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Abstract

This paper presents an end user's model for understanding the use of communications technology or media in the 21st century. The rapid advancement of communications technologies like Email, Group Decision Support System and Video Conferencing are not being taken advantage of today. A model is presented and then explained in terms of the existing technology. A review of the literature is provided at each step of the way. A table summarizes the information reviewed.

Introduction

The rapid pace of communication technology evolution creates confusion for many businesses in deciding what technologies fit the organization. Technologies such as Electronic mail, Group Decision Support Systems (GDSS), and Video Conferencing are mature and readily available. However, a difficult problem exists in determining how well such a media will work within a particular organization.

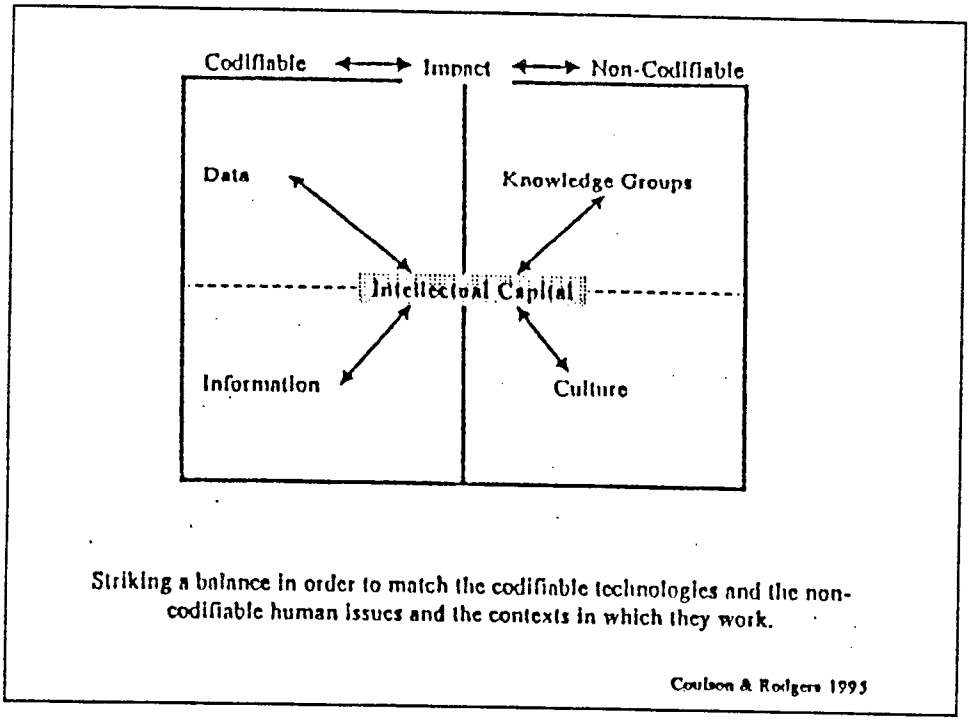
Simply putting good technology in front of an end user does not mean a system will be successful (Markus & Keil, 1994). The science of predicting the impact, acceptance, and success of certain communication media has been a question researchers have wrangled with for years (Davenport, 1994). This literature review examines case examples, research, and theories of communication media implementation from a contextual perspective. In particular, the context whereby Electronic Mail, Video Conferencing, and Group Decision Support Systems have been successful and unsuccessful are summarized. Also provided is an evaluative framework to identify the potential implementation difficulties relative to the media discussed.

The Relationship Between Codifiable and Non-codifiable Entities-

Technology is the *codifiable* aspect of communication media. For example, in electronic communication, the information and data to be transmitted are broken down into a code (codified) for the purpose of storage and transmission. This codification translates the information or data into a language the computer or technical media can understand. Information and data are then extracted and transformed into forms humans understand. It is at this point that the data and information are recorded into human interpretations.

