An Empirical Analysis of the Content of the Data Communications Course: Academics' and Practitioners' Perspectives

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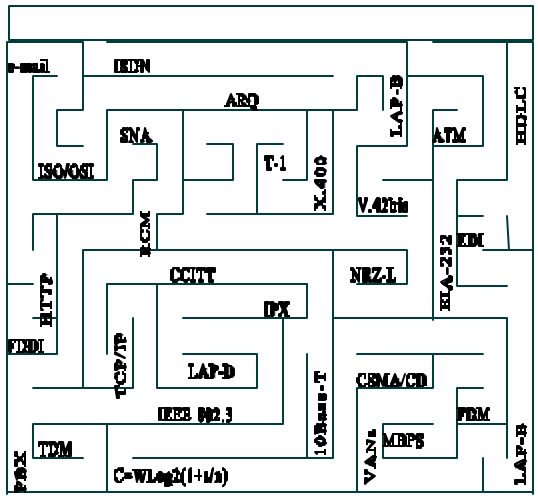
This article examines academic and practitioner perspectives on what concepts are important in a data communications senior-level undergraduate course. There were 101 concepts identified, and a survey instrument was distributed to over 800 academic and data communication professionals to determine if differences in perceptions existed. Data analysis expounds upon significant differences in the perceptions of these two groups. In addition, the concepts were grouped into categories and differences were examined. The findings indicate considerable consensus among academics and practitioners regarding the content of what should be taught in a senior-level data communications course.

Teaching a data communications course is somewhat like wandering through a complex maze. The course is fraught with numerous acronyms, definitions, organizations, and a preponderance of technical terminology that challenges the teaching skills of even the most learned information systems scholars. Figure 1 illustrates a representative example of this puzzle.

Figure 1: Data Communication Maze



According to recent surveys of information systems practitioners, *data communications* was ranked first in importance among courses in an undergraduate program of study for information systems majors (Hieat, Hieat, and Spicer, 1993). *Database management* was ranked second by practitioners. Academics in the same study ranked *systems analysis & design* first and the *data communications* topics third. While several scholars have conducted research to examine what the contents of courses such as Database Management and Systems Analysis & Design

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should contain, very little research has indicated what the important concepts would include for a senior-level data communications course. Several popular curricula such as the Office Systems Research Association's Model Curriculum and the joint effort among DPMA, AIS, and ACM (called IS '95), along with leading textbooks, makes this issue cloudy.

Some academics see the data communications course as a "networking" course involving practical hands-on experience in network operating systems such as Novell's Netware, while other scholars believe this course should teach fundamentals such as transmission media, communication history, and a broad appreciation of networking topics including WANs, MANs, and LANs. Gonzenbach conducted an international research study in 1996 to identify content areas to be included in a four-year office information systems degree. The survey instrument included sections on telecommunications and other content area. The target population of the study was members of the Information Industry Association, which represent 519 international companies with 4,500 members. Based on a 21 percent return (110 instruments), Gozenbach's findings indicate the respondents recommended placing the most emphasis within the curriculum on the content areas of telecommunications, operating systems, systems analysis and design, networks (LANs and WANs), and business communications (Gozenbach, 1998).

Within the computer science discipline, several articles have addressed the content of telecommunications tracks including the sequencing of courses and proposed content from the academic perspective (Barnard et al., 1996; Grygiel et al., 1996). To date, the literature contains no large-scale study of both practitioner and academic perspectives and compares the two. The purpose of this study was to conduct an empirical investigation into the importance of various concepts to the content of the data communication course taught within an information systems program taking both academic and practitioner perspectives into account. The primary objective was to assess the importance of specific concepts to these groups. In addition, we sought to determine whether academic and practitioner perspectives were similar.

Methodology and Scope

In Summer 1995, the authors reviewed several textbooks adopted by major universities for teaching data communications. The authors then synthesized the materials contained in these texts (see Appendix I) into a set of roughly 100 concepts. During Fall 1995, an instrument, to be verified and validated, was developed. This initial questionnaire was examined by 12 information systems practitioners and educators who have experience in data communications and research methods. Modifications were made to the questionnaire, and the results are reflected in final form in Appendix II.

