TECHNICAL COMPETENCY NEEDS ASSESSMENT FOR THE GRADUATES OF TELECOMMUNICATION SYSTEMS AT UW-STOUT

by

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ABSTRACT

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This study assesses the technical competencies needed for the graduates of the B.S. in Telecommunication Systems program at the University of Wisconsin-Stout (UW-Stout).

The descriptive research design contains a survey of telecommunications graduates of UW-Stout. The graduates responded to the survey questionnaire that listed a number of technical competencies and ranked each competency by its level of importance.

The study found that the program graduates ranked professional certification (Cisco and Microsoft) much higher than a number of existing program emphasis areas. Findings from the assessment provide a reference for program improvements and curriculum revisions for the B.S. Degree in Telecommunication Systems of UW-Stout.

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Background of the Problem

Telecommunications is one of the most rapidly evolving technologies in our society. The increasing adoption of new telecommunication technologies in business and industry has resulted in the growing demand for the training for the workforce in this field. Therefore, not only on-the-job training within an organization is important, it is critical to provide sufficient training for the students at school to fit into the work marketplace.

However, the existed training provided by education or training institutions may not always be able to keep up with the rapid change of technology used in workplaces. In order to provide up-to-date knowledge and skills for students, their curricula and program design need to be revised frequently.

The University of Wisconsin-Stout (UW-Stout) has developed a program, which offers a Bachelor of Science degree in Telecommunication Systems. Before the program was established, it had been one of the undergraduate concentration areas in Industrial Technology Bachelor of Science degree for over a decade. The intent of the program was to educate telecommunications analysts, planners and managers for the telecommunication industry.

Coping with the rapid evolution of telecommunication technology and the increasing demand for the workforce in this area, a competency needs assessment for telecommunication professionals is needed for the university to determine what

Telecommunication Systems students should acquire in order to be competitive in the industry.

Statement of the Problem

The problem of this study is to assess the technical competencies needed for telecommunications professionals. The purpose is to ascertain the proper training needed for the students of the Telecommunication Systems program of UW-Stout.

Research Objectives

This research project will attain the follow objectives:

1. Describe the telecommunications field.
2. Identify needed competencies for telecommunications workers.
3. Determine level of importance of telecommunications technical competencies.
4. Provide a reference for future program improvement and curriculum revision.

Significance of the Study

It is essential to measure the gap between the competencies needed for telecommunications professionals and the current courses offered by the telecommunications program. The result of the research will serve as a reference for the university to determine what competencies students should acquire, so that the program curriculum can be modified. Therefore, proper training for the future telecommunications workforce can be provided. This study is significant to both the university and the telecommunications industry. The results of the assessment also can be a reference to other education institutions that offer similar programs.

Limitations

One of the limitations of this study is that the scope of its population is small. Only the telecommunication graduates of UW-Stout are included. If the population was expanded to general telecommunications industry, including employers and workers, the survey result could be more objective.

Another limitation is that this study is particularly designed for the B.S. in Telecommunication Systems of University of Wisconsin-Stout. It specifically focuses on the needs of this program. To other education institutions that offer similar programs, the result of this study may serve as a reference, however, may not be totally applicable to them.

CHAPTER II

Literature Review

What is Telecommunications

According to Newton's Telecom Dictionary (Newton, 1998), the term "telecommunications" is defined as "the art and science of 'communicating' over a distance by telephone, telegraph and radio." It is "the transmission, reception and the switching of signals, such as electrical or optical, by wire, fiber, or electromagnetic (i.e. through-the-air) means" (p. 711).

O'Neil and Everett (1988) define "telecommunications is like communications, except that it involves communicating electronically across distances (generally over telephone lines) without any changes occurring to the original message. All forms of information may be sent electronically: voice, text, data, graphics, and video" (p. 2).

Another definition is given to "telecommunications technology" as "the electronic communication of information over distance" (Mitchell, Hendricks & Sterry, 1993, p. 7). The key word "electronic" in this definition "refers to the present-day use of telecommunications, which involves the use of technology for signaling purposes" (Mitchell, Hendricks & Sterry, 1993, p. 7).

Kooker and Brey (1991) state that telecommunications is broadly defined as "the process by which information gets transferred electronically from one place to another" (p. 6). They also pointed out some examples of telecommunications in our society, such as basic telephone system, cellular and mobile phones, credit card verification network, facsimile transmission, broadcast and cable TV/radio, etc.

