

TELECOMMUNICATION RESEARCH IN INFORMATION SYSTEMS: AN INVESTIGATION OF THE LITERATURE

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Telecommunications management is becoming a top priority of IS executives. Executives concerns range from network establishment and getting connectivity to using IS for competitive advantage. In a rapidly changing environment, these executives search for guidance and insights. Unfortunately they might find limited help from IS research. An extensive literature review of more than 9800 articles covering over eleven years of MIS research showed that academicians have not placed the same emphasis as practioners on telecommunications management. Furthermore, the majority of telecommunications research focuses on lower level management issues, such as installing a network, rather than using IS for competitive advantage. More research in telecommunications is needed to provide IS executives with insights on how to manage the telecommunications function.

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INTRODUCTION

In the past 30 years, the world has undergone a dramatic transformation from an Industrial to an information society. The number of white collar workers now outnumbers blue collar workers and information has replaced capital as our nation's leading resource (Naibitt, 1982).

Innovations such as satellite transmission, point of sale terminals, and electronic data interchange have allowed companies to reduce the information float to a atter of seconds. This issue has become so important that Clemons and McFarlan (1986) caution that lagard companies that do not capitaslize on the promise of telecommunications may find themsaelves at a competitive disadvantage. In *Competing in Time*, Peter Keen (1988) also warns that businesses that do not learn about telecommunications will experience potentially unrecoverable losses of market share in the late 1980's and early 1990's. To remain competitive, companies must reduce the information float -- the time information spends in the channel between sender and receiver.

Practioner concern over telecommunication has been highlighted in many publications. For example, a recent survey of information system (IS) executives (Brancheau and Wetherbe, 1987) found that using IS for competitive advantage was the second most important issue behind strategic planning. Telecommunications plays a key role in providing competitive advantage by linking companies to

their customers, distribution channels, suppliers, and themselves. Donovan (1988) stressed that IS manager's primary role is to establish a communications structure that provides application productivity. While practioner concern over telecommunication issues is well documented, what is not clear is how IS research has reflected these concerns. Can practioners turn to academicians for theories and insights on management of the telecommunications function? If academicians are researching telecommunications, what topics are they addressing? Are we providing technical or managerial advice?

The purpose of this paper is to investigate the degree to which IS research has discussed the area of telecommunications. In an attempt to answer these questions regarding the academicians' role in telecommunications research, selected IS literature from 1977 to 1987 was reviewed. To guide the literature exploration, Keen' stage theory of telecommunications was used to categorize the theme of each of the articles. This paper proceeds with a background discussion of stage theories, the description of the research methodology, and analysis of the data.

BACKGROUND

Telecommunications is defined here to include the technological, procedural, and managerial aspects of voice and data communications. Specifically excluded in this definition are the areas of human and organizational communication that are not explicitly supported by voice or data communications technology. Concentrating on the technology and its uses allows research about the evolution and maturation of telecommunications.

Stage theories provide a framework for the present study. Researchers have successfully used stage theories to explain and anticipate the changes in the information systems area. There are stage theories, for example, to describe the growth of applications, personnel selection and management techniques in the MIS industry (Gibson and Nolan, 1974), systems development methodologies (Hirschheim, et al., 1987), system development tools (Colter, 1984), and end-user computing strategies (Alavi, et al., 1987). In the field of communications at least three stage models have been proposed: Donovan (1988), Wightman (1987), and Keen (1988). These stage models are very similar because they describe telecommunications management as evolving from an in@house operation mentality to a more pervasive marketing strategy. Although any of these models could be selected to guide the literature search, Keen's model was chosen as a framework because it specifically addresses the telecommunications functions within the organization from the level of the telephone to the most sophisticated applications of the technology

available today. Keen's stage model is comprised of operations, internal utility, and coordinated business unit eras.

Era I: Operations Era. Telecommunications is basically synonymous with the phone system. While this function is essential to business efficiency, it hardly warrants top management attention. The most important challenge to telecommunications management is getting the equipment to function. Linking terminals to mainframes, buying local area networks, learning specific protocols, and installing other homogeneous systems are examples of telecommunication issues that can be classified into this era. Telecommunication managers rely heavily on vendor expertise.