These human entities consist of whole organizations, teams, and communities of practice within organizations. Additionally, human entities, in coexisting together, create both organizational culture and, of course, ethnic cultures. These human entities are the non-codifiable elements. That is, the information these units hold is not stored in a consistent manner. Group and team perceptions, methods, interactions, and reactions are difficult to predict, especially when compounded with different ethnic cultural elements. This unpredictability makes it virtually impossible to create a sound, all-purpose model of human behavior; therefore human entities are classified as non-codifiable.

Figure 1. The Relationship Between Codifiable and Non-codifiable Entities



As Figure 1 demonstrates, the purpose of a given communication media is to allow the information being stored in the non-codifiable group (humans) to interact with the codifiable group (technology). This ultimately leads to the creation of a synergy known as intellectual capital. In turn, the degree of impact between the codifiable and non-codifiable entities determines the usefulness of that synergy in creating a competitive advantage for the organization.

Codifiable Technologies:

It is no secret that the introduction of technology will have an impact on an organization in some fashion and to varying degrees. The IS profession has been searching for the 'silver bullet' of communication

technologies for some time, but has never been able to find it. Part of the reason can be attributed to the theories researchers have used to frame a technology. In one particular framing, the technology seems perfect, but when framed by another theory the previous research seems flawed.

Popular Theories

Information Richness:

Information Richness theory has been used primarily as an evaluative measure for media choice; 'fitting' the media to the intended purpose (Daft & Lengel, 1984; Daft, Lengel, & Trevino, 1987). In essence, Information (or media) Richness theory rates communication media on its capacity to provide feedback, accommodate language varieties, and provide various methods of verbal and non-verbal communication (Yates & Orlikowski, 1992).

On the Richness scale, a communication medium such as face-to-face interaction, is viewed as being rich, while standard reports are considered fairly rich. The importance of this classification scheme is to predict media choice and to predict *how* a communication media will be used. For example, empirical research on Information Richness theory has shown that a manager will use rich media to convey important communiqués, while he/she will use weak methods to convey not-as important communiqués (Giddens, 1979; Markus, 1988; Roberts & Scarpens, 1985). Thus, utilization of the Richness scale can be used to determine what communication media might be suitable for a given purpose.

Critical Mass Theory:

Critical Mass theory attempts to explain the communication media adoption process that exists within organizations. Essentially, Critical Mass assesses the affects of certain users' communication choice habits on other users' choices. In effective communication media environments, individuals must communicate as part of a group. Thus, the media choice and its use determine how effective the media will be. Before a media can be deemed effective, a 'Critical Mass' of users must adopt the technology. As the number of adopters increases, the value of the system increases, motivating other users to adopt that system (Markus, 1994).

Although there are many cases in which these two theories have been proven empirically, some case experiments have demonstrated unpredictable results. Non-codifiable human entities often surprise researchers by using the technologies in ways the research has not predicted nor intended (Markus, 1994). Hence, researchers have begun exploring many theoretical paths in an attempt to explain and predict human and technological interactions.

This literature review on communication media, including Electronic Mail, Video Conferencing, and Group Decision Support Systems, takes stock of what research has been done on each particular medium. More specifically, the review examines "what works," "what doesn't," and in what context the results occur. This type of review reveals commonalties and inconsistencies that are invaluable. Additionally, the theoretical perspectives mentioned above help in understanding the framing of results found by researchers.

Electronic Mail

A medium which "uses computer text-processing and communication tools to provide a high speed information exchange." (Sproull & Kiesler 1986) E-mail has been evaluated from the basis of being a sole group communication technology within an organization, to being part of a repertoire of technologies. Additionally, research has examined E-mail within the scope of organizations, individuals, and global entities. The results have been fairly consistent, yet sometimes unpredictable.

One particularly noteworthy evaluation of E-mail was a field experiment by Eveland and Bikson (1988). In their study, 79 male participants, all of them prior professionals, were divided into two equally distributed groups. Both groups possessed similar levels of expertise and shared backgrounds. For the purpose of the experiment, one group was placed in an office environment with traditional office equipment, such as typewriters and telephones. The other group was given the same equipment with the addition of electronic messaging (E-mail).