Fifty randomly selected educators were contacted to pilot test the instrument and to assess reliability. These 50 educators were drawn from the 1995 *Directory of Management Information Systems Faculty*, and listed data communications as their primary area of specialty. The response rate on this sampling was 32%, and Cronbach's alpha was 97.54%.

In Spring 1996, the survey was mailed to a national sample of 338 academics who listed data communications as their teaching focus in the 1995 *Directory of Management Information Systems Faculty*. Shortly thereafter, the survey was mailed to 500 information systems practitioners. The practitioners were randomly selected from the readership of a leading data communications publication. The rationale for selecting this population was the technical nature of this specific publication, the recognition that the readership would be comprised of individuals knowledgeable in the area of data communications, and a large population (> 10,000) from which to draw the sample. Response rate for the academics was 32 percent while the response rate for the practitioners was 22 percent.

Demographics of Practitioners

As shown in Table 1, practitioners responding to the survey came from a wide array of industrial categories based on the SIC classification codes. Services comprised the largest percentage (39.7%) and transportation/public utilities (24.7%) the second largest.

Table 1: Type of Organization

Type of Organization	% of Respondents
Mining	1.1
Construction	1.1
Manufacturing	9.7
Transportation & Public Utilities	24.7
Retail Trade	5.4
Finance, Insurance, Real Estate	7.5
Services	39.7
Education	3.2
Military	2.2
Government	4.3
Telecommunications	1.1

Table 2 shows job titles of those practitioners who participated in the study. The most prevalent title was telecommunications managers (25.3%). Positions such as systems analyst, director of management information systems, and consultant are represented among those included in the study.

The data indicate that 40% of the respondents work for firms comprised of less than 1,000 employees; 38% work for firms employing more than 10,000. Table 3 shows the size of the firms represented by the practitioners in the study.

Table 3: Organization Size

# of Employees	% of Respondents
Less than 1,000	40.0
1,000 - 2,500	9.5
2,501 - 5,000	10.5
5,001 - 7,500	1.1
7,501 - 10,000	1.1
More than 10,000	37.8

Table 2: Practitioner Job Titles

Job Title	% of Respondents
Director of MIS	13.6
LAN Administrator	8.4
Telecommunications Manager	25.3
Programmer	2.1
Systems Analyst	13.7
Consultant	11.6
Other	25.3

Demographics of Academics

Two types of demographic data were collected from the academics in this study. The respondents' academic ranks are shown in Table 4. The total enrollment at respondents' universities is shown in Table 5. Associate Professors (48.6%) constitute the most prevalent academic rank. More than 15,000 students (40.0%) make up the largest enrollments at the academics' respective universities. These demographic data were collected to assess variations between ranks and school sizes.

The purpose of collecting demographic data was to provide a profile of the respondents to the study.

Data Analysis

To analyze the importance of specific concepts, step 1 was to compare rankings and means of

Table 4: Respondents' Academic Rank

Rank	% of Respondents
Assistant Professor	27.6
Associate Professor	48.6
Full Professor	17.1
Other	6.7

Table 5: Total Enrollment at Respondents' Universities

# of Students	% of Respondents
1,000 - 5,000	19.0
5,001 - 10,000	23.8
10,001 - 15,000	17.2
More than 15,000	40.0

practitioners and academics for all 101 concepts included in the questionnaire. Results are shown in Table 6. There were 27 statistically significant differences in the degree of importance that practitioners and academics placed on particular concepts. To aid in the understanding of these differences, the following section includes a discussion of the eight concepts perceived by practitioners to be more important, followed by a discussion of 19 concepts perceived by academics to be more important.

Practitioners

Practitioners placed a higher degree of importance than academics on eight of 27 concepts. Several concepts related to history were perceived to be of greater importance from practitioners than academics. The concept's rank and mean for these perceived differences are shown in parentheses for each group. For example, practitioners (62, 3.50) placed greater importance on a student's acquaintance with *history of the personal computer* vs. academics (90, 2.88); *history of electronics* (85, 3.08) vs.(100, 2.40); and *acquaintance with the history of the radio* (98, 2.73) vs. (101, 2.36).

Practitioners placed a higher degree of importance on the *study of protocols* than academics. Practitioners (63, 3.49) perceived the *identification of logical link control protocols* of greater importance than academics (71, 3.29). Practitioners placed greater emphasis on *identifying components of the link access protocol, D-Channel* (69, 3.45) than did academics (86, 2.93).