The Evolution of Telecommunications

People who live in the last decade of the twentieth century are so accustomed to the convenience brought by modern technologies that most of the time they seem to take it for granted. If we review the history of human communication, we will find that the communication technologies we are using today were not achieved in one day; they are the result of evolution.

The ancient Egyptian, Athenian, and Roman utilized fire, smoke, and flags to communicate at a distance. Men also knew to send news by pigeons because they could fly hundreds of miles at speeds up to eighty miles an hour. Messengers strongly relied on horses to deliver written documents (Oslin, 1992).

Although electricity had been discovered early in ancient China, it was not widely known until the famous experiment of Benjamin Franklin in 1748: Franklin successfully discharged electricity through a wire across the Schuylkill River at Philadelphia. Later on, more electrical devices were invented one after another and were applied to our lives (Oslin, 1992).

During the 1800's, telegraph (1836), telephone (1876), and radio (1895) were invented (Heldman, 1993). They soon became new communication tools and brought a dramatic change to human lives. For telegraphy, early in 1753, people were suggested that using a wire for each letter of the alphabet. In 1787, a French mechanic used a wire to send words in code to another room. In 1794, Russer and Salva found that telegraph could be operated by "interrupting electric circuits on the desired wire and causing sparks to appear" (Oslin, 1992, p.3). More scientists continued improving telegraph devices. Among them, Samuel F. B. Morse designed the first commercial telegraph apparatus for public and practical use. The dot-and-dash Morse code, the Morse key, and the stylus recorder became the most well-known telegraph inventions (Oslin, 1992).

Like the telegraph, the telephone is a result from its preceding inventions. In 1861, a German physics teacher created a telephone with a make-and-break transmitter. It could be used to exchange words and sentences. After experimenting a number of telephone instruments, in 1876, Alexander Graham Bell demonstrated a telephone that could send voice at a distance through a wire from one end to another (Oslin, 1992).

As we look back at the history of communication technology, we found that it is also the “story of how man overcame the barriers of time and space” (Oslin, 1992, p. 474). Man adopted new technologies such as telegraph or telephone to communicate at a distance more efficiently, and no longer set fire to inform each other like his ancestors did.

After radio was invented, communication advances widely changed people’s lives. Radio broadcasting had not only met people’s need for the latest news and information but also entertained the masses. Simply turning knobs, people at homes or on farms were able to listen music played by radio stations from a thousand miles away. In the 1920s, amateur radio operators could set up short-wave stations in their homes and talk with other “radio hams” all over the world (Oslin, 1992).

Telecommunications innovations continued evolving in the twentieth century. There was television (1920), analog computers (1930), radar (1935), xerography (1937), digital computers (1954), artificial satellites (1957), lasers (1960), integrated circuits (1962), digital transmission (1964), VLSI computer (1980), super computer (1982-88), fiber optics (1985), broadband switching (1990), photonic switching (1990), optical amplifier (1990), voice recognition (1994), and more are coming (Heldman, 1993).

It is obvious that the later it is, the more rapidly the new technology emerges. Modern society is an "information society", which is built by advanced communication technologies coupled with computers (Naisbitt, 1984). The world we are living now is a computer world. It is hard to imagine that about two thousand years ago, the Chinese did calculating by moving beads on an abacus; and it was considered to be the fastest and most versatile way of calculating at that time (Oslin, 1992).

The development of computer also resulted from many previous inventions. In 1642, Blaise Pascal of France invented a gear-driven adding and subtracting machine. In 1801, Joseph-Marie Jacquard of France invented the automatic weaving loom. The design of computer is originally from the idea used to operate the machine. In 1822, Englishman Charles Babbage designed a calculator with the elements of a digital computer. It was able to do complex calculations and set up its results in type. In 1887, Herman Hollerith of the United States created a punched-card system to do statistical work (Oslin, 1992).

At the early stage of computer development, computer was conceived to be a bigger, faster, and more sophisticated electronic calculating machine. It was primarily a device for numerical calculations. However, the utilization of computers at modern stage is much more than numerical calculating. They can be used for editing, storing, manipulating, and retrieving text (Pool, 1990).