Initially, the experiment found that the group without E-mail capability finished their assigned projects in a more timely manner than the other group. As the experiment progressed, the E-mail group caught up and surpassed the non-Email group on completion speed of assignments.

Interestingly, it was found that the group structures had developed differently. The group without the electronic communication media had developed into a traditional hierarchical structure. In this environment, leaders had emerged and remained leaders regardless of the project content.

The group with E-mail developed a drastically different structure; they became team based. With every new project assigned, leaders would emerge who had requisite knowledge in a specific area relevant to the project. The E-mail system allowed the group to interact in a manner where status considerations were minimal. This group's projects were also more thorough and innovative.

Information Richness theory predicts that technologies, such as E-mail, are lean on the richness scale because they lack social cues and rely solely on the use of written language (Markus, 1994). However, this does not diminish the power of the medium. As shown by the group structures in the Eveland and Bikson case (1988), when used, E-mail has the power to shape the social processes within an organization.

Initial adoption of any media, including E-mail, is not a simple task. The technology not only has to *appeal to the users*, but it must be *perceived useful*. Researchers have labored over various hypotheses to attempt to predict who uses E-mail within an organization (Fulk, Schmitz & Steinfield, 1990), what it is used for (Sproull & Kiesler, 1986), and where it is successful (Eveland & Bikson, 1988; Markus, Bikson, El-Shinnawy & Soe, 1992).

The results of the research on the predictability of E-mail use are interesting because of the anomalies. While the overall purpose of E-mail was justifiable, the uses often varied unpredictably.

- It was predicted that senior managers would not use E-mail because of their lack of typing skills. This was not an inhibitor to use. Although, not touch typists, managers saw E-mail as a valuable tool (Fulk et al., 1990; Markus, 1994).
- It was predicted that managers would not use E-mail because of their high levels of decision making. This reasoning came from Information Richness theory where written communication media would be used for low level communiqués. This assumption was incorrect. Researchers found that managers used E-mail frequently for many types of communication as a matter of convenience (Fulk et al., 1990).
- It was predicted that E-mail would be used for short 'memo' types of communication (Fulk et al., 1990). This assumption was incorrect. Instead, it was found that E-mail was often used as an 'envelope' for file transfers (Markus et al, 1992).

Research has also suggested the following as being key factors in the acceptance and success of E-mail communication:

- The work that is being done- some jobs are more suitable than others for E-mail (Rice & Shook, 1988). e.g.
- Jobs that involve long distance communications where time zones are a concern.
- Social Factors- Who is using E-mail? If all group members use E-mail actively, then there will be success. It helps if the receiver actually reads their mail (Markus, 1990).
- Accessibility- How easy it is to access E-mail (Rice & Shook, 1988).
- Cultural Norms- Technologies tend to become ingrained within an organization. E-mail may become the expected method of communication for some types of messages. e.g. Agendas might be distributed before meetings are to take place so that contributors will be prepared.

Essentially, E-mail is a suitable media in some contexts, but not others. This, of course, is dependent on the organization concerned. As with other communication media, a successful E-mail project should find a balance between the codifiable technologies and the non-codifiable human factors to develop a system that provides good support. The application of E-mail should complement the information culture of the organization and should be used as a supplement to other items in the technological array.

Video Conferencing

The quality and availability of Video Conferencing systems has been improving over the last thirty years. However, the improvement of technology has not influenced companies to adopt this communication medium on a mass-market level. During the 1960's, when the first Video Conferencing systems were developed, market forecasts predicted the universal acceptance of the technology and the resultant elimination of audio phones (Snyder, 1971). In contrast to these optimistic forecasts, adoption of Video Conferencing technologies has been restrained (Johansen, 1984). Researchers have been intrigued by the seeming failure of Video Conferencing and have sought to discover why this advanced technology has been passed by.

Edigo (1990) attributes the failure of Video Conferencing technology not to the technology itself, but to the inadequacy of needs assessment methodologies. From an Information Richness perspective, this communication medium is very 'rich' as it offers verbal and non-verbal communication cues between conversants. While Richness Theory would expect Video Conferencing to be exploited as an advanced communication device for management, that prediction has not come to pass. This unpredictability of acceptance has shown that defining appropriate uses for Video Conferencing has been an imperfect endeavor.