Other concepts receiving a greater degree of importance by practitioners include *understanding data compression algorithms* (64, 3.48) vs. (86, 2.93); *interpreting EIA 232-Cs electrical specifications* (86, 3.06) vs. (98, 2.60); and *calculating the bits that comprise a postscript image* (95, 2.84) vs. (99, 2.52).

Academics

Academics placed a higher degree of importance than practitioners on 19 of the 27 concepts that were statistically significant based on the t-tests performed. As one might expect, academics viewed several theoretical concepts as more important. For example, *differentiating between packet switching and circuit switching networks* (6, 4.30 vs. 7, 4.04); *between bandwidth and frequency* (6, 4.30 vs. 16, 3.93); *between serial and parallel transmission* (11, 4.18 vs. 26, 3.83); and *between baseband and broadband* (8, 4.28 vs. 26, 3.83).

Academics also viewed the role of standards organizations as more important than practitioners as evidenced by the responses to items such as *identification of the acronyms of standards organizations* (61, 3.56 vs. 79, 3.21) and *identification of the members comprising standards organizations* (84, 2.98 vs. 99, 2.62).

Concepts by Categories

To assess further any potential variations between practitioner and academic perceptions of the importance of the concepts, the 101 concepts were grouped into 11 different categories. An analysis using the Wilcoxon signed rank test of the practitioner and academic data was conducted to determine if statistically significant variations existed among the rankings of these 11 categories. Table 7 shows the practitioner rank (P-Rank), academic rank (A-Rank), practitioner group mean (P-Mean, academic group mean (A-Mean). While the rankings are not identical, the two rankings do not represent a statistically significant difference.

The top-ranked 25 items for practitioners and academics were examined using principal-axes factor analysis. To aid in interpreting extracted factors, an orthogonal rotation to a varimax criterion procedure was used. This analysis revealed five eigenvalues greater than 1.0 for both groups of respondents (for practitioners, these

Table 6: Comparison of Rankings of Practitioners (P) and Academics (A)

P-Rank	A-Rank	Item	P-Mean	A-Mean
1	3	Understand framework for planning a network	4.27	4.36
2	1	Awareness of TCP/IP	4.26	4.40
	9	Understand framework for designing a network	4.26	4.25
4	13	Understand framework for implementing a network	4.24	4.17
5	1	Demonstrate the ability to use the Internet	4.15	4.40
6	13	Demonstrate the ability to use a LAN	4.12	4.17
7	6	Differentiate between circuit & packing switching	4.04	4.30*
	4	Demonstrate the ability to use electronic mail	4.04	4.35*
	25	Understand the basics of selecting security	4.04	4.02
	16	Understand the basics of WAN/LAN interconnectivity	4.04	4.14
11	43	Understand the basics of selecting WAN firewalls	4.02	3.79
12	5	Understand the basics of selecting LAN topologies	3.99	4.31*
	31	Describe characteristics of ATM networks	3.99	3.97
14	39	Describe characteristics of frame relay networks	3.95	3.81
15	*33*	*Describe characteristics of ISDN networks*	*3.94*	*3.94*
16	27	Understand multiplexing with regard to its application in technologies	3.93	3.99
	6	Differentiate between bandwidth and frequency	3.93	4.30*
	17	Understand the basics of selecting LAN hardware	3.93	4.13
19	47	Understand the basics of selecting WAN encryption	3.92	3.71
20	47	Understand the basics of selecting LAN OS	3.91	3.71
21	13	Differentiate between analog and digital signals	3.89	4.17
	33	Demonstrate the ability to use file transfer	3.89	3.94
23	10	Understand the basics of LAN selection criteria	3.86	4.21*
	52	Understand the basics of selecting WAN mgmt. systems	3.86	3.67
25	26	Understand the basics of selecting client/server	3.85	4.01
26	30	Have an awareness of Netware/IPX/SPX	3.83	3.98
	11	Differentiate between serial and parallel transmission	3.83	4.18*
	8	Differentiate between baseband and broadband	3.83	4.28*
29	38	Understand the basics of selecting LAN apps software	3.81	3.82

Table 6: Comparison of Rankings of Practitioners (P) and Academics (A) (Continued)