Era II: The Internal Utility. Telecommunications is responsible for providing cost effective service by centralizing control and planning over the often decentralized systems. Integration of these decentralized systems becomes a standard. Voice and data can be transmitted over the same lines. A proliferation of technologies gives managers many telecommunications alternatives. Standards become important as companies attempt to hook up heterogeneous systems. Companies hire their own technical expertise instead of relying on vendors.

Era III: The Coordinated Business Unit. The telecommunications function is viewed as a corporate resource. Telecommunications redefines the basic level of service industries such as the airline, banking, and financial industries, and can be extended to manufacturing environments as well. Competitive advantage is gained by building barriers to entry, increasing switching costs, changing the basis of competition, gaining power over suppliers, and generating new products. The IS department is no longer viewed as a cost center, but as a revenue generator.

Keen suggests that companies still in the earlier eras may lose competitive advantage in the early 1990's. Since telecommunications can redefine the basis of competition, laggard firms may not be able to catch up with competitors who are already treating the telecommunications function as a coordinated business unit. The following section presents the specific questions raised to assess whether this importance of telecommunications has been reflected in the literature.

RESEARCH QUESTIONS

Keen's model indicated the growing importance of telecommunications in the information systems area and depicts an organization that can compete by making decisions based on information that is provided in a timely fashion, regardless of its location within the firm. In essence, the communication component of IS is the conduit through which IT-supported competitiveness flows. The following research questions ask whether the IS literature supports a similar view of the importance of telecommunications.

1. What portion of the IS-related articles surveyed are concerned with telecommunications?
2. Have more IS-related telecommunication articles been written in recent years than in previous years to reflect the growing concern about telecommunications in industry?

3. Which of Keen's eras do these articles address? Are researchers concerned with getting the equipment to work, providing connectivity, or supporting competitive advantage?

4. Which IS journals publish telecommunication articles? What eras do these journals typically address?

These questions were answered by conducting an extensive review of the IS literature published between 1977 through 1987. The following section proceeds with an explanation of how this research was conducted.

RESEARCH METHODOLOGY

Journal selection was based on top IS journals as determined by Hamilton and Ives (1983), Vogel and Weitherbe (1984), Davis (1980) and Van Over and Nelson (1986), from which a composite list of 28 top journals was created. For the present study several titles from this list were excluded either because the title no longer exists (Systems, Objectives, and Solutions) or IS-related articles appear there infrequently (e.g., Academy of Management Journal). In addition, the Proceedings of the International Conference on Information Systems (ICIS) was included as an indication of trends and new research areas in the field. In all, eighteen journals were selected for this study. Both the Hamilton and Ives and the Davis lists are divided into practitioner and academic categories. The final list maintains this classification because the research question addresses the discrepancies between practitioners and academicians. Table 1 contains the list of journals used.

Table 1: Journals Reviewed

Journals Included in This Study	Classification
ACM Transactions on Office Automation	A
Communications of the ACM	A
Computing Surveys	A
Database	A,P
Datamation	P
Decision Sciences	A,P
EDP/IS Analyzer	P
Harvard Business Review	A,P
IBM Systems Journal	P
Intern'l Conference on Information Systems Proceedings	A
IEEE Computer	A
Information and Management	A,P
Interfaces	P
Journal of Management Information Systems	A
Journal of Systems Management	P
Management Science	A
MIS Quarterly	A,P
Sloan Management Review	A,P

A = Academic Journal, P = Practitioner Journal

DATA COLLECTION

The journals were reviewed for the period from 1977 to 1987, except for the ACM Transactions on Office Information Systems which was first published in 1983 and the Journal of Management Information Systems which first appeared in 1984.

For each journal reviewed, the following data was collected:

1. Total number of articles per issue,
2. Number of telecommunications articles per issue,
3. Number of era I telecommunications articles per issue,
4. Number of era II telecommunications articles per issue, and
5. Number of era III telecommunications articles per issue.

