please accept my sincere thanks. If you haven't had the opportunity to complete the questionnaire, please take a few minutes to do so today. I am especially grateful for your help because it is by asking people like you to share your experiences that the Computer Network Specialist program can better serve the workforce needs of the region. If you did not receive a questionnaire, or it was misplaced, please call 1-800-547-2882, extension 4626 and another one will be mailed to you today.

Brian Goodman
Instructor, Computer Network Specialist Department
Chippewa Valley Technical College

APPENDIX K

Follow-Up Survey Cover Letter to Non-Respondents

April 9, 2002

«FirstName» «MiddleName» «LastName»
«Address1»
«City», «State» «PostalCode»

Computer Network Specialist Graduate Follow-up Survey

About four weeks ago I sent a questionnaire to you that asked about your employment situation since you graduated from the Computer Network Specialist program at Chippewa Valley Technical College. To the best of my knowledge, it has not yet been returned.

The information gathered from graduates who have already responded includes an interesting variety of professional certifications they hold, job duties they perform, and further training needs they have. The results are going to be very useful to the Computer Network Specialist Department at Chippewa Valley Technical College as well as other Computer Network Specialist programs throughout the Wisconsin Technical College System. The results of the survey will help Chippewa Valley Technical College make positive, progressive, and relevant program changes to its Computer Network Specialist program.

I am writing again because of the importance that your questionnaire has for helping to get accurate results. Although I sent questionnaires to every identified graduate of the Computer Network Specialist program, it is only by hearing from nearly everyone that I can be sure that the results are truly representative of the employment situation of program graduates.

A few people have responded by saying they received a duplicate survey in error or because they prefer not to respond. If either of these concerns applies to you, please let me know by returning the blank questionnaire and indicating the reason for its return.

If you are concerned about survey procedures, your answers are completely confidential and will be released only as summaries in which no individual's answers can be identified. Identifying numbers on the survey are merely used to indicate who has and who has not yet responded.

I hope that you will fill out and return the questionnaire in the enclosed reply envelope today.

Thank you.

Brian Goodman
Instructor, Computer Network Specialist Department

Enclosures

APPENDIX L

Program-related Employers

Question 12

Chippewa Falls School District
1130 Miles St.
Chippewa Falls, WI 54729

Chippewa Valley Technical College
620 W. Clairemont Ave.
Eau Claire, WI 54701

E.O. Johnson Company
(no address provided)

Fall Creek School District
336 E. Hoover Ave.
Fall Creek, WI 54703

Luther Midelfort
1221 Whipple Street
Eau Claire, WI 54701

Menards
2114 Old Mill Center
Eau Claire, WI 54703

Menards
4777 Menard Drive
Eau Claire, WI 54703

Menominee Indian Tribe of Wisconsin
MIS Dept.
4 Office Loop Road
Keshena, WI 54135

Menomonie Area Schools
215 Pine Ave. NE
Menomonie, WI 54751

Nelco Corporation
3130 S. Ridge Road
Green Bay, WI 54304

University of Wisconsin-Stout
(no address provided)

URS Corp.
Thresher Square
700 Third St. South
Minneapolis, MN 55415

Vet Connect Systems (two occurrences)
2536 Alpine Road
Eau Claire, WI 54703

Wipfli Ullrich Bertelson LLP
3703 Oakwood Hill Pkwy
Eau Claire, WI 54702

APPENDIX M

Comments

Final Question

Program Content

Actual access to Network hardware is very limited. If router and switches are configured properly initially, then need for further intervention is limited. Computer support skills and Network OS and Network Priority skills are very important.

What helped me the most was spending after hours time in the lab troubleshooting computers. Troubleshooting and or preventing all sorts of problems is 70% of my job. Thinking in crisis is crucial. I spend 40% of my time in documentation to train and prevent problems. 20% of my time solving people problems after they occur. 40% of my time actually working with hardware and software.

I deal a lot with IMAC computers being networked in my current job with a school district. OS 9.9.2 (workstations) OS X.1.3 (servers)

Mr. Goodman,
I did not complete the survey as I did not pursue a career in my field of study. However, I was extremely marketable in the IT field with the A.A.S. earned at CVTC. I had a Junior Network Administrator job offered to me at the University of Wisconsin Hospital in Madison, WI. I chose to chase different avenues for carious reasons. I now reside in Champaign Il. Pursuing a career in commercial insurance.
I did prepare myself for the Cisco CCNA test prior to this new career in insurance by taking the Cisco III and IV classes in Champaign. I would encourage those pursuing the CNS program to definitely finish the Cisco program, if it isn't a requirement already.
I would encourage students to take field trips and pursue big companies for tours. I found by doing this so my pieces fall together. I would also encourage CVTC to explore wireless LAN technology and remote network software. I think Citrix was asked by every employer I met with. I don't know what it is, but I kept hearing about it.
Madison was abundant with opportunity, but that was spring 2000 when I was pursuing IT positions. I do not know much about the IT industry now and the job market. Hope this helps.