Video Conferencing As A Substitute For Face-To-Face Communication:

Video Conferencing has been offered as a substitute for face-to-face meetings. Within this context, the advantages of Video Conferencing include reduction in travel costs and 'quick response' to management situations where group consensus is necessary (Snyder, 1971). Unfortunately, research has indicated different results. Case research demonstrated that even with Video Conferencing systems in place, travel reductions are almost non-existent (Johansen, 1984). Groups still desired the advantages of physical presence. As for the 'quick response' nature of Video Conferencing, research initially suggested positive results. Unfortunately, in-depth case examples showed the by-product of 'quick response' was an increase in the frequency of meetings. In other words, with Video Conferencing in place, executives spent less time doing their work and spent more time on video conference meetings (Johansen, 1984).

In an attempt to discover appropriate uses of Video Conferencing, researchers have compared the added benefits of video communication versus traditional audio communication. In this research, the video channel was added to previously audio-only communications. The results suggest that in situations where audio communication was sufficient, the addition of video had little or no impact on specific contexts:

- *Problem Solving and Decision making in groups*- Video capabilities provided no improvement in situations where audio conferencing was previously used (Edigo, 1990).
- *Group problem solving of non-controversial issues*- Field experiments showed no improvement in the problem solving process when the video channel was added (Johansen, 1984).
- *Conflict negotiations*- Experiments showed no improvement in the results. In fact, some cases reported poorer results because of non-verbal interpersonal variables (Edigo, 1990).

With such negative results, it may sound as if there is no point to investing in Video Conferencing. However, research suggests some promising advantages for Video Conferencing technology:

1. Krauss and Fussel (1990) found that the video element can express a type of *social presence* to help facilitate communication effectiveness. This virtual-social presence enhanced the feelings between workers and created an environment of understanding that the authors termed 'mutual knowledge.' Within this environment, the frequent contact between video communicators developed into a strong relationship with high degrees of empathy and understanding.
2. Much of the research has focused on Video Conferencing as being a sole communication method versus being part of a suite of communication tools (Edigo, 1990). However, research has indicated that, when used as *a supplemental communication medium*, users tended to find their own appropriate uses for video conferencing. Hence, these results support the hypotheses of Critical Mass theory (Markus, 1994). In the case of Video Conferencing, users who found a use for the technology influenced other group members to follow suit (Edigo, 1990).

3. Video Conferencing technology has evolved since the advent of many of these studies. New features, such as virtual whiteboards and groupware applications, may create new possibilities for communication effectiveness. The *new features*, coupled with the fact that Video Conferencing media is becoming less expensive, may set the stage for users to give Video Conferencing another look.

It is hoped that the lacking acceptance of Video Conferencing may have taught some important lessons regarding needs assessment. The thirty year history of Video Conferencing demonstrates that it is not a median end users will blindly accept as a 'silver bullet' solution to all problems. Just like E-mail, and other technological communications media, Video Conferencing must involve an assessment of the non-codifiable user needs and cultural impacts.

CASE- USE OF VIDEO CONFERENCING AT J.C. PENNEY

J.C. PENNEY's Dallas and New York headquarters developed their video conferencing system to facilitate junior managers' communication and knowledge sharing. In this situation, junior managers who lacked the travel budget to attend high profile meetings, were given new opportunities to maintain a virtual presence via video conferencing. The system was designed whereby a senior manager (who was attending the meeting) could consult one of his/her junior managers *immediately*, over a video link. The junior managers endorsed the system because it gave them personal development opportunities they would not have had otherwise. Senior managers enjoyed the system because it enhanced their abilities to retrieve specialized knowledge. The goal of this system was to draw upon the knowledge of those who could not travel. The result was a social presence that enhanced the knowledge exchange of meetings (Edigo, 1990).

