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Department of Adult Education, Instructional Systems,
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SELECTING TELECOMMUNICATIONS TECHNOLOGY FOR CONTINUING PROFESSIONAL ENGINEERING EDUCATION (CPEE) PROGRAM DELIVERY: A STUDY OF THE ELEMENTS IN DECISION-MAKING WITHIN 20 HIGH-TECHNOLOGY MANUFACTURING COMPANIES

A Thesis in

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by

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ABSTRACT

This study focused on identifying issues addressed by high-technology businesses as they chose the media for delivering distance education and training, particularly continuing professional engineering education (CPEE). The main issue of study related to those elements in decision-making perceived to dictate organizational choices in the context of higher education and business. The participants in this study represent Fortune 500 companies and maintain membership on the National Technological University advisory board. Eighteen individuals participated in the study: education and training managers, engineering training managers, a distance learning manager, an instructional media developer, a director of instructional resources, and other continuing education managers. Additionally, this study investigated the involvement of CPEE professionals in the development and selection phases of decision-making, and how their roles differ within the various corporate decision-making environments.

Organizational relevance and cost effectiveness dominated selection importance and involvement, while application of adult education theory ranked last. Conversely, responses indicated a high level of involvement and championing of adult education theory, particularly in selection activities. Participants were CPEE leaders at a time when the high-technology industry stood on the cusp of technological evolution and innovation. Their companies all chose emerging satellite-based programs. Meanwhile, the continued emergence of cutting-edge technologies and the waning economy brought about many changes affecting the process of choosing telecommunications media.

Survey data was used to categorize organizations as one of three newly described decision-making styles: Judicious, Rational and Pragmatic - resulting in several conclusions. First, CPEE professionals are more involved and achieve more in Rational

decision-making styles for all kinds of development activity. Second, CPEEs are offered many opportunities to engage in search and design in Judicious corporate settings. Third, CPEEs take part to an even greater degree in the selection phase and achieve maximum involvement in Judicious and Rational environments. Fourth, CPEEs have high participation in final approval and authorization of delivery media decisions in Judicious and Rational environments. Fifth, CPEEs' involvement in decision-making is largely limited to consulting in Pragmatic corporate environments. Sixth, CPEEs are likely to be omitted from team and group decisions in hierarchy dominated Pragmatic settings. Finally, CPEE professionals have the greatest potential to affect decisions in Judicious and Rational environments. Furthermore, the study indicated that companies have shifted to a more judicious decision-making style, which means that CPEEs might have a future of greater involvement in the development phase of decision-making.

Current in-house adult educators now view themselves as project managers and knowledge brokers rather than deliverers of education, and believe that serving as a project manager signals a new strategy for greater use of self-directed learning at the workstation, and increasing involvement in business decisions. However, much discussion always returned to the present state of continuing education as affected by the economy and the technology. Twenty sub-components of the balance within the economy and technology theme are listed.

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I've never known many projects to be the work of a single individual, and that is particularly true for this research project. There is much delight in acknowledging some of the key people. It really started in 1989 with the launch of AMP's engineering education program, and later blossomed into fruitful relationships with Drexel, Penn State, Lehigh and the National Technological University.

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Chapter 1

INTRODUCTION

Background

For many, the "Information Age" arrived before we realized it, with the 1990s witnessing unparalleled growth and development of information technology. This has changed the world around us--not only how we view it, but also how we interact and cope with it. In the practice of engineering, the threat of technological obsolescence has always demanded a commitment to lifelong learning and presents a major obstacle to career success today. Holding one's own in this rapidly evolving world is a considerable challenge for those seeking to enhance their value as employees and expand their horizons as individuals. Career competition with growing numbers of increasingly sophisticated fellow "experts" is on the minds and tongues of those in virtually every profession. Engineers, in particular, must absorb, synthesize and apply a constantly expanding body of knowledge to keep current in their profession. Communication technology, foremost as a business opportunity today, ranks high with engineers as an area of need and opportunity.

Information Technology: Presenting Challenges, Offering Opportunities

Communication technology has had a dual effect on us – driving the need for continuing education and expanding our opportunities for obtaining it. As our appetite for continued career education grows, the diversity and sophistication of ways to deliver that education continue to evolve. "Distance education," for example, has been redefined as "distance learning," describing a particular teaching-learning relationship for adult education, in which participants interact through advanced communication technology.

Continuing education is especially critical in the engineering profession, where knowledge has had a generally accepted five-year half-life (Quinn, 1985) and where that half-life shrinks as new technologies emerge with increasing rapidity. Today, as technology changes virtually before our eyes, engineering knowledge half-life now seems to be related to the ever-diminishing technology life cycle.

Engineering also contains a long history of distance learning in its various incarnations, which makes continuing engineering education an especially good focal point for evaluating how decisions are, or should be, made with regard to distance learning in other areas of adult education. Before focusing on the specifics of continuing engineering education, a brief discussion of the decision-making process will lay the groundwork for understanding how decision-makers act in choosing distance learning approaches.

The Theoretical Thought Behind Decision-Making

Decision theory, which has a strong foundation in statistics and the behavioral sciences, has been proven valuable in a wide range of contexts, particularly as economists, political scientists and organizational experts have sought to understand decision-making behavior (Mintzberg, Raisinghani, & Theoret, 1976). Standard decision theory describes the process of making decisions as linear steps containing elements common to all decisions. In this view, the process is rational and follows prescribed steps that begin with a clear statement of the problem and end with an objective assessment of results.

However useful we may find the large body of literature pertaining to the theories of decision-making, it falls short in the real world. Behavioral decision theory tends to be descriptive, while normative learning theory tends to be prescriptive. That is, most of the research has suggested how decision-makers ought to make decisions, rather than reflecting on how the decisions are actually made. Likewise, hard data relating to how

Continuing Professional Educators and other providers of corporate training make decisions about communication media are sparse in today's distance learning research. We lack solid information about the substance and methodology of decision-making as it applies to adult education theory and practice.

The Real Thought Behind Decision-Making and Selecting

In practical reality, while the elements of decision-making are likely to be standard, an important hypothesis suggests they occur within a changeable, complex structure that is permeated with "human" elements. By understanding this complex structure and the nature of those human elements, the adult educator concerned with instructional design, the learning environment and the impact of the delivery medium on learning can better understand how decisions affecting these issues are made.

By going beyond traditional considerations about how these decisions are made, institutions of higher education can better design programs and services, promote awareness of those programs and services, and create useful and meaningful partnerships with corporate constituencies. This study of how highly competitive high-technology businesses choose distance-learning approaches will offer insight into the practical--and complex--realities of decision making in today's environment. This insight promises to enhance understanding of the impact of human elements on technology choices for delivering continuing education programs. Since the study will reflect the practical reality of decision-making in the world of continuing engineering education, it will help those seeking to improve the quality of decisions, enhance program delivery, and support adult educators as they define constituent profiles and develop marketing strategies to address profile elements.

Degreed engineers face a more pressing problem because their education must be updated regularly to reflect rapidly evolving technology. Ideally, this would lead to

Continuing Professional Education that enables them to keep abreast of new knowledge, maintain and enhance their competency, progress from apprentice to mature practitioner, advance their careers through promotion and other job improvements, and even move into different fields (Queeney, 1996).

As continuing engineering education has progressed, corporations have experimented with various approaches and delivery technologies. In 1992, the National Science Foundation funded several engineering educational institutions to test and verify some adult education theories about CPEE. The result was the National Engineering Education Delivery System (NEEDS). With NEEDS, the NSF demonstrated that it recognized the value of rapid response to specific business-related problems. Today, most of the Fortune 500 companies own their own videoconferencing production studios and operate a network of downlinks. CPEE has evolved as the concepts of adult education have also evolved. Although its approach may change, its primary purpose remains the same: helping adult individuals satisfy their life needs and achieve their life goals.

Given the constant change throughout today's business environment, there is a need for a continuous learning environment that helps individuals in various industries gain access to the resources they need to remain informed about organizational and professional changes as well as the new technologies available to them. This study will look at the field of Continuing Professional Engineering Education, its use of distance learning technologies, and how decision theory applies to its effectiveness at a distance.

The United States led the world in developing communication technologies and, as a result, television changed the education process. Instructional television (ITV) has proved so successful, in fact, that since the 1960s it has been the primary means by which engineers and technical managers receive Continuing Professional Education (Stone, 1990). Since the introduction of instructional radio and television, distance education has

adopted increasingly sophisticated communication technologies. Personal computers, the Internet and the World Wide Web have launched distance education into a new era. It means that continuing education adult students don't have to choose between the benefits of the working world and the benefits of the academic world. It also means that employers don't have to sacrifice employee productivity from day to day in order to enhance employee value for the long term.

In a vacuum, distance education sounds like an easy, ideal solution to everyone's problems, but it cannot be effective unless it reflects and supports practical realities. The key to effective choices in distance education is a full understanding of the environment in which such choices are made and how non- standard human elements affect decision-making. This study will focus on those issues.

