VIRTUAL ENTERPRISES AND EFFECTIVE INFORMATION

COMMUNICATION TECHNOLOGY SELECTION:

A RESEARCH FRAMEWORK AND

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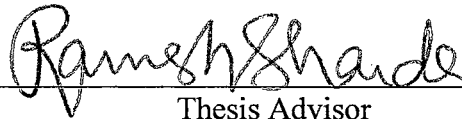
STUDY ANALYSIS

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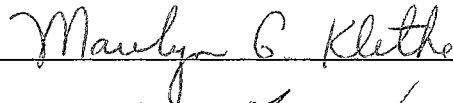Patiala, Punjab, India
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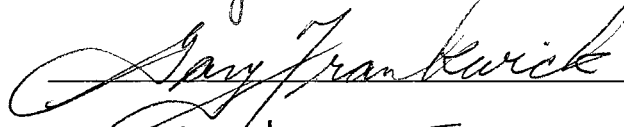Panjab University, Chandigarh
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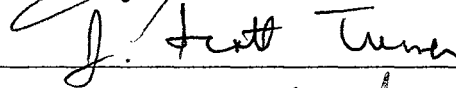DOCTOR OF PHILOSOPHY
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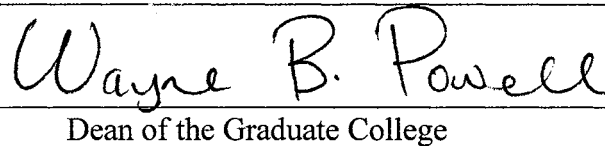
EXPLORATORY CASE

STUDY ANALYSIS

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

1.1   General Statement of the Problem

With the movement towards mass customization, organizations are hard pressed to perfect and maintain all the core competencies needed to provide customer specific products/services, in house. Due to this trend, it is becoming more practical for an organization to form strategic alliances with other business entities that offer competencies complementary to the organization's own. In light of the shorter product/service life cycles, the duration of such strategic alliances, which tend to be product/service specific, are also shorter than in traditional alliances. These short-term strategic alliances are also referred to as *virtual enterprises* (VEs)(Goldman et al., 1995). Virtual enterprises are formed dynamically, in response to customer demand, and dissolved as soon as they become economically unviable.

These virtual enterprises depend to a great extent on technology to appear seamless to the customer (Goldman et al. 1995). Information technology tends to lower transaction costs, and hence helps move organizations towards market structures instead of hierarchies (Malone et al., 1987). Efficient markets require speedy access to information in order to operate properly. In essence, a virtual enterprise is an organization based totally on a market structure.

Telecommunications is an integral component of IT, and it plays a significant role in enabling virtual enterprises. In the ideal case, virtual enterprises are fully connected

through information technology and there is total sharing of information among all constituent organizations. It is, however possible to achieve most of the advantages associated with virtual enterprises without the total integration of systems (Goldman et al., 95). In this study an attempt is made to identify the factors that affect the individual's choice of communication media in a virtual enterprise (by first identifying the characteristics of virtual enterprises that affect communication media requirements and then identifying factors that influence individual communication media choice). A model relating these factors to choice of communication media is developed and parts of the model are tested empirically using the case study methodology.

1.1.1 Virtual Enterprises

It is becoming progressively more difficult for a single organization to excel at all processes involved in producing a highest quality-lowest cost product or service. This becomes nearly impossible when we take into consideration the movement from mass production towards mass customization, where manufacturers essentially provide a product/service according to the customer's specifications [*Agile Manufacturing* is a term used to identify such customer-oriented manufacturing policies (Kidd, 1994)]. Virtual enterprises are being promoted as a way to overcome this problem. A virtual enterprise is a network of companies that work together to provide a product/service that none of them could provide individually in a timely and cost effective manner.

Virtual enterprises are formed with the customers' desires in mind (Davidow and Malone, 1992). The virtual enterprise includes organizations that have as their core

2

competencies the processes (manufacturing, design, support etc.) required to produce the product/service to satisfy the customer. Virtual enterprises are different from joint ventures and strategic alliances in their dynamism, and the fact that there is no obligation for virtual enterprises to continue functioning as entities after current projects are completed.

There is a lot of discussion in trade and practitioner journals on this emerging form of organizational structure, but there are no theory driven studies that confirm or disconfirm its viability. For example, Burden (1999) gives an example of Lockheed Martin Tactical Aircraft Systems creation of a virtual enterprise using Lucent Technologies desktop video conferencing server. Andrews and Hahn (1998) describe the creation and managing of value webs instead of value chains. These value webs consist of virtual enterprises as their members. There is also no major research on the nature of communication / coordination technologies (and the types thereof) needed to make this organizational structure viable.

1.1.2 Media Choice

There are two major types of theories that try to explain the choice of a communication medium by individuals in organizations. The first type of theory is the rational choice theory, which postulates that individuals choose the most appropriate communication medium for each task (Daft and Lengel, 1984). The second stream of theories, categorized under the heading of social influence theory, counters the rational human being concept by stating that human choices are affected by social influences, and

3

individuals may not (rather, do not) choose the most appropriate medium due to a number of extraneous reasons (Fulk et al.1990). These theories have been tested in organizational settings, and have partial support. In this research a mixed theory is proposed, which takes into consideration the fact that though rational, human beings are influenced by extraneous factors, and also make decisions under certain constraints.

None of these earlier studies have studied the dynamics of media choice in situations where more than one organization is involved, e.g., in interorganizational settings.

1.2   Purpose of the Study

The purpose of this research is to identify the factors that affect the choice of communication media in a virtual enterprise environment and to construct a model that relates these factors to an individual's choice of communication media. To achieve the research objectives, the study: (1) identifies the characteristics of virtual enterprises that affect communication media requirements; (2) identifies factors that influence individual communication media choice; (3) proposes an exploratory model of individual communication media choice in a virtual enterprise; and (4) tests parts of the proposed model using a case study approach.

1.3   Potential Contributions

Even though there has been research on virtual enterprises, most literature is focused either on descriptions of the concept of virtual enterprises, and anecdotal reports on the potential of such organizations (Boudreau et al., 1998; Dess et al., 1995; Jensen, 1998;), or on manufacturing and IS technology aspects, like the use of intelligent agents (Glushko et al, 1999; Jain et al., 1999), or production planning for virtual enterprises (Feng and Zhang, 1998; Mallidi et al., 1999; Rose, 1998; Zhou and Besant, 1998). This study will provide a better understanding of the communications technology requirements for the successful formation and working of virtual enterprises.

The second potential contribution of this study is that it integrates a number of pure theories to propose a more general theory of communications media choice. There are a number of theories used to explain the choice of media, but they are primarily pure, that is, either rational choice theories (Daft and Lengel, 1984; Rice et al.1989), or social influence models (Fulk, Schmitz, and Steinfield 1990). This study proposes a model that incorporates elements of both rational choice and social influence, and incorporates relevant situation-specific constraints.

As a third potential contribution, this study identifies and studies factors that impact individual communication media choice in virtual enterprises, thereby providing an understanding of the process of telecommunications selection in interorganizational collaborative environments. A model for the selection of communication technologies for specific types of tasks within a virtual enterprise environment is developed.

As another potential contribution, parts of the model will be tested in a real virtual enterprise setting using a case study approach (Yin, 1994), which involves the use of interviews, surveys and observation of participants to provide real-world data.

This research occurs at the intersection of organization theory, organizational communication, and telecommunication, resulting in an interdisciplinary study that draws from three widely divergent theoretical environments to propose an exploratory model, and test parts of that model.

1.4   Choice of Research Methodology

Since the concept of virtual enterprises is relatively new, and most of the prior literature is conceptual or anecdotal, it is appropriate to conduct exploratory research. Since identification of existing virtual enterprises is difficult, especially in numbers to justify survey research, a case study of one virtual enterprise can provide an idea of the dynamics and the factors necessary for communication media choice in a virtual enterprise environment. The use of the case study methodology does not lend itself to generalizability, even though it provides a base of information for follow up confirmatory studies. A future research could employ a multiple case study methodology that can lead to more generalizable results, though the number of cases involved would ultimately determine the validity of the results.

1.5   Organization of the Study

A review of the relevant literature is provided in Chapter II. Chapter III develops an exploratory model for individual communication media choice in virtual enterprises and then formulates the propositions for the parts of the model being tested. The methodology used in the study is presented in Chapter IV. Chapter V presents the results and analysis of the case study and discusses the implications and results. The limitations and implications for future research are presented in Chapter VI.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

The purpose of this study is to first identify the characteristics of virtual

enterprises that affect communication media requirements, identify factors that influence

individual communication media choice, then develop an exploratory model of individual

communication media choice in a virtual enterprise, and finally test parts of this model

using the case study methodology. A model is defined as the operationalization of a

theory in order to represent the relationships to be examined, in as succinct a manner as

possible (Hair, et. al., 1995). Authors have developed theory from previous literature,

common sense, and experience (Eisenhardt, 1989). In order to build a model to identify

the process of choosing appropriate communication media in a virtual enterprise

environment, the relevant literature is obtained from two distinct fields, namely

organization theory, and the communication media choice – which exists at the

intersection of organizational communication and information technology (primarily

telecommunications).

There is a reasonable body of work in organizational theory that deals with

strategic alliances, or collaborative work among organizations (Grant and Baden-Fuller,

1995; Ring and Van De Ven, 1992; Yoshino and Rangan, 1995), and some emerging

literature that identifies dynamic network organizations, or virtual enterprises, as yet

another way of accomplishing organizational objectives (Baker, 1994; Dess et al., 1995;

Miles and Snow, 1986). There is another distinct body of literature that looks at the choice of communication media and methods within organizations (primarily communication media choice among individuals within organizations) (Daft et al., 1987; Fulk et. al., 1990). There is not much literature that examines the choice of communication media in situations where more than one organization is involved in an intensely collaborative venture.

This chapter will try and answer a number of questions that would help justify the relevance of the study, and also help in the formulation of the theoretical foundations of the proposed model.

2.2 Virtual Enterprises

This section first discusses the competitive environment, and the environmental factors that are pushing organizations towards a virtual enterprise structure. The various organization structures that are related to virtual enterprises are discussed next, and the characteristics of virtual enterprises that make them different from the way organizations are currently structured are identified.

It is common knowledge that the more competitive organizations are becoming more customer-oriented. Visionaries in the field of strategy talk about the coming of the age of *Mass Customization* (Davidow and Malone, 1992; Goldman et al.1995; McHugh et. al., 1995) where the products are manufactured to the customers' specification, without the time and costs associated with customization. There is already the availability of the 72 hour car in Japan, where customers can go to a dealership, order whatever

features they need in a car, and the same would be manufactured according to these specifications within 72 hours (McHugh et. al., 1995).

The technology for such manufacturing exists in the form of flex lines, the integration of computer aided design (CAD) / computer aided engineering (CAE) systems and the flexible manufacturing systems (FMS). The movement of major manufacturers towards concurrent engineering is leading to shorter product design cycles, but what is needed ultimately is a paradigm shift, where this concept is extended to the next level (Tapscott and Caston, 1993; Tapscott, 1995).

This paradigm shift is enabled by the ability of each organization to concentrate on its core competence (Prahalad & Hamel, 1990). In fact the very concept of a virtual enterprise requires that organizations concentrate only on their own core competence, and leave everything else to other allied organizations. For something like this to happen a number of individual, organizational and technological factors need to be in place. The individual mind set has to move from suspicion to trust, the organizations have to give up all the non core processes, and the technology to allow total sharing of information among organizations has to be in place (McHugh et. al., 1995). In fact a virtual enterprise is defined as a group of organizations that are totally linked, and behave as one, for a particular project (McHugh et. al., 1995).

There is a good amount of organization theory literature that talks about virtual enterprises, also called dynamic networks (Miles and Snow 1986; Jarillo and Ricart, 1987). There is also a reasonable body of literature that compares the network form of organization structure with the traditional functional, divisional and the matrix forms but does not really distinguish between virtual enterprises and other forms of

10

interorganizational structures (Baker, 1994; Miles and Snow, 1995; Nohria and Eccles, 1994; Perrow, 1994; Piore, 1994). There is discussion of different kinds of network structures, namely - *Stable Networks*, *Internal Networks*, and *Dynamic Networks* (Miles and Snow, 1986; Miles and Snow, 1992; Miles and Snow, 1995; Snow et al., 1992).

The *Stable Network* has evolved from the functional form of the organization, where instead of a single vertically integrated organization, the network consists of a number of constituent organizations. Each constituent organization is tied closely to the core firm by some kind of contractual agreement, but is also free to serve organizations not in the network (see Figure 2.1). In this kind of structure the relationships are more long term, which makes it more like an aggregation of partnerships, joint ventures, cooperative agreements, outsourcing contracts, strategic alliances, or vendor/supplier arrangements (Goldman et al., 1995).
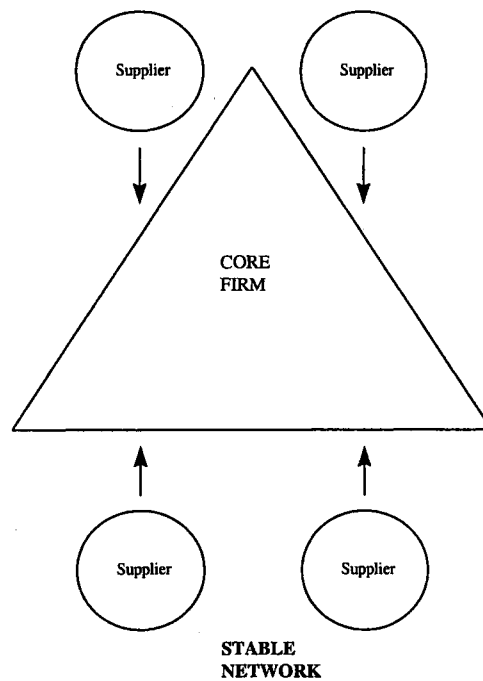
Figure 2.1:   Stable Network from Snow, Miles and Coleman (1992).

The *Internal Networks* have evolved from the matrix organization and require the creation of a market inside the firm (see Figure 2.2). The objective of this form of organization is to gain competitive advantage through the shared use of "scarce assets and the continuing development and exchange of managerial and technological know-how" (Miles and Snow, 1992). Examples of such organizations include Asea Brown Boveri, Hewlett Packard, Blue Cross-Blue Shield, Alcoa, and Control Data.

An internal network aims to capture entrepreneurial and market benefits without resorting to much outsourcing by the company. Most or all of the assets associated with the business are owned by the internal-network firm. The idea behind the internal network is that since the internal units will have to work with the market-set prices, they will constantly innovate to improve their operations (Snow et al., 1992).
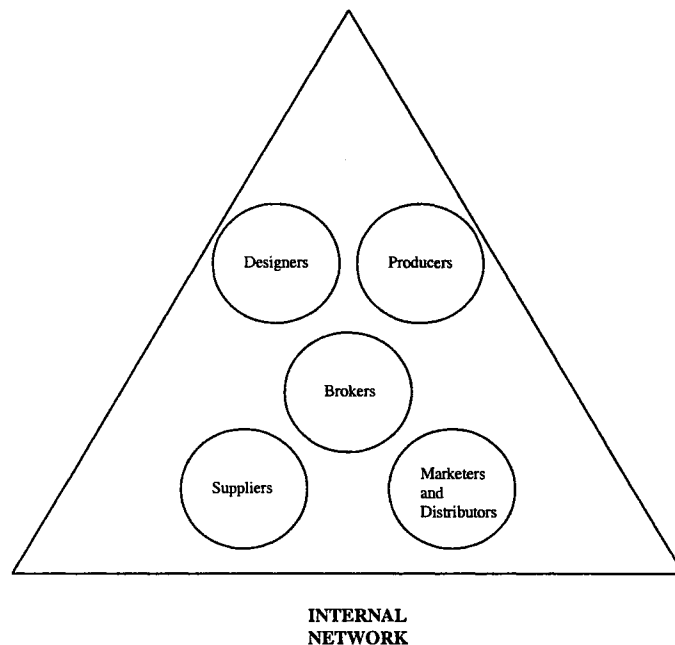
INTERNAL
NETWORK

Figure 2.2:   Internal Network from Snow, Miles and Coleman (1992).

A *Dynamic Network* consists of independent organizations linked together for a short-term production of a particular good or service - this is also the structure of a virtual enterprise (see Figure 2.3). This structure is logically similar to the divisional structure, with some sort of a central evaluating mechanism and local operating autonomy (Miles & Snow, 1992).

Faster-paced or discontinuous competitive environments result in some firms pushing the network form to its limit. Some kinds of businesses such as fashion, toys, publishing, motion pictures and biotechnology may require firms to engage in heavy outsourcing. Under such conditions, the lead company pinpoints and assembles assets owned largely or wholly by other companies. This is normally done by relying on a core skill like manufacturing (e.g., Motorola), R&D/ design (e.g., Reebok), design/ assembly (e.g., Dell Computer), or even brokering. So for example, an organization that has brokering as its core competency pulls together organizations with the required skills in order to take advantage of an opportunity that exists in the market.

The benefits of dynamic networks are specialization and flexibility. Every network node practices its individual expertise, and if brokers can combine resources efficiently, the company can accomplish total responsiveness. The risks of dynamic networks are quality variation across firms, the unavailability of needed expertise at a particular time, and the exploitation and possible misuse of proprietary knowledge or technology. The dynamic network works best under competitive conditions where each of the numerous players are obligated by market conditions to be both reliable, and on the leading edge of their expertise. The dynamic network is specially suited to situations of shorter design and production cycles where the danger of knockoffs can be eliminated. It is also

Designers

Producers

Brokers

Suppliers

Marketers
and
Distributors
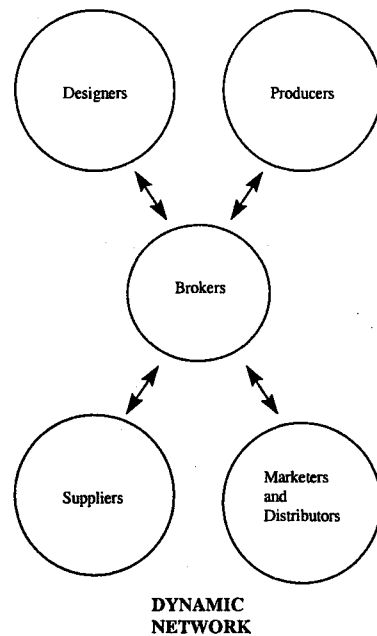
DYNAMIC
NETWORK

Figure 2.3:   Dynamic Network from Snow, Miles and Coleman (1992).

suited for conditions under which copyright laws can be implemented effectively, or by the

outsourcing of only standard parts and assemblies.

2.2.1   Characteristics of Virtual Enterprises and how they are different from Traditional Organizations

Chesbrough and Teece (1996) distinguish organizations on the basis of

decentralization - with virtual organizations extremely decentralized, and regular

integrated corporations highly centralized (see Figure 2.4). Other collaborative

organizational structures like Alliances, Joint ventures, and Corporations with

autonomous divisions are in this continuum, in the order of decreasing decentralization.

These organizations also vary in the incentives to risk taking they provide, with Virtual

companies providing the highest incentives to risk taking, while the integrated

corporations provide the least incentives. The ability to settle conflicts and coordinate

Finding the Right Degree of Centralization

high

As incentives to take risks decrease...

low

| Virtual company | Alliance | Joint venture | Corporation with autonomous divisions | Integrated corporation |

high

...the ability to settle conflicts and coordinate activities increases

low

| Virtual company | Alliance | Joint venture | Corporation with autonomous divisions | Integrated corporation |

Decentralized   Centralized

Figure 2.4:   The Degree of Centralization From Chesbrough and Teece, (1996).

activities consequently increase as we move along the continuum from Virtual companies

to integrated corporations (Chesbrough and Teece, 1996).

In the Virtual Organization / Enterprise literature, there is some effort at

distinguishing VEs from more traditional collaborative arrangements on the metrics of

the "degree of use and intensity of cooperation" (Goldman et. al., 1995). Another metric

for the virtual enterprise structure is the open ended membership of the web (some call it

the holonic network (McHugh et al.1995)) which forms the pool from which VEs are

formed - with organizations joining and leaving opportunistically. Some key

characteristics of virtual organizations center around extreme adaptability, and include:

(1) "Opportunity-pulled and opportunity-defined integration of core competencies" (Goldman et al.1995) that is, formed when an opportunity presents itself, and disbanded once that objective is met. (2) Excellence in its core competencies. (3) Uses world-class technology. (4) Borderless, that is, the collection of organizations comprising the VE appears as one single entity to the customer. (5) Mutual trust among participants, that is, no opportunistic behavior with respect to partners.

Some other factors distinguishing VEs from more traditional interorganizational collaborative arrangements include the capability of painless disbanding, ability to operate in a distributed mode, to exploit concurrency and the ability to include competitors.

In the alliance literature some authors seem to view networks (or Virtual Enterprises) as the next level of alliances - with the long term relationship aspect necessary in strategic alliances, being minimal or absent in virtual enterprises (e.g. Yoshino & Rangan, 1995).

Characteristics of a dynamic network identified by Miles and Snow (1986) also follow in a similar vein to those identified by Goldman et al. (1995). They include:

(1) Vertical Disaggregation - Various business functions typically performed by single organizations are performed by independent organizations in the network. Some of these business functions are product design and development, manufacturing, marketing, and distribution. Depending on the competitive circumstances, networks' complexity and dynamism is likely to vary.

16

(2) Brokers - Since each business function is not necessarily out of a single organization, brokers assemble and locate business groups. Sometimes, a single broker may play the lead role and subcontract services. In other cases, numerous brokers specializing in a service may create linkages among equal partners. Elsewhere, a network component may hire a broker to find one or more functions.

(3) Market Mechanisms - The major functions are held together by market mechanisms rather than the traditional plans and controls. This means that contracts and payments for results are a more effective means for achieving progress than progress reports and personal supervision would be.

(4) Full-Disclosure Information Systems - Instead of lengthy trust-building processes that follow from experience, dynamic networks use broad-access computerized information systems. Network participants agree to a general value added payment structure and align themselves with a continuously updated information system. Individual contributions then can be responded to, and promptly verified by the others.

Clark (1998) says that individual entities that make up virtual enterprises have at least one of the following four characteristics: geographic separation, functional specialization with separate reporting hierarchies, temporary membership as dictated by changing requirements over time, and separation of production across different time dimensions.

These characteristics identified lead to the conclusion that though similar in some respects, virtual enterprises and traditional forms of organizations are distinct in a number of aspects. Some of these, as identified in the review of the literature, include the ability to form and disband quickly, the ability to use market mechanisms for control, the use of full-

disclosure information systems, the ability to operate in a distributed mode, the ability to exploit concurrency etc. Some of these characteristics of virtual enterprises require certain media characteristics in order to function, and consequently would affect the communication media chosen.

2.3 The Role of Communication and Computer Technologies in Virtual Enterprises

In order that network organizations are able to operate effectively, member firms must be capable of communicating quickly, correctly and over long distances. With the developments in fiber optics, satellite communications and facsimile machines, managers can now more easily communicate within international network organizations. There is considerable literature on the role of information technologies in enabling the newer organizational forms (Foster and Flynn, 1994; Fulk and DeSanctis, 1994; Jarvenpaa and Ives, 1994; Lucas and Baroudi, 1994; Pickering and King, 1995; Lea et al., 1995).

The ease with which teams can be created and disbanded as required has become possible due to advances in communication technologies. Innovations such as voice and electronic mail (e-mail) promote more rapid exchange of information. Newer technological innovations like groupware and video teleconferencing enable effective imitation of the traditional face-to-face communication processes through sharing of nonverbal communication, including documents, annotations, facial expressions, and interactive discussion (Palmer and Speier, 1998).

Microcomputers provide computational capacity 24 hours a day and have the ability to follow users as well. That the cost of data transmission has been steadily declining since

the early 1970s and there is no sign of a slowdown in the decline is additional good news. So information processing capacity and geographic distance are no longer big constraints in designing organizations.

A new competitive reality has been forged as a result of globalization and technological change, along with deregulation and changing work force demographics. These forces are demanding firms to be both efficient and adaptive. Firms can now afford to hold only fully employed and flexible resources since global competition and deregulation have put a squeeze on the slack in the U.S. economy. Network structures allow both high utilization and flexibility. Thanks to computer-aided tools, sophisticated alliances can now be quickly forged, and disbanded when not required (Miles and Snow 1992).

Boudreau et al. (1998) say that virtual organizations respond to customers' needs quickly, introduce new products to the market more rapidly, and change their contours faster than other organizations. However this potential will be realized only when the virtual organization is in a position to meet its greatest challenge, namely coordination. Coordination costs are higher for virtual organizations due to the need for the management of various external and internal relationships across space and time. Traditional coordination and control mechanisms are rendered ineffective because of the federated and scattered nature of virtual organizations. Though particular attention must be paid to the technologies by which work is performed in the design of an organization, virtual organizations, in the absence of the advanced information technologies that link their parts together, would not be in a position to exist at all (Clark, 1998).

2.4   Communication Media Choice Models

There is a separate body of literature that deals with the communication media choice, which falls in the realm of organizational communication, organization theory, individual differences, and telecommunications. For the purpose of this study, the major theories in this area are identified, along with the major assumptions, the factors each of these theories find important, and the level of empirical support that exists for each of these theories.

The major theories that deal with the choice of communication technologies in organizations are the information richness theory, the related social presence theory, and the social influence theory. According to Daft et al. (1987), communication media can be thought to exist as a continuum of "information richness" which is determined by types of channels employed, a richness of language transmitted, ability for message personalization, and speed of feedback.

Short et al. (1976) first expounded the concept of social presence. Fulk and Boyd (1991) say that social presence represents the degree to which the mode of communication allows participants to experience one another as being psychologically close or present. According to Rogers (1986), social presence is conveyed by the use of multiple non-verbal communication channels and cues and continuous feedback. Communication modes that are high in social presence are able to communicate status and other social cues, while those with low social presence filter out these cues (Sproull and Kiesler, 1986).

People need to use rich media for communications that are uncertain and equivocal (Daft and Lengel, 1984,1986; Daft et. al., 1987), where uncertainty is the absence of "certain" data, and equivocality means that values, schema or the meanings for interpreting events are ambiguous or conflicting. This is similar to what Short et al. (1976) propounded, in that the performance of people who solve complex, non-routine problems is better when communication channels conveying social presence are used.