Group Decision Support System (GDSS)

"GDSS is an interactive computer-based system that facilitates the solution of unstructured problems by a set of decision makers working together as a group" (Desanctis & Gallupe, 1987).

GDSS technology is a response to the modern competitive environment where decision making ability can mean success or failure for an entire company (Huber & McDaniel, 1986). The goal of a GDSS is to facilitate decision making abilities within a group by adding a structured, codifiable computerized environment. This computerized communication environment possesses many characteristics for bringing groups together. However, the aim of GDSS goes far beyond bringing groups together for electronically enhanced meetings. In fact, GDSS focuses on improving decision making effectiveness by using the following techniques:

- *Removal of physical communication barriers*- Allowing groups to interact electronically although they are geographically separated.
- *Removal of interpersonal communication barriers*- Modern GDSS usually conceals the identity of those who enter comments on the screen. It is thought that participants will not be influenced by status and personality traits.

- *Structuring the discussion-* Sets of questions are posed and poll results of input are taken. This keeps the discussion on track, without looking at what the group views as unimportant.
- Systematizing the discussion- This adds parameters to group input in non-polling discussions, moving the discussion along.

There is no perfect definition of a GDSS because of its variability. Papers have been written that class E-mail, Voice Mail, and Video Conferencing as GDSS technologies. However, for the purpose of this literature review, a GDSS is hereby classified as a hybrid of group interaction media, particularly in the context of the electronic meeting technologies.

Six areas of concern for GDSS research were identified by Desanctis and Gallupe (1987). These areas are broad elements that have laid out the foundations of GDSS research.

GDSS Design- The hardware and software considerations of GDSS and the potential impacts on group effectiveness.

1. Similar to the 'Looking Glass' approach of evaluating the communications patterns within a group or organization (Rodgers, 1990). This macro view analyzes changes in communication between group members due to the introduction of a GDSS.

2. *Mediating Affects of Participation-* How the technology, skills, and preferences of participants affects the amount of participation in the discussion.

3. Affects of Perceived Physical Proximity, Interpersonal Attractions, and Group Cohesion- How the interaction of these three factors is influenced by the use of a GDSS. Specifically, whether a GDSS enhances a 'team' atmosphere for groups.

4. *Affects on Power and Influence-* This examines the quality of decisions made once the power and influence elements of group interaction are eliminated.

5. This area examines the levels of decision quality and satisfaction with the group decision process within the context of a GDSS.

GDSS research projects based on these elements were often completed using practical experiments and cases.

Implementing Electronic Meeting Systems At IBM:

This case study was completed by members of IBM's System Integration Division and University of Arizona (Grohowski, McGoff, Vogel, Martz & Nunamaker, 1990). Essentially, the case focuses on the spectacular results of GDSS as a decision improvement media.

Using a decision room scenario (See Figure 2), group tasks were evaluated for decision quality. Questions were posed to group members who would respond by entering responses on a terminal

keyboard. Responses were polled and participants were led through an electronic discussion based on inputs. Eventually consensus decisions were reached.

The room was tested for a variety of group tasks including brainstorming, issue analysis, voting, policy formation; later idea organizing and questionnaire tools were added. The results were excellent (Grohowski et al., 1990):

1. Anonymity was beneficial in the meeting process

2. Changes in the structure of groups

The paper did not examine the pitfalls of placing parameters on group decisions.

IBM and the University of Arizona developed the GDSS decision room technology jointly. IBM provided the hardware connections and University of Arizona wrote the software. Together, they sell this system as a product.

Context Issues Of GDSS:

Some of the factors discussed in the IBM case are definite benefits of GDSS meeting systems, however researchers have found several exceptions.

Inherently, when comparing the face-to-face aspects of group discussion versus written communication systems, one is eliminating non-verbal communication attributes such as status, body language, and spoken anomalies. This is a mixed blessing. Some types of decisions, such as opinion polling and surveying, are well suited to being made without non-verbal input. However, the written (PC terminal entry) environment of a GDSS lacks the verbal dynamics of spoken anomalies and sudden turns in discussion. Thus, the overall written structure of the discussion may cause sudden important input to be lost, hindering the thought processes of individuals within the group.