P-Rank	A-Rank	Item	P-Mean	A-Mean
30	*17*	*Understand the basics of selecting LAN MAC*	*3.80*	*4.13**
	17	*Understand media selection criteria*	*3.80*	*4.13**
32	55	Understand the basics of selecting WAN hardware	3.78	3.63
	57	Understand the basics of selecting WAN physical technologies	3.78	3.60
34	33	Understand modulation and its apps for technologies	3.76	3.94
	47	Understand data compression and its apps for software	3.76	3.71
36	27	Select media for specific applications	3.75	3.99
37	47	Differentiate between voice and video signals	3.73	3.71
38	32	Differentiate between bit and baud rate	3.72	3.96
	45	*Describe characteristics of BISDN networks*	*3.72*	*3.72*
	63	Understand the basics of selecting WAN OS software	3.72	3.51
41	22	Understand data compression's definition	3.71	4.10*
42	44	Understand the basics of selecting administration	3.70	3.77
43	21	Understand multiplexing with regard to its definition	3.69	4.11*
	56	Describe characteristics of SMDS networks	3.69	3.61
45	11	Differentiate between dial-up and leased line	3.68	4.18*
46	58	Differentiate between alternate and adaptive routing	3.67	3.59
	39	Differentiate between virtual circuits and datagrams	3.67	3.81
48	53	Differentiate between space and time division	3.66	3.64
	51	Understand the basics of selecting database servers	3.66	3.70
	27	Describe how each medium operates	3.66	3.99*
51	39	Acquainted with wireless LANs	3.65	3.81
52	53	Differentiate between PBX and data switch	3.63	3.64
53	37	Acquainted with cellular communications	3.61	3.83
54	66	Identify components of HDLC protocols	3.60	3.50
55	69	Identify components of SDLC protocols	3.59	3.37
56	39	Understand multiplexing with regard to the process	3.58	3.81
57	22	Have an awareness of OSI	3.56	4.10*
	63	Understand the selection of software licenses	3.56	3.52

Table 6: Comparison of Rankings of Practitioners (P) and Academics (A) (Continued)

P-Rank	A-Rank	Item	P-Mean	A-Mean
59	22	Understand modulation's definition	3.52	4.10*
	58	Contrast various LAN software systems	3.52	3.59
61	45	Differentiate between conditioned/unconditioned lines	3.51	3.72
62	90	Acquainted with the history of the personal computer	3.50	2.88*
63	71	Identify components of logical link control protocols	3.49	3.29*
64	47	Understand modulation process	3.48	3.71
	86	Understand data compression algorithms	3.48	2.93*
	81	Identify components of link access protocols (LAP-B)	3.48	3.11
67	36	Have an awareness of X.25	3.47	3.90*
68	68	Interpret EIA-232-C by specifying its applications	3.46	3.39
69	86	Identify components of link access protocol, D channel	3.45	2.93*
70	71	Demonstrate the ability to use on-line services	3.44	3.29
71	79	Differentiate between batch and on-line systems	3.43	3.15
72	63	Have an awareness of IBM SNA	3.37	3.51
	60	Describe the purpose of EIA-232-C	3.37	3.57
	70	Describe cyclic redundancy check	3.37	3.36
75	75	Contrast microcomputer communication software pkg.	3.31	3.25
76	61	Describe parity checks	3.28	3.56
77	73	Contrast middleware software systems	3.27	3.26
78	82	Identify components of binary synchronous protocol	3.25	3.10
79	61	Identify the acronyms of standards organizations	3.21	3.56
80	80	Describe X-Modem protocol	3.19	3.12
81	67	Identify standards organizations' responsibilities	3.18	3.44
82	78	Describe sliding window protocol	3.16	3.20
83	86	Have an awareness of DECNet	3.11	2.93
84	73	Describe stop and wait protocol	3.10	3.26
85	100	Acquainted with the history of electronics	3.08	2.40
86	98	Interpret EIA-232-C's electrical specifications	3.06	2.60

Table 6: Comparison of Rankings of Practitioners (P) and Academics (A) (Continued)