Focus on the Intersection of Vectors

A broad literature exists on distance education and its increasingly sophisticated and recently invented communications technologies. Most of the Fortune 500 companies own their own continuing education facilities within their own training organizations. There are nationwide generic delivery systems that provide public continuing education services; and many professional bodies use telecommunications satellites in their own continuing education programs (Moore & Thompson, 1997). In a like manner, changes of the last twenty years have affected the distinctive nature of Continuing Professional Education, labeling it as different from both pre-professional education and traditional continuing education.

The engineering profession claims that formal lifelong education is as integral to their profession as is the pre-professional training, and Continuing Professional Engineering Educators are being charged with developing and supporting a skills intensive learning environment (Smutz & Queeney, 1990; Society of Manufacturing

Engineers, 1993). This study presents the literature that focuses on the intersection of vectors of: (1) Distance Education and (2) Continuing Professional Education with the (3) Decision-Making process of the organization (Figure 1).

Purpose of the Study

The purpose of this study is to identify human elements addressed by decision-makers and continuing professional engineering educators in high-tech industries as they decide on delivery systems for employee continuing education opportunities. Also of interest is how they become aware of innovations in communications technology and their behaviors regarding the selection of delivery medium for their continuing education programs. Successful continuing professional education depends on knowledgeable, able employees who engage in continual learning to keep pace with changes in their industries. This depends, for all practical purposes, on distance education, which depends on the latest communication technology (Foden, 1995).

Distance Education Redefined into Telecommunicated Distance Learning

The rapid introduction of communications technology into the distance education world restructured its very nature. Distance education brought teachers and students together, and they shared information over distance and over time, separated by miles and hours. Evolving communication technologies had, in a sense, allowed distance education to evolve into a learning experience that closely mimics the standard teaching environment it replaces.

By 1997, descriptive research indicated that providers generally did not consider the effect of various communication technology media when implementing new programs (Moore & Thompson, 1997). Similarly, a number of issues related to the selection and educational use of the various media were unclear, particularly those related to their

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Study Areas of Concentration

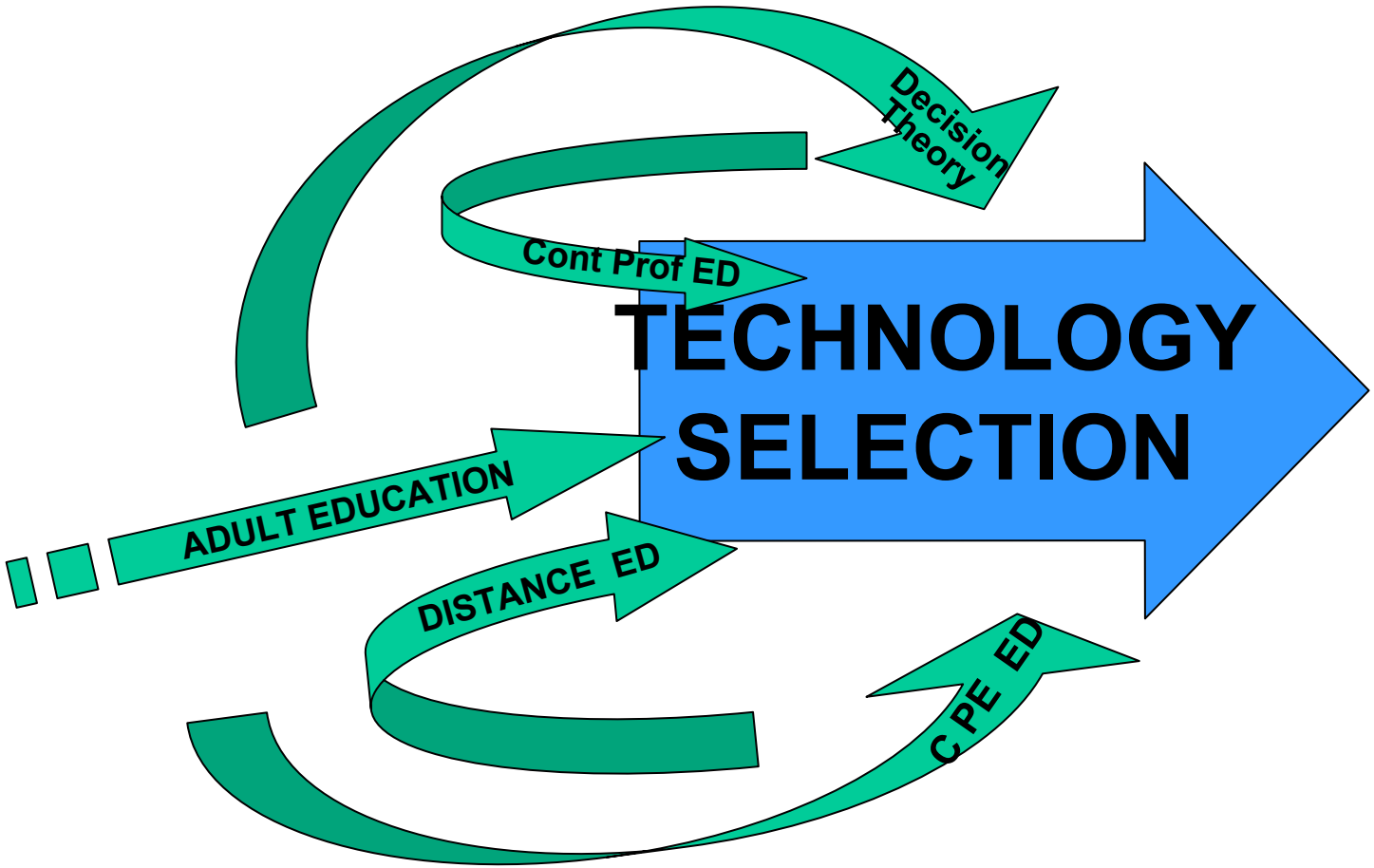

Figure 1. Focus on the Intersection of Vectors

relative effectiveness for various teaching tasks (Moore & Thompson, 1997). Since 1985, distance learning has integrated two dramatic, and dramatically different, kinds of communication technologies--interactive video and on-line communication (Schlosser & Anderson, 1994; Ostendorf, 1997). Interactive video, the culmination of a trend begun with microwave and satellite, extended the classroom paradigm, and helped instructional television to become the primary way engineers and technical managers continued their education while at work.

Choosing from the Vast Menu of Options

Adult learners, facing demands to improve their value as employees, consequently demanded to engage in distance learning because of the realities of their workplaces and lives, which prohibits them from engaging in traditional higher-level education (Simonson, 1997). Experts in workforce education and learning organizations as well as advocates of lifelong learning join that chorus.

Adult learners seek to choose from a spectrum of options based on the nature of their need to learn. Extended into the realm of a global economy, one sees how such demands have snowballed. Public and private entities now seek to support, and capitalize on, the trend. In the late 90s, AT&T, the largest cable-communication company in the United States, began implementing a strategy to bring on-line computing and broadcasting together into a very new and very different learning environment. Similarly, Lucent Technologies has gone beyond traditional by offering a broad range of communications options depending upon the learning situation (Chute, Thompson, & Hancock, 1998). This and other efforts spurred companies and educational providers to re-think how they do business.

Educators often overlook how learners choose their programs and for this reason need to understand which learning needs are best met by each particular technology. They must ask themselves about learners' criteria for selection and how they will be affected by decreasing costs. They must consider others' decision making in selecting and implementing various technologies and how that will change as newer possibilities emerge.

The central concept of this study is that certain elements are perceived to dictate or influence the selection of program delivery media, and that officers at the Fortune 500 companies with membership on the National Technological University's Advisory Board can provide a phenomenological description of themes or patterns that will help CPEEs understand the elements of decision-making and their link to making better decisions.

Since more institutions have adopted advanced technologies such as computer-, audio- and video- conferencing, and computer-based multimedia approaches, educational gaps are being bridged. This bridging has transformed processes associated with education and training, increasingly linking higher education and industry professionals (Chute, Hulik, & Palmer, 1987; Saba, 1988). Knowing how educators choose delivery media will further enhance these relationships and improve the meaningfulness of adult learning. Strategies based on the true benefits of the program and its beneficiaries will lead to improved levels of acceptance and success. This decision-making study can be used as a resource in developing those strategies.

Significance of the Study

The explosion in advanced communication technology may have created a gap between educational needs and educational providers, but communication technology itself may very well be the best means of bridging that gap. Distance education opens opportunities to more learners, and promises to improve the quality of education for everyone--but excitement concerning the opportunity to use new media must be overcome so that it doesn't distract us from choosing the most suitable alternatives.

Institutions of higher learning have become involved to a moderate degree in professional training and development programs during the past ten years, and the trend is to be more responsive to the needs of industry rather than to stay with rigid traditional curricula (Moore & Koble, 1995). The Society of Manufacturing Engineers (SME) has predicted that industry will require more continuing education, more frequently and at more complex levels of application. It also has noted that, rather than being designed in an academic setting, programs will be designed to respond to identified needs of industry (Society of Manufacturing Engineers, 1995).