There have been studies that have tried to establish links between task characteristics and uses of technology. For example it has generally been determined that people working on complex, nonroutine, "unanalyzable" tasks prefer face-to-face communication, or if that is not possible, a relatively "rich" technology like the telephone (Kraut et al.1992; Rice, 1992; Straus and McGrath, 1994; Weeks and Chapanis, 1976). The media richness theory is further modified by Trevino et al. (1987) to include contextual factors (distance and time pressures (Stienfeld and Fulk, 1986), accessibility of media, and critical mass of users (Thorn and Connoly, 1987)), and symbolic meaning associated with the medium. The symbolic meaning transcends the explicit message and in a way becomes the message (Trevino et al., 1987). Some of the symbolic reasons provided by managers for media choice include the use of face-to-face medium to signal a desire for teamwork, to build trust, goodwill or to convey informality. On the other hand written media were thought to show authority, make a strong impression, be legitimate and official, and to comply with protocol.

A basic critique of the rational choice models of media use (of which Social Presence Theory and the Media Richness Theory are the most prominent) by Fulk et al. (1990) is the restrictive assumption of the rational models, and the inability of the models

21

to explain a number of experimental findings. The rational choice models are based on the basic assumption that all individuals are rational, and so would always choose the most appropriate communication medium for each task (Daft and Lengel, 1984, 1986). Fulk et al. (1990) propose a social influence model for media use, which has the same basic assumption that individuals cognitively process stimuli, but is quite different from the rational choice models in explaining how the cognition develops and changes. The media perceptions are determined to some extent by the objective features like the ability to provide a permanent record, or asynchroneity, but are also substantially affected by the social influences exerted by coworkers - both through overt statements, and through vicarious learning by observing coworkers. The media choice is further influenced by other situational factors, which can be classified as individual differences, facilitating factors, and direct constraints. The individual differences include cognitive style, and media style - a psychological factor that basically predisposes individuals to select certain media types over others. The facilitating factors include accessibility of the medium, training support of the new media, critical mass of users, protection of documents, reliability and flexibility of the technology, compatibility of the technology with current values, organizational support for the technology etc. The third category of situational factors, the direct constraints on media use are the limitations imposed by factors like geography and time that prevent the use of certain media.

2.4.1 Media Richness Model

The Media Richness Model of media choice in organizations has attained a fair
amount of importance in organizational communication. Daft and Lengel's (1984, 1986)
initial formulation of this model was based on organizational information processing theory
(Galbraith, 1977; Tushman and Nadler, 1978). This approach pinpoints ambiguity as the
main attribute to understanding communication activity and also identifies the uncertainty
reduction mechanisms that organizations employ to cope with the ambiguity. According to
Daft and Lengel, communication media can be arrayed along a media "richness" continuum
depending on the differing capacities to resolve ambiguity. There are four criteria that
define relative media richness: speed of feedback, variety of communication channels
employed, personalness of source, and richness of language used. Face to face is the richest
communication medium followed by telephone and written documents. People choose
communication media whose richness matches the ambiguity level of the task (Daft and
Lengel, 1986).

One reason for equivocality would arise from the managers' differing frames of
reference. This is a common occurrence in organizations especially when problems are
perceived from different functional perspectives. Which makes it even more likely to
occur in situations involving more than one organization. Also, emotional messages are
subjective and open to multiple interpretations. In the absence of a common perspective,
shared meaning needs to be established for arriving at mutual understanding.

Managers can reduce equivocality by collecting their ideas, discussing the implications and reaching consensus. Exchange of subjective views to explain the problem and resolve ambiguous tasks is also an option.

The media richness hierarchy ranks media according to its capacity for processing equivocal information. The richness of a particular medium depends on a blend of four criteria: (1) instant feedback, allowing communicators to converge on some common interpretation or understanding; (2) the medium's ability to transmit multiple cues like body language, tone and inflection of voice thus conveying interpretations; (3) the use of natural language over numbers to convey subtleties; and (4) the personal focus of the medium. Some messages are conveyed more fully when they allow for the infusion of personal feelings and emotions (Daft and Lengel, 1986).

In the hierarchy, face-to-face ranks as the richest communication medium, with the telephone, electronic mail (Steinfield and Fulk, 1986; Trevino et al., 1988), personal written documents like letters, notes and memos, and impersonal written documents like fliers, bulletins, and reports following it in that order. The reason face-to-face is considered the richest is due to its immediate feedback, provision of multiple cues, natural language, and the ability to be highly personal. The message is adjusted, clarified, and reinforced instantaneously. Telephone conversations are less rich than face-to-face since they do not provide cues such as eye contact and body language.

Electronic mail systems can vary in the media richness they provide. They have the ability to provide for rapid, though not immediate feedback. The message is read when the receiver asks for his mail. Though electronic mail uses natural language and

can at times allow real time interaction, cues such as voice inflection and tone are absent. The new voice mail systems give voice cues but are not interactive.

Written media use natural language, but the are limited and the feedback slow. Voice and visual cues are restricted to those provided by the paper. The stationery and formality of the language do convey some cues. However, at best, addressed documents can only be tailored to an individual recipient and personalized.

The leanest communication media is formal, unaddressed documents. Fliers, bulletins and standard quantitative reports that fall in this category normally communicate simple, objective information to a big audience. There are very few cues and feedback is extremely slow.

According to Daft and Lengel (1986), the most effective communication takes place when the characteristics match the media characteristics. That is when the task has greater equivocality, a medium that is richer is more appropriate. The correct choice of medium would make the communication process more effective.

Trevino, Daft and Lengel (1990) modified the original information-processing based model of media richness to lean towards the theory of Structural Symbolic Interaction (Stryker and Statham, 1985). The revised media richness model (see figure 2.5) asserted that certain media carried symbolic meaning that overrode the explicit message content. For instance, the need to convey formality could deflect the media choice behavior away from the rational matching of task ambiguity and media richness. Electronic mail was added to the richness continuum in this revised model, above written documents, and three situational constraints to rational matching were proposed: geographical separation of

communication partners, time pressures emanating from the task, and the unavailability of a

critical mass of communication partners in computer-based networks.

The second focus for revision was the level of analysis for task ambiguity. Whereas

the initial model centered on an individual's job as a whole, the later model focused on the

individual communication interchange as a unit of matching. This conceptually matched

early communication research that argued that people match media choices to

communication requirements for a specific interchange based on "social presence" of the

medium and the complexity of the communication task (Short et al., 1976).

The third change was finding that high performing managers were more media

sensitive than low performing managers, or that high performing mangers better matched

media richness to communication task ambiguity (Daft, Lengel, and Trevino, 1987).

So in the revised media richness model, Trevino et al. (1990) determined that the

reasons why managers choose a certain media fall into three broad classifications. One of

these is message content (equivocality and uncertainty) and follows from the ideas

developed in the original media richness model. Managers generally used face-to-face

rich media to process ambiguous, equivocal communications. Written or electronic

media was used for unambiguous communications. The other two classes of reasons are

the *situational* determinants such as time and distance, and the *symbolic* cues inherent in

the medium.

2.4.1.1 Support

The media richness model has generated considerable research over the years.

Three studies that directly tested the media richness ranking of traditional media (face-to-face, telephone, and written documents – addressed and unaddressed) found support for it.

The ranking of electronic mail was supported by Trevino et al. (1990b), but two other

studies (Schmitz and Fulk, 1991; Fulk and Ryu, 1990) ranked it lower than predicted.

MESSAGE EQUIVOCALITY

CONTEXTUAL DETERMINANTS
    e.g.,   Distance
                Time Pressure
                Critical Mass

MANAGER'S MEDIA CHOICE

MEDIA SYMBOLISM
    e.g.,   Legitimacy
                Teamwork
                Formality/ Informality
                Urgency
                Caring
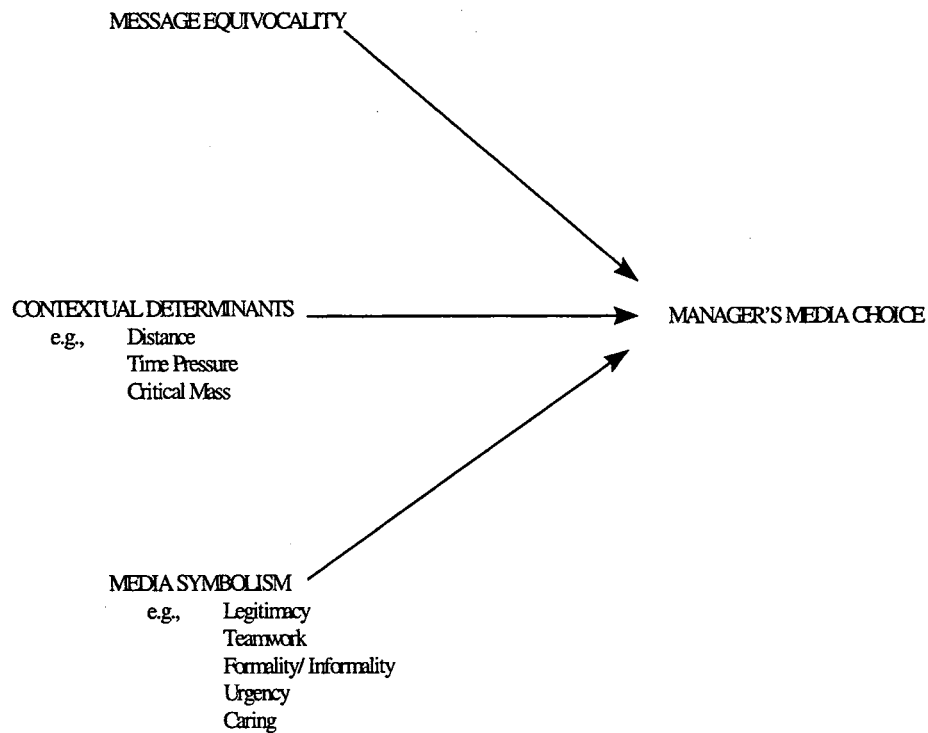
Influences on Managers' Media Choice Processes

Figure 2.5: Modified Media Choice Model Using the Media Richness Theory
(Trevino et al.,1990.)

27

The matching hypothesis, which is matching the task characteristics to the media richness, has also been tested repeatedly, but with conflicting findings. Five direct field tests of the original model were non-supportive (Markus, 1988, 1994; Rice et al., 1990; Rice et al., 1989; Rice and Shook, 1989; Jones et al., 1988-89). However, Rice and Shook's (1989) meta-analysis of 40 early media studies (conducted before the media richness model was developed) gives the matching notion some credence. According to their analysis, higher level managers, with presumably more ambiguous tasks, used face-to-face communication more frequently than lower level managers who used the telephone and written media more frequently. An experimental study by Dennis and Kinney (1998) did not find any support for the task media-matching hypothesis.

Tests of the revised media richness model, that focus on communication interchange rather than overall tasks, fare better. Three studies using hypothetical communication incidents found support for the model (Trevino et. al., 1987; Trevino et. al., 1990a; Daft et. al., 1987 - also reported in Russ et al., 1990). Studies of electronic mail per se, a low richness medium, find that it is used for tasks that are high in socio-emotional content (Hiltz and Turoff, 1978; Kiesler, 1986; Kiesler et al., 1984; Phillips, 1983; Rice and Love, 1987; Steinfield, 1986). A recent study by Donabedian et al. (1998) found strong support for the media richness model. It was determined that managers chose richer media for low levels of task analyzability and high levels of task variety.

To sum up, the results support the media richness continuum for traditional (that is Face-to-face, Telephone, addressed documents, and unaddressed documents) rather than newer media (computer mediated communication), and the revised model that focuses on communication activities rather than whole tasks.

2.4.2 Social Influence Model of Technology Use

A contrasting model for newer communication media tries to cope with the ever-increasing anomalous findings. The Social Influence Model of Technology Use (Schmitz, 1987; Fulk et al., 1987; Fulk et al., 1990) begins with alternative assumptions (see Table 2.1) that the perceptions of electronic media vary across individuals in systematic ways and also that this variance is as important to media selection as is any constant component identified in the media richness model (Fulk and Boyd, 1991). Coming from the Social Information Processing Theory (Salancik and Pfeffer, 1978), Social Learning Theory (Bandura, 1986), and Symbolic Interactionism (Mead, 1934), the model (see Figure 2.6) argues that media perceptions are socially constructed. The four forms of social influences on both media perceptions and media use are a) direct statements made by coworkers at the

RATIONAL CHOICE MODELS	SOCIAL INFLUENCE MODEL
	Media and Task Features
• Fixed	• Variable
• Objective	• Subjective; socially constructed
• Uniformly salient	• Variably salient
	Choice-Making
• Cognitive	• Cognitive
• Independent	• Subject to social influence
• Prospectively rational	• Can be retrospectively rational
• Objectively rational	• Subjectively rational
• Efficiency-motivated	• Can be efficiency motivated but need not be

Table 2.1
Comparisons of Assumptions (Adapted from Fulk et. al., 1990)

workplace, b) vicarious learning, c) norms for evaluating media, and d) social definitions of rationality.

According to the theory, there would be a fair amount of variation in the perceptions and use of communication technologies depending on the social processes in play within the organization. Also, since workgroups are considered important sources of social support and regular interaction, there would be similar patterns of media use within groups (irrespective of task ambiguity) and dissimilar patterns of media use across groups.

MEDIA
FEATURES

MEDIA EXPERIENCE
AND SKILLS

MEDIA
EVALUATIONS

SOCIAL INFLUENCE
• Direct statements
• Vicarious learning
• Norms for media behavior
• Social definitions of rationality

MEDIA
USE

TASK EXPERIENCE
AND SKILLS

TASK
EVALUATIONS

TASK
FEATURES

SITUATIONAL FACTORS
• Individual differences
• Facilitating factors
     (e.g., accessibility)
• Constraints
     (e.g., geography)

A Social Influence Model of Media Use

Figure 2.6:   Social Influence Model of Media Use (Fulk et. al., 1990)

Media perceptions are to a certain extent, subjective and socially constructed. It is clear that they are determined to some degree by objective features such as the capacity to

30

provide a permanent record, asynchroneity and so on (see Culnan and Marcus, 1987 for a review of features). However, attitudes, statements and behavior of coworkers also determine media perceptions to a large extent.

Coworkers exert social influence most directly by overt statements about media and task characteristics, which are then assimilated by evaluative individuals (Salancik and Pfeffer, 1978). By virtue of discussing these features, the indirect effect is of coworkers increasing the saliency of these features. In addition, individuals also accept the judgments and interpretation of events that are voiced by coworkers (Bandura, 1986; Salancik and Pfeffer, 1978). Therefore, it may be said that media perceptions are not fixed and objective, but instead vary across both individuals and situations.

Social influence can occur through vicarious learning from the observation of others' experiences (Bandura, 1986). When it is observed that the choices exercised by others have resulted in positive consequences, an individual may resort to behavior modeling. To elaborate, effective behavior by a person is likely to be emulated by others through observational learning. On the other hand, choices that have led to unpleasant experiences may be avoided altogether.

2.4.2.1 Support

There is evidence to support this model. Firstly, five studies that were done of closely connected co-workers (supervisors included) found convergence in their media perceptions (Svenning, 1982) or media use (Nosek, 1989; Rice, et al. 1990; Rice and Shook, 1989) which were unexplained by the task demands. Secondly, using measures of

social influence, four studies have predicted individual media attitude and/ or use. Individuals' perceptions of electronic mail richness depended on their communication network partners' perceptions of its usefulness (Fulk and Ryu, 1990; Schmitz and Fulk, 1991) and by the network partners' actual use (Schmitz and Fulk, 1991). The individuals' electronic mail use was predicted by communication network members' actual use (Schmitz, 1987; Schmitz and Fulk, 1991), and by the proportion of coworkers who used electronic mail (Fulk and Steinfeld, 1989). Finally, to test that variation in richness perceptions is linked to the social context, Ryu and Fulk (1991) concluded that perceptions of electronic mail richness were more similar in cohesive workgroups than in non-cohesiveness ones. The findings overall support the model.

There is a movement towards the amalgamation of the rational choice and the social influence theories, but the champions of the respective theories maintain that the factors propounded by their theories are more central, with the factors from the competing theory as ancillary to the media selection process. Webster and Trevino (1995) show the complementary nature of the rational and social theories in their study. While El-Shinnawy and Markus (1998) show that neither the rational choice nor the social influence theory could completely explain the individuals' choice between voice mail and electronic mail. The model proposed in this research follows from these studies and tries to integrate the rational choice and social influence factors.

CHAPTER III

MODEL DEVELOPMENT AND RESEARCH PROPOSITIONS

3.1 Introduction

In this chapter the model for information communications media choice in virtual enterprises is developed. Chapter II introduced virtual enterprises, and the major theories of communications media choice. This chapter integrates the different theories in order to develop an exploratory model of individual communication media choice in a virtual enterprise. The parts of the model to be tested are identified and the relevant research propositions developed.

Based on the review of relevant literature, an exploratory model for individual communications media choice in a virtual enterprise environment is developed (Figure 3.1). This model depicts the major categories of characteristics that affect the choice of communication media in a virtual enterprise environment, and their relationships.

There are three levels of factors that indirectly affect the information communications media choice. These factors affect the task characteristics and hence the media attributes required, and also the perception of the various information communication technologies. The first type of characteristics are those that occur at the virtual enterprise level. These characteristics primarily influence the task environment and characteristics, thereby influencing the logical or rational media characteristics desired in the information communications technology. These characteristics are identified in section 3.2.1. The decision to choose a particular medium for

communication is influenced by more than just the rational task / media fit (Fulk et al.

1990, Trevino et al., 1990). There are organizational factors that are primarily social in

nature, but also some that impose constraints on the possible choices of the information

communications technology. Section 3.2.2 identifies these organizational factors. Finally

there are individual factors that modify the decision making process due to the specific

make up of the individuals involved in the process and these are enumerated in section

3.2.3.
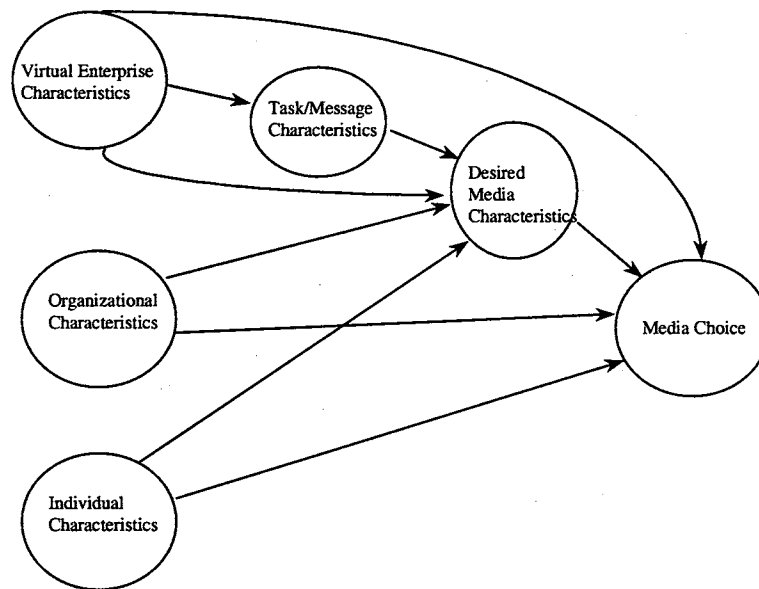
**Figure 3.1   Model of Communication Media Selection in a Virtual
Enterprise**

The measurement of the task/message characteristics is important since in order

for the rational choice to be accomplished, the task/message characteristics should match

the media characteristics (Daft and Lengel, 1984, 1986). The constructs and measures for

the task/message characteristics are developed in section 3.2.4, and for the media

Factors	Components
Virtual Enterprise Characteristics	Type Size Phase
Organizational Characteristics	Symbolic Meaning of Media Social Factors Situational Factors
Individual Factors	Cognitive Style Media Style
Task/Message Characteristics	Equivocality Uncertainty
Media Characteristics	Information Quality Information Accessibility Cue Variety Immediacy of Feedback Message Personalization Receiver Access
Media Choice	Paper Documents Facsimile Electronic Data Interchange Electronic Mail Computer-Supported-Collaborative-Work- Environment Telephone Video Conferencing Face-to-face meeting

Table 3.1   Categories of Factors Affecting Communication Media Choice in Virtual Enterprises.

characteristics in section 3.2.5. Finally the media choice construct is developed in section

3.2.6. A list of all the factors used in the model and their components is provided in

Table 3.1.

35

3.2 Description of the Factors Affecting Communication Media Choice in Virtual Enterprises

3.2.1 Virtual Enterprise Characteristics

Certain characteristics of virtual enterprises affect the need for specific attributes in communication media. These characteristics are the type, the size, and the phase of the virtual enterprise. These factors influence to a great degree, the kinds of tasks performed, the level of uncertainty and ambiguity existing in a given situation, and also directly affect the requirements of the information communications media chosen.

3.2.1.1 Type

A review of the virtual enterprise/dynamic network organization literature brings out three major virtual enterprise types or structures. These are:

3.2.1.1.1 Hierarchical Type

The hierarchical type of virtual enterprise, where the organization performing the major part of the work, or the lead contractor takes on the role of the integrator. This is similar in nature to a stable network (Miles and Snow 1986) except that the duration of the existence of the virtual enterprise is a lot shorter than a stable network, being disbanded once a particular project is over.

3.2.1.1.2 Integrator Lead

The integrator or broker lead type of virtual enterprise, where the coordination role is undertaken by an organization whose core competence is in the area of coordinating virtual enterprises. This is by far the most common type of virtual enterprise, and is similar to the dynamic network that Miles and Snow (1986) have identified.

3.2.1.1.3 The Web Type

The web type of virtual enterprise, where there is no single coordinator/integrator, and this role is distributed among the constituents of the VE. This structure is what the futurists claim will be the ultimate form of virtual enterprises, once the technological infrastructure for total information sharing among organizations is in place (McHugh et al.1995). Here the initiator of contact may coordinate the efforts initially, but the task would ultimately be distributed among all the participants in the virtual enterprise.

The type or the structure of a virtual enterprise would influence the choice of information communication technology chosen, and the number and direction of communication incidents that occur.

3.2.1.2   Size

The number of nodes/organizations that make up a virtual enterprise and the geographical dispersion of these organizations also affect the communication requirements. The number of organizations or communication nodes would determine to a great extent which attributes are critical in the communications technology used, and hence influence the technology chosen. The geographical dispersion of organizations may also constrain the use of more suitable media due to unfeasibility (Trevino et al.1990, Fulk et al.1990). For example, even if the task/communication characteristics in a situation require the use of a face-to-face meeting, the distances involved may make it infeasible.

3.2.1.3 Phase

The phase specifies the specific stage in the VE life cycle the virtual enterprise is in. The agility forum (1996) has identified 5 stages or processes in the life cycle of the VE, namely Opportunity Identification, Partner Selection, Formation, Operation, and Reconfiguration and Dissolution. For the purpose of this research, these activities have been combined into three major phases in the life of a virtual enterprise, namely the Pre Project Phase, the Design/Bid Phase, and the Manufacture/Delivery Phase. This taxonomy follows that used by Adler (1995) to identify the three distinct phases in

product development, with different types of tasks, thereby needing different coordination methods.

3.2.1.3.1 Pre Project Phase (Phase I)

The pre project, or the webbing, stage is when the organizations are negotiating or discussing whether to join the virtual enterprise or not. The communication in this phase is quite ambiguous because of the inherent nature of the task (negotiation). The equivocality is heightened by the fact that more than one organization is involved in this process, each with its own vocabulary and methods. According to Grimshaw and Kwok (1998), in a virtual organization, "working across cultures is the biggest challenge - transfer [ing] their business policies and culture to work with dispersed business teams-spanning organization, geography, and culture." The cultural dimension impacts the extent to which virtual enterprise members share values and beliefs about their work (Schein, 1990). Cultural similarities are greater within functional areas or companies than across companies. These cultural differences across distinct companies make team interactions more laborious (Chesbrough and Teece, 1996). According to Clark (1998) cultural differences also contribute to the extent to which the members of the virtual organization can feel disassociated from each other.

In virtual enterprises, due to the fact that a number of organizational cultures are involved, there is greater likelihood that a lack of common schemata would lead to messages that are difficult to interpret. This would necessitate communication media that are richer (Daft and Lengel, 1986).

3.2.1.3.2 Design/Bid Phase (Phase II)

The design/bid stage is when the organizations have decided to join the virtual enterprise and are working together to design/develop the product, or prepare a bid for the project/product they want to manufacture. Logically, the communication in this phase will be less ambiguous, as some common ground would have been established by this time ameliorating some of the problems due to a lack of common schemata. The communications would involve a lot of critical information, and hence the focus would be on reducing uncertainty through the use of higher quality information. The communication media of choice in this phase would be those that provide the ability to transmit higher quality information, reliably and in the form needed by the participants.

3.2.1.3.2 Manufacturing/Delivery Phase (Phase III)

The manufacturing/delivery stage is when the product has been finalized, the manufacturing processes are taking place, and the delivery of the finished product takes place. At this stage the organizations involved in the virtual enterprise are quite familiar with their partners, and most of the information is not time critical (the movement of physical material, and process reports gain criticality in this phase). The uncertainty levels are low, as is the ambiguity, so the communications media needed do not need to be either rich or extremely reliable.

3.2.2   Organizational Characteristics

These are the factors that come about primarily due to the situations that exist within individual organizations that make up the virtual enterprise. All organizations have certain norms, shared contexts, and constraints, which affect the choice of the information communications technology (Fulk et. al., 1990). These organizational influences can be divided into three major categories, (1) The Symbolic Meaning of Media; (2) Social Factors; and (3) Situational Factors.

3.2.2.1 Symbolic Meaning of Media

Different media convey different symbolic meanings to the initiator/receiver of the message. For example:

Face to Face meeting signifies   - openness

- a desire for teamwork

- a desire to build trust.

When the medium of communication is selected for the symbolic meaning that transcends the actual message, the medium itself becomes a message (Trevino, Lengel, and Daft, 1987). For instance, conveying a message in writing may imply a commitment to an idea. A manager may opt for a face-to-face meeting to convey flexibility and an openness to others' ideas.

The interpretive approach to organizational communication (Putnam and Pacanowsky, 1983) emphasizes the importance of symbolic processes and subjective meaning, and so lends credence to the concept of the communication media being symbols themselves. Perceptions form the basis of communication behavior to a great extent, and so involve the use of language and symbols to create shared meaning (Feldman and March, 1981; Pfeffer, 1981; Pondy and Mitroff, 1979).

It is important to note that symbolic cues are independent of the objective characteristics or capabilities of the medium. They are basically interpretations of the subjective norms that exist in a given situation. These norms for the appropriate choice of media in a given situation and the meaning or symbolism attached to a particular medium are developed over time. These norms then become a part of the organization's culture, and so affect the media choice process, even if an individual does not agree with the symbolism. For example, some organizations have strong verbal cultures, while others focus on documentation and written memos (Fulk and Boyd, 1991).