Each article was classified by examining the title, abstract and keywords. Since telecommunications is a broad subject, many types of articles -- such as distributed processing, office automation, or electronic mail -- may be deemed as involving telecommunications. However, only articles that focused on the transportation of information were classified as telecommunication articles. Thus, a distributed processing article would have been classified as a telecommunication article if it dealt strictly with how the system transported data or how the system was connected. A distributed processing article that focused on why companies should have decentralized computing would not be categorized as a telecommunication article. Three judges independently reviewed and categorized each article as to the era addressed. If any of the three judges classified an article differently the article was then discussed by the group until a consensus was researched. In total, 9,817 articles were reviewed from the 18 journals. Examples of the types of articles categorized into each era should clarify the application of Keen's model and are presented in Table 2.

Table 2: Topics and Examples of Telecommunication Eras

Era I

Vendor specific equipment
 Measuring performance on a local area network
 Packet switching on a homogenous system
 Case studies on a specific LAN
 Flow control in a specific network
 Telephone systems
 Micro to mainframe connections
 Examples: "Routing and Flow Control in Systems Network Architecture" (Ahuja, 1979), "Evolution of the Ethernet Local Computer Network" (Shoch, et al., 1982)

Era II

Integrating voice and data
 Application connectivity
 Standards
 Heterogenous computing environments
 Electronic funds transfer
 Examples: "Interconnecting Heterogeneous Computer Systems" (Notkin, et al., 1988)
 "Implementing Computer-mediated Communication Technologies" (White and Massello, 1987)

Era III

Information technology for competitive advantage
 Multinational information systems
 Inter-organizational information systems
 Telecommunications and corporate strategy
 Examples: "The Changing Value of Communications Technology" (Hammer and

Mangurian, 1987) "Implications of Changes in Information Technology for Corporate Strategy" (Rockhart and Morton, 1984)

RESULTS

From this extensive literature review, it is possible to address the four research questions.

Question 1. What portion of the IS-related articles surveyed is concerned with telecommunications? Four hundred articles of the 9,817 articles reviewed were about telecommunications, accounting for only 4% of the total articles published. In addition, most of these articles were published in practitioner journals. If only the research journals are considered, only 140 articles, or just over 1%, were about telecommunications.

Question 2. Have more IS-related telecommunication articles been written in recent years than in previous years, reflecting a growing concern about telecommunications in industry? To answer this question, rank regression analysis was performed to see how the number of telecommunication articles has changed over the eleven years. To assure that the increase in telecommunications articles was not due to an overall increase in the number of articles published, the ratio of telecommunication articles to total number of articles was used. Specifically, the following four models were tested:

1. Number of era I articles as a function of year,
2. Number of era II articles as a function of year,
3. Number of era III articles as a function of year,
4. Total number of era I, II and III articles as a function of year.

5. Percentage of all articles which were telecommunications related as a function of year.

Table 3 shows the t-test for each of these regressions. In each case, the number of telecommunications articles has increased over the years.

Table 3: How the Number of Telecommunication Articles Vary by Year

REGRESSIO NMODEL	PARAMETER ESTIMATE	T-STAT FOR HO: PARAMETER = 0	PROB>T
Era I = f(Year)	.01768	6.818	.0001
Era II = f(Year)	.00942	7.068	.0001
Era III= f(Year)	.00100	3.289	.0012
All Eras = f(Year)	.00083	7.554	.0001
%Tcom = f(Year)	.02809	8.172	.0001

Question 3. Which of Keen's eras--getting the equipment to work, providing connectivity or competitive advantage--do these articles address? Table 4 contains the breakdown of telecommunications articles by era. The majority of telecommunication articles (61%) are categorized into era I, getting equipment to function on

homogeneous systems. Very few articles (4%) were written about telecommunications for competitive advantage.

Table 4: Number of Telecommunication Articles Published Per Year

Year	Era I	Era II	Era III	Total
1977	15	4	0	19
1978	14	7	0	21
1979	25	13	1	39
1980	17	6	0	23
1981	18	5	1	24
1982	14	9	4	27
1983	44	21	1	66
1984	29	9	2	40
1985	18	13	1	32
1986	15	14	1	30
1987	24	22	2	48
	233	123	13	369