Learning over the Airwaves

Since the 1980s, engineering professionals in the global economy generally have recognized the importance of continually improving their understanding of new tools, processes, and systems that can improve performance and productivity. In the United States, this imperative was supported by data (Martin, 1988). As the 21st century approached, communication technologies continued to increase in number, complexity, and power. As the number of technologies increased, so did the difficulty in choosing the appropriate solutions for particular educational and training needs (Chute, Thompson, & Hancock, 1998). Even though the task of selecting delivery media has not gotten easier,

instructional television has clearly become the avenue of choice in the United States (Baldwin, 1997). Therefore, this study will consider how decisions have been made in choosing instructional television programs.

Instructional television became the primary way engineers and technical managers continued their education while at work (Baldwin, 1997). This is evident in the National Technological University (NTU), the major provider of continuing engineering education (Baldwin, 1998). This study will focus on the decision making process of corporate NTU participants to identify and define elements in the decision making process.

NTU and the Distance Education Environment

The NTU is a cooperative effort of 46 major engineering and management colleges linked by satellite and compressed digital-video technology to provide 25,000 hours of post-graduate and continuing education for today's busy engineer, technical professional, and manager (Baldwin, 1997). Through the NTU, regional interactive television systems operated by the 46 individual major universities are interconnected simultaneously. All of its programs focus strongly on learner needs and it is an accredited and respected university.

NTU has grown significantly since its formation. A 1992 study reported that it provided 78 percent of all university instruction delivered by satellite in North America (Hansell, 1992). The network has become the primary way engineers and technical managers engage in continuing education in the workplace (Baldwin, 1991). The network consists of 46 uplinks and more than 600 receivers linked by a state-of-the-art compressed digital-video system, and beams 22,000 hours of credit courses to 115,000 participants annually (Baldwin, 1997).

One of NTU's innovations, the Technical Vitality Initiative, offers its most popular credit courses to students who choose to update and upgrade their knowledge, but do not

choose to enroll for credit. A similar customer-driven initiative is the Advanced Technology and Management Program, which delivers non-credit specific development programs to more than 100,000 enrollees each year (Baldwin, 1998).

Clearly, innovative use of communication technology has caught on, but on-line communication has dramatically affected distance learning. Such blending and convergence of approaches requires that companies and educational providers re-think their strategies.

On-line communication, for example, challenges traditional notions about access. Even though companies see the value in workers educating themselves through on-line courses, they also incorporate security "firewalls" into their systems that prevent workers from using office equipment to access the Internet. This study identifies ways in which distance learning providers can work with corporate partners to create solutions that overcome such problems.

Statement of the Problem

In the United States, most engineering graduates enter the workforce today with a baccalaureate degree, just as they did in 1900 (Baldwin, 1997)-despite the enormous complexity and rapid change of evolving technology. Once they enter the workforce, engineers face that complexity and change quickly and so they must engage in career-long learning to remain effective and employed (Baldwin, 1991). Since instructional television, particularly through the NTU, has long been the approach of choice for providing career learning in the engineering field (Baldwin & Johnson, 1995), engineers have become acclimated to it as a learning medium (Baldwin & Down, 1981). By studying how the engineering profession has chosen this approach, we can learn more

about how decision makers go about choosing communication technologies for continuing education.

It is known that business organizations focus largely on technical issues when they consider certain communication technologies for engineering education. They rarely, or only marginally, consider the non-technical or human factors ultimately influencing levels of acceptance and effectiveness of the chosen technologies on the part of teachers and participants. It is unclear whether they select the medium based on defined learning needs or because it is more glamorous or more expensive. Wagner and Reddy (1987) warned against selections that are "hardware driven," insisting that media must be selected according to instructional needs, professional and technical expertise, and available budget. According to Bates (1984), the greatest problem is deciding which media to use, and the different ways in which each medium should be used so that they complement one another... It is a great pity that as much energy and investment is not put into deciding which media to use as there is in media production and distribution (p. 227). He further writes that the appropriate choice and use of technologies depend on the particular context in which they are used" (Bates, 1995), and that barriers do not result from technological limitations, but rather from the difficulty of matching programs to learner needs and other adult education principles (Bates, 1996).

As higher education and adult educators go about creating, packaging, reorienting, and delivering educational programs for use by continuing professional educators in high-tech corporate training organizations, they must be prepared to market their programs in terms beyond the apparent educational value and in terms of their value to the organization. Corporate decisions equally affect the final value of distance learning.

Adult education programs and services are more likely to be accepted and succeed if the strategy is based on program benefits and beneficiaries (Morse & Selter, 1998).

This study can help distance education providers better understand the issues faced by corporate learning professionals and therefore become more valuable as business partners. Its exploratory nature, posing questions and evaluating how responses indicate overall trends and paradigms, will offer insight into the unique challenges faced by business learning professionals. The same insights can aid corporate learning professionals in understanding how learning is perceived throughout their organizations, proving especially helpful in winning acceptance from other corporate stakeholders.

Considerations evaluated include key factors, the criteria for media selection, and how salient elements change relative to rapidly emerging technologies. For communications technology to exhibit high standards of educational value, adult educators need to understand and control distance education. Of particular importance to the continuing professional educator is the relative effectiveness of each medium for its matching teaching task, and which media best meets learning needs.

> Necessary research questions should focus on the ways in which media are selected: By whom are they selected? What are the criteria for selection? What training should be given to the administrators and other decision makers who make these selections? (Moore & Thompson, 1997, p. 62)

Research Questions

In this context, the goal of continuing professional distance education is to develop programming that effectively interconnects academia and industry. Meaningful interconnections become increasingly possible through current and emerging communication technologies, but this process also involves human elements. Educational

and industry professionals make the decisions. Answers must be sought to the following specific questions that identify the elements affecting their decisions:

1. What are the key factors Continuing Professional Engineering Educators within the corporate training function consider when selecting, accepting and implementing communication technologies for delivering CPEE?

2. What understanding do Continuing Professional Engineering Educators have or sense do they make of these selected factors regarding the convergence of technologies, and the new learning approaches (active, collaborative, inquiry-based, resource-centered learning) that are coming to be associated with technology based education?

3. Within the context of adult education, how do high-technology organizational CPEE decision-makers within the corporate training function integrate educational, individual and organizational goals and objectives into choosing the media relative to distance education theory and practice, and what is needed to support that technology?

The question of how they perform in a complex environment connects with questions of meaning. Exploring the perspectives and actions of decision makers provides insight into how individual and organizational variables are integrated and implemented, and reveals the relative order of importance of those human factors and how their weight changes over time.

Research Methods and Design

An initial step is a literature review to inventory, classify, and analyze the salient factors in decision making that dictate or influence individual and organizational choices, as well as acceptance and accommodation of communication technologies in the context of Continuing Professional Education. In this way, one can identify individual human elements and broader organizational elements that constrain or enable choices as

businesses select institutions for education and training. Of particular interest are the technical arguments that underlie these decisions and the fact that choices depend on a relationship between technology and organizational dynamics that is unique to each business.

A structured quantitative and qualitative study of "significant actors" in industry using techniques such as a biographical data/reflection questionnaire, and individual reflective interviews provided in-depth detail-rich data based on individual perspectives and experiences. Those significant actors included Continuing Professional Engineering Educators at Fortune 500 companies represented on the National Technological University (NTU) Advisory Board. The author has been an active member of that board, and as such, has been associated with the business of the board for years. All have been involved in decision making regarding the planning and programming of corporate engineering development programs. Some typical job titles include: manager of education and training, engineering training manager, distance learning manager, instructional media development manager, director of instructional resources, graduate and technical degree program manager, and human resources information technology coordinator.

In 1998 and 1999, the NTU Advisory Committee included representatives from twenty-two major Fortune 500 corporations. Today, the NTU Advisory Board and the complete university are in a transition brought about by the rapidly advancing growth and development of information technologies and telecommunications technologies. Changes are being considered which will have a distinct impact on the future operational goals of their programs and of their organization.

According to the process recommended by Dillman (1978), the first activity is to invite the actors to participate. The first step was the initial interview with the President and Founder of the National Technological University to solicit his perceptions and

gather information related to educational program design and delivery considerations as being witnessed by NTU. Questions regarding major problems facing Continuing Professional Engineering Educators in the recent past, currently and as foreseen from the perspective of the major provider of advanced engineering educational programs were pursued. Plans for addressing concerns about meeting the educational needs of working graduate engineers by the university and for CPEEs regarding the future of their practice were also addressed.

Following this step, a questionnaire based on adult education theory, continuing professional development, distance education, and decision-making's unstructured decision process model focusing on key decision factors was designed and piloted. The survey instrument concentration covered forces existing in the environment, and called for an awareness of their influences on the part of the practitioner. The suggestion of a more holistic perspective on the issues of adult education program planning was an expected outcome of the investigation.

The survey questionnaire involved specific questions about communication technologies directed at business-based managers. The questions defined which technologies are perceived to be the best match for delivering externally provided competency education, as well as the concerns, reservations, and challenges currently known and foreseen. Factors human, economic, environmental, and technological were compared against known constructs identified in the literatures. Reference was made to a leadership model (Vroom-Jago, 1988) that focused on roles played by leaders in decision-making; and the questionnaire was piloted among ten CPEEs from industry and academia.