Four major elements have evolved into a computer: binary logic, stored programs, storage medium, and input and output devices. Computers can function so sophisticated that sometimes they are called “artificial intelligence” or “thinking machines.” Due to the combination of telecommunications and computers, people in the information society not only interact with each other but also with media machines. Modern communication is a phenomenon of “talking and thinking among people and machines” (Pool, 1990, p. 50).

After we review the history, we know that technologies have evolved from one another. Each new technology adopted something from the existing technology and often replaced the older technology (Carne, 1984). In the 1900’s, newer and better computers are created, and old computer devices are no longer in use. When a new technology is introduced to our society, it brings us a greater convenience and efficiency; therefore, old technology sooner or later will be replaced. For instance, telegram is no longer a major communication means in our society. Telephone has been widely adopted; and nowadays, cellular telephone is even getting more popular.

The Trends of Telecommunications

As we near the end of the twentieth century, people are getting more anxious to know how our society will be in the new millennium. By looking at the impact of past technologies, one can see that “today’s society is really a result of yesterday’s technology;” therefore, “today’s technology will create tomorrow’s society” (Heldman, 1993, p.3).

To clarify where we are today and where we are going in the next century, several trends in telecommunications have been identified (Mitchell, Hendricks & Sterry, 1993):

- Deregulation of telecommunications services
- Growth and improvement of LANs and WANs

- Migration to Integrated Services Digital Networks (ISDN)
- Standardization of data communication protocols
- Wireless technology
- Increase reliance on optical carriers over copper
- Expansion of video teleconferencing
- Increased computer processing capacity
- Integrated software applications
- Increased utilization of voice processing
- Enhanced use of optical storage technologies
- Multimedia
- Information as a strategic resource

A global information society is emerging. Heldman (1993) suggested a five-step program to restructure America's telecommunications infrastructure and take us to the "Information Millennium":

Step 1: Public switched voice network services.
Step 2: Private overlay networking services.
Step 3: Public switched data network services.
Step 4: Public switched wideband network services.
Step 5: Public switched broadband network services (p. 115).

Competencies Needed

In the United States, there are some colleges and universities established telecommunications programs; however, their curricula are not quite the same. Since there is no "standard" curriculum, it remains a question that which one can serve as the best preparation for the future workforce for the telecommunications industry.

First of all, the competencies needed for telecommunications professionals should be determined, so that what courses should be offered in the program can be decided. Kooker and Brey (1991) report that besides the English language communication ability, interpersonal skills, and managerial skills, the following technical competencies are beneficial to the graduates for finding a job in the telecommunications industry:

> A strong background in all the basic areas of electronic theory, including analog and digital circuit operation, microprocessors, radio-frequency theory and practice, telephone systems basics, communications networks and systems design standards, computer software including UNIX operating system usage, and selection and usage of test equipment used in the telecommunications field. (p. 53)

According to above findings, Austin Community College (Austin, Texas) developed a curriculum for a Telecommunications Technology 2+2 program (Kooker & Brey, 1991).

Several recent reports indicate that there is a shortage of skills in the telecommunications industry. Demand is high for skilled wireless engineers (Carter, 1998 & Gohring, 1998), networking specialists (Lippis, 1998; Goff & Leinfuss, 1999), firewall specialists (Goff & Leinfuss, 1999; Makris, 1999), and people who know computer skills and data information skills, such as C++ and Java programming (Goff & Leinfuss, 1999; Grimsley, 1999).

A complete list of competencies for the occupation of telecommunications specialist is published by The Ohio State University (1995). Those competencies are divided into 17 units: employability skills; professionalism; teamwork; professional and ethical standards; economic and business principles; customer relations; problem analysis; project management; technical documentation; basic personal computer (PC) concepts; packaged PC applications; general accounting functions; operating systems;

network operations; basic mainframe concepts; computer hardware design; and supervision.