I felt the teachers at CVTC were well trained, and able and willing to spread their knowledge to the students. I also felt the students were able to persuade some teachers to be more lenient then they should be. I think students should be held more accountable for items like test and homework assignments, better preparing them for the work force. Overall. CVTC was very enjoyable and prepared me well for the work force. Thanks!

I think there either should be more of the TCP/IP protocol stack in the intro to OS class or make a separate class. I feel that this is very important to have a complete grasp of what can be done with all of those commands to test networks and troubleshoot them.
There should be at least one mare programming class in the CNS program. Java is very helpful when creating help documents. I believe many more documents are being posted to inter/intra company websites. They are easier to use when they are java scripted. More emphasis on Network+. You don't have to renew that certification which may make it more popular than before.

Internships and Employment

One important thing is to have internships for students available in the school or in some companies in the area.

The overall educational experience was good, with the exception of Cisco, which was excellent. However, the program could use more exposure marketing internships, etc. within the business community to increase graduate employability. The degree just isn't enough to obtain employment.

My education at CVTC was a very good starting point to get into computer networking. This program really needs to be a four year program. More hands on experience is needed!! When applying for jobs in CNS most employers want at least 3 years experience. They want you to just jump on into your job with no training by them. It's a very tough career to get into without experience. It took me 9 months to get the consulting job I have and I was very lucky to get it. It took me 4 months to even get a job at Best Buy in the tech branch area. A one year internship in CNS is almost a must.

I graduated with a CNS-software degree. While in school I inquired about internships. I was told to find one myself and I would be given credit for it. I was under the impression that the department had lists of employers willing to take on interns. I didn't have a clue where to go for an internship. After graduation I received one job opening possibility from CVTC. I don't understand 98% placement I got a temp. job because of a company upgrade. I have worked there for 5 months now, and I have been job hunting the entire time. I have not found one job opening in my field that the degree I received qualifies me for.

CVTC should not allow students to obtain an emphasis in hardware – there is hardly a demand for such training. CVTC should eliminate or have a greater preparation for the programming for systems Admin. Course. That was my only deterrent from taking the software track. CVTC should also help with job placement or at least small interns.

There are only a few things that I have applied to my current job other that the few on the side jobs that I do that have to do with computers. I hope to find a computer networking or hardware related job in the area in the near future. Thank you for you concerns and the phone card.

I think there should be some mandatory guidance for seeking employment. A bit more help in actually finding a job. Thank You!

I'm not sure how much this area needs or wants computer networking specialists. When I graduated it was hard to find a job in this field. I hope it is growing. I feel the training I received was excellent and helped me in my current position as a maintenance tech at Bush Brothers. I'm not sure if I will pursue a computer networking job. Thank you for the phone card.

I looked hard for a job in this field and finally (after 11/2 years in the program and looking for a job and then 6 months of job search after graduating from the program) decided to settle for a job out of the field. I liked the program and thought I'd enjoy the work, but have not bad a chance to apply my schooling. I would take more classes, if I was sure of getting a job in the field or had a job in the field.

Other Comments

I am a transfer student at UW-Stout in their telecommunications program. I will have my bachelors soon and feel that CVTC is an excellent place to start if you want a thorough "ground up" base education. UW-Stout instructors are less thorough with CISCO classes. I definitely fell I've profited from beginning my training at CVTC. Send another survey in Jan. 2003 as I will then be in the workforce.

I think you covered the bases well and would recommend this college to any of my friends and co-workers.

I think this survey is very helpful for future students who want to enroll in the computer networking field. In my opinion, I really enjoy going to Chippewa Valley Tech. as a student in the computer networking. Teachers and Instructors are very helpful in determining student's education and future needs. Even though I am not employed, the program really benefit me of what I have learned because I enjoy working with electronics and computers.

The program was great! Just not what I needed to do with my life. I'm working in the medical field now. Thanks

I reviewed the survey and think it is put together well. I'm currently working where I did during school. I'm also updating my resume and preparing to send it out. I'm not employed in my field because I'm waiting for my fiancé to be done with is current teaching position. It DOES NOT have anything to do with the lack of education I was given. I believe once I start applying my education will come in quite well. Thanks for the survey.

No problem, I enjoyed to do this survey.

Sorry that it took so long to respond, but I did travel Europe and wasn't getting my mail sent home for a while. I hope this is still helpful. Have a good rest of the year.