Following this step, a number of select advisory board members participated in in-depth individual reflective interviews. At this point, they were asked about their

reaction to the survey responses, and about how they went through the selection process in choosing the system they are now using, identifying variables, and outlining common threads of thought about their respective corporate settings.

In this way, members who indicated willingness to discuss their responses on the questionnaire offered further clarification and detail. Final results have been compiled, analyzed, and summarized into a discussion of the findings' implications, from which an executive summary will be made available to the entire board.

Limitations

Certain limiting factors affect the study. Not all major corporations or Fortune 500 companies are studied or interviewed. The study analyzes information from twenty major high-technology companies whose select representatives serve on the NTU board. Still, the Advisory Board is representative of the total.

In addition, there is little documentation of the process for selecting communication technologies for Continuing Professional Engineering Education. Most practitioners do not view the temporal stages of decision-making as a coherent process and so do not have a true measure of the human elements involved. As a result, survey participants may not have possessed a true measure of the integral elements of decision-making and their link to making better decisions. To counteract this, the author initially described the decision-making process and its stages before administering the survey questionnaire.

Other limitations include the unwillingness of surveyed companies to share information they may consider to be proprietary, especially in e-mail and telephone conversations. This concern will be alleviated largely by rapport developed with the interviewer, a former colleague in the NTU advisory committee.

Caution should be used in attempting to generalize and apply survey results to other industries because of the relatively small number of companies represented and because the study will evaluate only one distance learning provider.

Other possible limitations are the bias of the observer and the bias of participants. The author's corporate experience includes familiarity with the decision process in selecting satellite delivery of his company's distance learning courses, implementing that decision and participating in its operation. In addition, the author is a former member of the NTU advisory board, the targeted group of participants. Subjectivity is recognized as a possibility to be considered in the interest of impartial analysis.

Definition of Terms

Asynchronous: Communication, in which the interaction between participants is delayed, allowing convenient interaction through self-determination of time and place.

Communication Technology: Telecommunications applications such as cable television, fiber-optic, microwave, slow-scan television, satellites or microcomputer networking as introduced and applied to distance education.

Continuing Professional Education (CPE): The education of professional practitioners, regardless of their practice setting, that follows their preparatory curriculum and extends learning throughout their careers. Ideally this education enables them to keep abreast of new knowledge, maintain and enhance their competence, progress from beginning to mature practitioners, advance their careers through promotion and other job changes, and even move into different fields (Queeney, 1996, p. 698).

Continuing Professional Engineering Education (CPEE): The pursuit of adding to knowledge in the professional engineering discipline throughout an individual's career.

Decision: A specific commitment to action (usually a commitment of resources).

Decision Process: A set of actions and dynamic factors that begin with the identification of a stimulus for action and ends with the specific commitment to act.

Distance Education: The simultaneous telecommunicated delivery of instruction from a host site or classroom to distant sites, coupled through advanced communications technology between teacher and students.

Distance Learning: The teaching-learning relationship in which participants interact through advanced communications technology.

Download: Using the network to transfer files from one computer to another.

Electronic Mail (E-mail): Sending messages from one computer user to another.

Facsimile (FAX): System used to transmit textual or graphical images over standard telephone lines.

Human Elements: Conceptual construct of the "soft" issues of human interaction, such as change forces, likes, barriers, constraints, pressures, stresses, attitudes and roles.

Instructional Television: Microwave-based, high-frequency television used in educational program delivery.

Interactive Video: (Two way interactive video) Two sites interact with audio and video as if they were co-located.

Internet: An international network of networks primarily used to connect education and research networks begun by the United States government.

Managerial Choice: The process identifying a choice or judgment to be made, evaluating information about alternatives, and selecting from among the alternatives.

Multimedia: Any document that uses multiple forms of communication, such as text, audio, and/or video.

On-Line: Active and prepared for operation. Also suggests access to a computer network.

Protocol: A formal set of standards, rules, or formats for exchanging data that assures uniformity between computers and applications.

Satellite TV: Video and audio signals are relayed via a communication device that orbits around the earth.

Server: A computer with a special service function on a network, generally receiving and connecting incoming information traffic.

Synchronous: Communication in which interaction between participants is live, real time, and/or simultaneous.

Telecommunication: The science of information transport using wire, radio, optical, or electromagnetic channels to transmit receive signals for voice or data communications using electrical means.

Teleconferencing: Two way electronic communications between two or more groups in separate locations via audio, video, and/or computer systems.

Unstructured Decision: Decision process not previously encountered in the same form and for which no predetermined and explicit set of ordered responses exists.

Uplink: The communication link from the transmitting earth station to the satellite.

Video Teleconferencing: A teleconference including two way video.

World Wide Web (WWW): A graphical hypertext-based Internet tool that provides access to homepages created by individuals, businesses, and other organizations.

Summary

Continuing Professional Engineering Educators enrich careers by providing information that enhances competence and opportunity. Clearly, how information is delivered has as strong an effect on individual success as what is delivered (Moore & Koble, 1995). More particularly, how Continuing Professional Engineering Educators

integrate human considerations into the selection process affects its outcome. This awareness of relevant issues is critical to successful instructional design and a supportive learning environment.

It is hoped that information learned from corporate educators about their decisions will provide rich and unique insights and will serve as a meaningful resource for further inquiry by researchers and practitioners in continuing adult education.

Chapter 2

LITERATURE REVIEW

Distance Education in the Workplace

> *...equations which previously guided corporate decision-makers have been inexorably altered. Where American wealth and power were historically based on natural resources and capital investment in physical plant and machinery, the balance is tipping toward investment in people and knowledge as key resources.*
>
> (Botkin, Dimancescu, & Stata, 1982)

As the world of technology continues to change rapidly, business and industry have found it increasingly difficult to maintain a competitive and enlightened professional workforce. According to *Workforce 2000* and *A Nation at Risk (1983)*, the challenge of maintaining a qualified and competent work force has intensified as the baby-boom generation ages (Johnston & Packer, 1987). The response has been a clarion call for innovative technological systems that can deliver vast amounts of information to large numbers of people under a variety of conditions.

Models Meet the Challenge

Several distance education and instructional design models have met the challenge of delivering the right amount of critical information when and where necessary, including (Chute, Hancock & Balthazar, 1991):

1. The Performance Support Model.
2. The Knowledge Transfer Model.
3. The Instructional Technology Model.

These models reveal the development of program delivery technology and help identify the current state-of-the-art in technology as well as offer insights into how educators have made selection decisions.

First, *the Performance Support Model* outlines an overall strategy for applying instructional and technological solutions to performance problems. The final phase of this model involves choosing the appropriate technology option for program delivery and lists factors such as selection criteria, logistics, cost effectiveness, and organizational culture. To further explain this phase, Chute and Hancock developed the *Knowledge Transfer Model* to show that several types of communications media can work together in various ways to mediate the flow of information between source and destination. They demonstrated that several combinations offered the potential to greatly improve the quality of distributed instruction.

The *Instructional Technology Model* depicts the range of technology in a hierarchical gamut, from simple face-to-face voice-based technology through complex knowledge systems and artificial intelligence. This model defines three groups, or stages, of instructional technology (Naisbit, 1984). The first, classroom learning, is the least sophisticated and includes examples typically thought of as communication enhancements or teaching aids. The second, distance learning, includes systems for tele-training such as audio, audiographics, personal computer, and video instruction systems. Naisbit considers the final stage, the just-in-time performance support stage, the most sophisticated option, including new and developing technologies that require sophisticated design and development skills. The top of the hierarchy includes complete knowledge and artificial intelligence systems. It also describes a software system for advising and coaching that customizes each situation.

While these three models reveal the development of program delivery technology, it also is valuable to consider their applicability to educational organization models used today. Evolving technologies are viable in either the nationwide open educational institution or embedded in the more traditional institution (Neil, 1981).

Moving from distance learning to just-in-time performance support opens a world of multiple-technology options to the continuing educator. Despite the opportunities, we need to develop greater resources for understanding human learning and motivation, especially in the context of adult development, and greater understanding of the effects of technology on human behavior, as Coldeway first identified in 1986.

Continuing Engineering Education in the Context of Adult Education and Continuing Professional Education

In 1984, the Institute of Electrical and Electronic Engineers (IEEE) devoted the entire November issue of its journal *Spectrum* to the status of the educational enterprise for engineers and other technical experts. The issue included the IEEE Lifelong Education Survey (in cooperation with the IEEE Educational Activities Board), supported by a grant from the National Science Foundation. The survey polled four thousand electrical engineers to determine the role of lifelong education in their work.

The survey results indicated that although eighty percent of all technical employees felt their employers needed professional development plans, only one third had such plans. If there is to be massive useful learning in the workplace, standardization and institu-tionalization are necessary pre-conditions and necessary consequences. These serve as the socio-cultural determinants in the changing nature of distance education (Keegan, 1986).