A number of competencies are listed under each unit. Each competency contains a list of competency builders as well. Some of the important technical competencies are as follows:

Unit: Basic Personal Computer Concepts

Competencies:

- Explain use of personal computers in business
- Describe personal computer operations
- Explain information processing
- Demonstrate computer literacy

Unit: Operating Systems

Competencies:

- Describe operating systems
- Explain central processing unit (CPU) control
- Describe memory management
- Explain auxiliary storage management
- Store media
- Explain security issues
- Maintain security requirements
- Define open system concepts
- Operate system
- Maintain system

- Administer system

Unit: Network Operations

Competencies:

- Explain communication standards
- Describe network structures
- Explain network transmission and media
- Explain network connectivity and interoperability
- Describe network operating systems
- Describe potential networking problems with applications software
- Explain network management
- Explain network security
- Explain installation procedures
- Use network knowledge
- Apply network operations
- Administer network
- Perform network maintenance and diagnostics

Unit: Computer Hardware Design

Competencies:

- Explain standards
- Describe computational site environment
- Differentiate among architecture and processor types
- Analyze computer systems architecture
- Describe operation of chips and boards
- Describe operation of connectivity devices

- Explain operation of microprocessor systems
- Troubleshoot a microcomputer system
- Install computer system (i.e., monitor, keyboard, disk drive, and printer)
- Explain operation of peripheral equipment
- Repair peripheral equipment
- Explain communication interfacing

Conclusion

The evolution of telecommunications, communicating over a distance using technology, remains functionally the same on the surface; information enters the telecommunication circuit at one end and is transported to another location at the other. Telecommunications started with digital information (telegraphy), transporting the information digitally to the far end of the communication circuit. Information was manually encoded and decoded into digital form by trained human operators with the telecommunication circuit transporting binary data (on/off signaling).

The introduction of the analog telephone allowed the general public direct access to telecommunication networks. The telephone network quickly grew far beyond the telegraphic networks that gave consumers a taste of instant communications over great distances. As the telephone evolved and became a household necessity, the volume of long distance traffic gave birth to a need for a way to increase capacity, the hidden transport systems evolved back to digital form.

Computers, and the need for computer-to-computer communications over distance, have brought us back full circle to mainly digital transport network, not much different from the early telegraph but at a much faster speed and utilizing optical fiber and wireless as opposed to copper for the transport media. Telecommunications today has become a high-speed digital computer transport network with the analog telephone circuits only existing in the last few miles of the circuit. Technology is even replacing the analog telephone with digital telephones, connected with digital communication circuits from the device to the network over both wired (copper and fiber) and wireless.

Once the information enters today's telecommunications network, it is all transported as one, be it data from a computer, voice from a telephone, or images (video and pictures). The telecommunication industry workforce has evolved right along with the technology. Telegraph operators, who not only handled the encoding and decoding of the information, but also serviced the technology and transport media, were replaced by telephone operators that switched calls for subscribers and skilled technicians to maintain the transport systems...The evolution of the technology, evolving from discrete components to miniature integrated circuits and computerization has also changed the level and type of skills needed for the technical workforce of the telecommunication industry.

CHAPTER III

Research Methods

Introduction

This study is to assess the technical competencies needed for telecommunications professionals. The study identifies needed competencies for telecommunications workers and determines the level of importance of each technical competency. The purpose is to measure the gap between curricula and industry. The result will provide a reference for UW-Stout Telecommunication Systems program improvement and curriculum revision. So that proper training for the Telecommunication Systems students can be ascertained.

This chapter discuses the methods and procedures used of the study. Included is a description of research design, population and sample, and the instrumentation used for data collection.

Research Design

A descriptive research design was used and a survey was conducted in this study. A questionnaire was developed to collect related data from the graduates of UW-Stout's Telecommunication Systems and predecessor program. The data needed in this study were the technical competencies needed for the telecommunication professionals and the level of importance of each competency. Demographic data were also collected.

Population and Sample

The scope of the population is the 1993-1998 graduates from the B.S. in Industrial Technology/Telecommunication specialization and Telecommunication Systems of UW-Stout. The 1999 graduates were not included in this population because of their negligible industrial experience after graduation at this time. The size of the population is 49. Since the population is small, it is not necessary to sample.

Instrumentation

A questionnaire was developed and a number of telecommunications technical competencies were listed (see appendix). The responses provided information on the level of importance of each competency. Questions regarding to subjects' demographic information were also listed.

Questionnaires were sent out to all the 49 subjects. The data collected from the questionnaire were analyzed. The needs assessment was the report of the results of this study.

CHAPTER IV

Presentation of Results

Introduction

Of the 49 survey questionnaires that were sent out to the subjects, 20 (40.8%) were returned. All of the returned surveys are included in the data set; one respondent did not include their current job title, and one respondent failed to score the importance of one topic. The data was entered and processed using SPSS 9.0.