Feldman and March (1981) asserted that a manager's communication behavior stemmed from an almost ritualistic response to requiring to appear competent, intelligent, legitimate, and rational.

Support for the symbolic role of media was found in research by Trevino et al. (1987). Managers cited symbolic the reasons for the choice of certain media. Face-to-face was used to convey a desire for teamwork, to build trust, goodwill, and show informality. Face-to-face and telephone media both conveyed urgency, personal concern, and deference to those who preferred that medium. Written media, on the other hand

symbolized authority, made a strong impression, and conveyed legitimacy. It was also

considered an attention getter and showed compliance with protocol (Trevino et al.1990).

3.2.2.2 Social Factors

The social factors that affect the choice of a communication medium are primarily

due to peer group influence. There is a direct effect when users listen to the

feelings/experiences of others in the organization about the various communication

media. There is an indirect effect through vicarious learning and observation of the use

of the various communication media in the organization (Fulk et.al., 1990).

3.2.2.3 Situational Factors

There are two categories of situational factors that are organizational in nature and

affect the choice of a communication medium. These are; (1) Facilitating factors; and

(2) Direct constraints. The third situational factor as identified by Fulk, Schmitz, and

Steinfield (1990) is individual differences and would be treated separately.

3.2.2.3.1 Facilitating Factors

Facilitating factors are a group of factors which consist of variables such as

accessibility of the medium, training support for new media, critical mass of users,

protection of documents, non punitive budget and pricing policies, reliability and flexibility

of the technology, compatibility of the technology with current values, and organizational

support for the medium, as well as specific hardware and software features.

Accessibility of the medium within the organization, and other organizations in

the VE is extremely important. With new communication technologies, access to the

technology, and a critical mass of willing users (Thorn and Connolly, 1987; Markus,

1987), also are important determinants of the choice of media. A study (Steinfield, 1986)

found that system access to an electronic mail system was imperative for a manager's

choice of that particular medium. That is even if the manager had access to e-mail, it was

not a communication medium even considered if some of the recipients of the

communication did not have access to e-mail.

In addition, to effectively use an interactive medium like electronic mail, the

development of a critical mass of users is mandatory (Markus, 1987). One needs

communication partners who also have access to the system. In the absence of a critical

mass of users, the medium's use will not spread and may entirely stop (Hiltz, 1984;

Uhlig, Farber, and Bair, 1979).

3.2.2.3.2 Direct constraints

The last category if situational factors is direct constraints on media use. This

consists of factors like geographical barriers and time that may not allow the utilization of

some media (Steinfeld and Fulk, 1986; Trevino et. al., 1987). Here again factors other than

equivocality affect managerial media choices. For instance, lower level managers may be

constrained by a lack of funds to travel across the country for a face-to-face meeting.

Also, research has shown managerial work as fast-paced, varied and fragmented

(Mintzberg, 1975). Managers may not have enough time to use the richest medium.

Some research studies indicate that the situational characteristics too determine

choice of media. One study (Steinfeld and Fulk, 1986) pinpointed geographical distance

and time pressure as significant determinants of this media choice. Despite message

influence ambiguity, managers under time pressure were more likely to use the telephone.

Again, managers who were geographically distant tended to use electronic mail more.

Therefore under these two constraints, message content took a back seat (Fulk et al.1990).

3.2.3 Individual Factors

These are the set of factors that affect the choice of the information

communications technology at the individual level, given the constraints imposed by the

virtual enterprise characteristics, and the organizational factors.

3.2.3.1. Individual Differences

Individual differences are one of the sets of factors that are classified under

individual factors. It has been found that perceptions of computing are related to a person's

cognitive style (Aydin, 1987) and to individual media style (Rice and Case, 1983). Though

individual media style is defined behaviorally in this context, it implies the existence of

psychological factors that may predispose the selection of certain media over others by

individuals, irrespective of the circumstances. Some other communication style factors are

telephone apprehension (Reinsch et al., 1990), communication competence (Monge et al., 1982), and general communication apprehension (McCrosky, 1982).

Other differences at the individual level are media experience and skills. The propensity to use a particular medium depends on how comfortable the user is with that particular medium, and how skillful the user is in using that medium (Fulk et al., 1990).

3.2.4 Task/Message Characteristics

According to the "rational choice" theories of media choice the message / task characteristics determine the richness (Daft and Lengel 1984, 1986) or the social presence (Short et al.1976) of the most appropriate media. For more ambiguous tasks, richer media are desirable, and for tasks lower in ambiguity, leaner media should suffice. Similarly, for situations with greater uncertainty media that can provide higher quality information, with the least effort are more desirable.

3.2.4.1 Equivocality

Equivocality is ambiguity or the lack of methods to handle a situation (Daft and Lengel, 1986). The equivocality of a message is an important determinant for the selection of a communication medium that would be the most appropriate for delivering a full and complete message (Trevino et al.1990). Equivocality implies the existence of numerous and conflicting interpretations of an organizational situation (Daft and Macintosh, 1981; Daft and Lengel, 1986). As developed by Weick (1979), equivocality

refers to situations or messages that "are indeterminate, inscrutable, ambivalent, questionable, and they permit multiple meanings... [Equivocality] is the richness and multiplicity of meanings that can be superimposed on a situation that organizations must manage" (p. 174). An equivocal message can be likened to an Rorschach inkblot - depending on their unique needs, backgrounds and perspectives, different individuals are likely to interpret it differently.

When the situation or message is ambiguous, equivocality may be high. Managers would be unsure of the questions to ask and the answers would not be simple and objective. As a result of this, lack of understanding, confusion and differing interpretations are likely to arise. Most high level organizational decisions are generally made in ambiguous conditions, with managers interpreting the situation from vague cues and executing solutions (Mintzberg, Raisinghani, and Theoret, 1976).

Another reason for equivocality would arise from the managers' differing frames of reference. This is a common occurrence in organizations especially when problems are perceived from different functional perspectives. Also, emotional messages are subjective and open to multiple interpretations. In the absence of a common perspective, shared meaning needs to be established for arriving at mutual understanding.

3.2.4.2 Uncertainty

Uncertainty indicates lack of data/information. There is a whole body of literature in organizational information processing that deals with the reduction in uncertainty via communication. Galbraith (1977) was one of the earlier researchers to formally express

this. A majority of early research in organizational communication defined uncertainty reduction as the primary reason for communication (Daft and Lengel, 1986). Uncertainty can be reduced effectively if better quality of information is communicated. In the late 1970s research showed that the accessibility of the source of information is considered more important than the quality of information gathered (Allen 1977). The predominance of accessibility over quality was later confirmed (O'Reilly 1982). So the two factors affecting uncertainty in task/communication would be information quality, and the accessibility of the information.

3.2.5 Media Attributes

There are six media attributes that have been identified as affecting the choice of a communication mode in a given situation by Zmud, Lind, and Young (1990). Zmud et al. (1990) used previous research in information acquisition, information richness or social presence, and computer-mediated channels in order to generate this list of attributes. They are Information Quality, Information Accessibility, Cue Variety, Immediacy of Feedback, Message Personalization, and Receiver Access.

It is postulated in the information acquisition literature that in order to reduce uncertainty information is needed (Galbraith, 1977). There are two aspects to information, its quality and the accessibility, and these are discussed in sections 3.2.5.1 and 3.2.5.2 respectively.

48

3.2.5.1. Information Quality

If we were to assume completely rational individuals, the criterion for acquiring information would be based solely on its quality. Prior research has determined that information was considered to have objective quality characteristics such as relevancy (Zmud 1978), accuracy (Zmud et al. 1990), comprehensiveness and timeliness (Swanson 1987), which would affect the way information systems should be designed and implemented.

3.2.5.2. Information Accessibility

A number of studies have identified the fact that in most cases individuals tend to use information that is more accessible, than that of higher quality (Allen, 1997; Hardy 1982; O'Riley, 1982; Culnan, 1983; Rice and Shook, 1988). Attributes of information accessibility such as convenience, easy access, and reliability were found to be important for information users (Culnan 1984; Swanson 1987).

So on the basis of information acquisition literature, communication media can be differentiated on the basis of information quality, and accessibility in order to handle uncertainty effectively (Zmud et. al., 1990).

Daft and Lengel (1984, 1986) suggest that in addition to the reduction of uncertainty, individuals in organizational settings also try to reduce equivocality. Since equivocality is essentially either the lack of schema to interpret information, or the existence of multiple schema, individuals need the ability to define/refine the schema

applied to interpret a solution. This can be achieved through the use of rich

communication channels. Daft and Lengel (1984) suggest that the three major attributes

associated with these rich communication media involve cue variety, immediate

feedback, and message personalization. These are discussed in sections 3.2.5.3, 3.2.5.4,

and 3.2.5.5 respectively.

3.2.5.3. Cue Variety

A channel with greater cue variety allows a person to communicate using multiple

cues, and also provides the ability to use cues with a greater variety of meanings (Daft

and Lengel, 1984). For example, face-to-face communication allows the communicators

to use a number of cues like verbal cues (e.g. tone of voice) and nonverbal cues (e.g. hand

gestures or eye movement), in addition to the spoken words, while written documents

provide only those cues that can be put down on paper.

3.2.5.4 Immediacy of Feedback

The immediacy of feedback would determine the ability of individuals to ask

questions and instantly receive answers. The speeding up of feedback would enhance the

process of assessment and modification of message meaning and appropriateness (Zmud

et al, 1990). There is also research that shows that as the delay between the sending of a

message and the receipt of feedback increases, so does the time for completing a task

(Kraus and Bricker, 1966). For example, using a medium like telephone, immediate

feedback enables the sender to determine if the receiver has understood the message. In case of a medium like written documents, this process may take a long time, thereby delaying the completion of the task.

3.2.5.5 Message Personalization

The capability for message personalization would enable a person to better fit the message to the requirements of the recipient, and or the situation. The tailoring of the message to the recipient should result in a more effective communication (Daft and Lengel, 1986).

3.2.5.6 Receiver Access

A number of computer mediated communication channels have been introduced in the work environment. These include electronic mail, voice mail, teleconferencing, computer supported collaborative work environments. Access to all these channels, though widespread, is not automatic. A critical mass of users in an organization needs to have physical access to these channels, and the inclination to use them, before these become universally used.

The effective use of a particular communication technology would be determined by whether both the initiator and the recipient of a message have potential access to the channel. (Zmud et. al., 1990)

3.2.6 Media Choice

This factor identifies the communication medium chosen for a particular situation. The most common media used for communication within and between organizations include: paper (mail), facsimile (fax), electronic data interchange (EDI), electronic mail (e-mail), computer supported collaborative work environment (CSCW - e.g. Lotus Notes), telephone, video conferencing, and face to face meeting (FTF) (Zmud et al.1990).

3.3   Description of the Model for Communication Media Choice in Virtual Enterprises

The various factors that influence the choice of a communication medium by an individual in a virtual enterprise environment were identified in section 3.2. This was based on the literature that was reviewed in chapter 2. In this section, the relationships among the various factors so identified are articulated.

The virtual enterprise characteristics (type, size, and phase) affect the task/message characteristics. For example, the type of tasks performed in the pre project phase in a virtual enterprise differ from the kind of tasks performed in the bid/design phase on the amount of equivocality that exists in them. The virtual enterprise characteristics may also directly affect the desired media characteristics, by emphasizing certain aspects of the communication process, like mandated speed of feedback. Finally the virtual enterprise may directly affect the choice of a communication medium by agreeing to a particular communication infrastructure, to the exclusion of others. For example, if the virtual enterprise is of the hierarchical type, the lead organization may

mandate the use of EDI for most VE related communication. This would directly influence the communication medium chosen for most situations.

The organizational characteristics also impact the desired media characteristics, and the media choice itself. For example access to certain media (media access) may be limited in an organization. On the other hand, chargeback systems, or punitive pricing systems may make certain media choices unattractive to individuals within organizations.

Individual characteristics too would impact both the desired media characteristics, and the media choice. For example, if a person is an extrovert, then that person would need higher cue variety than someone who is introverted. On the other hand the direct impact on media choice would be if someone is not good at writing, then that person would prefer not to use written communication.

The fact that task/message characteristics impact the desired media characteristics is driven by the rationality assumption that for equivocal tasks a richer medium would be needed.

Desired media characteristics would drive the ultimate choice of the communication medium, though they would be only one of the four direct influences on media choice. For example, if the desired media characteristics require a richer medium (that is high cue variety, faster feedback, and greater message personalization), then the choice would exclude the leaner media like written documents, computer printouts etc.

3.4 Formulation of the Propositions

The communication media choice model developed in the previous section needs to be tested. For the purpose of this study, a part of this model is tested. There has been prior research that identified and tested the various media choice theories, and these have been described in the literature review. Studies that empirically test these theories in a virtual enterprise setting (or even in an interorganizational setting) have not been conducted (or at least were not identifiable after an extensive literature search). As identified in chapter II, even in the studies that empirically test the various media choice theories, the major thrust has been in identifying the relationship between the task characteristics (again, primarily focused on equivocality) and the appropriateness of the medium. In this study the parts of the media choice process that are tested are those that impact the choice of the medium, but not the actual media choice itself (the relationships shown with solid lines in Figure 3.2). That is:

1.   this study looks at the relationship between the Virtual Enterprise level characteristics and the task characteristics – whether there is a significant difference among them during the different phases in the virtual enterprise;

2.   this study looks at the relationship between the virtual enterprise characteristics and the characteristics of the communication media – whether different media characteristics are needed at different phases in the virtual enterprise;

3.   and finally, this study looks at the relationship between task characteristics, and the characteristics of the communication media – whether certain media characteristics are needed for tasks that have certain characteristics.

The basic tenet of the rational choice models is that the information communication media choice is driven by the task characteristics. That is, for tasks or interaction environments where there is greater ambiguity, the appropriate choice would be a richer medium (Daft and Lengel, 1984, 1986). While for tasks which are less equivocal, the rational choice would be a less rich medium. So according to the media richness theory, there should be a task-media match. Due to the nature of the tasks performed, it is expected that the level of ambiguity varies with the phase a virtual enterprise in, with the highest equivocality in Phase 1 which is the Pre-Project phase, and the lowest in Phase 3, the Manufacturing/Delivery phase. There are three sets of propositions that are developed, each set enumerating the relationships that exist for the part of the communication choice model being tested.
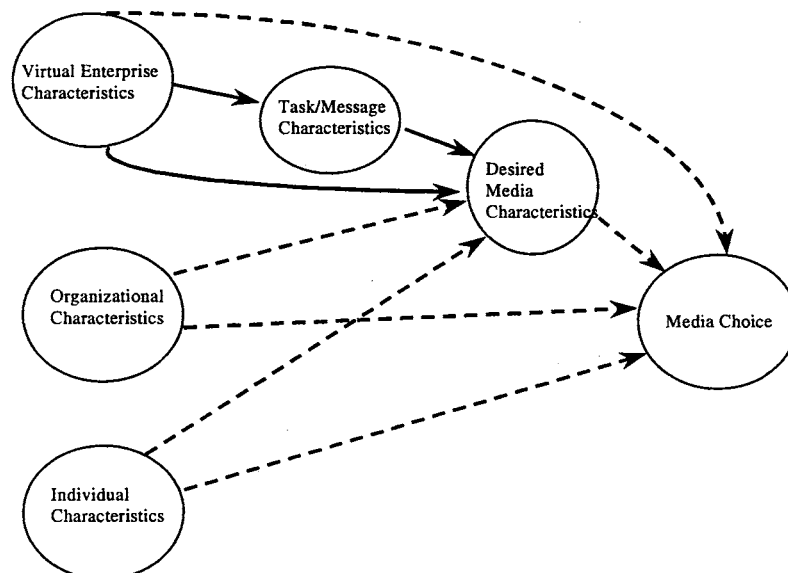
Figure 3.2   Parts of the model to be tested

3.4.1. The virtual enterprise characteristics will have an effect on the task / message characteristics.

As identified in chapter III, The equivocality and uncertainty in a virtual enterprise varies with the phase the virtual enterprise is in. The type of information that needs to be communicated changes with the phase, thereby changing the degree of uncertainty and equivocality involved.

> Proposition 1.a.   Tasks/messages in the manufacturing/delivery phase of virtual enterprises will possess less equivocality than tasks/messages in the pre project phase of virtual enterprises.

> Proposition 1.b.   Tasks/messages in the pre project phase of virtual enterprises will possess less uncertainty than tasks/messages in the design/bid phase of virtual enterprises.

> Proposition 1.c.   Tasks/messages in the manufacturing/delivery phase of virtual enterprises will possess less uncertainty than tasks/messages in the design/bid phase of virtual enterprises.

3.4.2 Virtual enterprise characteristics will have an effect on the media characteristics desired.

From the media richness theory we know that media vary in their characteristics on three distinct measures, namely, the ability to provide cue variety, feedback capability, message personalization. Propositions 2.1.a., 2.1.b., and 2.1.c., relate the phase of the virtual enterprise with the communication media characteristics. From the decision-making literature it is known that information quality and accessibility are essential in order to reduce uncertainty. Since uncertainty varies in the different phases of the virtual

enterprise, the communication media characteristics to handle this would need to include ability to provide differing degrees of information quality, and access to information. Propositions 2.2.a, 2.2.b., 2.2.c., and 2.2.d. relate the phase of a virtual enterprise with the information quality, and information accessibility.

Proposition 2.1.a.   Cue variety required in a communication medium in the pre project phase of virtual enterprises will be greater than the cue variety required in a communication medium in the manufacturing / delivery phase of virtual enterprises.

Proposition 2.1.b.   Immediacy of feedback required in a communication medium in the pre project phase of virtual enterprises will be greater than the immediacy of feedback required in a communications medium in the manufacturing / delivery phase of virtual enterprises.

Proposition 2.1.c.   Capability for message personalization required in a communication medium in the pre project phase of virtual enterprises will be greater than the capability for message personalization required in a communication medium in the manufacturing / delivery phase of virtual enterprises.

Proposition 2.2.a.   Information quality required in the design/bid phase of virtual enterprises will be greater than the information quality required in the pre project phase of virtual enterprises.

Proposition 2.2.b.   Information quality required in the design/bid phase of virtual enterprises will be greater than the information quality required in the manufacturing / delivery phase of virtual enterprises.

Proposition 2.2.c   Information accessibility required in the design/bid phase of virtual enterprises will be greater than the information accessibility required in the pre project phase of virtual enterprises.

Proposition 2.2.d.   Information accessibility required in the design/bid phase of virtual enterprises will be greater than the information accessibility required in the manufacturing / delivery phase of virtual enterprises.

3.4.3 The task characteristics will have an effect on media characteristics desired.

The media richness theory proposes that tasks higher in equivocality require richer media, than tasks with lower equivocality (Daft and Lengel, 1984, 1986). Propositions 3.1.a., 3.1.b., and 3.1.c. address this by individually testing for the effect of equivocality on the media characteristics of cue variety, feedback, and message personalization. On the other hand, tasks with a higher degree of uncertainty require higher quality information and information that is more accessible, than tasks with lower degree of uncertainty. Propositions 3.2.a., and 3.2.b. address this.

> Proposition 3.1.a.   Communication media with high cue variety will be required for tasks high in equivocality.

> Proposition 3.1.b.   Communication media with higher immediacy of feedback will be required for tasks high in equivocality.

> Proposition 3.1.c.   Communication media with high capability for message personalization will be required for tasks high in equivocality.

> Proposition 3.2.a   Communications media with capability of providing high information quality will be required for tasks high in uncertainty.

> Proposition 3.2.b.   Communications media with capability of providing high information accessibility will be required for tasks high in uncertainty.

All these propositions are represented visually in Figure 3.3

Figure 3.3 Visual Representation of the Propositions

Phase	Equivocality	Uncertainty
Pre Project	High	Low
Bid / Design	1a	High — 1b
Manufacturing	Low	Low — 1c

Phase	Cue Variety	Feedback	Message Personalization
Pre Project	High	High	High
Bid/Design	2.1a	2.1b	2.1c
Manufacturing	Low	Low	Low

Phase	Information Quality	Information Accessibility
Pre Project	Low	Low
	2.2a	2.2b
Bid/Design	High	High
	2.2c	2.2d
Manufacturing	Low	Low
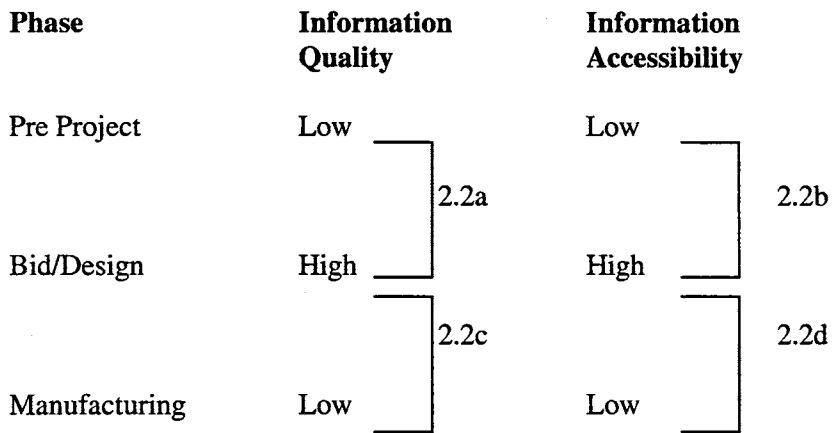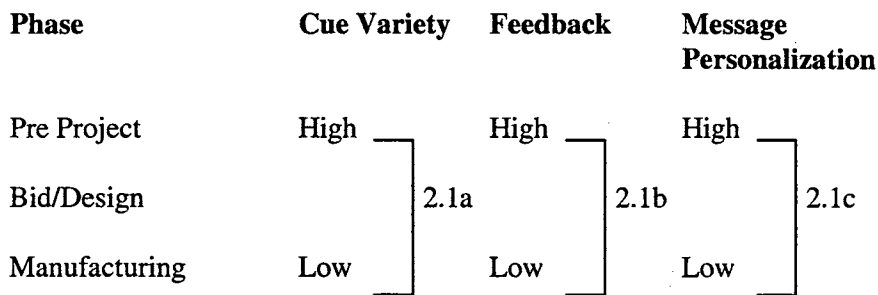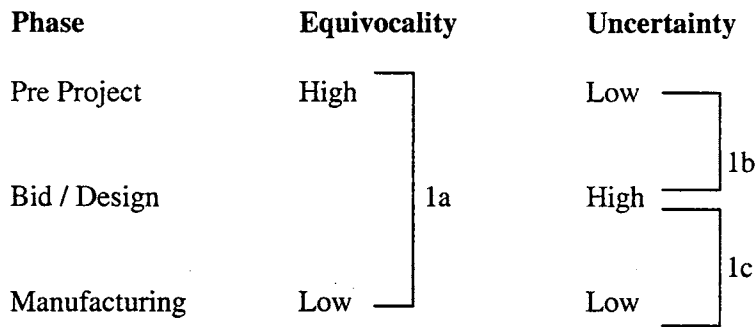
Task/Media Characteristic	Cue Variety	Feedback	Message Pers.	Information Quality	Information Accessibility
Equivocality	High (3.1a)	High (3.1b)	High (3.1c)		
Uncertainty				High (3.2a)	High (3.2b)

CHAPTER IV

RESEARCH METHODOLOGY

4.1 Introduction

In order for the communications media choice model developed in Chapter III to be useful, it needs to be empirically tested. The process used to test the chosen parts of the model is described in chronological order. First, an extensive review of literature was conducted to identify the factors that affect the choice of communication media in a virtual enterprise. Second, a model that shows the relationships among the factors so identified was developed. Third, for the model so developed, a part of the overall model was identified for testing, and the relevant research propositions developed. Finally, in order to validate the propositions a case study was conducted and the findings analyzed.

The rest of this chapter describes the research design. This discussion includes a description of the case study methodology, data collection, interview and questionnaire design, and the setting for this study. Finally, a description of the data analysis methods used is provided.

4.2 Research Design

The methodology for this study is a case study. According to Feagin, Orum and Sjoberg (1991, p. 2) a case study is "an in depth, multifaceted investigation using qualitative research methods, of a single social phenomenon" which: 1) permit the

grounding of observations and concepts in natural settings, 2) provide information from a number of sources which permits a more holistic study of complex activities, 3) furnish the dimensions of time and history, and 4) encourages and facilitates, in practice, theoretical innovation and generalization. Yin (1994) defines a case study as "an empirical enquiry that investigates a contemporary phenomenon within its real life context," and says that "the case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result benefits from prior development of theoretical propositions to guide data collection and analysis."

4.2.1 Case Study Appropriateness

Case study methodology was chosen for this research because, according to Schramm (cited in Yin, 1984, p.22), "the essence of a case study ... is that it tries to illuminate a decision or set of decisions; why they were taken, how they were implemented, and with what result." Merriam (1988, p.7) states that "descriptive case studies ... are usually inductive in nature. It is impossible to identify all the important variables ahead of time. Results are presented qualitatively, using words and pictures rather than numbers." Though the case study method lacks in generalizability and the present tense compared to other empirical research methods like laboratory and field studies, it provides the richest context in which research can take place (Buckley, Buckley and Chiang, 1976). The practicing manager prefers case studies due to their closeness to

detail and acquaintance with ongoing organizations and the measuring in real

organizational terms (Mintzberg, 1979). The preoccupation with abstract variables that

are typical of much quantitative research is not quite as meaningful to the manager as the

case study method (Bryman, 1989). In this study, due to the lack of a cumulative

theoretical base, the need to examine complex phenomena in depth, terminological

variations, and the sensitive nature of the data to be collected, a case study research

design was used.

4.2.2 Case Study Design

The research design for this study has five components that have been cataloged

by Yin (1994) as being of importance for case study research. These are: the study's

question, the study's propositions, its units of analysis, the logic linking the data to the

propositions, and the criteria for interpreting the findings. These components are

described in the sections that follow.

4.2.2.1 The Study Question

Generally speaking, the study question provides a focus for the study by stating

what the study is about. This study develops a theoretical model for communication

media choice in virtual enterprises, and then goes on the test a part of this model in real

virtual enterprises. The research question for this study is:

What are the factors that affect the choice of a communication medium in a virtual

enterprise and how can these factors be organized into a model that explains the process

of choosing a communication medium in a virtual enterprise?

4.2.2.2 Propositions

The propositions of the study reflect the significant theoretical issues and direct

attention to something that should be examined within the scope of the study (Yin, 1984,

p.30). The rationale for this research is based on an extensive literature review and on the

development of an initial conceptual model. Propositions were developed for the part of

the model that is to be tested based on prior research, and logical reasoning.