Times have changed since Houle promoted his concept that “the primary responsibility for learning should rest on the individual” (Houle, 1980) and since Apps

agreed that "each practitioner in continuing education has primary responsibility for his or her own professional growth" (Apps, 1985). Andrews set the stage for changing perceptions when he clearly stated that "individual professional development is a responsibility of management" (Andrews, 1984).

Telecommunications in Continuing Engineering Education

As we have refined technologies, the task facing professional educators has been to ensure accessibility of continuing engineering education and the development of new and more sophisticated delivery systems, while maintaining the integrity of traditional engineering universities (England, 1987).

The use of telecommunications for delivering continuing engineering education was not novel. The University of Florida's Graduate Engineering Education Systems (GENESYS) began using educational television and two-way voice communications to provide advanced training to working engineers as early as 1964. The Association for Media-based Continuing Education for Engineers (AMCEE) continued to offer continuing education courses to engineers in industrial and university sites across the United States throughout the 1980s. During the 1980s, more than two hundred and sixty of the National University Teleconference Network's member universities offered more than one hundred satellite programs each. A member of that network, and an outgrowth of the AMCEE, the National Technological University now delivers continuing education and Master of Science degrees for engineers through its national satellite delivery system. The National Technological University network of forty-six major engineering and management universities has become the primary way for engineers and technical managers to receive continuing education in the workplace (Baldwin, 1995).

That telecommunications media proves effective in delivering education and learning has been known for many years. In 1977, a pioneer in the field of

communication research reported that "…over and over again the answer has come back: of course students can learn effectively from the media, from any medium….It depends on the performance of the teacher, the content of the media, what is being taught, and to whom." (Schramm, 1977). The literature today about the effectiveness of electronic technologies, from radio to computer networks and satellites, continues to prove Schramm correct.

By 1989, experts had determined that the ongoing concern should not be whether telecommunications proves effective but how best to use instructional resources in order to benefit from the unique capabilities of each (Gibbins, 1989). The focus of research shifted to describing effective instruction in the distance education context and the factors that influence effective learning (Whittington, 1987). Attempts to understand this environment involved studies of the comparative effectiveness of different delivery technologies and other behavioral and learning characteristics (Moore and Thompson, 1997). Studies overwhelmingly concluded that teleconferencing is educationally effective for continuing education and higher education achievement (Hoyt and Frye, 1972) (Kuramoto, 1984) (Weingard, 1984) (Ritchie and Newby, 1989).

Additionally, using telecommunications technology restructured the definition of distance education. Distance education came to mean the simultaneous telecommunicated delivery of instruction from a host site or classroom to distant sites, coupled with live audio and/or video interaction between teacher and students (Barker 1987a) (Benson and Hirschen 1987) (Garrison and Shale 1987) (Paulsen 1987). Rapidly changing technology has radically altered the format and delivery of continuing professional education, providing highly convenient, cost-effective alternatives educationally equal or superior to traditional offerings (Queeney, 1999). However, successful use of distance education depends on proper use of educational principles,

alignment with organizational and operational considerations, and professionals' familiarity with and willingness to use the mechanism (Leavitt, 1997).

Beyond Educational Effectiveness

When Souder compared the achievements of traditional Master of Technology students with those receiving instruction through the National Technological University, he reported that distance-education students scored higher grades and reported higher comprehension than usual in traditional education (Souder, 1993). Additional advantages included a broader network of colleagues, improvement in teamwork and collaboration skills, and expanded social skills. Interestingly, several other factors came into play. Distance-education students saw themselves as employees first, then as students. They considered straightforward questions "too academic and unchallenging," integrating answers to questions with practical awareness of world events and the literature of the field. They combined experience-based wisdom with formal information to create real-world solutions to real-world problems. Conversely, traditional academic students disdain distance learning as a second-class affair, and express emotional reservations regarding their value.

Studies of distance education and training within the military reveal additional insights. One study concluded that the more expensive two-way video systems did not compare favorably to a one-way video system when achievement alone is the measure, because of the additional burden on the instructor (Simpson, Pugh, & Parchman, 1991) or because of the difference in training methods (Lehman & Kinney, 1992). Another military study reported that in the Florida Teletraining Project, two-way video, audio, and graphics systems rated equally as effective as resident training (Bramble & Martin, 1995). Yet another military study of US Army Reservists concluded that computer-

mediated communication provides comparable instruction and permits expansion of course offerings (Phelps et al, 1991).

These outcomes reinforce the opinion that a student's self image, reference points and interpretation of assignments influences the learning process (Souder, 1995). Other studies have shown the importance of a social presence between teacher and learner (Gunawardena, 1994) and that limited or inappropriate teaching behavior interferes with learning through telecommunication technology (Vandehaar, 1986).

The literature indicates that distance programming is educationally effective and, more importantly, that it can match each medium's unique benefits to the desired educational outcome. Distance education is truly a complex socio-psychological innovation warranting empirical analysis of the process as it applies to continuing professional education.

Distance Learning Technologies: An Overview

> Ideally, the choice of technology – or even the decision to use no technology –should be based on a consideration of the characteristics and needs of the learners, the content, the organizational context, and the process people in the educational or training system.
>
> Chute, Thompson, & Hancock, 1998

Telecommunications-based alternatives for distance learning have become more powerful, more complex, and more plentiful and, as their numbers have increased, the difficulty in choosing the appropriate solutions for each need has grown more complicated. The more familiar and widely used options focus on audio and video technologies, but more advanced computer-based technologies such as computer conferencing, electronic performance support systems and the Internet provide greater control of the process to learners and have transformed distance learning into a more learner-centered option. These changes have prompted some to suggest that everyone is a potential distance learner (Kerka, 1996).

Despite their enthusiasm, educators realize that no one technology is the single ideal or best technology. The needs of the organization and program design determine the best choice and mode of interaction. Each approach has its own characteristics, strengths, and limitations.

Experts categorize delivery technologies in various ways. One method categorizes by 1) the kind of message sent and 2) the type of interaction it enables (Chute, Thompson, & Hancock, 1998). In this context, the kinds of message sent include audio, data or video, and the types of interaction are one-way synchronous (real time), two-way synchronous or two-way asynchronous (delayed).

Interactive approaches range from simple to complex, with the telephone serving as the most common simple form of interaction (an audio-only system). Individuals commonly use the telephone to exchange information for informal learning, problem solving, and decision-making. Telephone conference calls more formally integrate course design, content, and delivery while providing greater access to distant experts. Experts anticipated this trend. In the late 1980s, the use of telecommunication for distance education grew so rapidly that it was impossible to accurately document the many projects underway or in consideration (Barker, Frisbie, & Patrick, 1987). Combining the data capabilities of the personal computer with the telephone has allowed a higher degree of interaction. Additionally, a multitude of support mechanisms increased convenience and flexibility, including voice mail, automatic call back, or facsimile.

The introduction of video technology injected a new array of resources into the learning process. During the last twenty years of the 20th century, instructional television and videotapes became widespread and more cost-effective.

Rapid adoption of increasingly sophisticated communication technologies has marked distance learning (Schlosser & Adderson, 1994). Some of the many innovations include one-way video broadcasts, video on demand, video plus computer-based training (CBT), and two-way video. Innovation in video compression, digital signal processing and full-motion video continue the rapid evolution in telecommunications technology, with each innovation building on its predecessor and offering more application options.

When the computer was introduced the computer into the education and training equation, it opened multiple avenues to the instructor in assisting and managing instruction. When smaller, less expensive, and versatile personal computers replaced the mainframe in the 1980s, they brought with them increasing processing power, graphics, color, sound and flexibility. The stand-alone desktop computer soon became the preferred mode for delivering computer-based training. The appeal of this approach is clear. During the 1990s, the personal computer became the cutting-edge medium for gaining access to information and engaging in interpersonal communication in many areas of life. Teachers and students easily could share text, graphics, audio, video, and virtual reality experiences despite physical separation (Weinstein, 1997).

It wasn't long before computer conferencing became a generally accepted way to support communication between teacher and learner. Computer conferencing operates either live (synchronous) using both audio and video or operates over time (asynchronous). Most on-line teaching is asynchronous, allowing the student to send or read text messages at his or her convenience.

The three most common forms of computer-based conferencing are electronic mail, group conferencing, and interactive messaging. E-mail usually involves one-to-one or one-to-many communication among users. It offers the advantage of being asynchronous, permitting more opportunity for convenient interaction through self-determination

of the time and place of the interaction. Many students find e-mail less threatening than live interaction and prefer this mode because the time delay fits workplace schedules. In 1996, approximately one million students participated in web-based courses. By the late 1990s, experts projected participation to reach three million by 2000 (Edelson, 1998).