Question 4. Which IS journals publish telecommunication articles? What eras do these journals typically address? The five journals which have published the most telecommunications articles are listed in Table 5. Three out of the top five are practitioner journals. Interestingly, the two journal which have the highest percentage of telecommunication articles the $\sqrt{\sqrt{}}$ IBM Systems Journal and the EDP Analyzer (now IS Analyzer) are not generally available as an outlet to MIS researchers. The top telecommunication publications were also categorized by eras in Table 6. Table 6 shows the top five journals that publish era I and era II articles. This table gives an indication of where a researcher may want to submit articles about specific topics in telecommunications. Researchers who address connectivity issues may have a better chance of publication in these journals. Table 6 also lists the top two publications for era III journals. The Harvard Business Review and Sloan Management Review have published the most articles (61%) about the use of telecommunications to gain competitive advantage. The IBM Systems Journal, ICIS Proceedings, Information and Management, and MIS Quarterly account for 57% of identified articles dealing with telecommunications for competitive advantage.

Table 5: Journals That Published the Most Telecommunication Articles

Journal	Number of Telecomm. Articles	Total Articles	%TCOM over Total TCOM
Datamation	115	1,326	28.68%
IEEE	64	1,148	15.96%
Computer IBM Systems Journal	59	253	14.71%
EDP/IS Analyzer	27	132	6.73%
Communications of ACM	25	988	7.54%

Total 290 3,847 7.54%

Table 6: Journals that have Published the Most Articles per Era

Journal	Era I Articles	Total Articles	% of Era I over Total
Datamation	74	1,326	30.20%
IEEE	55	1,148	22.45%
Computer IBM Systems Journal	44	253	17.96%
Communications of ACM	21	988	8.57%
ACM Transactions on OIS	12	94	4.90%
Total	206	3,809	5.41

Journal	Era II Articles	Total Articles	% of Era II over Total
Datamation	39	1,326	28.87%
EDP/IS Analyzer	15	132	13.38%
IBM Systems Journal	14	253	9.86%
ACM Transactions on OIS	10	94	7.04%
Journal of Systems Management	10	944	7.04%
Total	88	2,749	3.20%

Journal	Era III Articles	Total Articles	% of Era III over Total
Harvard Business Review	5	1,012	35.71%
Sloan Management Review	3	283	21.43%
Total	8	1,295	0.62%

DISCUSSION

The collection, storage, and analysis of data in support of decision making may no longer be a sufficient capability of an information system. Data may be acquired in one location, manipulated in another, and used in a specific decision task in yet another. The ability to share the correct information may be more important than its original gathering. Communication systems can provide increased customer and supplier access to organizations, can improve feedback on policy and product issues, and can create access or barriers to new markets.

IS research in the area of telecommunications is in its infancy. Although the topic certainly is not novel, it might be viewed as a field that still has technological as well as managerial concerns. For example, work in

telecommunication standards and connectivity are technical concerns that are progressing quickly and with great interest.

IS researchers are beginning to concentrate more on issues of improving individual and organizational effectiveness and efficiency through telecommunications. Research classified as era 2 can be thought of as being more in line with other topics of managerial concern often found in the IS literature. Era 3 research concentrates on the management of the telecommunication function as a strategic resource that must be effectively managed in order to extract sufficient returns on the technological investment. It is difficult, however, to separate the use of information technology for competitive advantage and the use of telecommunications for competitive advantage. Consequently, some articles not classified here as era 3 telecommunications articles might be viewed by some as qualifying in this category. As was previously discussed, more general research is being conducted about this topic and represents an exciting area for further investigation.

SUMMARY

Several important findings emerged from this study. Researchers have not placed the same level of importance on telecommunication issues as practitioners. Only 4% of the articles published during the period 1977-1987 addressed telecommunication issues. The majority of these telecommunication articles dealt with operational topics such as getting the equipment to function or describing specific technologies. There is evidence, however, that the number of telecommunication articles published about the management of telecommunications is increasing slightly over time.

Some journals are more likely than others to publish telecommunication articles. *Datamation*, *IEEE Computer*, and *Communications of the ACM* are examples of journals that are available to researchers to publish telecommunication articles about implementation of communication systems on homogeneous and heterogeneous systems. Telecommunication articles that address competitive advantage are most likely to appear in *Harvard Business Review* or *Sloan Management Review*. Apart from these few journals, research on telecommunications has not appeared widely in the literature.

There is much to be learned about individual, inter-organizational, and intra-organizational uses and management of communication technologies. This area should provide a fertile ground for future examination that could be of interest to researchers and practitioners alike.

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