P-Rank	A-Rank	Item	P-Mean	A-Mean
87	75	Describe stop-and-wait ARQ	3.06	3.25
88	83	Specify major media vendors	3.05	3.02
89	77	Describe go-back-N ARQ	3.04	3.21
90	92	Calculate the bits that comprise a bit-mapped image	2.95	2.72
91	93	Acquainted with the history of the telephone	2.94	2.68
	85	*Specify current media pricing*	*2.94*	*2.94*
93	96	Calculate the bits that comprise a video clip	2.89	2.62
94	89	Calculate the bits that comprise alphanumeric text	2.88	2.89
95	99	Calculate the bits that comprise a postscript image	2.84	2.52*
	91	Have an awareness of AppleTalk	2.84	2.80
97	95	Calculate the bits that comprise an audio clip	2.83	2.64
98	101	Acquainted with the history of the radio	2.73	2.36*
99	84	Identify members comprising standards organizations	2.62	2.98*
100	94	Identify the history of standards organizations	2.59	2.66
101	96	Acquainted with the history of the Carterphone decision	2.50	2.62

* Significant at the 95% confidence interval.
Items in italics had the same mean.
P-Rank – Practitioners' Rank A-Rank – Academics' Rank
P-Mean – Practitioners' Mean A-Mean – Academics' Mean

eigenvalues were 13.12, 2.27, 1.72, 1.22, and 1.14, respectively; for academics, these eigenvalues were 10.36, 2.96, 2.12, 1.28, and 1.15, respectively; percentages of variance explained for practitioners were 52.5, 9.1, 6.9, 4.9, and 4.6, respectively; for academics, the percentages of variance explained were 41.1, 11.9, 8.5, 5.1, and 4.6, respectively). Recognizing that the eigenvalues-greater-than-one rule overestimates the number of factors to be extracted, additional criteria were considered. In the end, only four factors were extracted. The fifth factor for both practitioners and academics was dropped because of its relatively low reliability ($\alpha = .60$ for practitioners and .69 for academics).

The first dimension for practitioners was identified as *LAN/WAN Basics*, the second as *Networking*, the third as *Network Characteristics*, and the fourth as *Basic Abilities*. The first dimension for academics was identified as *Signals & Transmission*, the second as *LAN Basics*, the third as *Basic Abilities*, and the fourth as *Networks*. Only items cleanly loading on their intended factors at $\geq .40$ were retained in the item pool. Loadings for the 21 items of practitioners and the 22 items for academics, as well as their eigenvalues, percents of variance explained, and their reliabilities, are shown in Table 8.

As indicated in the table, the dimensions underlying the practitioners and academics' rankings were not very similar. While some items

Table 7: Rankings and Means of Grouped Items for Practitioners and Academics

P-Rank	A-Rank	Group	P-Mean	A-Mean
1	2	Advanced Network Topics	3.96	3.95
2	1	Applications	3.94	4.03
3	6	WANs	3.87	3.74
4	3	LANs	3.75	3.90
5	4	Fundamentals of Networks	3.73	3.81
6	5	Multiplexing & Compression	3.69	3.78
7	7	Network Protocols	3.50	3.65
8	8	Transmission Media	3.44	3.61
9	9	Fundamentals of Data Communication	3.37	3.44
10	10	Data Communication Protocols	3.33	3.35
11	11	Communication History	2.92	2.86

loaded together into a factor for both groups, the strengths of the loadings, as revealed by the eigenvalues and the percents of variance explained, were not similar.

Findings

The prominent finding of this study indicates considerable consensus among academics and practitioners regarding the degree of importance of the concepts that should be taught in a senior-level data communication course. Of the 27 items that showed a statistically significant difference, most variations were within the same degree of importance on the Likert scale. For example, while academics placed greater importance on *the student's ability to use electronic mail* (4.3), practitioners viewed this concept as "of above average importance" with a mean of 4.04.

Another finding of this study indicates that while there is consensus among the two samples with respect to individual concepts, the factor analysis revealed that the underlying structure of the items was not the same. Academics and practitioners organize their attitudes about these items quite differently. Some may speculate that this arises from the differences inherent in the training of academic and practitioners (i.e., formal education versus on-the-job experiences). While others may consider the tendency of educators to follow a highly structured prescriptive approach to the teaching of the subject matter as outlined in textbooks by experts in the field.