Demographics

95% of the respondents were male; 85% of them age 30 or under; 15% reported that their current job was not in the telecommunications industry nor had they had any telecommunication job. The mean experience in telecommunications was 3.725 years. The respondents were evenly distributed across the organizational size of their employers as shown in Table 1.

Employees	***f***	***P***
5000 or more	4	20.0
1000-4999	4	20.0
500-999	2	10.0
100-499	4	20.0
50-99	2	10.0
Less than 50	4	20.0

Table 1: Employees in Organization

Table 2 shows the salary range was skewed into the $60,000+ range, the range offered may have been too low.

Dollars	***f***	***P***
60,000 or more	6	30.0
55,000-59,999	3	15.0
50,000-54,999	2	10.0
45,000-49,999	2	10.0
40,000-44,999	3	15.0
35,000-39,999	3	15.0
Less than 35,000	1	5.0

Table 2: Salary

Table 3 shows the graduate year for the respondents.

Year	***f***	***P***
1998	6	30.0
1997	3	15.0
1996	6	30.0
1995	3	15.0
1994	1	5.0
1993	1	5.0

Table 3: Graduation Year

What type of jobs do the graduates obtain in the field? The respondents (n=19) identified their current job titles as:

Customer Engineer, Senior
Engineering Assistant
Engineering Manager
Field Engineer
Field Engineer, Senior
Hardware System Supervisor
Information Systems Manager
Network Administrator
Network Engineer (3)
Network Manager
President, CEO and CFO
Project Manager
System Analyst, Senior
Systems Engineer
Systems Administrator
Telephone Technician (2)

Topic Ranking

The survey asked the respondents to indicate the importance of the following topics for Telecommunication Systems program graduates based upon the individual's knowledge and experience. The Likert unidimensional scale with a range of 1-5 was used: 1-*No Importance*, 2-*Little Importance*, 3-*Moderate Importance*, 4-*Very Important*, and 5-*Critical*. Table 4 contains the 75 topics in descending order by rank importance; multiple topics having the same *M* are in alphabetical sequence.

Topic	***n***	***M***	***SD***
TCP/IP	20	4.85	.67
Windows NT/2000 Server	20	4.45	.89
Routers	20	4.30	1.08
Windows NT/2000 Workstation	20	4.30	.73
Match Requirements to Available Products	20	4.25	.85
Client/Server Environment	20	4.25	.85
Transport Network Troubleshooting	20	4.20	1.06
Recommend System Design based on Analysis	20	4.15	.81
Cabling Infrastructure	20	4.15	.99
OSI 7-layer Networking Model	20	4.15	1.09
Layer 3 Switches	20	4.15	.93
Transport Network Design	20	4.15	.93
Professional Certification (in general)	20	4.10	1.17
Install/Configure OS	20	4.10	1.07
Evaluate Equipment Capabilities	20	4.05	1.15
Layer 2 Switches	20	4.05	.89
Network Security	20	4.00	1.17
CCNA Certification	20	4.00	1.17
Transport Network Simulation	20	3.95	1.05
Analyze Telecommunication Requirements	20	3.95	1.05

Topic	***n***	***M***	***SD***
MCSE Certification	20	3.90	1.12
CCNP Certification	20	3.90	1.21
Voice, Data, Video Integration	20	3.85	1.31
Statistical Network Analysis	20	3.80	1.20
Voice over IP	20	3.75	1.25
Frame Relay	20	3.65	1.04
Unix/Linix	20	3.65	1.04
MCP Certification	20	3.60	1.23
ATM	20	3.60	1.27
Basic Rate ISDN	20	3.60	1.19
Video over IP	20	3.60	1.27
Basic Telephony	20	3.55	1.00
Windows 95/98	20	3.55	1.05
Help Desk Management	20	3.45	1.15
Primary Rate ISDN	20	3.45	1.15
Private Branch Exchange	20	3.40	.99
Interior Gateway Routing Protocols	20	3.40	.99
Exterior Gateway Routing Protocols	20	3.35	.93
Computer Telephony Integration	20	3.35	1.35
SONET	20	3.30	1.22
Wireless Data Networking (MAN/WAN)	20	3.30	1.17
T-n/OC-n Carriers	20	3.25	1.02
IPX/SPX	20	3.20	1.36
Broadband ISDN	20	3.20	1.24
Wireless Data Networking (LAN)	20	3.20	1.24
Data Compression	20	3.15	1.18
Wireless Mobile Telephone Systems	20	3.10	.91
FDDI	20	3.10	1.12
Electronic Communication Fundamentals	20	3.05	1.05
Wireless Network Optimization/Troubleshooting	20	3.05	1.23