When interaction extends beyond two participants, group conferencing permits one or many to interact with many. Individuals can post messages on a virtual bulletin board and others can reply directly to the sender or distribute their responses to all of the members. Naturally, simultaneous synchronous or real-time, communication among members of the group or network can contribute to problem solving or decision making when they require rapid feedback. Internet relay chat systems exemplify this natural flow of ideas and discussion. Groupware, another variation of specialized conferencing, uses software that sorts, organizes, and stores input from networked individuals. This way, a network of users simultaneously works on the same document and any changes appear immediately to all users. Audio teleconferencing and audiographics have also proven successful in aiding professional development. In 1993, Anderson and Mason reported that computer conferencing and video teleconferencing on the Internet linked distance educators worldwide, allowing discussion and reflection prior to and during the 1992 International Council for Distance Education (ICEDE) conference. Others reported successful delivery of courses to National Aeronautics and Space Administration (NASA) personnel around the US and that Lockheed used this approach to provide launch-critical skills training (Hosley & Randolph, 1993).

Distance learning as a complete system has become widely discussed in the literature (During, et al, 1993), (Moore & Karsley, 1998). Opportunities for distance learning continue to expand rapidly, with Internet courses emerging as the technology-of-choice for higher education courses (Edelson, 1998).

Learning Support and Performance Support on the Job

Performance support programs seek to create rapid improvements in job performance and the personal computer's unique capabilities allow employers to construct such programs. Computer-based tools incorporate knowledge bases, expert system advisers, and learning experiences to correct, advise, and coach inexperienced users to an acceptable level of performance.

For example, when a user writes a sentence to translate a mental concept onto paper, most word processing programs highlight improper spelling and grammar. Similarly, presentation software with embedded templates coaches users through the process of preparing presentation graphics. Computer tools similarly allow businesses to provide training and retraining on the job throughout the year in response to changing market conditions using a system that supports users' job performance.

The World Wide Web and the Internet

> The World Wide Web (WWW): A graphical hypertext-based Internet tool that provides access to homepages created by individuals, businesses, and other organizations.
>
> The Internet: An international network of networks primarily used to connect education and research networks begun by the United States government.
>
> Adapted from:
> Distance Education – Strategies and Tools and Distance Education,
> A Practical Guide, Dr. Barry Willis, University of Idaho
> Engineering Outreach (1998).

The Internet acts as a flexible, continuous learning environment for knowledge workers. As Internet access has expanded, so has familiarity and comfort with the Internet as a communication tool. Its use as an instructional tool has also become more widespread. Employees can easily access the resources they need to stay informed about changes in their professions, their companies and their markets. As a network of networks, the Internet links the communication capabilities of any one user to any other

user with compatible equipment and access. The World Wide Web (WWW) uses the Internet to exchange information, with documents in various formats stored on servers and accessed by personal computers (clients). Browsing software on the personal computer searches for and gains access to documents. When its specifications became standard and public, the World Wide Web soon attracted many communities of users and providers.

As companies linked on to the Internet, these users found it necessary to protect valuable data and created electronic barriers (firewalls) to separate their internal networks (intranets) and the outside Internet. In most cases, selected outsiders may gain access through the firewall to some of a company's proprietary resources. (Those with special passwords to gain access actually operate on the company's extranet.)

From the perspective of distance learning, the Internet is one of the most basic yet powerful options available to deliver training quickly and update it regularly, so many companies increasingly turn to the WWW for training and development. As evidence, experts expect that the amount spent on web-based training in business and industry will increase more than twenty times between 1996 and 200l (Wagner, 1998)

> … but that is where we are heading. The Web is so convenient and cost effective for everybody. It is labor-intensive at the origination site. But for industry, it is not labor-intensive at all. Administration is very easy at our end (Sanoff, 1999, p. 26).

The Internet also offers a wide variety of delivery options. Companies that have struggled with various training media for years suspect they may have found that the WWW offers a breakthrough (Gantz, 1997). Many organizations have begun to experiment with new and more powerful ways to combine distance-learning technologies with WWW delivery. Students can download the most recent technical and pricing information using combinations of compact discs and the WWW. While working, a

designer can gain access to a supplier's catalog and build the supplier's part into the design, confident of availability, technical interchangeability, and pricing. Similarly, instructional hybrids enable employee learners and instructors to create powerful customized learning experiences using innovative telecommunication technology. Users, who grow increasingly familiar and comfortable with this kind of technology, often prefer the newer method. The author recalls being quoted as stating:

> What engineers are saying is that the demands of their jobs are such that they can't get away from work. They are working 60 hours a week. So any education they get has to be at their convenience. They feel that they won't get anything in the way of advanced education unless they get it through distance. The Internet and the Web are upon us. That's where I see the future (Sanoff, 1999, p. 26).

Researchers have found that although distance learning offers less access to teachers, learners prefer it over the traditional classroom because of its convenience and that, in many cases, they prefer that convenience over face-to-face instruction (Klesius, Homan, & Thompson, 1997).

Another impact of the Internet is the emergence of global universities and national universities, and virtual universities. Distinctions exist between:

1. The traditional university offering embedded programs to a global audience.
2. The national open model university operating within a country.
3. The virtual university through which the learner becomes fully immersed in an artificial, three-dimensional world generated by a computer.

It is noteworthy to mention that the National Technological University in 1985, with its unique organizational structure and technology, simultaneously interconnected multiple networks of individual universities via satellite to pioneer what is now known as the virtual university (Baldwin, 1997). This emerging concept delivers programs to people anywhere, anytime, at the convenience of the learner.

Newer Doesn't Mean Better and It's Not the Technology

Even though distance education's most notable characteristic is that regular communication between learners and teachers occurs through an artificial medium, one cannot simply add an old program to the new medium to improve the program. New technologies do not necessarily improve on older technology. All technologies, old or new, must pass the test based on how well they promote and enhance learning.

At issue in distance learning is not the technology use but the goals for student learning, including how and where that learning should take place (Bates, 1995). New varieties of electronic media can distract educators and other decision makers from choosing the most suitable medium or media, and experts have warned educators against hardware-driven educational decision-making. Delivery media must "be selected according to instructional needs, professional and technical expertise, and according to one's available budget" (Wagner & Reddy, 1987). Considering the power, speed, flexibility, and plummeting cost of new approaches, it "seems almost a given that those who engage in the fundamental rethinking forced by this technological potential are very likely to significantly shape nontraditional study and administrative patterns (of distance education) in the next two decades" (Duning, 1989). Only through careful planning and implementation that focuses on creating a new system rather patching up an old system with an add on maximizes potential benefits (Chute, Thompson, & Hancock, 1999).

This view of its delivery from the system perspective serves as another notable characteristic of distance education. Distance education revolves around a learner-centered system, with teaching focused on facilitating learning and recognizing the role of instructional technology as a learning resource (Beaudoin, 1990). One typical model considers the elements of the total: the learners, the content, the process people, and the

organizational context (Moore & Kearsley, 1996). This expanded view highlights many aspects of each element:

1. The Learner: presence, characteristics, thoughts, needs, interests, thoughts, actions, system size, setting, purpose.
2. The Content: characteristics and needs.
3. Process people: instructors, systems support, component support, instructional designers, counselors, student support, administrators, technical design, and technical support.
4. Organization: context, purpose, settings, characteristics, needs, resources, philosophical support, attitudes, leadership support, and financial support.
5. Technology: mechanisms that allow interaction and instruction to extend beyond the classroom time and place.

Systems design integrates many specialties. Each serves as an integral, interrelated part of the system and brings needs and strengths to the overall shape and potential of the system. Ideally, the choice of technology revolves around the system's characteristics and needs, but the relationship and integration of these elements truly identifies the nature and power of a distance learning system (Chute, Thompson, & Hancock, 1999).

Electronic communication offers many opportunities for student interaction and participation. And yet, the exciting advantages can easily distract educators from making the most suitable selection among the various media. Experts urge them to select media based on instructional needs (Wagner & Reddy, 1987). "The appropriate choice and use of technologies will depend on the particular context in which they are used…They all have their strengths and weaknesses…Therefore they need to be combined." (Bates,

1995). Educators face the challenge of using technology in ways that enhance and support learning and that respond to the needs of learners (Wagner, 1999).

A New Paradigm Evolves

Changes in education brought about by changes in distance learning have led to a major shift in the educational paradigm. By focusing on telecommunications media interactivity, experts have reported its effects on important educational variables, noting changes in areas such as learner achievement and attitudes, teacher achievement and attitudes, course design and curriculum issues, cost effectiveness, administration and organization, and policy-making in education.

Documentation exists for many examples of the use of telecommunications media for delivering post graduate coursework and continuing professional development courses to working professionals (Burgess, 1994). The Pennsylvania State University's Independent Learning Program, for example, offers more than three hundred credit and non-credit post graduate courses to working professionals (Distance Education 1996-1997). The University of Maine's interactive television delivery of a laboratory course permits students to complete lab work in their homes or at off-campus sites and centers (Naber & LeBlanc, 1994). All of the vocational-technical colleges, county extension offices, and twenty campuses of the University of Wisconsin feature equipment for educational programming via satellite downlinks.

Similarly, multiple graduate-level programs delivered to engineers and scientists by higher education institutions have gained increasing respect for their effectiveness and for other gains in areas such as social skills, collaborating skills, and network building. Interestingly, students in the National Technological University's Management of Technology program have demonstrated an impressive comprehensive knowledge of the world around them and an ability to correlate course materials to that knowledge. They

have shown themselves to be adept at integrating answers with real situations and responding to questions in a comprehensive fashion (Souder, 1993). Many business schools offer master of business administration programs to working professionals, such as Western Michigan University's statewide satellite delivery to nine separate sites throughout the state (Stevenson, Oliver, & Schma, 1993).