The anonymity aspects of GDSS are also a mixed blessing. Anonymity is helpful for decisions that should not be affected by individual status. However, working in an anonymous environment does not provide rewards for critical input. Hence, there may not be an incentive for individuals to share knowledge because of the lack of recognition. In a corporate culture where recognition leads to advancement, a GDSS may lack participative effectiveness (Gabarro, 1987). Anonymity of input also creates problems for decision making where individual accountability and responsibility are required. Status and leadership are lost in the anonymous environment, but may be a necessity for some types of decisions (McGrath, 1990).

Group size contributes to the potential success of a GDSS particularly in the area of efficiency. The highly structured nature of a GDSS can help mediate large group exercises, facilitating discussions and preventing them from being bogged down. However, for small groups, the structured nature of GDSS can be a hindrance. It often takes longer to get the discussion parameters setup within the GDSS than it does to complete the whole meeting.

Finally, GDSS application has been analyzed in an ethnocentric manner, with little focus on international issues. In particular, the impact of non-English language and culture on GDSS performance. Aiken, Hwang, Paolillo, Kim, and Lu (1994) conducted a study on GDSS suitability in a non-English environment. In this case the experimenters concentrated on three pacific rim languages: Japanese, Chinese, and Malaysian. Using a situation similar to IBM's decision room, software that supported the different languages was tested to see if the results varied from English speaking results. The results of the pilot studies showed that there was no significant benefit of using a GDSS in business meetings for the three cultures. Even more surprising is that the Chinese actually preferred using English (a secondary language) on the GDSS system rather than their own language. Because these were only pilot studies, the cultural attributes that could have contributed to the non-improvement of decision making results have not been explored. However, it could be hypothesized that the teamwork culture that exists in these countries surpasses the team building attributes contributed by a GDSS.

After the IBM paper was published, two of the authors, Vogel and Nunamaker (1990), wrote a paper clarifying some aspects regarding the contexts within which a GDSS is successful. A successful GDSS project should find a balance between the codifiable technologies and the non-codifiable human factors to develop a system that provides good support for certain types of decisions. Essentially, one should consider using a GDSS for decisions that require structure and where anonymity is a benefit. The application of the GDSS should complement the culture of the organization and should be used as a supplement to other items in the technological array.

Discussion

The cases, examples, and research reviewed in this literature survey demonstrate the potential impact of the introduction of communication media technology into an organizational environment. All three codifiable communication media, E-mail, Video Conferencing, and GDSS, resulted in various impacts on the non-codifiable human entities. Some of the results were consistent with research, others were not.

The common elements and related impacts on non-codifiable human entities, which are consistent with the research for these three communication media, are very broad. For example, it can be said that each of the media impacted the human entities in some positive or negative manner. It can also be said that each of the three media have the potential for success, if the users are willing and able to use them. These broad consistencies are common across E-mail, Video Conferencing, and GDSS.

More interesting issues are raised when the results are inconsistent with research. For example, Video Conferencing was predicted to be a good substitute for face-to-face communication. However, research suggests the opposite. Video Conferencing did not replace the elements of physical presence that effective face-to-face communication required (Johansen, 1984). Another example where results were inconsistent with research involves E-mail. Researchers predicted that E-mail would be used for informal, memo types of communication. Instead, in that particular case, E-mail was more commonly used as an 'envelope' for file transfers (Markus et al., 1992). These inconsistent results all contain one common 'wild-card' element, the non-codifiable human entities.

The research, cases, and examples, discussed the unpredictable results that have occurred when a codifiable technology is mixed with non-codifiable human elements. While some general predictability has occurred, the detailed issues have been relatively unpredictable. Referring back to Figure 1, the goal of blending codifiable elements with non-codifiable elements is to produce a synergy we call intellectual capital.