Topic	***n***	***M***	***SD***
Thin Client Environment	20	3.05	1.10
Network+ Certification	20	3.00	1.08
Wireless Network Design	20	2.95	1.23
Wireless Local Loop	20	2.90	1.12
Distance Learning Networks	20	2.90	1.12
Voice Mail Systems	20	2.90	1.02
Satellite Communication Systems	20	2.80	1.15
Erlangs and Traffic Studies	20	2.75	1.07
Interactive Video	20	2.75	1.12
SS7	19	2.68	1.06
Fundamentals of Microprocessors	20	2.50	1.10
NetBEUI	20	2.50	1.24
C/C++ Programming	20	2.50	1.05
Java Programming	20	2.45	1.10
Expert Systems	20	2.30	.98
Digital Logic and Switching	20	2.30	.92
Perl Programming	20	2.30	1.03
AC/DC Circuit Analysis	20	2.10	.97
Calculus	20	2.05	1.15
Solid State Electronics	20	1.90	.72
Apple OS	20	1.75	.79
Basic Programming	20	1.75	.85
AppleTalk	20	1.60	.82
Assembly Programming	20	1.45	.76
Fortran Programming	20	1.35	.67

Table 4: Topic Importance in Descending Order

Additional Topics Identified

Respondents were given the opportunity to identify additional topics that they felt were very important or critical and should be included in the program curriculum. The following is a complete list of their input.

Routing (Cisco, 3Com, Bay Networks)
NOS's (Novell, Microsoft)
Switching
VLANs
Cabling Systems
DSL
XDSL
WAN Infrastructure
IP Designs and schemes
Cable Modems
ISDN
TROUBLESHOOTING!
A+ Certification
More hands-on training
Coop or Internship needs to be required
Too much focus on management, a student just graduating isn't going to start at the top.
Technical staff management
Technical writing
Technical presentations
Career/Financial management
Communication skills
Problem solving
Proactive monitoring and analysis
Database (queries, reports, SQL)
Novell Netware
Scripting (shell scripts, batch)
Project management skills
Methodologies
Interpersonal communications
E-mail etiquette
Certification
Operating systems
Product training
Hands on
Unix – Extremely Important

Conclusion

Besides the significance ranking of the topics in the survey, the jobs that the graduates are filling reflects a diversity of technical and managerial positions. Even the lower scoring topics had some level of importance to some of the graduates and some of the topics were scored very high by almost all of the respondents. The additional topics identified by the respondents that were not part of the survey can give insight into areas that need to be considered in the curriculum revision process.

CHAPTER V

Summary, Conclusions, and Recommendations

Summary

The focus of this research was to assess the technical needs of Telecommunication Systems graduates as identified by prior graduates according to their working and professional experiences. As UW-Stout's B.S. in Telecommunication Systems is a relatively new program and the field of telecommunications is rapidly evolving, it is important that the program adapts to changing needs of industry.

This research is one input that can be used to identify curriculum changes that are needed to bring the program inline with the current needs of graduates entering the workforce. While it is doubtful that any curriculum can stay in front of the evolving telecommunication industry trends, the education foundation built in the undergraduate program needs to be focused on the direction that the graduates will be heading.

While the quantity of educational preparedness remains relativity constant, new concepts and directions can only be introduced into the curriculum with the removal of outdated or unnecessary content. In some cases the existing curriculum content may not be needed because of the actual career opportunities that exist as opposed to earlier perceived paths by the program developers.

The 75 curriculum topics in the survey were selected based upon the existing curriculum, current trade publications, and advisory committee recommendations. Survey respondents were also given the opportunity to identify topics they consider very important or critical that were excluded from the list; while these additional identified topics are not ranked in this study, they should be considered and are a valuable addition to the original set of topics.

Conclusions

The area of professional certification in general (*M*=4.10) is an important issue as reinforced by the rankings for all the higher-level certifications MSCE (*M*=3.90), CCNA (*M*=4.00), and CCNP (*M*=3.90). The two lower level certifications in the survey, MCP (*M*=3.60) and Network+ (*M*=3.00), are still viewed as having moderate or higher ranking by the respondents. It should be noted that many of the topics in the survey that ranked high are part of the professional certification content.