As noted, the use of interactive telecommunications in continuing professional development has succeeded in National Aeronautics and Space Administration (NASA) centers around the country, including Lockheed Technical Training Department's videoconference delivery of launch-critical and safety skills training (Hosley & Randolph, 1993).

The Challenge: Meeting the Learner's Needs

As previously discussed, although distance learning's potential educational value has been proven by focusing on its efficiency as compared with that of the traditional classroom, the issue in distance learning should be the goals for student learning, and not the technology (Bates, 1995).

Many factors come into play in the distance learning environment. Distance learning, for example, requires that students focus strongly and manage their time and energy. It also demands that they work independently and as group members (Hardy & Boaz, 1997). Distance learners also face additional challenges. For one, many must learn how to learn in a technological environment (Eastmond, 1998) so that they fully comprehend how their students learn.

Since learners are motivated by more than just personal preferences, they may seek to supplement and/or replace conventional learning experiences and will engage in distance learning to do so. In other words, they may not prefer to learn at a distance, but will do so because it makes the most practical sense (Simonson, 1997).

"The challenge is to use any technology or medium in ways that enhance and support learning and that respond to the needs of learners. When planning and implementing distance learning opportunities, the technology should be invisible and the emphasis should be on the learning" (Wagner, 1999). The key to effective distance education involves a focus on the needs of the learners, content requirements, and constraints faced by the teacher, before a delivery system can be selected. Successful distance education programs rely on the consistent and integrated efforts of students, faculty, facilitators, support staff, and administrators. Appropriate technology can only be selected once these elements are understood in detail. Typically, this systematic approach results in a mix of media, each serving a specific purpose.

Human Factors as Elements in the Learning Equation

As adult educators go about creating, packaging, and delivering educational programs for use by continuing professional educators in high-tech corporate training organizations, they must look beyond the apparent educational value to value in terms of the customer organization.

Company-based decisions strongly influence the effectiveness of distance education. Most Fortune 500 companies own their own videoconferencing production studios and networks of down sites at locations nationwide and overseas. When distance education providers and corporate training partners better understand how selection decisions are made, they can better support and serve learning needs.

The same holds true of the corporate distance-education professional, in terms of dealing with other stakeholders. Adult education programs and services are more likely to be accepted and succeed if the decision strategy is better understood, and if that strategy is based on program benefits and beneficiaries (Morse & Selter, 1998). In addition, the

strategy more likely achieves success if it focuses on the human elements of decision making.

Much research has focused on the process' selection routines, even though they are regarded by many as trimmings in the overall process. In his general model, Henry Mintzberg focuses on elements and routines that make up decision support, of critical importance since they determine, however implicitly, the subsequent course of action and incorporate the human elements.

The following summarizes human elements in decision-support as behavioral factors, dynamic factors, decision control elements, and political routines. These elements, where the human elements reside, when taken together have an enormous total impact on the decision-making process:

Behavioral Factors

Implicit Weightings, Implicitly, Confirmation, Soft, Non-quantitative, Value Issues, Emotions, Politics, Power, Personality, Dynamic, Uncertainty, Cognitive Limitations, Information Overload, Intended Bias, Unintended Bias

Dynamic Factors

Interrupts, Scheduling Delays, Feedback Delays, Timing Delays and Speedups, Comprehension Cycles, Failure Recycles

Decision Control Elements

Metadecision making, Preliminary Steps, Planning Approach, Allocation of Resources, Decision Planning, Switching, Project Management, Decision Communication Elements, Exploration, Investigation, Dissemination

Political Routines

Internal, External, Influence of Individuals, Power Relationships, Bargaining

(Mintzberg, Raisinghani, & Theoret, 1976)

It should be noted that these elements exist in the decision-making process for selecting delivery media and are not the other human factors in distance learning such as

social integration, the constructs of loneliness, communication apprehension, communication competence, and locus of control.

It has been suggested that distance educators broaden their focus to comprehend the forces acting on program management, to consider the managerial framework within which programs are applied, and to view the totality of program development issues (Duning, 1990). Strategic management requires creativity and entrepreneurial thinking to provide an appropriate learning environment that fosters continuing professional development and builds organizational capabilities.

Media Selection for Delivering Distance Learning

Since each technology affects learners and instructors, and influences the appropriateness of instructional design, media selection is critical. Distance delivery places unique conditions on the learning environment that early program design must address (Norenberg & Lundblad, 1987). Some of the applicable factors suggested by Norenberg and Lundblad depend on various characteristics, including:

1. Objectives of the organization.
2. Initial cost.
3. Personnel.
4. Anticipated use.
5. Desired level of interactivity.
6. Existing technological infrastructure.
7. Legal considerations.
8. Topographical context.
9. Equipment compatibility.
10. Users.
11. Governmental and school jurisdictions.

12. Business service areas.

13. Cost of operation.

The above factors illustrate the complexity of media selection. In a like manner, the literature on professional development in distance education emphasizes the importance of developing teaching skills appropriate for use with the different media. Instructors using interactive delivery systems must learn strategies that encourage interaction, while those teaching prepackaged telecourses need coaching on the development and organization of interactive support materials, the incorporation of mechanisms for student questioning and feedback, and appropriate assessment of learning in telecourses (Cyrs, 1991). Instructors teaching via audio teleconferencing should understand how to relay course materials with visual communication. Instructors teaching via computer conferencing must understand how to set the context and weave various messages into a unified whole (Feenberg, 1989; Murphy et al, 1996).

Although literature points overwhelmingly to the conclusion that distance education using interactive electronic telecommunications media is effective, much of the evidence comes from evaluation research (Coldeway, 1988). Various procedures provide guidelines for media selection based on the quantity of productive educational methods they deliver. Although effectiveness studies, by their nature, usually take place after expensive devices are in place, they usually relate to cost rather than to effectiveness (Stubbs & Burnham, 1990). Even then, most media selection schemes do not deal with critical dimensions of time and place dependence, ease of use, immediacy, linkages, and degrees of abstraction (Reiser & Gagné, 1982). And even with the Stubbs and Burnham application of PEI only one aspect is usually considered. They recognize that research is needed on various issues related to selection and educational use, with particular emphasis placed on the relative effectiveness of each medium for particular teaching and

learning tasks so that program development can apply that information. These questions of media selection fail to take advantage of the unique advantages of technologies that allow distributed knowledge creation and building. The technology should be the starting point of the process – Technology First, and guide the devising of learning strategies and approaches (Harvey, 2001). Central to this study are identified needs for additional media selection research. According to Moore and Thompson, "Other necessary research questions should focus on the ways in which media are selected. By whom are they selected? What are the criteria for selection? What training should be given to the administrators and other decision makers who make these selections?" (Moore & Thompson, 1997).

This study will provide a theoretical basis for information that can be generalized beyond the primary setting. It will contribute to the development and integration of knowledge about the distant learner, teacher, administrator, social system, and communication technology.

Continuing Professional Development and Adult Education

> Just as the whole world is a school for the whole of the human race, from the beginning of time to the very end, so the whole of his life is a school for every man, from the cradle to the grave …nor is man given other goals in learning than in life itself.
>
> John Amos Comenius, 1670

Continuing education ultimately seeks to instill a complex attitude in individuals that readies them to use the best ideas and techniques of the moment but also to expect that those approaches will be modified or replaced (Houle, 1980).

Prior to the 1960s, continuing education focused on helping practitioners understand new content and techniques (Schuchman, 1981). Later, it became apparent that the content-centered approach was not working. It encouraged dependence upon

teachers even though professionals demanded a significant measure of self-reliance (Miller, 1967). At about the same time, there was a growing focus on the perception of professional responsibility, accountability and service. This focus was being called into question by government agencies, consumers and professions (Azzaretto, 1990).

The move toward process models offered educators freedom from traditional learning patterns and provided opportunities to experiment with other educational concepts. Thus, multiple models emerged and were used. Models arose from analyses of continuing education, but many of these borrowed from the literature of adult education, psychology and managerial control systems (Houle, 1980).

Houle's "prescriptive list of working policies for the future" provided guidance for developing Continuing Professional Education programs besides advising that the primary responsibility for learning rests with the individual. It advised that:

1. The goals of professional education, and those of continuing learning, should concern the entire process of professionalization.
2. Continuing education should be considered as part of an entire process of lifelong learning.
3. The provision of continuing education should expand so that it pervades all aspects of professional life.
4. Professions should collaborate on the planning and provision of continuing education.

Houle also pointed out that continuing education should be planned and conducted in terms of inquiry, instruction, and performance. It was indeed visionary of Houle to see how continuing education can aid professionals, "whether in natural employment settings or in specially designed educational situations…to refine their sensitiveness, enlarge their conceptions, add to their knowledge, and perfect their skills…" (Houle, 1980).