4.2.2.3 Unit of Analysis

The study's questions will determine the unit of analysis to be selected. According

to Yin (1989), the selection of the unit of analysis will affect the data collection and

analysis. In this particular study, the unit of analysis is the organization that participates

in a virtual enterprise. The data is collected from individual respondents in each

participating organization through the use of a semi-structured interview, and a survey

questionnaire. The interactions among the participating organizations are also observed

to get a better feel of how the communication actually takes place, and the context within

which it takes place. An effort was made to ensure that interactions among the

participants in different phases of the virtual enterprise life cycle were observed. That is,

participants were observed in the pre project phase, the design/bid phase, and the manufacturing/delivery phase.

4.2.2.4 Logic Linking Data to the Proposition

The data consists of the words and terms that the respondents used to describe relationship between the phase of the virtual enterprise and the type of communication, and the capabilities of the communication media; and the relationship between the type of communication and the capabilities of the communication media. The survey questionnaire also directly measures the strength of these relationships through a series of close-ended questions. The development of these instruments was guided by the theoretical framework and the model, developed after a thorough review of the literature.

4.2.2.5 Criteria for Interpreting the Findings

One criterion for substantiating the model is by examining the degree to which there is correspondence between the factors perceived by the respondents and the initial conceptual model. Another criterion is how well the model describes the parts of the communication media choice process that are being tested in a virtual enterprise.

4.2.3   Case Study Methodological Problems

Lee (1989) states that there are four problems that can be identified in case MIS research. The first problem lies in the ability to make controlled observations. The analysis of a real-world case in a real-world scenario does not allow the use of laboratory controls and generally produces more variables than actual data points, making statistical controls inapplicable (Yin, 1981). This problem can be solved by the use of natural controls. In this case study, the data gathering was done using the same respondents for all three phases of the virtual enterprise life cycle, thereby ensuring that the differences in responses were due to the treatment (the phase), rather than factors internal to the respondent.

The second problem is with regard to making controlled deductions. The single case must be in a position to handle qualitative data and verbally stated propositions. By following the preceding case study design, controlled deductions can be achieved. The validity of the deductions (of the expressed propositions derived from the previous theories) should be apparent from the reported facts of the case study.

The third problem lies in how to allow for replicability as the single case study is not likely to play out in the same way again. It may be noted that the multiple case design allows for replication logic. Additionally, the same propositions that have been tested in this case study could be applied to a different set of initial conditions. Thus, despite the fact that the observations in a particular case study are non-replicable, the case study's findings would be replicable.

The fourth and last problem is with regard to allowing for generalizability. Given that the study of a single case is characterized by unique and non-replicable events, the accusations that its conclusions cannot be applicable to other settings makes it vulnerable. As Lee (1989, p.41) states, "...generalizability is a quality describing a theory that has been tested and confirmed in a variety of situations, whether such testing is conducted through case research, laboratory experiments, statistical experiments, or natural experiments." Thus, additional research would be required to test the empirical evidence against other settings.

4.2.4   Case Study Validity Issues

The challenge of case study research requires that data collection and analysis meet the tests of reliability, construct validity, and external and internal validity (Yin, 1994).

Reliability was encouraged by the use of a case study convention wherein all subjects were exposed to the same sequence of entry and exit procedures and interview questions and by the creation of a case data base (Yin, 1994). Additionally, in order that errors and biases be minimized and the data collection and data analysis processes be repeatable, the case study procedures were fully documented (Yin, 1994). The case study interview and questionnaire questions were based on earlier studies using comparable constructs.

Yin (1994) suggests using multiple sources of evidence, and establishing a chain of evidence as means of increasing construct validity. For this study, multiple sources of

evidence include interviews, survey questionnaires and direct observation. The chain of evidence is established by following a clear and logical process of theory development, data collection, and data analysis.

External validity is ensured by replication in two virtual enterprises and the results rather than being generalizable to a population, are generalizable to the broad theory behind the communication choice in virtual enterprises.

Internal validity for this study was enhanced by the use of pattern matching as the analysis method, and triangulation by source and method (Yin, 1994).

4.2.5 The Research Setting

The research was conducted within the context of a federally funded program that is studying the use of virtual enterprises as a mechanism for procuring parts on demand for the department of defense. For this purpose, a number of virtual enterprises have been established. These virtual enterprises bid on components that are needed by the department of defense, as and when the relevant request for quotations (RFQ), or request for proposals (RFP) come. The membership of these virtual enterprises consists of small and medium manufacturing enterprises (SME) restricted to a state in the mid south of the United States. Most of the SMEs are initially walked through the process of government procurement by more experienced organizations within the same virtual enterprise. Since different groups of organizations have different core competencies, the virtual enterprises do not compete against each other in all component categories, but certainly do so in some categories. The data collection was conducted over the period of a particular

component procurement cycle. That is, the data was collected right from the initial phase

where organizations (SMEs) with the relevant core competencies were asked their

intention to participate in the bid process, through the actual bidding for the project, and

till the final delivery of the finished product.

4.2.6   Data Collection

The data was collected using multiple methods: (1) questionnaire survey; (2)

interviews; and 3) observation. According to Jick (1979) data may be categorized as

qualitative or quantitative, and as objective or subjective. The use of different types of

data in the analysis is preferable as no single type of data can capture all the aspects of a

phenomenon. The data collection methods used in this study address each category of

methods identified by Jick (1979), namely, qualitative, quantitative, objective and

subjective, enhancing the reliability of the findings (Jick 1979; Zack, 1993; Zack and

McKenney, 1995).

Questionnaires were employed to measure the respondent's perceptions of

constructs, thereby collecting quantitative and subjective data. The questionnaire was

administered to a sample of the population under study, that is organizations participating

in of each of the virtual enterprises studied. Interviews with the central organizations

(either the lead manufacturing organization or the coordinating organization) and other

members of the virtual enterprise were used to identify, frame, discuss, and corroborate

the constructs, thereby yielding qualitative and subjective data. Direct observation of

communication interactions among pairs of virtual enterprise participants was also used

to gather qualitative and objective data.

The interview questions (Appendix A) and the survey questionnaire questions

(Appendix B) were based on those used in previous studies (Zmud et al., 1990).

Proposition	Corresponding Interview Questions
1. The effect of virtual enterprise characteristics on the task / message characteristics.	1. During Phase I, that is the part when you were deciding .... 3. During Phase II could you describe the type of communication that took place.. 5. During Phase III could you describe the type of communication that took place ..
2. The effect of virtual enterprise characteristics on media characteristics desired.	2. During Phase I, could you describe the ... 4. During Phase II, could you describe the properties ... 6. During Phase II, could you describe the properties
3. The effect of task characteristics on media characteristics desired.	7. Describe the characteristics of the communication medium needed ... a. When the task or message is... b. When there is a lot of ... c. When there is lack of ... d. When the task requires ... e. When the situation.... f. When you do not ...

Table 4.1   Propositions and Related Interview Questions

Measures and constructs that were used in the earlier studies (identified in Chapter III),

were modified (if needed) to the virtual enterprise context. The questionnaire was

evaluated by a group of expert researchers for readability and comprehension. The

questions for the qualitative and quantitative research are directly tied to the propositions,

as shown in Tables 4.1, and 4.2.

Yin (1994) suggests several rules for within-case analysis, which were followed in

this research. Detailed interview notes, and impressions were completed within one day

Propositions	Survey Question
1. The effect of virtual enterprise characteristics on the task / message characteristics.	Q 1 – Q7
2. The effect of virtual enterprise characteristics on media characteristics desired.	Q8 – Q27
3. The effect of task characteristics on media characteristics desired.	Q28 – Q33

Table 4.2   Propositions and Corresponding Survey Items

of the interview to comply with the 24 hour rule. All data was included, to comply with

the second rule. The researcher's impressions were recorded, but kept separate from the

respondent's story to comply with the third rule. Note taking was chosen as the medium

for recording the data.

4.3 Analysis of Data

According to Yin(1994), the researcher should have a general analytic strategy

before analyzing case study evidence, in order to ascertain what to analyze and why. This

Main Phases   Intervening Processes

Theory

Deduction

Hypothesis

Operationalism

Observations/
Data Collection

Data Processing

Data Analysis

Interpretation

Findings

Induction
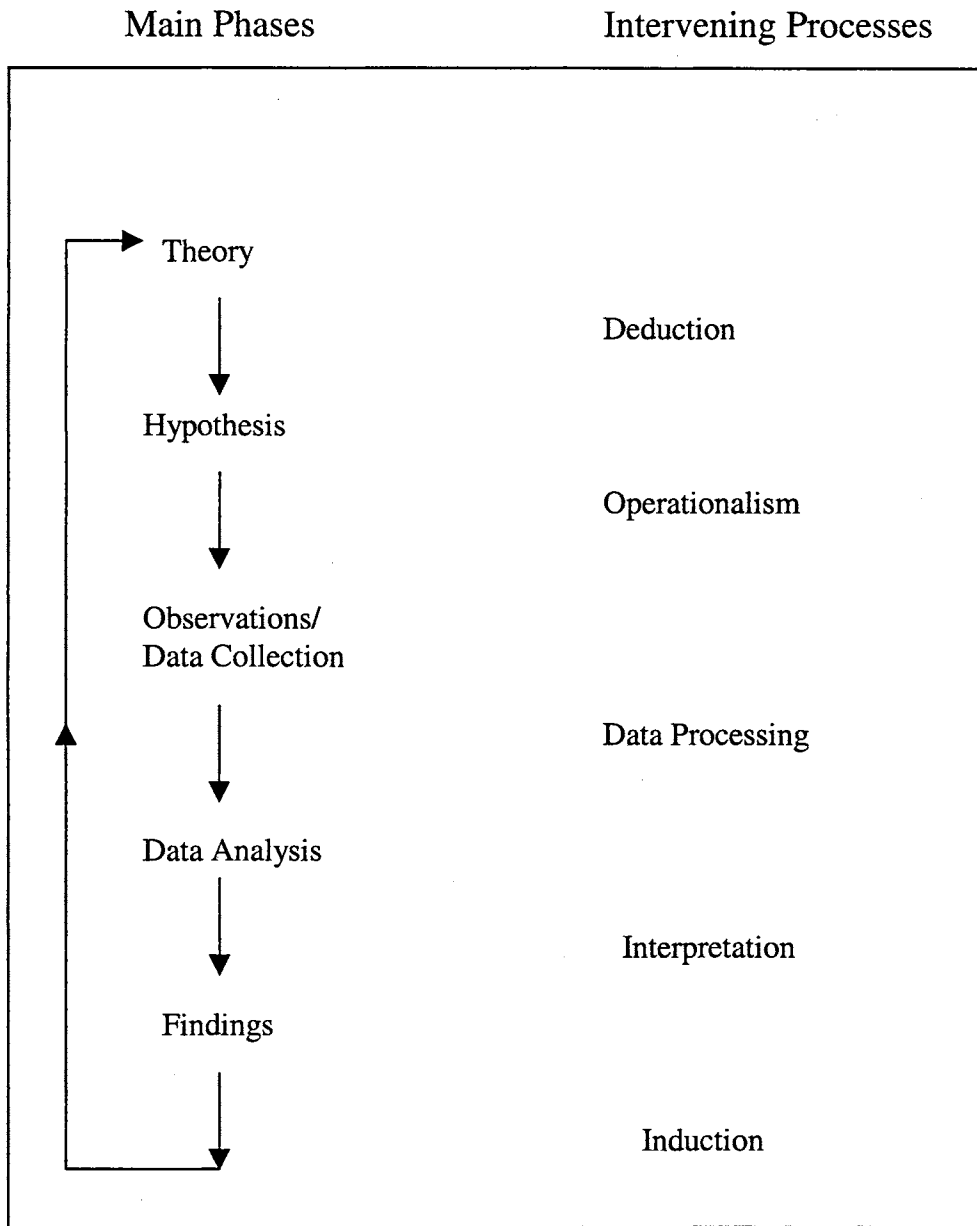
Figure 4.1   Structure of the Quantitative Research Process
                Source: Bryman (1989)

71

case study followed the logical structure suggested by Bryman's (1989) quantitative research process (Figure 4.1).

The starting point for this case study was a theory of about communication media choice in virtual enterprises, which is outlined in the model developed in Chapter III. Specific propositions (Section 3.3) were formulated based on the theory, and the specific research objectives of this case study. These propositions were used to shape the data collection plan, and are used to identify the relevant analysis strategy. The data will be analyzed in Chapter V, while the findings will be outlined in Chapter VI, which might result in a modification of the theory proposed in this study, and so the research cycle would continue.

Within the context of the general analysis strategy identified, Yin(1994) suggests four primary analytic techniques: pattern matching, explanation building, time-series analysis, and program logic models. The research technique used in this study is pattern matching. The propositions developed from theory provide a pattern of predicted values, which are compared with the data collected, and in case there is a matching of the patterns of the predicted values and the results, strong conclusions can be drawn.

To provide some degree of order to the evidence collected for the case study, a conceptually clustered matrix is created. A conceptually clustered matrix consists of rows and columns arranged in order to bring together items that belong together conceptually. Such a matrix allows a) the display of all relevant responses of key informants on one page, b) allows an initial comparison between responses and between informants, c) allows you to see how the data can be analyzed further, d) lends itself for cross-case analysis for multicase studies (Miles and Huberman, 1994). In this

study, the creation of such a matrix allowed a comparison between the informants and the responses, and the degree to which the informants converge was determined. This was accomplished by the use of simple frequency counts in order to identify patterns in the responses (Glesne and Peshkin, 1992). For the survey data, histograms of the responses for each question, the mean of the responses, the number of responses agreeing and disagreeing with the statements in each question, and the polar values of responses (Strongly Agree and Strongly Disagree) were used to identify patterns in the responses. These patterns and the observed interactions among the virtual enterprise participants were then used to evaluate the propositions.

CHAPTER V

CASE STUDY ANALYSIS AND RESULTS

5.1 Introduction

According to Bryman (1989), measurement is extremely important in the research process, as it links theoretical categories with research and so is the way in which these categories are deemed researchable. For this research, three measures were used, one qualitative/subjective, and another quantitative/subjective, and the third qualitative/objective. This was done in order to ensure the validity of the findings by using very different approaches to data collection.

Respondents from nine organizations were asked face to face, semi structured interview questions regarding their communication with other members of the virtual enterprise they were involved in (qualitative/subjective) (Jick, 1979). These participants and ten other participants who could not be scheduled for a face to face interview completed questionnaires (quantitative/subjective) (Jick, 1979) again relating to their communication with other members of the virtual enterprise they were involved in. Finally, three sets of interactions between members of virtual enterprises were directly observed (qualitative/objective) (Jick, 1979). These observations covered the three phases of the virtual enterprise life cycle, and provided a context within which to analyze the rich data that was gathered. The questions used in the interview, and the survey questionnaire were derived from instruments used in earlier studies, and were pre-tested to ensure that they had the ability to capture the right information, without being overly

complex. The interviews used follow up probes to ensure that the original question was understood and the answer was complete.

The analysis followed the following sequence of steps:

1.   The interview data was analyzed.

2.   The questionnaire data was analyzed.

3.   The direct observation data was analyzed.

4.   The results of the first three steps were used to analyze the propositions.

The following sections outline the case study setting, the analysis of the interview, and questionnaire data, a description of the direct observation conducted, analysis of the propositions, and implications of the results.

5.2   Case Study Environment

The case study was conducted within the context of a federally funded program that is studying the use of virtual enterprises as a mechanism for procuring parts on demand for the Department of Defense (DOD). For this purpose, a few organizations act as Virtual Enterprise Development Centers, with the prime role of recruiting Small and Medium Enterprises (SMEs), mentoring them in the government parts procurement process, and forming virtual enterprises of selected SMEs to produce prototype parts as a means of qualifying firms to do business with the DOD. Other roles such mentoring organizations play is that to help form virtual enterprises to produce actual parts rapidly in response to government solicitations. This research used virtual enterprises formed by two such mentoring organizations, as the site for the case study (though, since these were

Virtual Enterprises, there was no actual site – as a virtual enterprise in one sense is a synergistic sum of its constituting organizations).

Of the organizations interviewed, three were affiliated with one mentoring organization, while the other six were affiliated with the other, but given the dynamic nature of virtual enterprises, there were crossovers, and some of these organizations were working with organizations from the other camp (i.e. ones affiliated with the other mentoring organization). Of the organizations surveyed using the questionnaire, seven organizations were affiliated with the first mentoring organization, seven with the second, while the remaining organizations were not formally working with either (though they had worked with at least one of them on earlier occasions).

5.3   Analysis of Interviews

The responses of each participant for all seven interview questions are presented in Table 5.1 in the form of a conceptually clustered matrix (Miles and Huberman, 1994). The analysis of the interview responses is done by identifying patterns that are apparent for each of the questions.

Question 1 in the interview was "During Phase I, that is the part when you were deciding whether to join the alliance or not, could you describe the type of communication that took place?" All respondents indicated the presence of ambiguity and complexity in communication during this phase. Some respondents felt that the communication context was complex, but the communication itself was clear.

Question 2 addressed the media attributes by asking "During Phase I, could you describe the properties (or abilities) of the communication medium (or the communication technology) needed for proper communication?" For this question the majority or the respondents indicated the need for Cue Variety (88.9%), and Feedback (77.8%). Some of them also related this to meeting face-to-face.

Question 3 in the questionnaire addressed the communication process in Phase II of the virtual enterprise life cycle by asking, "During Phase II could you describe the type of communication that took place?" The responses to this question indicate the sustained presence of complexity and ambiguity, though most of the respondents felt that the levels of complexity and ambiguity in this phase were less than Phase I (66.7%).

Question 4 tried to ascertain the media attributes required during Phase II by asking "During Phase II, could you describe the properties (or abilities) of the communication medium (or the communication technology) needed for proper communication?" Most of the respondents rated Feedback (88.9%) as an important attribute, along with information related attributes of Information Quality (100%), and Information Access (55.5%).

Question 5 looked at the communication process in Phase III by asking, "During Phase III could you describe the type of communication that took place?" Detail oriented (77.8%) seemed to be the common definition for the communication process in Phase II. Mostly routine, clear, less ambiguous, and not complex (77.8%) were some of the other ways used to describe the process.

Respo ndent	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7
1	Ambiguity, complexity	FB CV	Unclear, Less ambiguous than Phase I	FB IQ	Less ambiguous, minor clarifications	FB IQ IA	a. FB IQ b. IQ FB CV MP RA c. IQ IA CV FB MP RA d. IQ IA CV FB e. IQ IA MP f. RA FB CV
2	Lack of common context, ambiguity	IQ, IA, RA	Lot of interaction, unclear, more context than Phase I	IQ FB MP	Less ambiguous, more detail oriented	FB, MP, IQ, IA	a. IA CV FB RA b. CV FB RA MP c. IA IQ CV FB RA d. CV FB RA MP e. FB MP RA CV f. FB MP RA CV
3.	Complex	FB CV Face to Face	Clarification, information	IQ, IA, FB	More detail	IA, IQ, FB	a. IQ CV RA b. CV FB MP c. MP FB CV IQ d. FB IQ IA e. IQ f. FB CV MP
4	Expectation of how to work together – Context building Equivocal	FB, CV – meet face to face	Unclear, complex	FB, IQ, IA Fax/Pho ne	More detail, telephone tag is a problem.	FB IA IQ	a. CV FB b. FB CV c. IQ IA d. IQ IA e. CV FB IQ f. CV FB MP
5.	Not clear – ambiguous	FB, CV Face to Face	Less ambiguous, Clearer	More Detail – IQ, No fast FB	Straightforward but did not get enough information	Detail oriented – IQ, IA	a. FB CV b. FB IQ c. IQ d. IQ e. FB CV f. FB CV
6.	Clear, Ambiguous at times	FB CV IQ	Complex at times	FB IQ CV	Clear, Routine	No FB, Not much Detail (No IQ IA)	a. FB MP b. FB CV MP c. IQ IA d. IQ IA e. FB IQ IA MP f. CV MP FB
7.	Ambiguity, Complex, Lack of common ground, not much need for information, Communication was a problem	FB CV	Less Complex, Common terminology, clearer, less ambiguity, more detail needed	IQ IA FB	Clear, more routine. Detail oriented	IQ IA FB	a. FB CV MP b. IQ IA FB CV RA MP c. IQ IA FB CV RA d. IQ IA CV e. IQ FB CV RA MP f. IQ IA FB CV RA MP
8.	Not clear, uncertainty complex, lack of common grounds	MP IQ CV	Less complex, more common ground, more clear, more detailed info. needed	FB MP CV IQ IA	Not complex, at times needed more info., precise info., clearer communication	FB MP CV IQ IA RA	a. FB CV IQ IA MP RA b. FB CV IQ IA RA c. FB IQ IA MP RA d. IQ IA FB CV e. RA MP FB CV IQ IA f. IQ IA CV RA FB
9.	Complex, lack of context, but Clear, need for details	FB CV MP RA IQ IA	Complex – a little less than Phase I, common ground set, Clear, needed details	FB MP CV IQ IA RA	Less Complex than Phase I, no equivocality, clear, but required details	FB CV MP IA	a. CV FB MP b. IQ IA FB CV MP c. IQ IA CV FB MP RA d. IQ IA FB CV MP RA e. IQ IA CV FB MP RA f. IQ IA CV FB

Table 5.1 – Conceptually Clustered Matrix of Respondents and Responses

FB–Feedback; CV–Cue Variety; MP–Message Personalization; IQ–Information Quality; IA–Information Accessibility; RA–Receiver Access

Question 6 addressed the media attributes needed in Phase III, by asking "During Phase III, could you describe the properties (or abilities) of the communication medium (or the communication technology) needed for proper communication?" Responses to this question showed a preponderance of Feedback (77.8%), Information Quality (77.8%), and Information Access (88.9%) among the attributes identified by the respondents.

The purpose of Question 7 was to identify if there exists a correspondence among the communication characteristics, and media attributes by asking a series of sub questions tying media attributes to a number of communication instances. For a compilation of the answers, see Table 5.2. For Complex interactions, the media attributes thought necessary were Cue Variety (77.8%), Feedback (88.9%), and to some extent Message Personalization (44.4%), with the figures in the parentheses representing the percentage of the respondents who identified that particular attribute as required. For interactions where there was a lot of Ambiguity in the situation, the desired attributes identified were Feedback (100%), Cue Variety (88.9%), and to a lesser extent Information Quality (55.5%), and Message Personalization (66.7%). For communication situations where there is a lack of Concrete information, the media attributes identified were Information Quality (100%), Information Access (77.8%), and to a lesser extent Feedback (66.7%), Cue Variety (55.5%), and Receiver Access (55.5%). When tasks required lots of Detailed information the desired media attributes were Information Quality (88.9%), Information Access (77.8%), and to a lesser degree Feedback (55.5%) and Cue Variety (55.5%). When the situation involved Negotiation with others, the media attributes needed were identified as Information Quality (77.8%), Feedback (77.8%), and to a lesser

79

extent Cue Variety (66.7%), and Message Personalization (66.7%). Finally for situations

where the other person was not known, the media attributes identified were Feedback

(100%), and Cue Variety (100%), and to a lesser extent Message Personalization

(55.5%), and Receiver Access (44.4%).

Comm. Situation	Feed-back	Cue-Variety	Message Pers.	Info. Quality	Info. Access.	Receiver Access
Complex Message	8	7	4	3	2	3
Ambiguity	9	8	6	5	3	4
Lack of Concrete Information	6	5	4	9	7	5
Detailed Information required	5	5	2	8	7	2
Negotiation	7	6	6	7	4	4
Do not know the other person	9	9	5	3	3	4

**Table 5.2   Number of responses for Task/Media
Characteristics Requirement for Each Communication Situation**

5.4 Analysis of Questionnaires

The responses to the questions in the survey instrument were on a seven point

likert scale, with a 1 signifying that the respondent strongly disagreed with the statement

in the question, and a 7 signifying the respondent's strong agreement with the statement.

A response of 4 signified that the respondent neither agreed, nor disagreed with the

statement. There were 33 questions in all, with each question having multiple parts. The

questions themselves were split into three distinct sections, each corresponding to the

three high level relationships were sought to be identified in the propositions formulated

in Chapter III. The first section (Questions 1 through 7) related to **the effect of virtual**

enterprise characteristics on the task / message characteristics. The second section

(Questions 8 through 27) related **to the effect of virtual enterprise characteristics on**
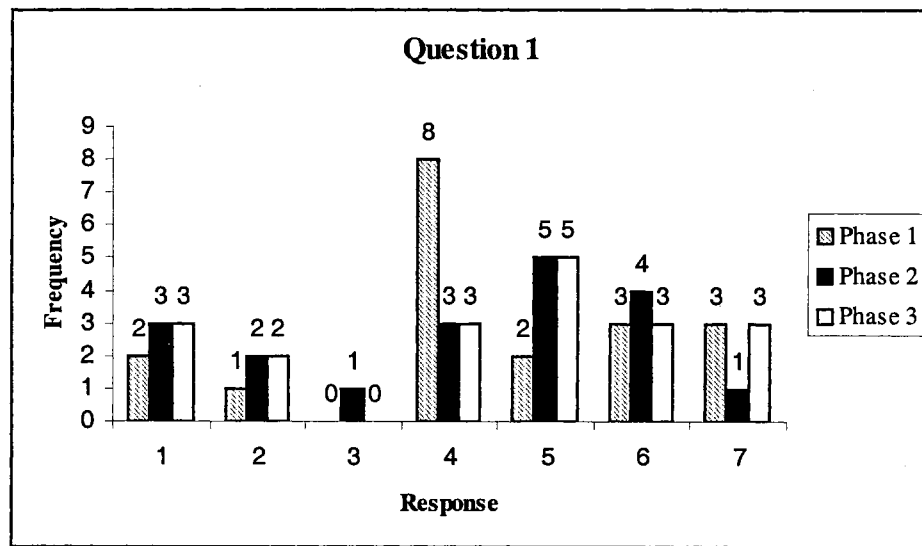
Figure 5.1   Histogram for Responses to Question 1

media characteristics desired. While the third section (Questions 28 through 33)

related to the third set of propositions, i.e., **the effect of task characteristics on media**

characteristics desired.

In order to identify patterns of responses in the questionnaires, a number of

methods were used: 1) Histograms for responses to each question were generated, these

were then studied to find out how many of the respondents agreed or disagreed with

particular questions 2) the mean scores of the responses to each question were used to

identify the degree of agreement with the statements, and 3) the number of "polar" responses (Strongly Agree, and Strongly Disagree) were computed for each question. All these methods were used to judge how the propositions were supported. For example, Question 1, which is "When you communicated with other organizations to make the parts for the DOD Parts on Demand project, your interaction was very complex," (this is repeated for all three phases). The histogram in figure 5.1 shows the pattern of responses.