The existing program curriculum in the areas of Calculus (*M*=2.05), Assembly Programming (*M*=1.45), Solid State Electronics (*M*=1.90), AC/DC Circuits (*M*=2.10), Digital Logic and Switching (*M*=2.30), and Fundamentals of Microprocessors (*M*=2.50) needs to be revised into a smaller portion of the curriculum or eliminated as indicated by the low importance reported by the respondents. Unix/Linix (*M*=3.65) , not part of the current curriculum, the equal importance of C/C++ (*M*=2.50) and Java (*M*=2.45) and low scoring of other programming languages in general indicates the need to revise the existing curriculum to be more in line with program graduate needs.

The current needs of the program graduates are not parallel to the curriculum content of the program. A very strong program emphasis in meeting the professional certification requirements is supported by the data, while a decline in electronics and computer programming content is defensible.

Recommendations

It is important in any field of study that the curriculum allows the student to achieve the goals of the program. Telecommunications is a rapidly evolving discipline that is constantly integrating new technology into the underlying infrastructure. The program as developed placed significant emphasis on technical areas of study that may have either lost significance in the career paths of the program graduates or the career paths are along a different avenue than originally envisioned.

One of the problems in the curriculum as currently exists is that all the students are being prepared for a career path that many do not seem to be taking. This is evident by the low importance given to parts of the curriculum, and the high ranking of professional certification. The whole question of the importance of professional certification by those in the field as opposed to the lack importance in the curriculum requires serious consideration in the curriculum revision process.

It is impossible to add new content without reducing existing content to make room. This study has identified areas where the curriculum needs to be reinforced and other areas where content can be reduced for the overall program.

It may be time in the evolution of the program to consider a smaller core curriculum with the addition of specializations. Specializations could easily exist in the areas of network design, network/system administration, network operation, wireless systems, and electronics. While outside this study, the direction that the survey results are pointing indicate that the industry is merging the information technologies and telecommunications into one business area, as shown by the importance of professional certification in both the transport (Cisco) and computers systems (Microsoft).

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APPENDIX

Survey Instrument

University of Wisconsin-Stout

Technical Competency Survey for
B.S. Degree in Telecommunication Systems

I understand that by returning this questionnaire, I am giving my informed consent as a participating volunteer in this study. I understand the basic nature of the study and agree that any potential risks are exceedingly small. I also understand the 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 or research advisor and second to Dr. Ted Knous, Chair, UW-Stout Institution Review Board for the Protection of Human Subjects in Research, 11 HH, US-Stout, Menomonie, WI, 54751, phone (715) 232-1126.

Demographic Information:

1. ____Male; ____Female

2. Age: ____20-30 ____31-35 ____36-40 ____41-45 ____46-50 ____51 and above

3. What year did you complete your undergraduate degree? ______________________________

4. How long have you worked in the field of telecommunications? ________________________

5. Is your current job in the field of telecommunications?____Yes; ____No

6. What is your current job title? ____

7. How many employees are there in your organization?

____ less than 50	____ 50-99	____ 100-499
____ 500-999	____1000-4999	____ 5000 or more

8. Your salary range is

____less than $35,000	____$35,000-$39,999	____$40,000-$44,999
____$45,000-$49,999	____$50,000-54,999	____$55,000-$59,999
____$60,000 or more		

PLEASE RETURN THE COMPLETED SURVEY BY TO:

Scott Simenson
Telecommunication Systems Program Coordinator
University of Wisconsin-Stout
CET Department
206 Fryklund Hall
Menomonie WI 54751
715-232-1212
715-232-5300 (fax)

Directions: Listed below are a variety of topics that may be needed by program graduates in their jobs. Please use the following response scale and determine the degree of importance of each item based upon your knowledge and experience:

1 - No Importance or Not Applicable **4 - Very Important**
2 - Little Importance **5 - Critical**
3 - Moderate Importance