The data in this study show both academics and practitioners have a preference for a course focused on applied networking topics rather than more theoretical concepts. The theoretical topics such as *an appreciation for a wide array of protocols* are ranked much lower by both groups. In addition, *history topics* and *the ability to calculate the size of data* are concepts that should receive little emphasis in a data communications course at the senior level.

Contributions and Conclusions

This study contributes to the literature in information systems by empirically examining the potential content of a senior-level data communications course. This study could provide guidance to Information System educators who teach such a course as well as practitioners who may hire Information System graduates. In addition, textbook authors may use these data to assess the necessary coverage of specific topics for a data communications course. Curriculum designers may use results to define a telecommunication course sequence, which could involve multi-data communications offerings at the university level.

Table 8: Rotated Factor Loadings for Top Twenty-five Ranked Items for Academics and Practitioners

PRACTITIONERS	
FACTOR 1* LAN/WAN Basics (eigenvalue = 13.12; percentage of variance explained = 52.5; reliability = .94)	
Items Loading into this Factor:	**Factor Loadings:**
Understand the basics of selecting WAN firewalls	.83
Understand the basics of selecting WAN encryption	.82
Understand the basics of selecting WAN mgmt systems	.76
Understand the basics of WAN/LAN interconnectivity	.69
Understand the basics of LAN selection criteria	.63
Understand the basics of LAN OS	.58
Understand the basics of selecting LAN topologies	.57
ACADEMICS	
FACTOR 1* Signals & Transmission (eigenvalue = 10.36; percentage of variance explained = 41.4; reliability = .93)	
Items Loading into this Factor:	**Factor Loadings:**
Understand modulation's definition	.87
Understand multiplexing with regard to its definition	.83
Understand data compression's definition	.81
Differentiate between serial and parallel transmission	.79
Differentiate between bandwidth and frequency	.76
Differentiate between dial-up and leased line	.74
Differentiate between baseband and broadband	.72
Differentiate between analog and digital signals	.71
Differentiate between circuit & packet switching	.62

Table 8: Rotated Factor Loadings for Top Twenty-five Ranked Items for Academics and Practitioners (Continued)

PRACTITIONERS	
FACTOR 2* Networking (eigenvalue = 2.27; percentage of variance explained = 9.1; reliability = .92)	
Items Loading into this Factor:	**Factor Loadings:**
Understand the framework for designing a network	.85
Understand the framework for planning a network	.81
Understand the framework for implementing a network	.80
Understand the basics of selecting LAN hardware	.60
Understand the basics of selecting client/server	.55
Differentiate between circuit & packet switching	.48
ACADEMICS	
FACTOR 2* LAN Basics (eigenvalue = 2.96; percentage of variance explained = 11.9; reliability = .88)	
Items Loading into this Factor:	**Factor Loadings:**
Understand the basics of selecting LAN MAC	.80
Understand the basics of selecting LAN topologies	.75
Understand the basics of selecting LAN hardware	.72
Understand the basics of LAN selection criteria	.71
Understand the basics of selecting security	.65
Understand the basics of selecting client/server	.61
Understand the basics of selecting WAN/LAN interconnectivity	.58

Table 8: Rotated Factor Loadings for Top Twenty-five Ranked Items for Academics and Practitioners

PRACTITIONERS	
FACTOR 3* Network Characteristics (eigenvalue = 1.72; percentage of variance explained = 6.9; reliability = .91)	
Items Loading into this Factor:	**Factor Loadings:**
Describe characteristics of ISDN networks	.83
Describe characteristics of frame relay networks	.81
Describe characteristics of ATM networks	.80
Awareness of TCP/IP	.52
ACADEMICS	
FACTOR 3* Basic Abilities (eigenvalue = 2.12; percentage of variance explained = 8.5; reliability = .91)	
Items Loading into this Factor:	**Factor Loadings:**
Demonstrate the ability to use electronic mail	.90
Demonstrate the ability to use the Internet	.90
Demonstrate the ability to use a LAN	.79

Table 8: Rotated Factor Loadings for Top Twenty-five Ranked Items for Academics and Practitioners