We see that in Phase 1, eight of the respondents' answer was either 5 or above, which would signify some degree of agreement with the statement, while for Phase 2, this number was 10, and for Phase 3, it was eleven. If we look at the distribution of the responses, the mean of the responses for Phase 1 was 4.47, which signifies a higher degree of agreement the statement than disagreement. For Phase 2 the mean response was 4.11, signifying a slightly higher degree of agreement with the statement than disagreement. Finally for Phase 3 the mean response was 4.37, which would again signify a slightly higher agreement than disagreement with the statement. On the other hand, if we look at the number of respondents who agree with the statement (responses 5, 6 or 7), for Phase 1 (a total of 8), and compare it to those for Phases 2 and 3 (10 and 11 respectively) we find that it is lower than those for the latter phases (Phases 2 and 3). Thus indicating that the number of respondents who thought that their interaction was complex was more in Phases 2 and 3 than in Phase 1. If we compare the number of respondents who disagree with the statement we find that less respondents disagree in Phase 1 (3), than in Phase 2 (6) and Phase 3 (5), indicating that less respondents thought that communication in Phase 1 was not complex as compared to the number of

respondents who felt that for Phases 2, and 3. The histograms for all 33 questions are attached in Appendix C.

Task/Message Characteristic	Question Number
Equivocality	1, 2, 4, 5, 7 across Phases 28, 29, 32, 33 across Media Characteristics.
Uncertainty	3, 6 across Phases 30, 31 across Media Characteristics

Table 5.3   Task/Message Characteristics

Media Characteristic	Question Number
Feedback	8, 12
Cue Variety	9, 11, 13, 14
Message Personalization	10, 15
Receiver Access	24
Information Quality	16, 17, 18, 19, 20,
Information Access	21, 22, 23, 25, 26, 27

Table 5.4   Media Characteristics

Tables 5.3 and 5.4 relate the questionnaire instrument to the constructs. While Table 5.3 relates the survey questions to the Task/Message Characteristics, Table 5.4 relates the survey questions to the Media Characteristics.

Following the same method as was used for individual questions, patterns of responses for the constructs were determined using three methods: 1) group/composite means for the construct, 2) the total number of responses agreeing/disagreeing with the statements in the questions measuring a construct, and 3) the total number of responses strongly agreeing/disagreeing with the statements in the questions measuring the construct. Looking at the patterns in the histograms for questions 1, 2, 4, 5 and 7 (the

83

construct for equivocality across phases) there are no glaring differences apparent between Phases 1, 2 and 3 as far as equivocality goes. Upon looking at the numbers on equivocality, the mean response for Phase 1 was 3.87, as compared to 3.61 for Phase 2, and 3.37 for Phase 3 (note that since the statement for Question 5 effectively represents a lack of equivocality, the responses were reverse coded to keep the numbers meaningful). This suggests that at on the whole respondents felt that equivocality decreased as the virtual enterprise progressed from Phase 1 to 3. When looking at the total number of responses agreeing with the statements for this construct, Phase 1 had 34, Phase 2 31 and Phase 3 26 (note that for Question 5, the number who disagreed with the statement were the ones who agreed to the presence of equivocality, and these numbers reflect that). This too suggests that the equivocality went down as the virtual enterprise moved from Phase 1 to Phase 3. On the other hand, the totals for those disagreeing were 35 for Phase 1, 41 for Phase 2, and 45 for Phase 3, again indicating that more respondents disagreed with the presence of equivocality in Phase 3 than in Phase 1. Looking at the third measure, the responses strongly agreeing with the statements for this construct, were 10 for Phase 1, 9 for Phase 2, and 6 for Phase 3. The responses strongly disagreeing with the statements on the other hand were 15 for Phase 1, 20 for Phase 2, and 22 for Phase 3. Similar measures were computed for all the other constructs across the phases of the virtual enterprise life cycle and are summarized in Table 5.5. Table 5.6 summarizes the means of the responses for the variation of the media characteristics with the task/message characteristics.

	Equivocality				
Phase	Mean Response	Number Who Agree	Number Who Disagree	Strongly Agree	Strongly Disagree
1	3.87	34	35	10	15
2	3.61	31	41	9	20
3	3.37	26	45	6	22
	Uncertainty				
1	4.95	24	6	8	2
2	5.34	29	5	10	2
3	4.76	23	7	8	5
	Feedback				
1	5.21	23	5	10	0
2	5.47	26	4	13	0
3	5.42	27	4	11	1
	Cue Variety				
1	4.03	23	24	9	11
2	4.18	33	19	10	12
3	4.04	27	21	8	14
	Message Personalization				
1	4.11	16	12	6	6
2	4.53	21	8	7	5
3	4.32	17	9	7	6
	Information Quality				
1	5.87	77	3	45	0
2	6.25	90	1	54	0
3	5.99	88	4	49	3
	Information Accessibility				
1	5.5	80	12	36	2
2	5.91	95	8	45	2
3	5.77	96	9	41	5

Table 5.5 Measures of Task/Message and Media Characteristics across Phases

	Information Quality	Information Access'	Cue Variety	Feedback	Message Pers.	Receiver Access
Equivocality	6.03	5.89	5.54	5.67	5.2	5.86
Uncertainty	5.97	5.82	6.03	5.76	5.32	6.03

Table 5.6 Media Characteristics across Task/Message Characteristics.

5.5 Description of the Direct Observation

Three different communication interactions were observed between organizations constituting a virtual enterprise. The first interaction was between the coordinating organization, and an organization that was interested in joining the virtual enterprise. The second interaction observed was between that coordinating organization and a member of the virtual enterprise where work was being done in order to prepare a bid. The third interaction observed was between the coordinating organization and a member of the virtual enterprise during the manufacturing phase. These three distinct interactions provide a rich context to the interviews and the data gathered via the questionnaire.

5.5.1   Observed Interaction I

The interaction was between the coordinating organization (Organization S), and an organization that had certain core competencies, and excess capacity at that point in time (Organization N). Organization N was interested in knowing more about the virtual enterprise model, and joining a virtual enterprise when the opportunity arose. The only time that the two organizations had interacted before was when S had contacted N to see if they might be interested in joining a virtual enterprise, and then to set up this appointment. This meeting was the first time that the concept of a virtual enterprise was explained to organization N. The communication interaction was "face-to-face". S started off by explaining what was involved in the task, emphasizing the coordination requirements, the role that the coordinating organization plays etc. N asked a lot of

questions, primarily about the virtual enterprise, the coordinating mechanism etc. and **S** answered them. **S** too asked questions, mainly about the core competencies and the excess capacity that **N** possessed. The points to note about this interaction were that in spite of the technological sophistication of organization **S** (and that of Organization **N**), this was a face-to-face meeting. **S** did not send out written information about the virtual enterprise in advance, but all the legal paperwork, the forms etc. were handed to **N** during this interaction. There were situations in the communication where **N** had to ask for explanations, the context that **S** was coming from was not the same as **N**, so there were situations where the message communicated was ambiguous. There was no really detailed information communicated, just getting the idea of the virtual enterprise across, and setting up a common context so that both organizations could communicate better.

5.5.2   Observed Interaction II

The second interaction directly observed was between Organization **S**, and Organization **D**. Organization **D** had already joined the virtual enterprise, and was working on preparing a part of the bid that was due to be submitted. The context of the interaction was some details needed about the Mil Specs (Military Specifications) for the material to be used for the part that was being bid on. Organization **D** did not have the background in working for DOD, and so was unfamiliar with the specifications. Organization **S** had worked on a number of such projects, and had in their possession all the specification manuals.

This interaction too was a "face-to-face" meeting. There were two reasons for that. One was that both organizations were playing telephone tag and could not connect with each other. The other reason was that since the researcher was accompanying the team from Organization **S**, for observing another interaction, and Organization **D** was on the way, they decided to drop by and see what was happening with **D**. The interaction primarily focused on the details needed by **D** in order to determine the price of the material to be used, and identify suitable vendors too. The end result of this interaction was that **S** promised to send the relevant specification, and also identify the equivalent non-military specifications. So for this interaction there actually was not need for the "face-to-face" interaction, as it was simply need for the relevant information which was driving the communication.

5.5.3   Observed Interaction III

The third interaction directly observed was between Organization **P** and Organization **S**. Organization **P** was performing a particular manufacturing process on the part being manufactured by the virtual enterprise. This interaction was in order to make sure that **P** knew exactly what needed to be done before starting the job. Both **P** and **S** are technologically sophisticated organizations. The exchange of the technical drawings was done via email, and e-mail seemed to be the preferred mode of communication. In spite of that, for resolving an ambiguous situation, the team from **S** drove 60 miles to meet with **P** and pore over the same drawing at the same time. The issue was a relatively straightforward one but required a lot of fast feedback, the ability to

provide a number of cues. The information exchange had already taken place via e-mail (though S did carry all the diagrams on a Zip disk, just to make sure). Once both parties went over the drawings, the issue was resolved rather quickly.

5.6 Analysis of the Propositions

On the surface, the three methods of data collection seem to have provided seemingly different results. Looking at these results within the context of the propositions we realize that there is a significant congruence in the findings from all three methods.

5.6.1 Analysis of Proposition 1

The virtual enterprise characteristics will have an effect on the task / message characteristics

Proposition 1.a. Tasks/messages in the manufacturing/delivery phase of virtual enterprises will possess less equivocality than tasks/messages in the pre project phase of virtual enterprises.

The interviews and the questionnaire both support this proposition, with more respondents indicating the presence of equivocality to a greater degree in Phase 1 (Pre Project) than in Phase 3 (Manufacturing /delivery). The mean response for the Equivocality construct from the questionnaire survey was 3.87 in Phase 1, and 3.37 in Phase 3 (see Table 5.5). The number of responses agreeing with the presence of Equivocality in Phase 1 was 34 as compared to 26 in Phase 3. The direct observation also

seemed to indicate that equivocality existed in both the phases, though again, the degree

of equivocality was significantly higher in Phase 1.

Proposition 1.b.   Tasks/messages in the pre project phase of virtual enterprises will possess less uncertainty than tasks/messages in the design/bid phase of virtual enterprises.

The interview and the questionnaire data support this proposition, as the

trends indicate that more respondents thought that there was less uncertainty in Phase 1

compared to Phase 2. On the survey questionnaire the mean response for the Uncertainty

construct was 5.34 in Phase 2 as compared to 4.95 in Phase 1. On conducting a paired

sample T-Test, the difference in the means was significant at the 0.15 level. The number

of responses agreeing to the presence of uncertainty in Phase 2 was 29 as compared to 24

in Phase 1. Even the direct observation seems to support this as the communication in the

interaction observed for Phase 2 was primarily due to lack of information, while in Phase

1, information was not of primary concern.

Proposition 1.c.   Tasks/messages in the manufacturing/delivery phase of virtual enterprises will possess less uncertainty than tasks/messages in the design/bid phase of virtual enterprises.

This proposition was again supported by the interview and the questionnaire data

and to a greater degree by the direct observation of interactions relating to Phases 2 and 3,

where the real need for specific information was more in Phase 2 than in Phase 3. On the

survey questionnaire, the mean response for the uncertainty construct was higher in Phase

2 (5.34) as compared to Phase 3 (4.76), while the number of responses agreeing with the

presence of uncertainty in Phase 2 were 29, against 23 for Phase 3. Using a paired

sample T-Test, the difference in the means was significant at < 0.10 level. So the

uncertainty in the design/bid phase was significantly higher than uncertainty in the manufacturing/delivery phase.

5.6.2 Analysis of Proposition 2

The virtual enterprise characteristics will have an effect on media characteristics desired.

Proposition 2.1.a.   Cue variety required in a communication medium in the pre project phase of virtual enterprises will be greater than the cue variety required in a communication medium in the manufacturing / delivery phase of virtual enterprises.

The patterns in the interview data support this proposition while the patterns in the questionnaire data did not support this proposition. For the survey questionnaire, the mean response to the Cue Variety construct was 4.03 for Phase 1, and 4.04 for Phase 3. The number of responses agreeing with the requirement for Cue Variety in Phase 1 was 23, as compared to 27 for Phase 3. On the other hand the responses strongly agreeing the requirement for Cue Variety in Phase 1 were 9 as compared to 8 for Phase 3. The direct observation on the other hand supported the proposition, but weakly.

Proposition 2.1.b.   Immediacy of feedback required in a communication medium in the pre project phase of virtual enterprises will be greater than the immediacy of feedback required in a communications medium in the manufacturing / delivery phase of virtual enterprises.

This proposition was not supported by either the interview data, or the questionnaire data. The direct observation too did not provide any significant support for this proposition.

Proposition 2.1.c.   Capability for message personalization required in a communication medium in the pre project phase of virtual enterprises will be greater than the capability for message personalization required in a communication medium in the manufacturing / delivery phase of virtual enterprises.

This proposition too was not supported by either the patterns in the interview data or patterns in the questionnaire data. The direct observation provided a weak support for this proposition.

Proposition 2.2.a.   Information quality required in the design/bid phase of virtual enterprises will be greater than the information quality required in the pre project phase of virtual enterprises.

The patterns in the interview data strongly supported this proposition, while the patterns in the questionnaire data also supported this proposition. The mean response for the Information Quality construct in Phase 1 was 5.87, as compared to 6.25 for Phase 2. On conducting a paired sample T-Test, the means were different at a significance level <0.10. So the Information Quality required in the Pre bid Phase was significantly lower than that required for the Design/Bid Phase. The number of responses agreeing to the requirement for Information Quality in Phase 2 was 90 compared to 77 for Phase 1. The direct observation also indicated support for this proposition.

Proposition 2.2.b.   Information quality required in the design/bid phase of virtual enterprises will be greater than the information quality required in the manufacturing / delivery phase of virtual enterprises.

The support for this proposition exists in all three types of data. The patterns in the interview data support it as do the patterns in the questionnaire data, and the direct observation supports it to a degree too. In the survey questionnaire, the mean response for the Information Quality construct was 6.25 for Phase 2, as compared to 5.99 for Phase

3. The number of responses Strongly Agreeing to the requirement for Information

Quality in Phase 2 was 54, as compared to 49 for Phase 3.

Proposition 2.2.c   Information accessibility required in the design/bid phase of virtual
enterprises will be greater than the information accessibility required in the pre project
phase of virtual enterprises.

This is supported by the patterns in the interview data, though not as strongly as

the proposition dealing with information quality. The patterns in the questionnaire data

are supportive, while the direct observation did not support this proposition. In the

survey questionnaire, the mean response for the Information Accessibility construct was

5.91 for Phase 2, as compared to 5.5 for Phase 1. While the number of responses

agreeing with the requirement for Information Accessibility in Phase 1 was 80 as

compared to 95 for Phase 2.

Proposition 2.2.d.   Information accessibility required in the design/bid phase of virtual
enterprises will be greater than the information accessibility required in the
manufacturing / delivery phase of virtual enterprises.

This proposition was not supported by the patterns in the interview data. In fact

the need for information accessibility is shown greater in the manufacturing / delivery

phase than the design/bid phase. The results were not very different when studying the

patterns in the questionnaire data. The mean response for the Information Accessibility

construct was 5.91 in Phase 2, as compared to 5.77 in Phase 3. The number of responses

agreeing to the requirement for Information Accessibility in Phase 2 was 95 as compared

to 96 for Phase 3. The responses Strongly Agreeing to the requirement for Information

Accessibility in Phase 2 were 45 as compared to 41 for Phase 3. The direct observation

too was inconclusive on the extent of the differences in information accessibility for

phases 2 and 3.

5.6.3 Analysis of Proposition 3

The task characteristics will have an effect on media characteristics desired.

Proposition 3.1.a.   Communication media with high cue variety will be required for tasks high in equivocality.

This proposition is strongly supported by both the interview data (see

Table 5.2), and the questionnaire data (see Table 5.6). The pattern of responses in Table

5.2 shows, that for all the task/communication characteristics associated with

Equivocality, the majority of the respondents deemed Cue Variety as required (83.3% on

average). While in the case of the questionnaire data, the mean response for the

requirement for Cue Variety in Equivocal situations was 5.54 (Table 5.6), thereby

signifying that the majority of the respondents agreed with the statements. The direct

observation did not capture this relationship too well, but during the tasks that involved a

lot of Equivocality, the richest communication medium, that is "face-to-face" was used,

providing a high degree of cue variety.

Proposition 3.1.b.   Communication media with higher immediacy of feedback will be required for tasks high in equivocality.

This proposition too was strongly supported by both the interview data, and the

questionnaire data. The pattern of responses in Table 5.2 shows that for all the

task/communication characteristics associated with Equivocality, the majority of the respondents deemed Feedback as required (91.67% on average). While in the case of the questionnaire data, the mean response for the requirement for Feedback in Equivocal situations was 5.67 (Table 5.6), thereby signifying that the majority of the respondents agreed with the statements. The direct observation did not capture this effect very well, but during the tasks that involved a lot of Equivocality, the richest communication medium, that is "face-to-face" was used, providing a much higher turnaround time or faster feedback.

Proposition 3.1.c.   Communication media with high capability for message personalization will be required for tasks high in equivocality.

The interview data did not support this proposition as strongly as the earlier two propositions relating media characteristics to Equivocality, but it was still well supported. The pattern of responses in Table 5.2 shows that for all the task/communication characteristics associated with Equivocality, the majority of the respondents deemed Message Personalization as required (58.3% on average). The questionnaire data supported this proposition too (mean response of 5.2), while the direct observation could not capture this effect.

Proposition 3.2.a   Communications media with capability of providing high information quality will be required for tasks high in uncertainty.

This proposition was supported strongly by the patterns in the interview data, as well as patterns in the questionnaire data. The interview data shows that the majority of the respondents deemed Information Quality as required in situations where Uncertainty

exists (94.4%). The questionnaire data supports the proposition, with the mean response

for the need for Information Quality on the items representing Uncertainty, of 5.97. The

direct observation also showed (indirectly) that in Phase 2, where there was a situation

with Uncertainty, ultimately a medium with the capability of higher information quality

was used.

Proposition 3.2.b.   Communications media with capability of providing high
information accessibility will be required for tasks high in uncertainty.

This proposition was supported by the patterns in the interview data, but not as strongly

as the proposition relating to information quality. 77.78% of the responses indicated the

need for Information Accessibility for situations involving Uncertainty. The

questionnaire data supported this proposition strongly, with the mean response of 5.82 for

the need for Information Accessibility in situations involving Uncertainty. Direct

observation also supported this proposition indirectly.

5.7 Implications of Results

The results of the study show that the propositions that were proposed using the

theory behind the model for communication media choice among virtual enterprises have

some degree of empirical validation. Even though not all the propositions were supported

strongly, most of the propositions did have some degree of support. These results though

not statistically generalizable, can be used to generalize to the theory behind the model.

Even though only a part of the overall model for communication media choice in virtual

enterprises was tested in this case study, the results do warrant further research in this area to fully validate the complete model.

The implications are discussed in the next two sections. Section 5.7.1 identifies the implications for practicing managers, while Section 5.7.2 discusses the implications for research in the area of virtual enterprises, as well as communication media choice.

5.7.1 Implications for Practicing Managers

This section looks at the implications of the results of each set of propositions for the practitioners working in virtual enterprises.

Propositions addressing the relationship between the phase of the virtual enterprise life cycle and task/media characteristics were well supported. Equivocality was less in Phase 3 as compared to Phase 1. This basically implies that with time, the organizations working in a virtual enterprise form a context within which communication takes place, which then reduces Equivocality. Managers can use this information to make sure that they allocate enough time up front to ensure that all organizations participating in a virtual enterprise can get through the context building effort speedily. Uncertainty was deemed to be more in Phase 2 as compared to Phases 1 and 3 (This result was statistically significant). This implies that there exists the need for the communication of greater detail in Phase 2 as compared to Phase 1 and Phase 3.

The propositions addressing the relationship between the phase of the virtual enterprise life cycle with media characteristics were not all supported. The propositions dealing with the relationship between the phase of the virtual enterprise life cycle, and

Information Quality, and Information Accessibility were strongly supported by the results. While the propositions dealing with the relationship between the phase in the virtual enterprise life cycle and the other media characteristics were either not supported strongly, or not supported at all. These results imply that the organizations participating in virtual enterprises should be geared towards exchange of higher quality information in the design/bid phase, and this information should be in a form that is easy for the recipient to access.

The propositions dealing with the relationship between the task/message characteristics, and the media characteristics were strongly supported for the most part. Only the role of Message Personalization in Equivocal situations was not strongly supported by the results. For organizations participating in virtual enterprises, then, the results imply that in situations where there is equivocality, there is a need for faster feedback, and higher cue variety, and to a lesser degree there is a need for the capability for message personalization. Communication media that have these characteristics (faster feedback, higher cue variety, and the ability to personalize messages) are then better suited for situations where there is ambiguity, complexity, need for negotiation etc. Similarly, the results show that there is a need for higher Information Quality, and Information Accessibility in situations where there is uncertainty. This implies that the communication media that have the ability to provide information that is relevant, accurate, reliable, timely, available, dependable, easy to use, and convenient are required in situations where there is uncertainty. These results when used in conjunction with earlier research tying communication media, with media characteristics (e.g. Zmud et

al.1990) can help in the choice of the appropriate medium for each type of communication situation.

5.7.2 Implications for Research

The results of the study have several implications on the research in the fields of organization theory (specifically in the area of Virtual Enterprises) and communication media choice. One result that stands out as far as contribution to virtual enterprise literature is that there do exist differences in the three phases in terms of the types of communication/tasks that take place. This implies that instead of a static structure, virtual enterprises evolve over time, and need different capabilities from communication media. Further research in this area can lead to more specific information on aspects of these phases, like their duration, the specific tasks that need to be done in each phase, the measures of success in each phase etc. Even though this research shows the implications of the Phase on task characteristics, and media characteristics, further research is needed to identify and study the impact of the remaining virtual enterprise characteristics – that is the "type" and "geographical dispersion" on these constructs.

The communication choice literature had predominantly studied the task-media fit, and the impact on performance. This research proposed a holistic model of communication media choice in virtual enterprises, and has tested a part of that model. The part that was tested, that is the impact of virtual enterprise characteristics on task characteristics and the impact of task characteristics on media characteristics, is one that is generally not even looked at by most researchers in this area. The results do show that

significant relationships exist among the task and media characteristics, and to a lesser extent virtual enterprise characteristics and task characteristics, and media characteristics. This study, using the case study methodology sets the stage for the development of hypotheses for propositions and then testing in a large field study.

Similar case studies and appropriate follow up research needs to be done to validate the other relationships demonstrated in the model, but not tested in this study.

CHAPTER VI

SUMMARY AND CONCLUSIONS

6.1 Research Summary

The purpose of this study was to identify the factors that impact the choice of the communication media in a virtual enterprise environment, organize them into a generalizable model for communication media choice in virtual enterprises, and finally test a part of this model empirically.

This study attempted a thorough review of the literature relevant to communication media choice, and the literature relevant to virtual enterprises in order to identify the factors that could impact that decision making process. This study thus represents a meeting of two diverse bodies of literature in order to come up with a comprehensive choice model.

A part of the model so created was tested in a real virtual enterprise using the case study methodology. The results of this case study suggest that the part of the model tested is capable of showing the relationships that exist between a) virtual enterprise characteristics, and message characteristics, b) between the virtual enterprise characteristics and media characteristics, and c) between message characteristics and media characteristics. These results show that this model is a step in the right direction, but needs to be validated completely, and that will be the subject of follow up research.

6.2 Accomplishments of the Study

This research accomplished the objectives outlined in section 1.2. In addition to the stated objectives, the study also resulted in the development of new measurement instruments (qualitative and quantitative) to measure the relationship between the factors.

6.2.1 Accomplishment of the Research Objectives

This research project was based on four objectives (section 1.2):

1) To identify the characteristics of virtual enterprises that affect communication media requirement; (2) to identify factors that influence individual communication media choice; (3) to propose an exploratory model of individual communication media choice in a virtual enterprise; and (4) test a part of the proposed model using a case study approach.

The following list summarizes how these four objectives were realized.

1. The major characteristics of virtual enterprises that could affect communication requirements were identified through a thorough review of the literature on organization structures, which included the study of a number of allied organizational structures including organizational networks.

2. The factors that affect communication media choice were identified via a comprehensive study of the media choice literature. Competing theories

102

were analyzed in order to come up with the most parsimonious list of factors.

3.   The model incorporated the factors identified in the two previous sections in a logically generalizable structure, which could then be empirically tested.

4.   A part of this model was then tested in a virtual enterprise environment. A set of propositions were developed that postulated the relationship between the three sets of characteristics that were identified to be tested, namely the Virtual Enterprise characteristics, the Media characteristics, and the Message characteristics. A case study was used to validate these propositions.

6.3   Limitations of the Current Study

There are several limitations to this study. These limitations exist in both the methodology, and the data that was collected. This research was exploratory in nature, in that it was the creation and initial validation of a research model that outlined factors, and their interrelationships in a communication media choice situation in a virtual enterprise environment. The methodology used was a case study. So it is difficult to make statistically valid generalizations about the results across different industries, different sizes of virtual enterprises, different structures etc. Case studies are limited in terms of generalizability, the use of qualitative measures, the lack of statistical rigor, the lack of longitudinal measures, and the lack of comparative measures. So a case study must be

evaluated in light of this particular situation. The results for this study were obtained from respondents who agreed to participate in this study. Other participants within the same organizations might have interpreted the questions differently, and responded differently. Even though the qualitative and quantitative instruments used were based on theory and previous research, and were tested on a panel of experts, there was no statistical validation of these measures for this current study. Finally this study represents one investigator's interviews, and observations and so may be biased by the researcher's own predisposition and biases.

6.4 Further Research

The findings of this research show that the model proposed in this study warrants further research. The next steps in this study would be to fully validate the complete model, using the case study methodology, replicate the study in more virtual enterprises, preferably across industries. Then this model should be tested over a larger population of virtual enterprises, in order to come up with a statistically valid model of communication media choice in virtual enterprises. Further research should be able diminish the impact of some of the limitations mentioned in the previous section. The generalizability of the model can be enhanced by performing this research in different virtual enterprises. Further validation and refinements of the measurement instruments will also lead to more rigor in methodology and validation techniques.

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APPENDIX A: INTERVIEW QUESTIONS

This study attempts to look at the nature of communication and communication technologies used at at various stages in a virtual enterprise environment. In this case, the manufacturing of parts within the context of the CATT project.

Phase I is the Pre Bid part of the project where you discussed whether you were going to join the alliance or not.