	TOPICS	IMPORTANCE
1.	UNIX/LINIX	1 2 3 4 5
2.	Windows 95/98	1 2 3 4 5
3.	Windows NT/Windows 2000 Workstation	1 2 3 4 5
4.	Windows NT/Windows 2000 Server	1 2 3 4 5
5.	Apple OS	1 2 3 4 5
6.	Installing/Configuring Operating Systems	1 2 3 4 5
7.	C/C++ programming	1 2 3 4 5
8.	Fortran programming	1 2 3 4 5
9.	BASIC programming	1 2 3 4 5
10.	JAVA programming	1 2 3 4 5
11.	PERL programming	1 2 3 4 5
12.	Assembly language programming	1 2 3 4 5
13.	Client/Server environment	1 2 3 4 5
14.	Thin Client environment	1 2 3 4 5
15.	OSI 7-layer networking model	1 2 3 4 5
16.	Layer 2 switches	1 2 3 4 5
17.	Layer 3 switches	1 2 3 4 5
18.	Routers	1 2 3 4 5
19.	ISDN BRI	1 2 3 4 5
20.	ISDN PRI	1 2 3 4 5
21.	Broadband ISDN (B-ISDN)	1 2 3 4 5
22.	Frame Relay	1 2 3 4 5
23.	ATM	1 2 3 4 5
24.	FDDI	1 2 3 4 5
25.	SONET	1 2 3 4 5
26.	Cabling infrastructure	1 2 3 4 5
27.	Transport network design	1 2 3 4 5
28.	Transport network simulation	1 2 3 4 5
29.	Transport network troubleshooting	1 2 3 4 5
30.	TCP/IP	1 2 3 4 5
31.	NetBEUI	1 2 3 4 5
32.	IPX/SPX	1 2 3 4 5

	TOPICS	IMPORTANCE				
33.	AppleTalk	1	2	3	4	5
34.	Interior gateway routing protocols	1	2	3	4	5
35.	Exterior gateway routing protocols	1	2	3	4	5
36.	Wireless mobile telephone systems (cellular/PCS)	1	2	3	4	5
37.	Wireless Local Loop (WLL)	1	2	3	4	5
38.	Wireless data networking (local/in-building)	1	2	3	4	5
39.	Wireless data networking (metro/WAN)	1	2	3	4	5
40.	Satellite communication systems	1	2	3	4	5
41.	Wireless network design	1	2	3	4	5
42.	Wireless network optimization/troubleshooting	1	2	3	4	5
43.	AC/DC circuit analysis	1	2	3	4	5
44.	Digital logic and switching	1	2	3	4	5
45.	Solid state electronics	1	2	3	4	5
46.	Electronic communication fundamentals	1	2	3	4	5
47.	Fundamentals of microprocessors and microprocessor systems	1	2	3	4	5
48.	Basic telephony	1	2	3	4	5
49.	Private branch exchanges (PBX)	1	2	3	4	5
50.	Computer telephony integration (CTI)	1	2	3	4	5
51.	Voice mail systems	1	2	3	4	5
52.	T-n/OC-n carriers	1	2	3	4	5
53.	SS7	1	2	3	4	5
54.	Interactive video	1	2	3	4	5
55.	Erlangs and traffic studies	1	2	3	4	5
56.	Network security	1	2	3	4	5
57.	Help desk management	1	2	3	4	5
58.	Distance learning networks	1	2	3	4	5
59.	Expert systems	1	2	3	4	5
60.	Voice, data, video integration	1	2	3	4	5
61.	Voice over IP (or other routed protocol)	1	2	3	4	5
62.	Video over IP (or other routed protocol)	1	2	3	4	5
63.	Analyze telecommunication requirements	1	2	3	4	5
64.	Recommend system design based on analysis	1	2	3	4	5
65.	Match telecommunication requirement to available products	1	2	3	4	5
66.	Evaluate equipment capabilities	1	2	3	4	5
67.	Data compression	1	2	3	4	5
68.	Statistical network analysis	1	2	3	4	5
69.	Professional certification (in general)	1	2	3	4	5
70.	Cisco Certified Network Associate (CCNA)	1	2	3	4	5
71.	Cisco Certified Network Professional (CCNP)	1	2	3	4	5

	TOPICS	IMPORTANCE
72.	Microsoft Certified Professional (MCP)	1 2 3 4 5
73.	Microsoft Certified System Engineer (MCSE)	1 2 3 4 5
74.	CompTIA Network+ certification	1 2 3 4 5
75.	Calculus	1 2 3 4 5

Please list below any general technical topics not listed above that you feel are very important or critical and should be included in the program curriculum.

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