PRACTITIONERS	
FACTOR 4* Basic Abilities (eigenvalue = 1.22; percentage of variance explained = 4.9; reliability = .94)	
Items Loading into this Factor:	**Factor Loadings:**
Demonstrate the ability to use electronic mail	.89
Demonstrate the ability to use the Internet	.86
Demonstrate the ability to use a LAN	.84
Demonstrate the ability to use file transfer	.57
ACADEMICS	
FACTOR 4* Networks (eigenvalue = 1.28; percentage of variance explained = 5.1; reliability = .94)	
Items Loading into this Factor:	**Factor Loadings:**
Understand the framework for planning a network	.81
Understand the framework for designing a network	.81
Understand the framework for implementing a network	.80

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Appendix I: Resources

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Appendix II

DATA COMMUNICATIONS STUDY

What degree of importance should be placed on each of the following concepts in an introductory senior-level business data communications course to be taken by CIS majors? Use this scale:

1 = Of no importance; should be eliminated
2 = Of below average importance
3 = Of average importance
4 = Of above average importance
5 = Of extreme importance

Differentiate between 1 2 3 4 5
- analog and digital signals
- voice and video signals
- batch and on-line systems

Calculate the bits that comprise
- audio clip
- video clip
- alphanumeric text
- bit-mapped image
- postscript image

Understand modulation with regard to
- its definition
- the process
- its application for technologies

Understand multiplexing with regard to
- its definition
- the process
- its application within technologies

Understand data compression with regard to
- its definition
- the various algorithms (i.e., V.42 *bis*)
- its application for software systems

Differentiate between
- circuit and packet switching networks
- space and time division switching
- private branch exchanges and data switch
- alternate and adaptive routing
- virtual circuits and datagrams

Identify components of the following protocols
- high-level data link control
- synchronous data link control
- link access protocol (LAP-B)
- binary synchronous communication
- logical link control
- link access protocol, D channel

Have an awareness of 1 2 3 4 5
- Netware/IPX/SPX
- X.25
- IBM SNA
- TCP/IP
- DECnet
- OSI
- Apple Talk

Demonstrate the ability to use
- electronic mail
- the Internet
- on-line services (e.g., Prodigy)
- a LAN (e.g., Novell)
- file transfer (e.g., mainframe to PC)

Acquainted with the history of
- electronics
- the telephone
- the radio
- the Carterphone decision
- the personal computer

Differentiate between
- serial and parallel transmission
- dial-up and leased lines
- conditioned and unconditioned lines
- bit rate and baud rate
- bandwidth and frequency
- baseband and broadband

Identify organizations (e.g., ANSI, ISO) with regard to
- acronym
- members comprising
- primary responsibilities
- their history

Understand the framework for
- planning a network
- designing a network
- implementing a network

Understand the basics of selecting LAN 1 2 3 4 5
- hardware
- operating system software
- topologies
- media access control protocols
- application software
- selection criteria

Understanding the basics of selecting
- software licensing
- client/server configurations
- administration
- database servers
- security

Describe characteristics of
- Frame relay networks
- ATM networks
- SMDS networks
- BISDN networks
- ISDN networks

Understand the basics of selecting WAN
- hardware
- operating system software
- management systems
- security systems
- - firewalls
- - encryption
- - physical techniques
- interconnectivity with LANS

Illustrate media characteristics (e.g., twisted pair, coaxial cable, fiber optics, satellite) by
- describing how each medium operates
- understanding media selection criteria
- selecting media for specific applications
- specifying major media vendors
- specifying current media pricing

Interpret EIA-232-C (i.e., RS-232-C) by
- describing its purpose
- describing its electrical specs
- specifying its application

Contrast 1 2 3 4 5
- various microcomputer communication software packages
- various LAN software systems
- various middleware software systems

Describe
- sliding-window protocol
- stop-and-wait protocol
- cyclic redundancy check
- parity checks
- stop-and-wait ARQ
- go-back-N ARQ
- XModem protocol

Acquainted with
- wireless LANs
- cellular communications

DEMOGRAPHICS: Please check applicable statements.

In what college is your Information Systems department?
- College of Business
- College of Engineering
- College of Sciences
- College of Education
- Other: _____

What is the total enrollment size of your institution?
- less than 1,000
- 1,000 - 5,000
- 5,001 - 10,000
- 10,001 - 15,000
- greater than 15,000

What is your rank?
- Assistant Professor
- Associate Professor
- Professor
- Other: _____

Have you taught a course in business data communications or telecommunications?
- Yes
- No