Phase II is the Bid Preparation stage, where you were actively involved in the preparation of a bid for a part.

Phase III is the manufacturing/delivery stage, where you were involved in the manufacture and the subsequent delivery of the part.

1. During Phase I, that is the part when you were deciding whether to join the alliance or not, could you describe the type of communication that took place.

2. During Phase I, could you describe the properties (or abilities) of the communication medium (or the communication technology) needed for proper communication.

3. During Phase II could you describe the type of communication that took place?

4. During Phase II, could you describe the properties (or abilities) of the communication medium (or the communication technology) needed for proper communication.

5. During Phase III could you describe the type of communication that took place?

6. During Phase III, could you describe the properties (or abilities) of the communication medium (or the communication technology) needed for proper communication

7. Describe the characteristics of the communication medium needed in the following situations:

a. When the task or message is very complex.

b. When there is a lot of ambiguity in the situation.

c. When there is lack of concrete information.

d. When the task requires a lot of detailed information.

e. When the situation involves negotiation with others.

f. When you do not know the other person(s) involved in the communication.

APPENDIX B: SURVEY QUESTIONNAIRE

This section seeks information on your communications in each phase of your involvement with the DOD Parts on demand project.

Phase I is the Pre Bid part of the project where you discussed whether you were going to join the alliance or not.

Phase II is the Bid Preparation stage, where you were actively involved in the preparation of a bid for a part.

Phase III is the manufacturing/delivery stage, where you were involved in the manufacture and the subsequent delivery of the part.

Please use this scale to indicate the extent of agreement or disagreement with the following statements by circling the appropriate number .
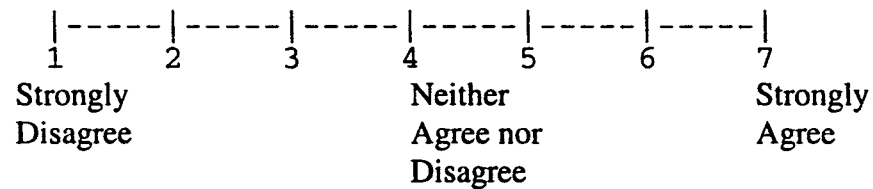
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|-----|-----|-----|-----|-----|-----|
1     2     3     4     5     6     7
Strongly              Neither              Strongly
Disagree              Agree nor            Agree
                      Disagree
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When you communicated with other organizations to make the parts for the DOD Parts on Demand project,

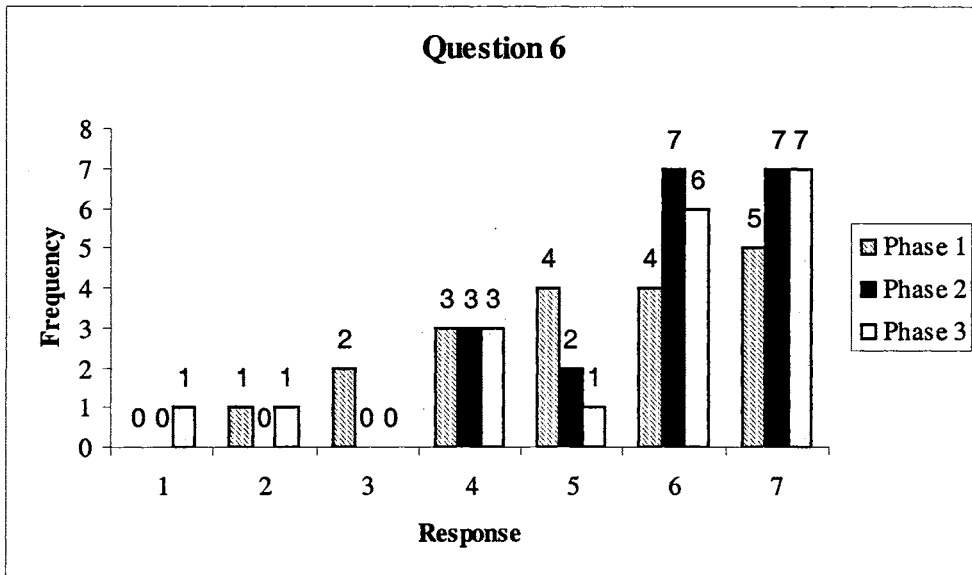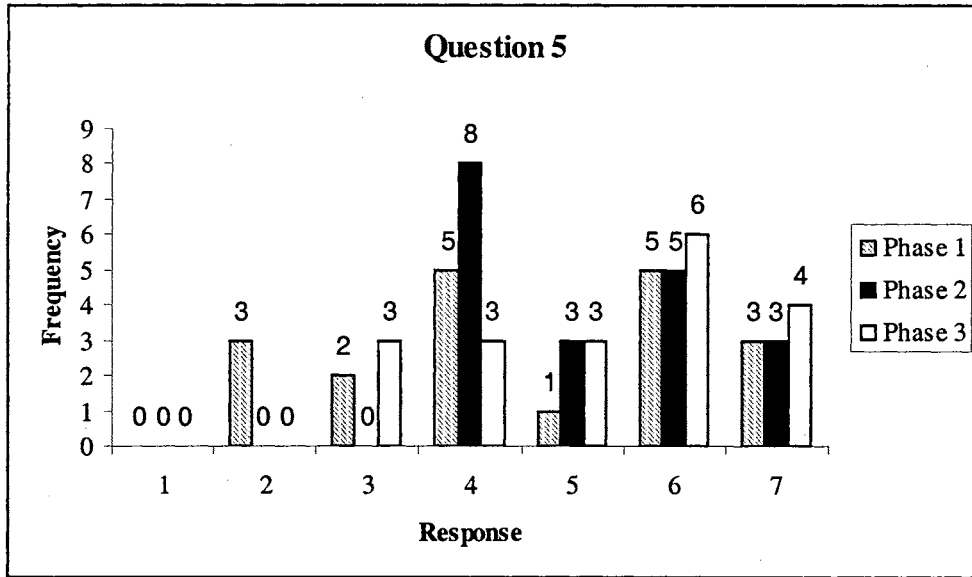|	In Phase I (Pre Bid Stage)	In Phase II (Bid Stage)	In Phase III (Manufacture / Delivery Stage)
1. Your interaction was very complex	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
2. There were major differences in terminology used to communicate	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
3. There were situations when you had to ask for more information	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
4. There were situations when you had to ask for explanations	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
5. The communication was very clear	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
6. There was requirement for detailed precise information	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7

7. Effective communication was a problem	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7

In order to communicate properly in the different phases of the project, it is **essential** to:

	In Phase I (Pre Bid Stage)	In Phase II (The Bid Preparation Stage)	In Phase III (Manufacture / Delivery Stage)
8. Give and receive timely feedback	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
9. Transmit a variety of different cues beyond the explicit message	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
10. Tailor messages to your own or other personal circumstances	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
11. Use rich and varied language	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
12. Provide immediate feedback	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
13. Convey multiple types of information (verbal and non verbal)	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
14. Transmit varied symbols (e.g. words, numbers, pictures)	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
15. Design messages to your own or others' requirements	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
16. Transfer information / data clearly	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
17. Transfer information / data precisely	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
18. Transfer information / data accurately	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
19. Transfer information / data fast	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
20. Transfer information /data reliably	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7

	In Phase I (Pre Bid Stage)	In Phase II (The Bid Preparation Stage)	In Phase III (Manufacture / Delivery Stage)
21. Communicate using a medium that is dependable	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
22. Communicate using a medium that is easy to use	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
23. Communicate using a medium that is convenient	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
24. Communicate using a medium that is always available	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
25. Communicate using a medium that is simple	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
26. Communicate using a medium that is technical	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
27. Communicate using a medium that shows urgency	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7

In the following task / message situations, these characteristics of the communication medium are **essential**:

	The relevance, accuracy, reliability and timeliness of the information.	The availability, dependability, ease of use, and convenience of the information source.	The ability to use different modes of expression like voice, pictures, text etc.	The ability to get a response fast.	The ability to finely tailor a message to best fit an individual and/or situation.	Potential access to the medium by the intended recipient.
28. When the task or message is very complex.	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
29. When there is a lot of ambiguity in the situation.	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
30. When there is lack of concrete information.	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
31. When the task requires a lot of detailed information.	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
32. When the situation involves negotiation with others.	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7
33. When you do not know the other person (s) involved in the communication.	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7	1—2—3—4—5—6—7