The details regarding precisely *how* to effectively blend the two elements together is what has proven to be difficult. However, some of the research in this literature review has indicated that *specific, detailed assessments of a particular organization's non-codifiable attributes could lead to more predictable results* (Edigo, 1990). In other words, since we understand the basics of the E-mail, Video Conferencing, and GDSS technologies and their respective impact (See Table 1), it seems logical that the next area to examine would be the human entities and the organization's locations in which they reside.

Instead of taking a prescriptive approach to communication media technology, where every media is viewed as a solution to make the organization 'feel better,' it would be prudent to review the non-codifiable contexts. Using this approach, one would carefully examine and assess the specific information culture, power structure, and group cohesion elements before attempting to fit a technology to an organization. In this approach, one develops a framework which can be used to select technological communication media elements that are suitable for specific organizations and their corresponding needs. The logical assessment of the non-codifiable elements may provide information to better blend the codifiable technologies within an organization, thereby creating and enhancing the synergy known as intellectual capital

Figure 2.

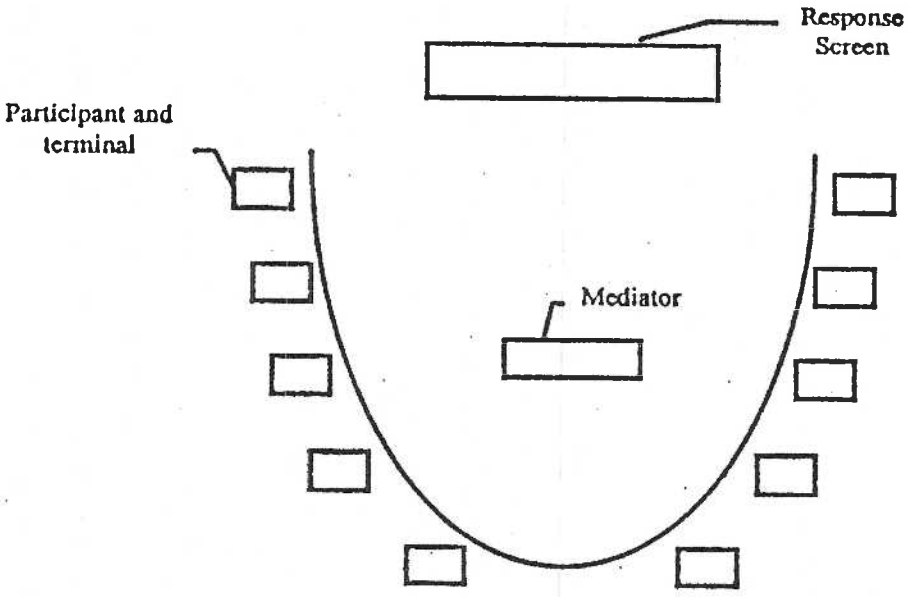


Table 1.

Communication Media	Distinctive Characteristics	Major Strengths	Potential Weaknesses
Electronic Mail	- Text based - High speed transmission - Asynchronous - Technology is mature - Individual to individual or group to group implementations	- Receiver can respond at own convenience - Efficient medium for group mailings - Little lag time between message send and receive - Receiver does not have to be present to receive messages	-Written communication eliminates non-verbal cues - Not suitable for all types of communication interactions - Not suitable for all types of work environments (i.e. privacy issues - Users may get bogged down in answering messages
Video Conferencing	- Visually oriented - Synchronous - Allows non-verbal cues - Use can range from individual to group implementations	- Allows interactions not possible over audio only systems (i.e. social presence) - Non-verbal cues are transmitted between conversants	- Users must "meet" at the same time - Does not substitute face-to-face interaction - Non-verbal cues may be a hindrance for particular situations
Group Decision Support Systems	- Group oriented - Purpose: to solve unstructured problems in a structured environment. - Often text-based	- Removal of physical communication barriers - Removal of interpersonal communication barriers - Structuring of discussions - Large group discussions are kept on track by structure	- Anonymity removes reward incentives to participate - Individual responsibility (leadership) may be eliminated in situations where it is necessary. - Small groups may be slowed by structure - Text environment eliminates spoken anomalies and discussion turns

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