APPENDIX C: HISTOGRAMS

Question 1

Question 2

Question 3

Question 4

Question 5

Question 6

Question 7

Question 8

Question 9

Question 10

131

Question 11

Question 12

Question 13

Question 14

133

Question 15

Question 16

Question 17

Question 18

Question 19

Question 20

Question 21

Question 22

Question 23

Question 24

Question 25

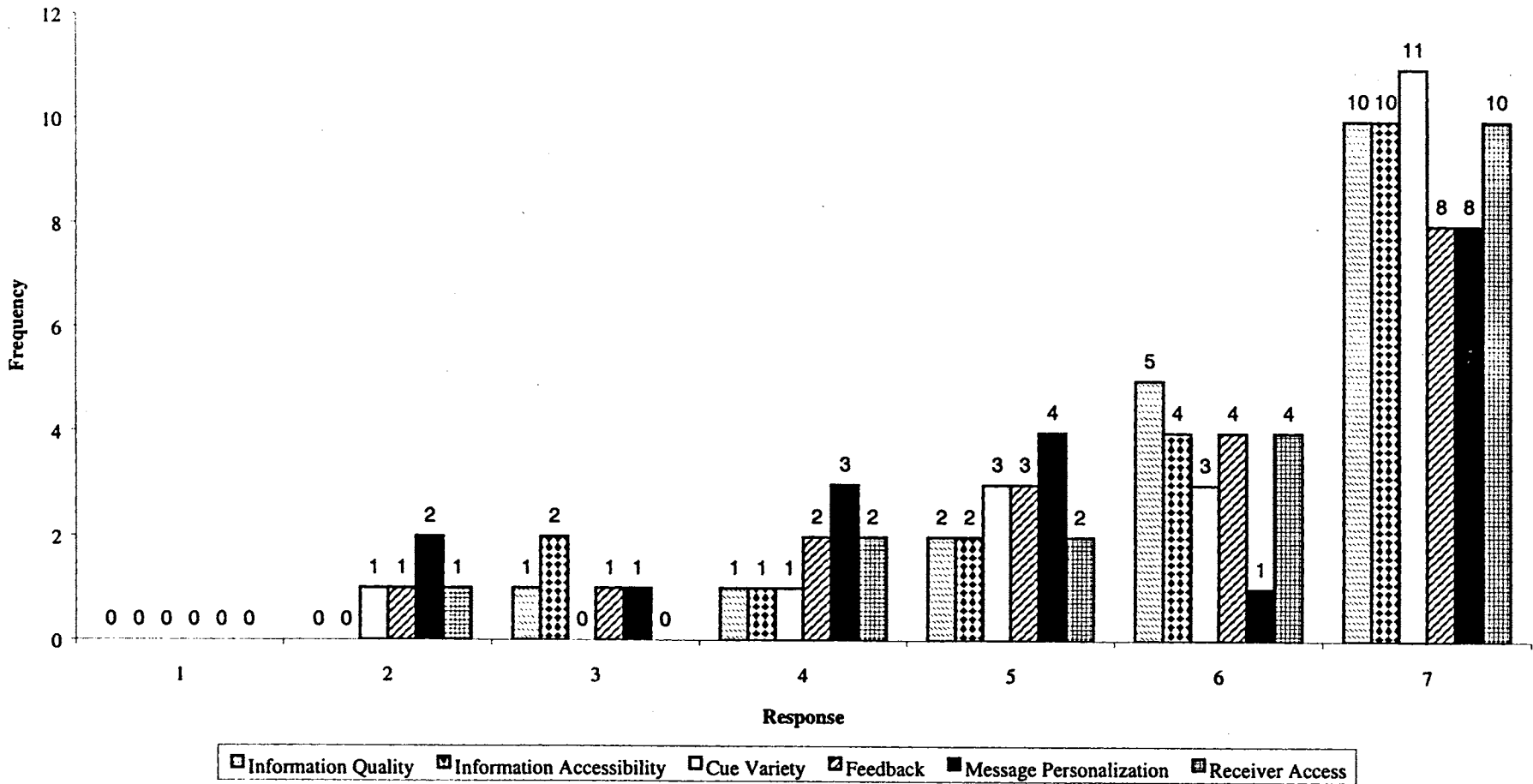Question 26

Question 27

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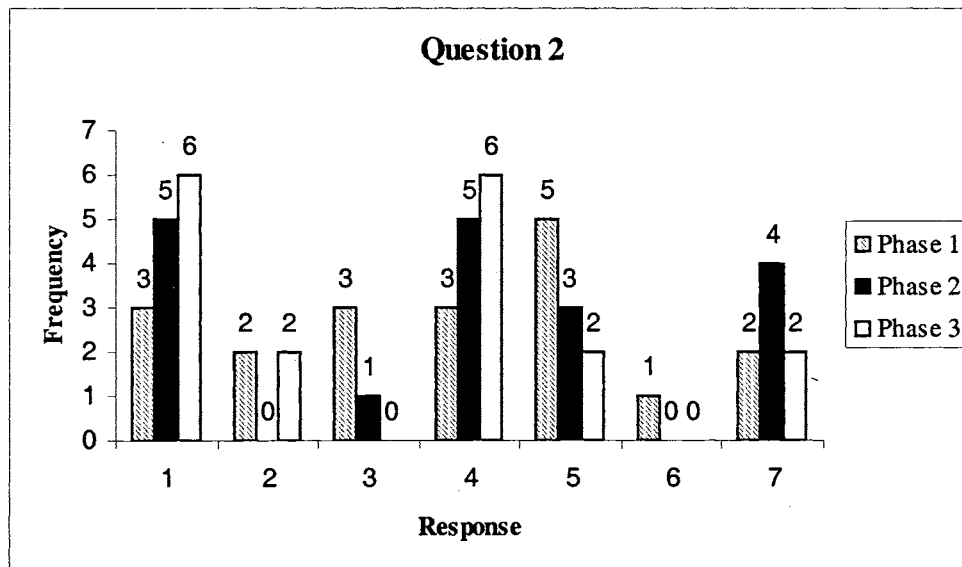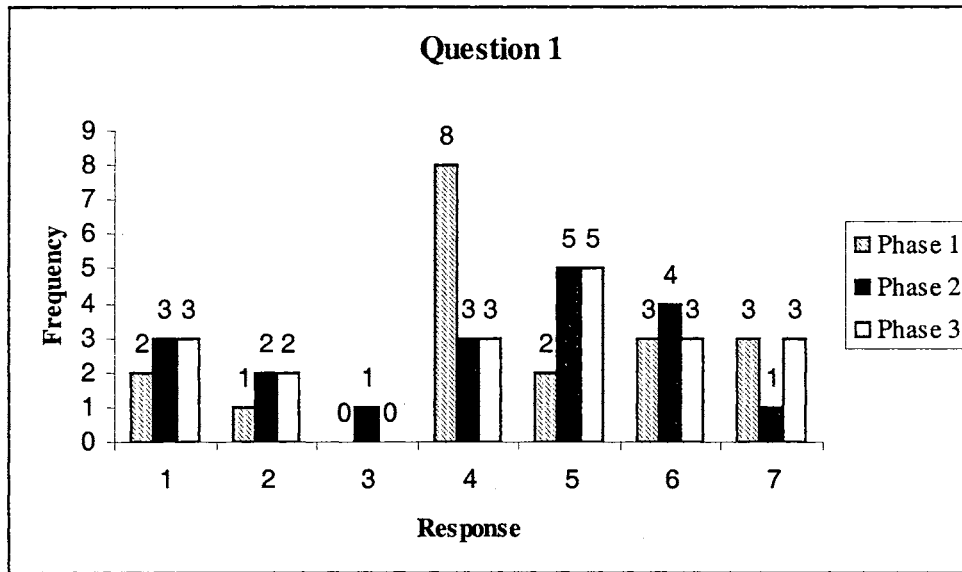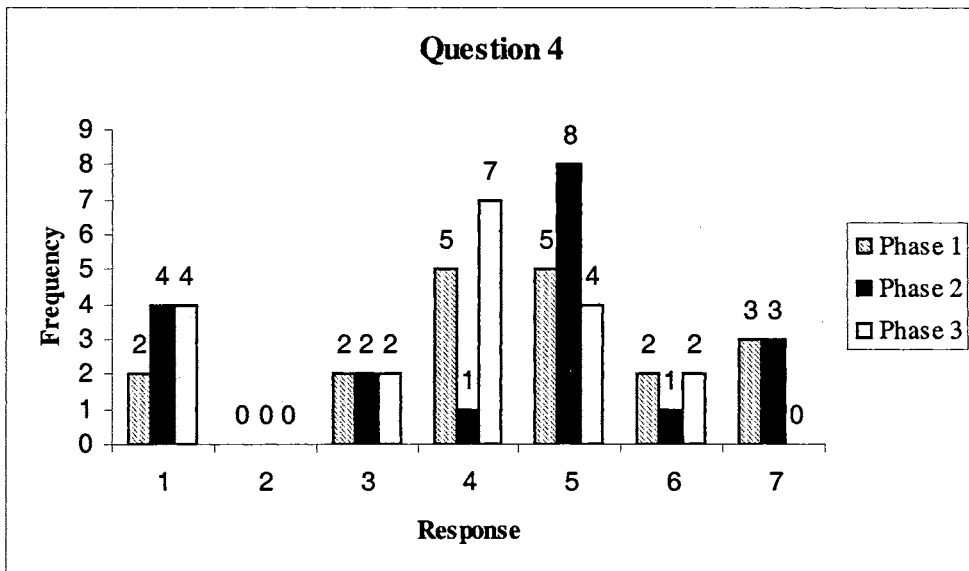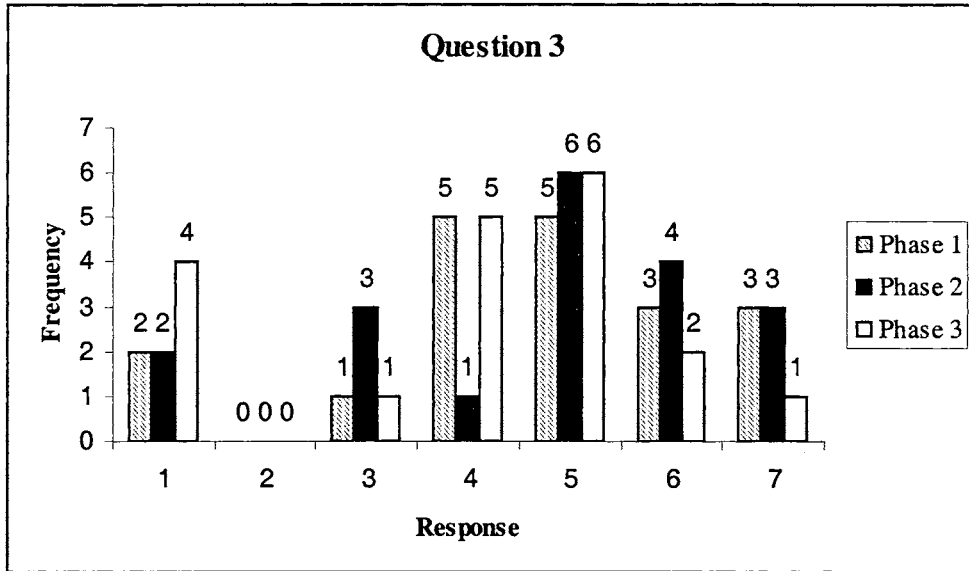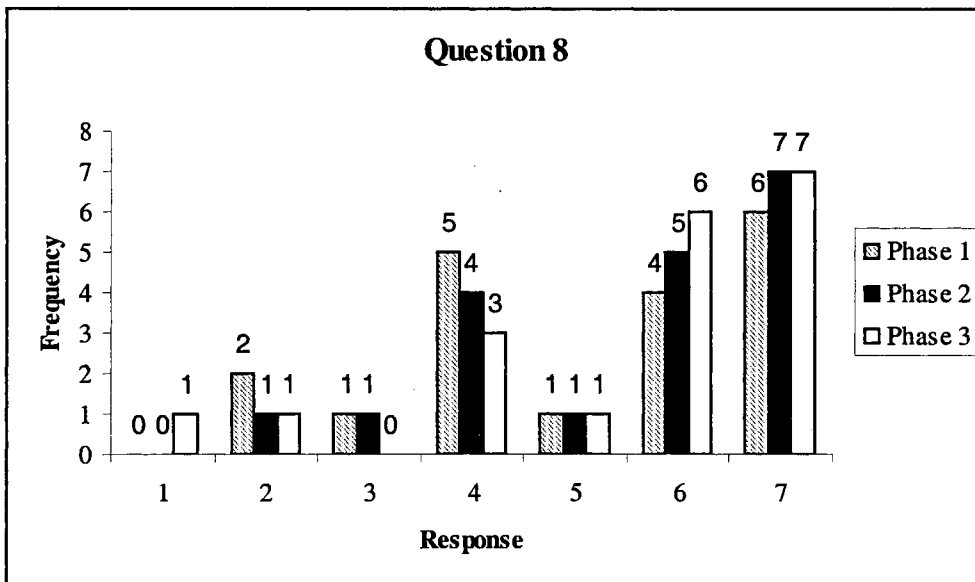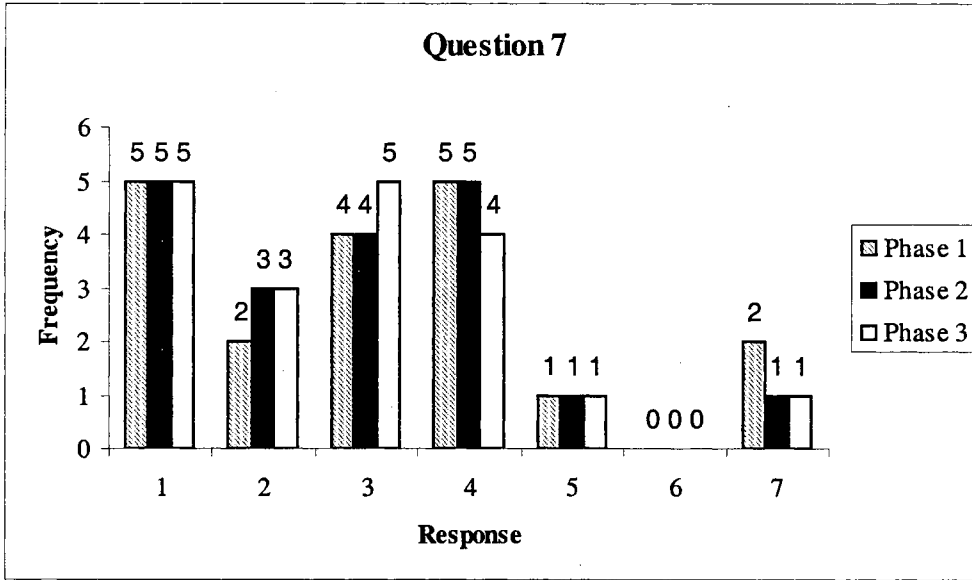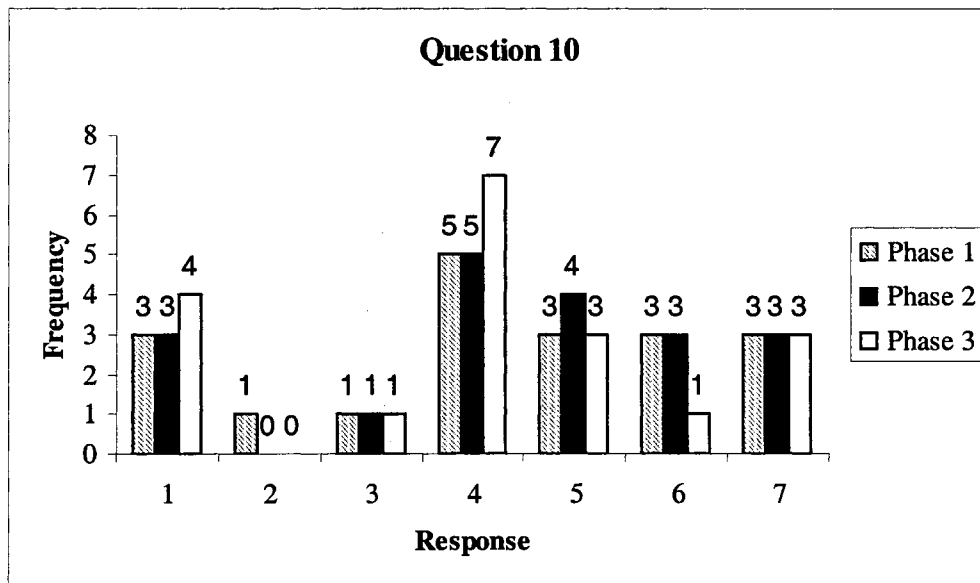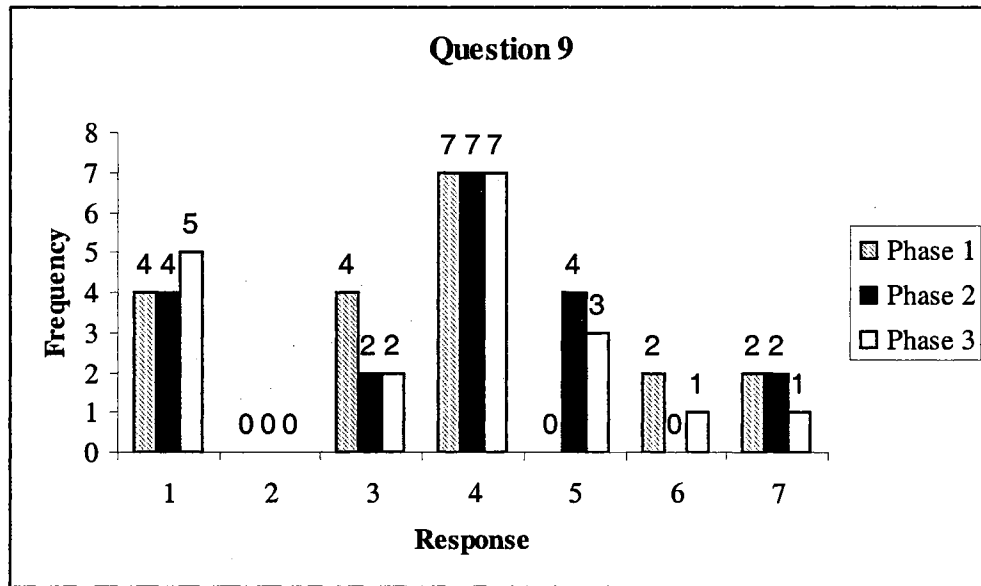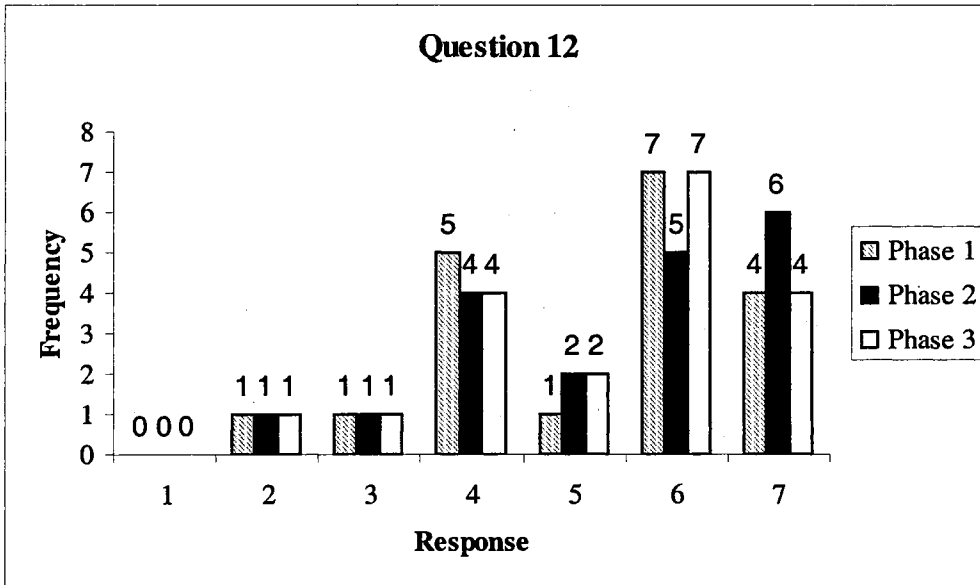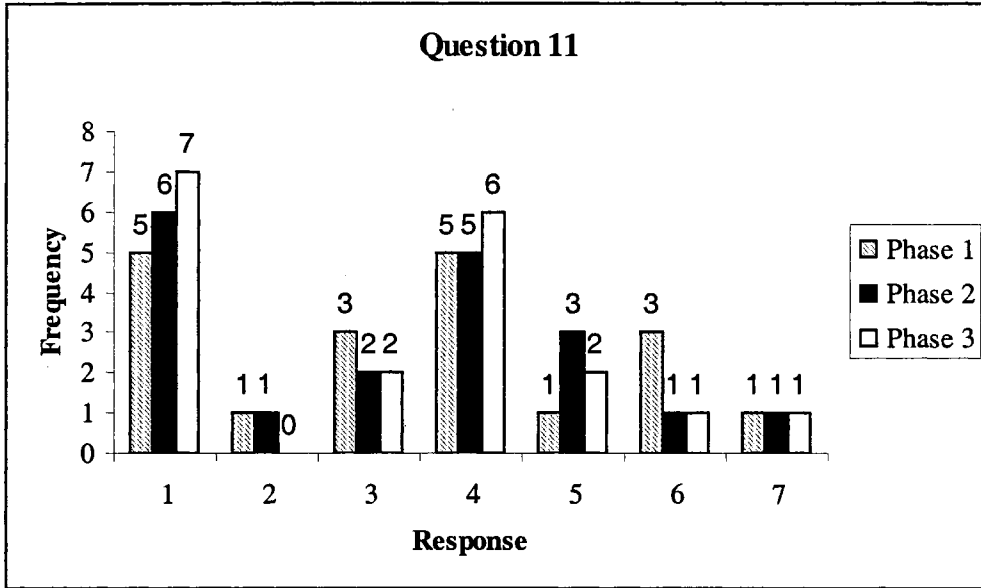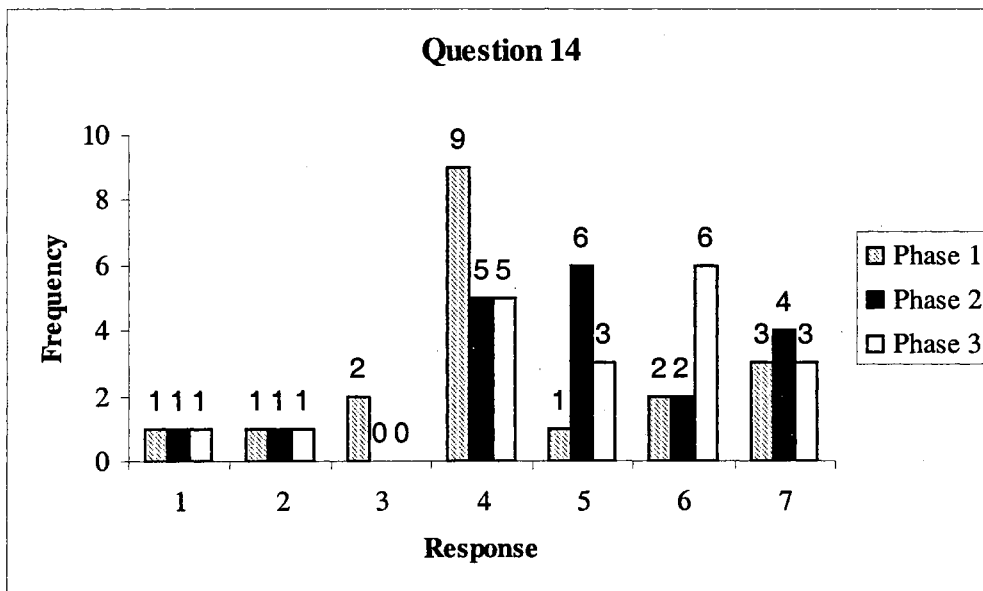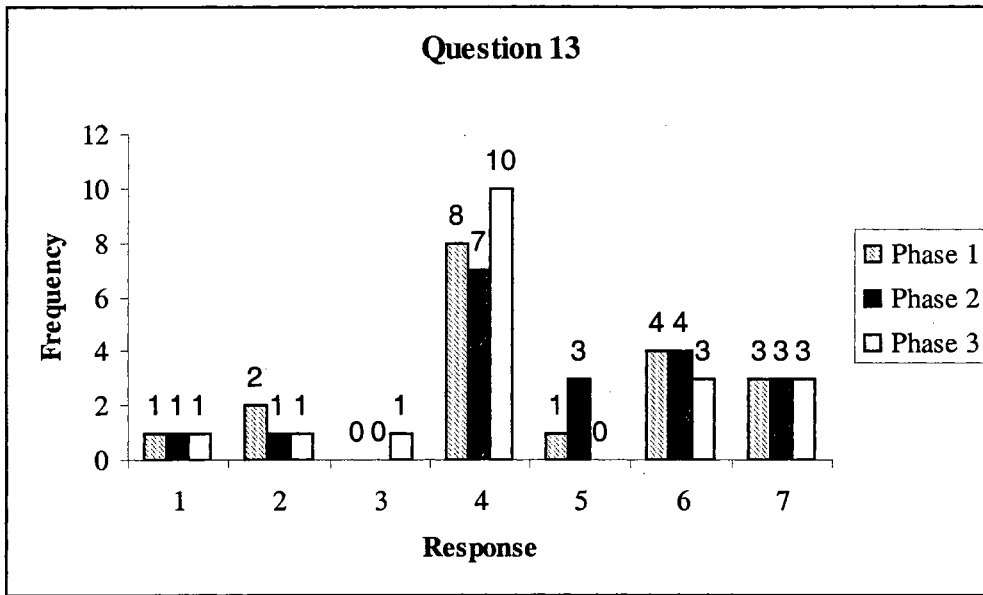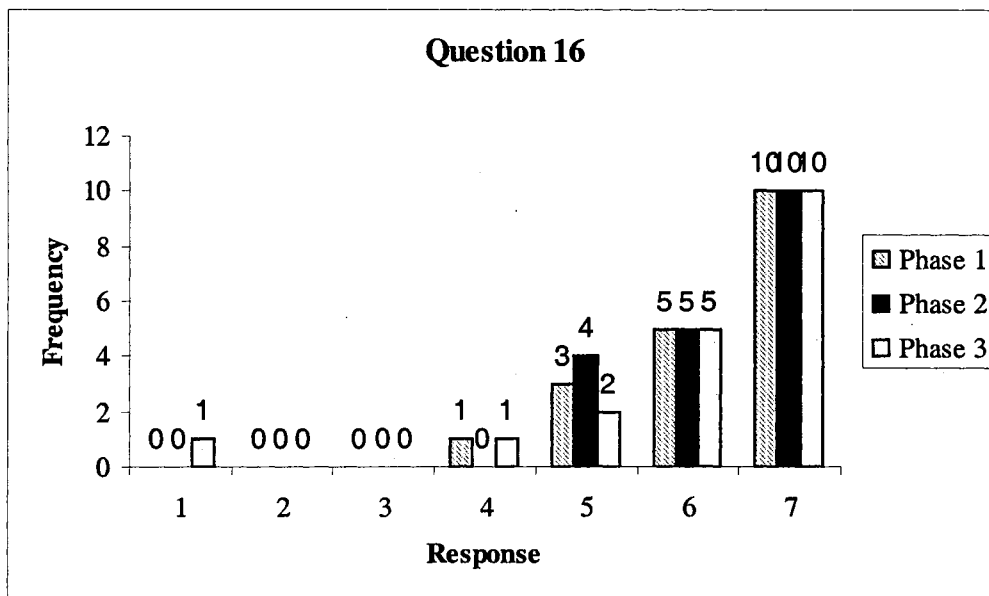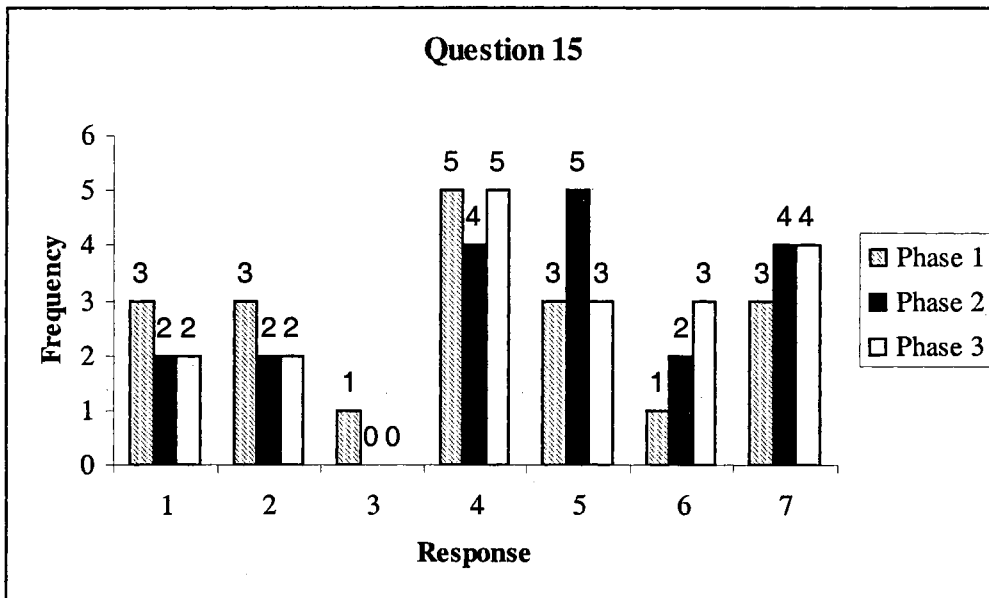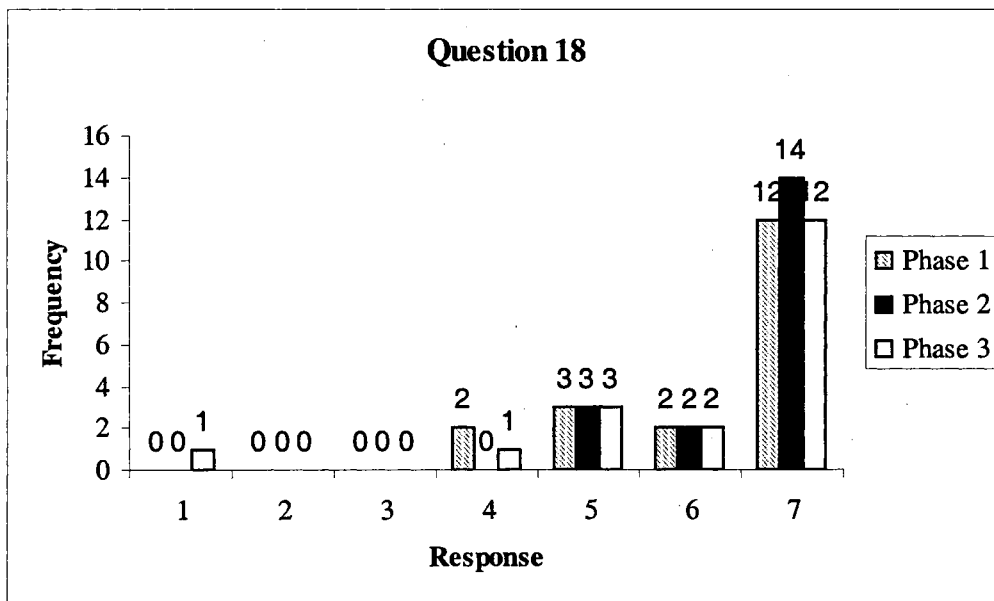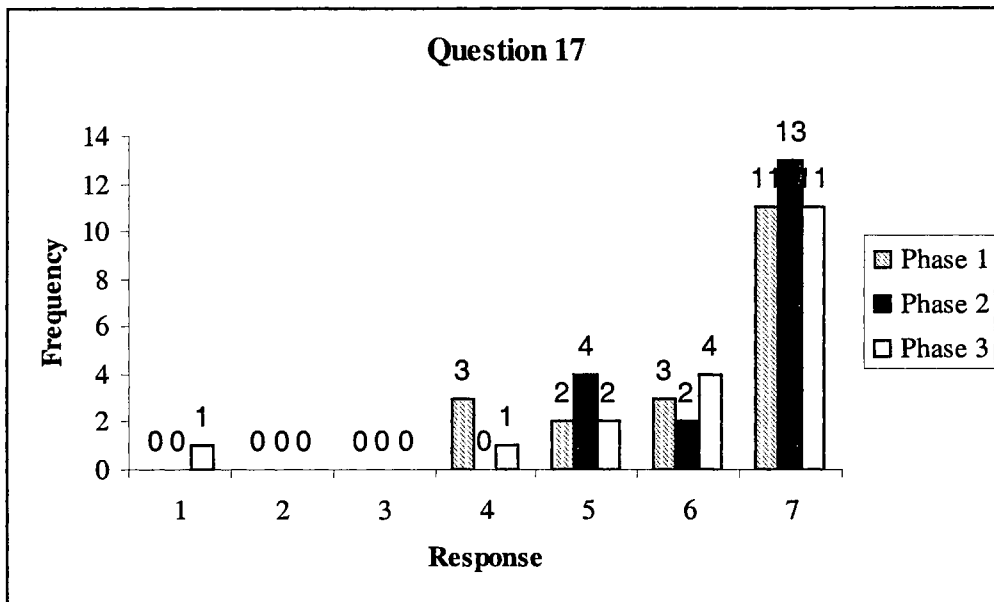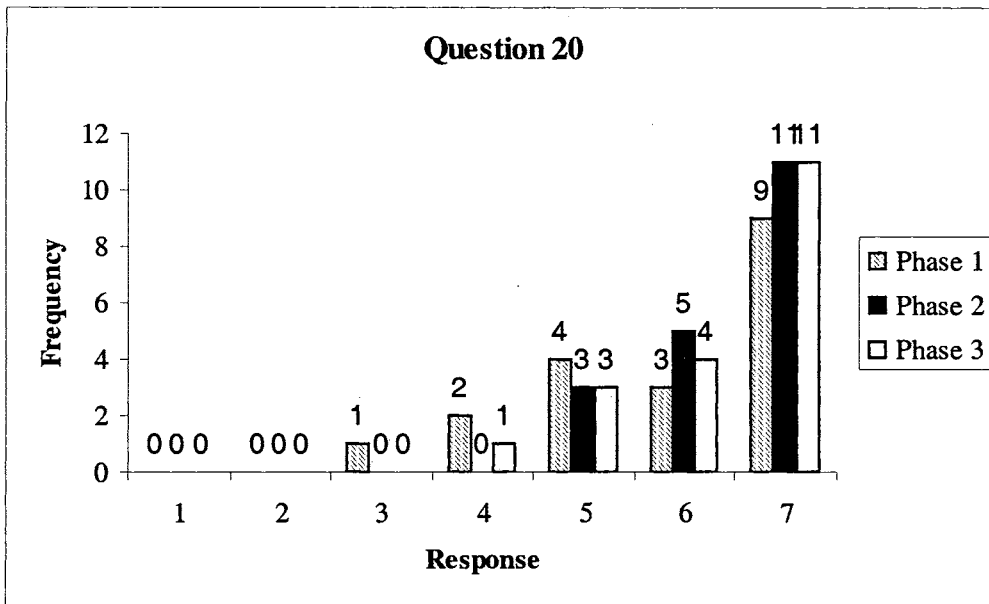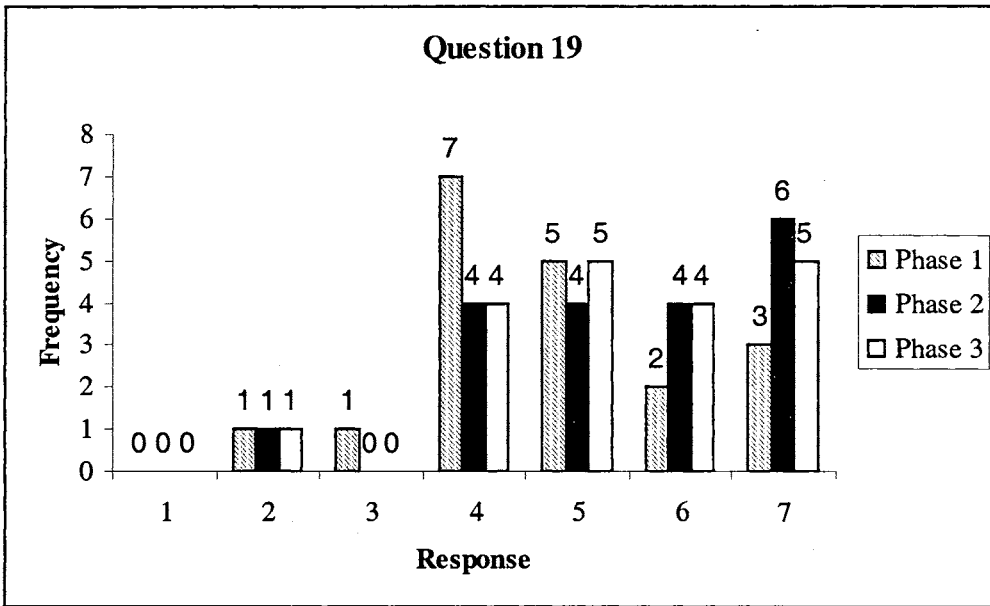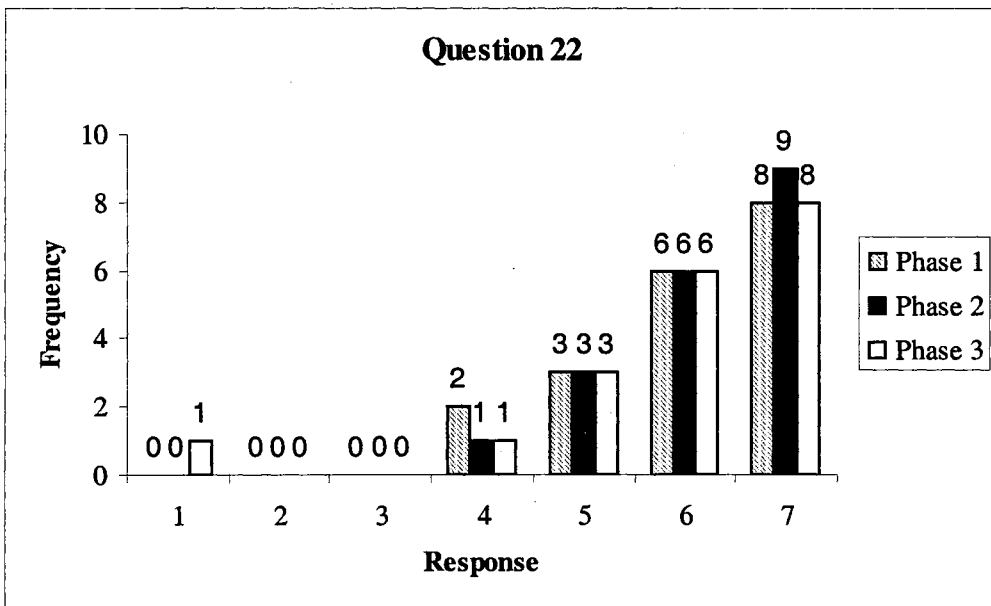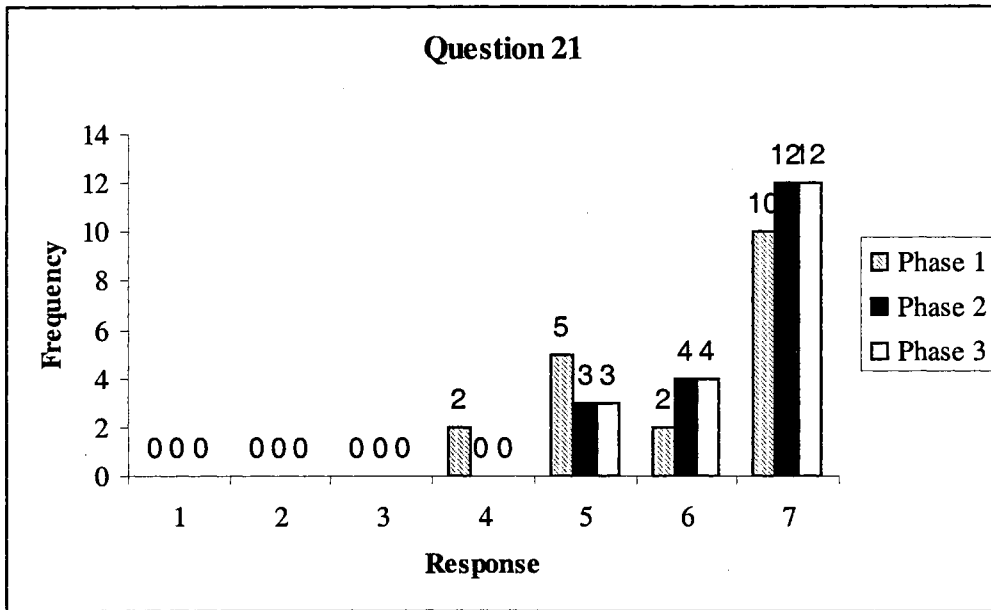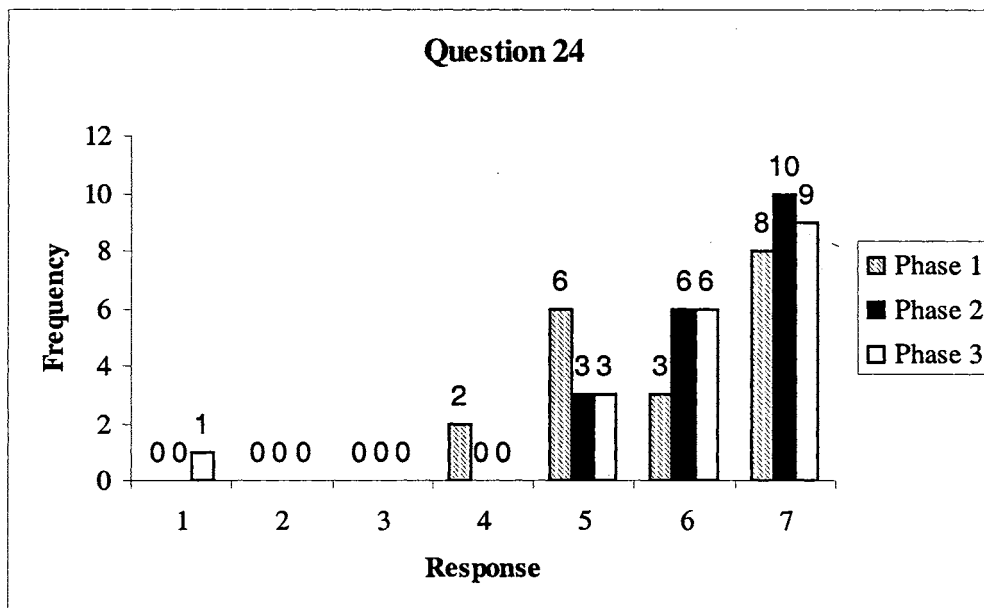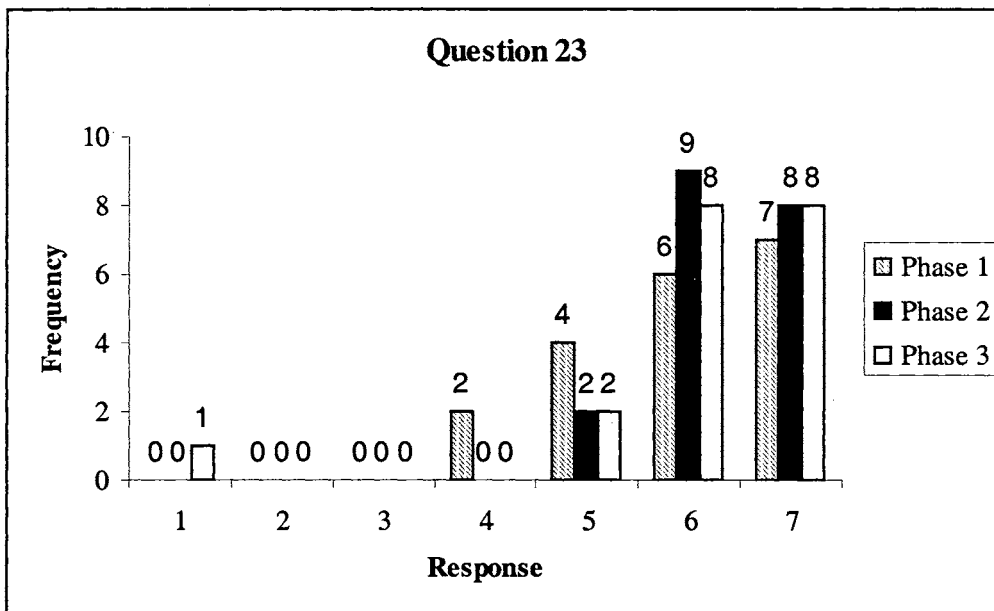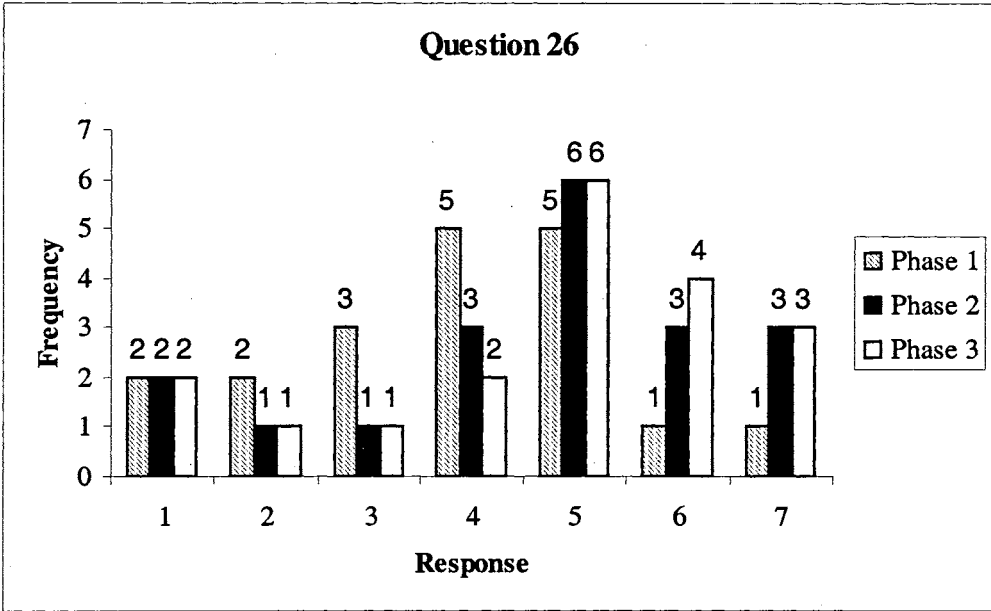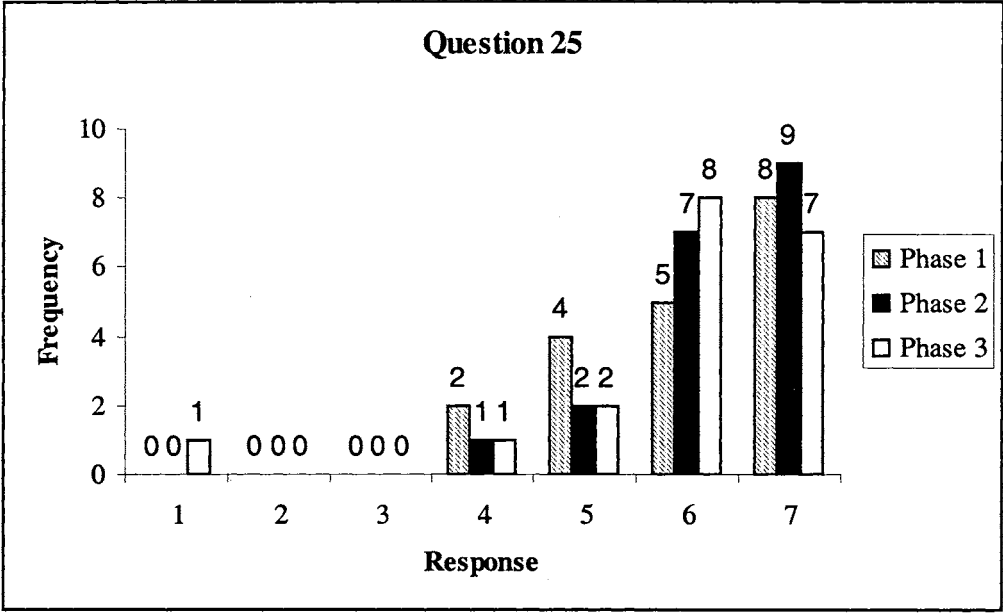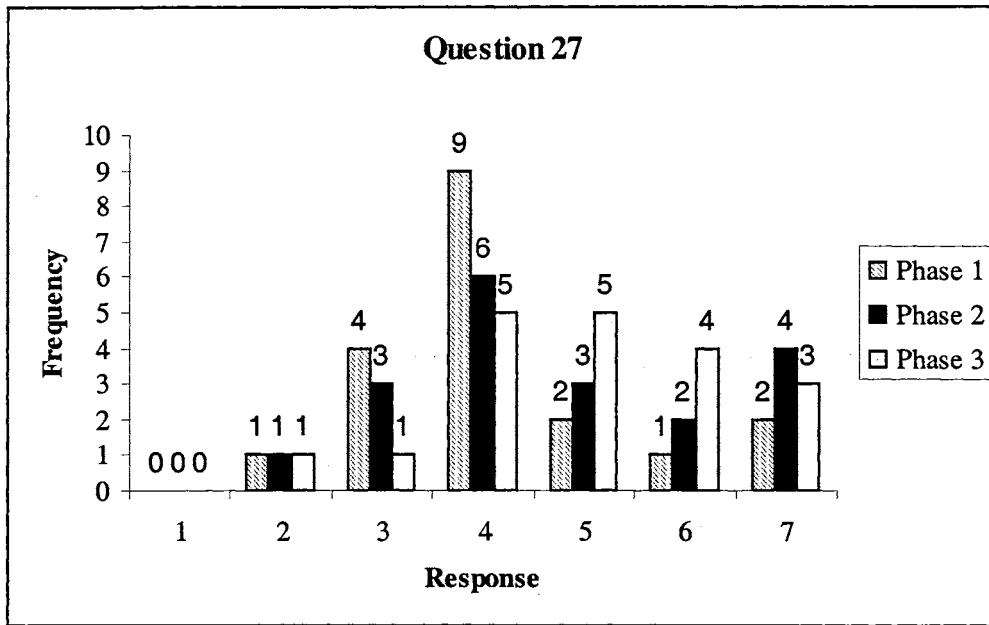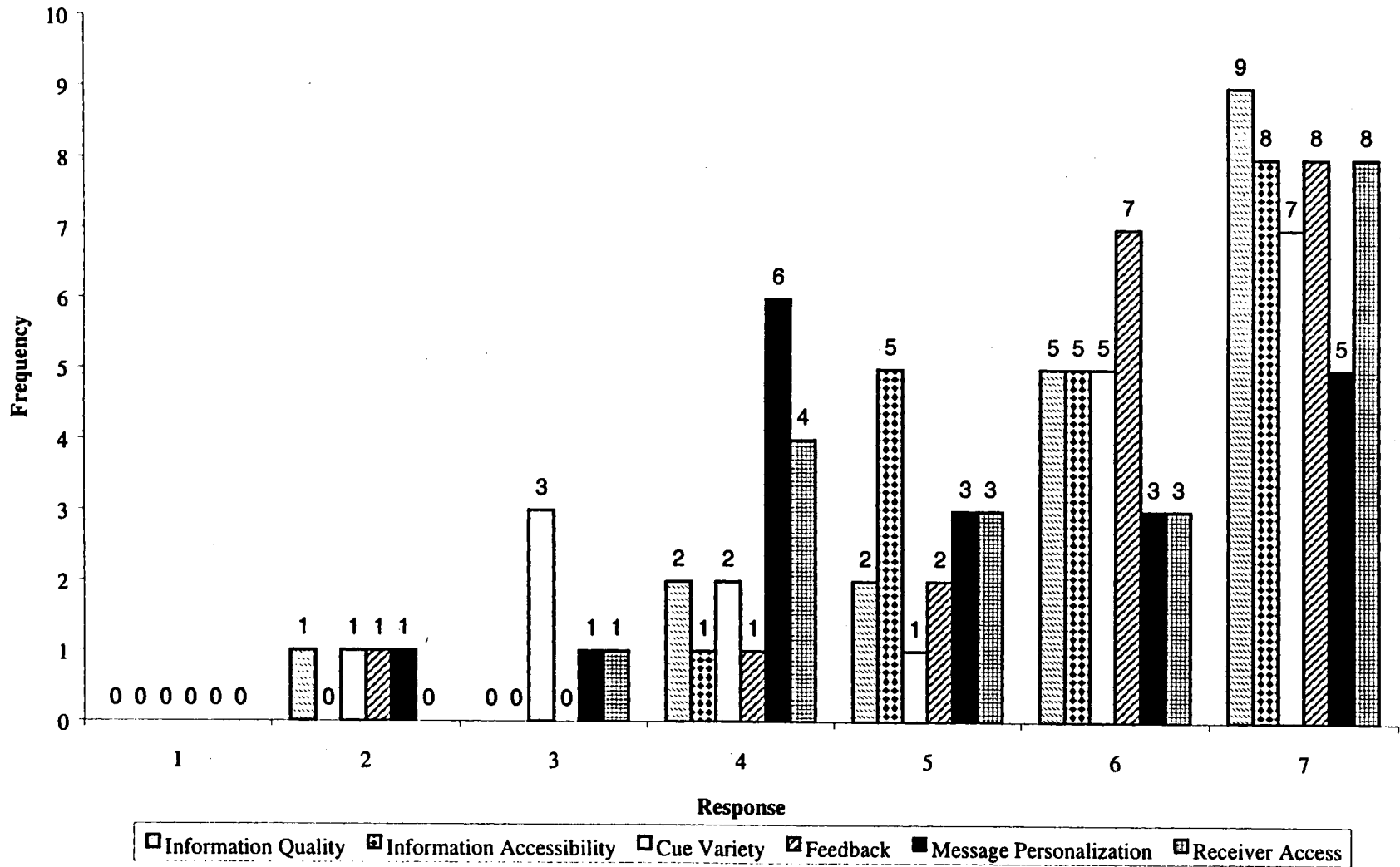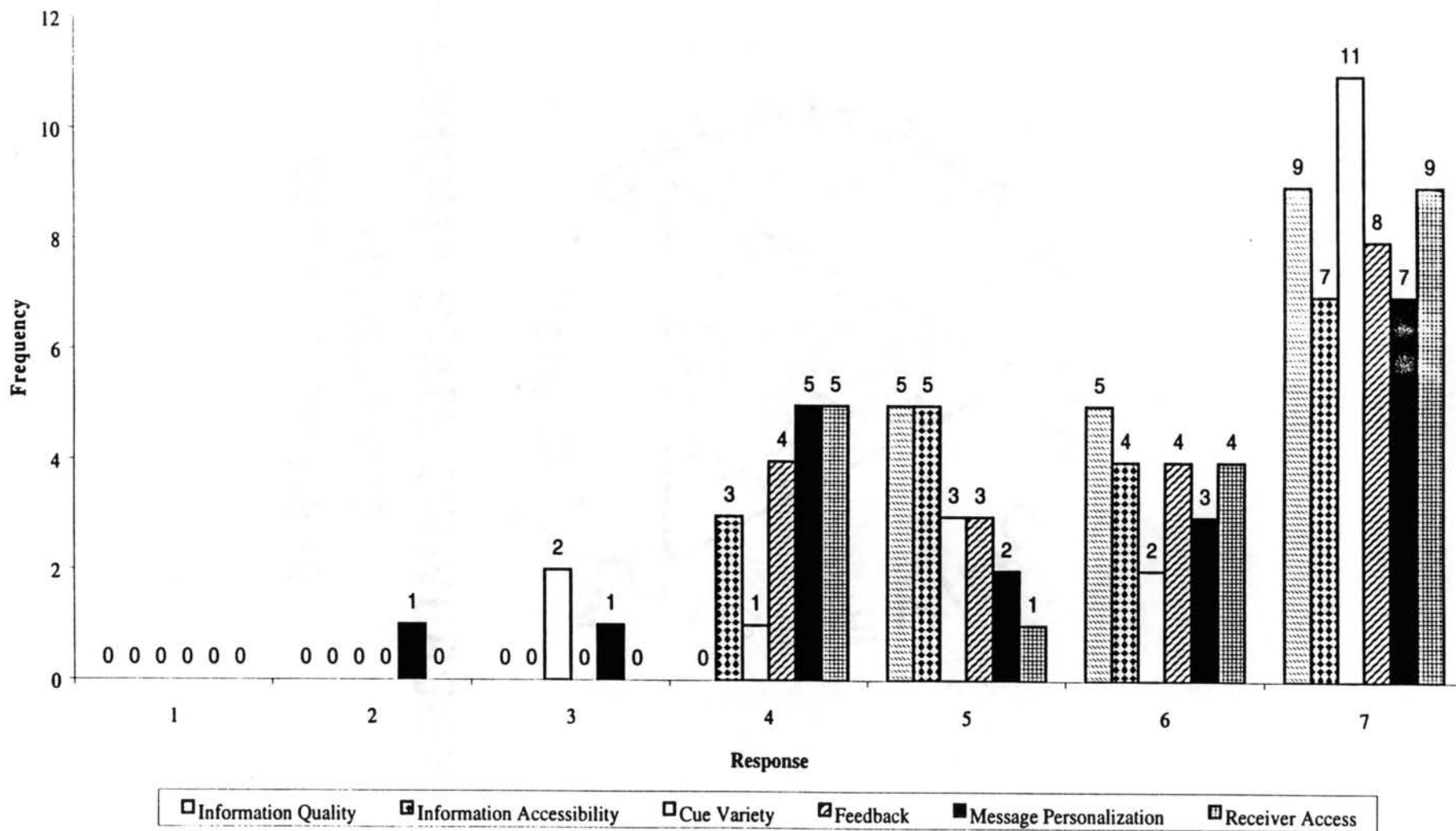
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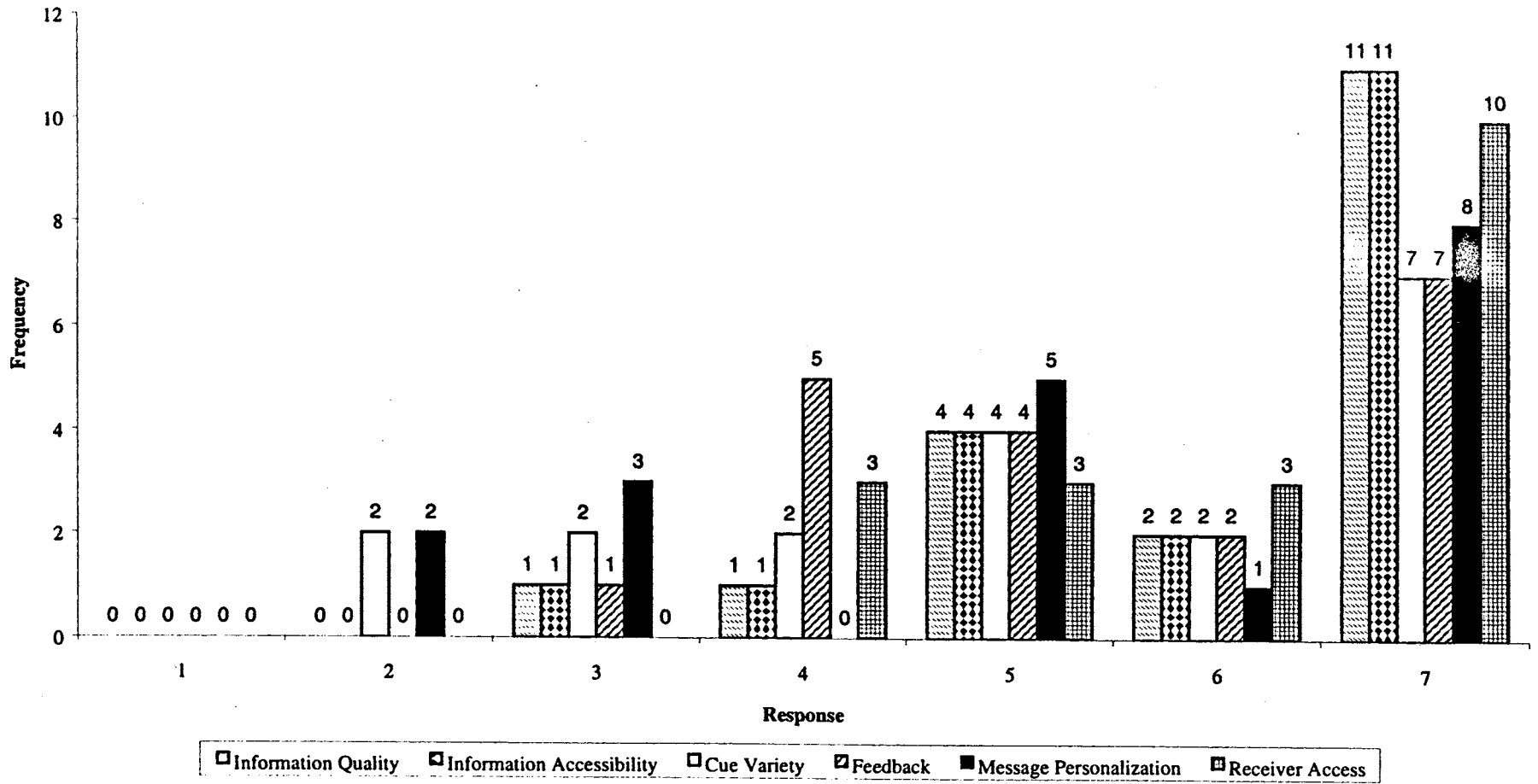# Question 29
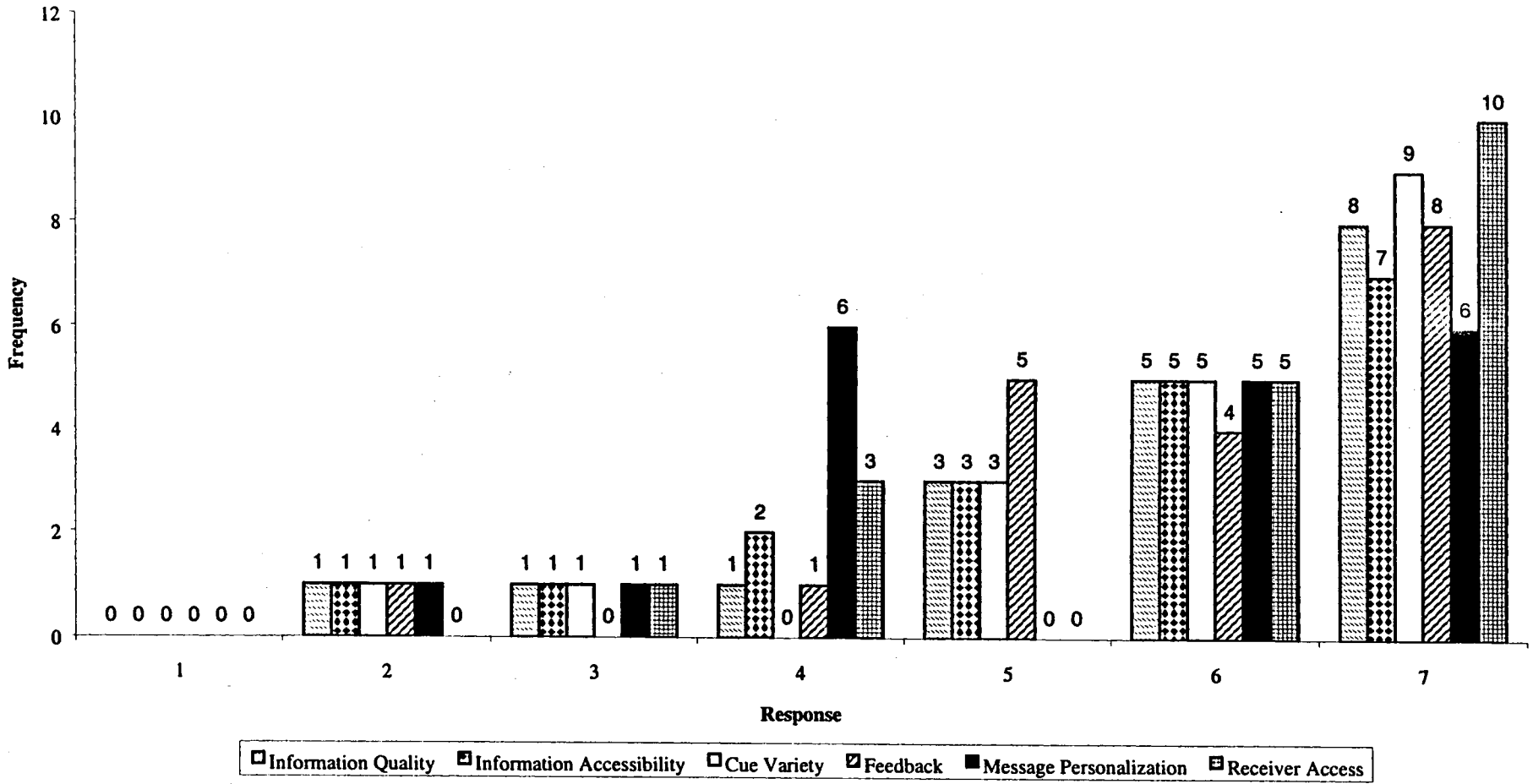
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Question 31

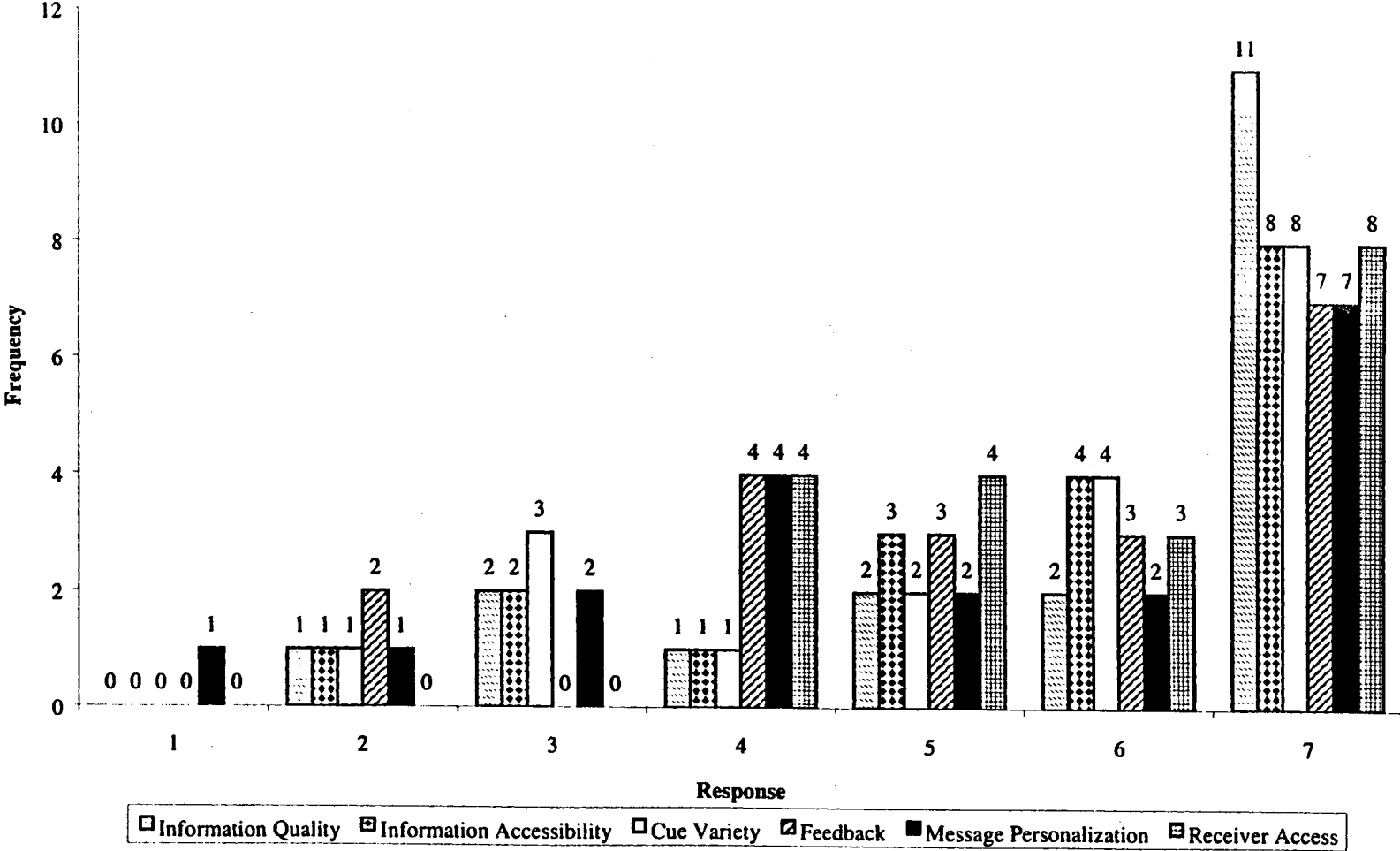Question 32

Question 33

APPENDIX D

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW   .

Date: January 7, 1997   .   **IRB #: BU-97-007**

**Proposal Title: VIRTUAL ENTERPRISES AND EFFECTIVE INFORMATION
COMMUNICATIONS TECHNOLOGY SELECTION: A RESEARCH AND EXPLORATORY CASE
STUDY ANALYSIS**

Principal Investigator(s): Gary Frankwick, Rohit Rampal, Ramesh Sharda

Reviewed and Processed as: Continuation

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT
NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE
APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR
PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE
SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

===

Comments, Modifications/Conditions for Approval or Disapproval are as follows:

Signature: Date: January 27, 1998

Chair of Institutional Review Board
Cc: Rohit Rampal

ν

VITA

Rohit Rampal

Candidate for the Degree of

Doctor of Philosophy

Thesis: VIRTUAL ENTERPRISES AND EFFECTIVE INFORMATION
COMMUNICATION TECHNOLOGY SELECTION: A RESEARCH
FRAMEWORK AND EXPLORATORY CASE STUDY ANALYSIS

Major Field: Business Administration

Area of Emphasis: Management Information Systems

Biographical:

Education: Graduated from MGDAV College, Bhatinda, India in July 1980;
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Management Information Systems at Oklahoma State University in July
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Experience: Worked for various organizations in India and the Sultanate of
Oman from 1984-1990. Employed by Oklahoma State University,
Department of Management as a graduate research/teaching associate
from 1991 to 1996. On the faculty of the University of Rhode Island,
Department of Management Science and Information Systems from 1997
to present.

Professional Memberships: Academy of Management, Association for
Computing Machinery, Decision Sciences Institute, Information Resource
Management Association, and Institute for Operations Research and
Management Science.