Similarly, about 1980 Malcolm Knowles recognized the era of knowledge explosion and technological revolution, and called the defined mission of education to "produce competent people…with the foundational competence to engage in lifelong self-directed learning" (Knowles, 1980). Hence the accelerating spread in the seventies and eighties of competency-based (performance-based) education. In the same way, it was visionary of Knowles to see how several notions besides the competency models would affect continuing education. He advised that:

1. Research and practice would shift away from a focus on teaching to a focus on learning.
2. In a world of accelerating change, learning needed to be a lifelong process.
3. These forces proclaim a concern for developing new ways to deliver educational services to individuals "so that they can go on learning throughout their lives at their convenience in terms of time and place" (Knowles, 1980).

In this way, Continuing Professional Education evolved into a sub-specialty of continuing education--focusing on those who have previously earned their professional qualifications (Griffith, 1985) and consisting of a professional's learning activities completed after the pre-service training (Smutz, Crowe & Lindsay, 1986). In the Fall of 1984, the National Technological University was the newest entry into the growing number of corporate colleges. It was the "space age model for the immediate future… with instruction going by satellite… at off hours and night, courses can be recorded for use in various time zones at the convenience of students…electronic mail for feedback… with teleconferencing for students and faculty… with video out and telephone back" (Eurich, 1985). The field of Continuing Professional Education began in this way, dedicated to practitioners in the profession by providing settings for career-long

development opportunities. Of course, Houle recognized that continuing professional education began in ancient times, continued through the Middle Ages, and right up to the present, noting that it was during the 1970s that enough professions became interested in their own continuing education to form the critical mass for CPE (Queeney, 1996).

Relating Continuing Professional Education to Practice

> As the years have gone by, I have found…more and more of my time being a consultant to larger social systems… to fulfill the new mission of adult education, which is to develop a total environment conducive to human growth and self-actualization, and to create an educative society.
>
> Malcolm Knowles, 1980

Consider the many types of Continuing Professional Education providers. Each of the four major types--educational institutions, professional institutions, the enterprises where professionals work, and independent providers (Knox, 1982), have their own strengths and weaknesses. Consider also that Continuing Professional Education is associated with role performance and the organizational context in which the practice occurs. Therefore, strategic planning must consider not only the knowledge and experience of the practitioners, but also the contextual influences of their performance. Equally important, the possible combination of providers greatly affects planning that goes into developing programs (Merriam & Cunningham, 1989; Queeney, 1990). In addition, societal influences have an impact on Continuing Professional Education, involving highly educated professionals with acute awareness of technological trends and multiple stakeholders focused on other goals in a collaborative arrangement (Knox, 1982).

When considering Continuing Professional Education, one must look beyond general adult education considerations to encompass the specific aspects and settings of non-educational environments.

Continuing Professional Engineering Education (CPEE)

Immediately after completing pre-professional training, engineers need to develop specific knowledge and skills for their first engineering roles. Depending upon job assignment, their quest pursues varying degrees of breadth and depth. Later, there is the need to keep abreast of the new emerging technologies related to those roles, career developments, or job changes (Ferguson, 1997). Continuous learning usually is "Just-In-Time" learning as appropriate to the task at hand, and it can follow one or more of the three dimensions of depth, breadth, and technology.

Engineers serving simultaneously as content experts and Continuing Professional Engineering Educators in the corporate environment must understand adult learners to diagnose their needs, plan their learning experiences, create learning environments for them, select the most effective methods and techniques, and measure outcomes. They must acknowledge that, in this context, learners and administrators work and learn within the hidden curricula of corporate habits, values, attitudes, and beliefs. Even though educating and developing the careers of engineering and scientific employees has ranked secondary to the primary function of the organization, such as manufacturing, employers and employees know that participating in Continuing Professional Education programs is a valid strategy. It supports professional development and improvement, improves professional service to clients, fosters collegial learning and interaction, professional commitment, interaction and reflection, and enhances personal benefits and job security (Grotelueschen, 1980). The Continuing Professional Engineering Educator must help learners identify and solve their individual on-the-job problems. Their clients, just as most other adult learners, are highly motivated, experienced, heterogeneous, mature, and independent. The provider/administrator must accommodate the context in which these professionals work, as well as the value and ethical judgments underlying their decisions.

Continuing Professional Engineering Education, like Continuing Medical Education, is shaped by situational influences such as changes in the field of practice, cost containment pressures and accessibility of programs, all of which must be addressed by objective, strategic planning (Fox, Mazmanian, & Putnam, 1989; Knox, 1990). Other situational influences may include factors like extent of role change and career advancement, work and family demands, level of affluence, access to educational opportunities and an occupational tradition of valuing career-long learning (Knox, 1992). To ignore the dangers of situational influences such as an organizational setting is like walking across a busy intersection with one's eyes closed (Cervero & Wilson, 1994).

More so than other professionals, most occupational learning for engineers has been job-directed or self-directed, in work settings characterized by rapid technological change and fierce market competition. In its 1996 review report of engineering education, the Institution of Engineers noted that the focus of engineering education in the years to come would be "on creating lifelong learners from early education, through undergraduate education, to continuing professional education" (Institution of Engineers, 1996). Others noted that project-based, problem-based, and inquiry-based programs shift ownership from teacher to learner, allowing students to take responsibility for their own learning (Cribb, 1996). Lifelong learning is critical for engineers who must acquire skills and habits that will enable them to update their knowledge and skills continually (Smerdon, 1996). It has been suggested that a cognitive approach of information skills training would be the ideal way for students to learn how to locate, find, use, analyze and evaluate information regardless of its format or source (Sonntag & Ohr, 1996).

In any case, the Continuing Professional Engineering Educator's responsibilities extend beyond routine scheduling of activities or programs. Some other responsibilities include helping to define higher aspirations, diagnose obstacles and plan strategies to

achieve desired results. The role could be defined better as that of helper, guide, encourager, consultant and resource. The continuing professional educator also provides opportunities for learning and reinforcement that help professionals acquire and improve performance-oriented skills and knowledge and broaden the scope of their profession. Further, for all practical purposes, that learning feature adult styles of inquiry, practice and reinforcement, and not traditional classroom instruction focused on "how to do the job" (Nowlen & Queeney, 1984).

The Massachusetts Institute of Technology's Lifelong Cooperative Education study indicated a new pattern of engineering education that meets the needs of a world characterized by rapid technological change and highly complex systems. The study committee concluded that the only apparent way to enliven the vitality and competitive-ness of US high-technology industry depends upon widespread acceptance of lifelong formal educational activities as an integral component of productive engineering work (Bruce, Siebert, Smullen & Fano, 1982).

It has been suggested that engineering should follow the lead of medicine with regard to periodic updating of knowledge and skills. And yet, there are several basic differences between the medical and engineering situations. Whereas physicians practice medicine alone or in small groups, treating individual patients in private offices, few engineers are in private practice. Most engineers are employees of companies and their work is interwoven with multiple professions engaged in the design and production of goods. There is no equivalent of a teaching hospital in engineering, and the real engineering work of design and production is done without the benefit of educational faculty. The linkage between engineering education and engineering practice must be developed along different lines than in medicine. A practical solution requires active support and participation by the industry (Bruce, Siebert, Smullen & Fano, 1982). How

Continuing Professional Engineering Educators provide motivation and leadership to engineers while setting the objectives of their work is how performance-based objectives are born. Without the evidence of a causal relationship between engineering knowledge and skills performance and the strategic business performance, there is no convincing way to demonstrate the return on investment for Continuing Professional Education (Davidove, 1993).

Continuing Professional Education Defined

Given the practical context, within which professional engineers need to learn, they serve as an excellent model for examining Continuing Professional Education. Their experiences appear to align with the definition of Continuing Professional Education offered by Stark, Lowther and Hagerty:

> Continuing professional education can be broadly defined to include all forms of professional study; learning academic concepts, learning necessary professional skills, integrating concepts and skills, and becoming socialized into professions.
>
> Stark, Lowther & Hagerty, 1986

As new professions, expanding technologies, and rapidly burgeoning knowledge bases have emerged, the need for more structured education has clarified. Today, Continuing Professional Education "…refers to the education of professional practitioners, regardless of their practice setting, that follows their preparatory curriculum and extends their learning…throughout their careers. Ideally, Continuing Professional Education enables practitioners to keep abreast of new knowledge, maintain and enhance their competence, progress from beginning to mature practitioners, advance their careers through promotion and other job changes, and even move into different fields" (Queeney, 1996).

Characteristics of a Successful Program

The most effective continuing professional engineering education programs share several common characteristics. Saline identified seven in the *IEEE White Paper on Education (1985 pp 45)* and Quinn delineated five others in the *Study and Analysis of Education and Training Programs for Technical Professionals* (1985), which combined, form a set of guidelines for successful program development. Analysis of the guidelines demonstrates the importance of human issues is critical to successful instructional design and a supportive learning environment for Continuing Professional Engineering Education. The relationship between efforts in providing programs and in selecting delivery technologies, plus the resulting experiences provide a unique resource of data and further inquiry for researchers and practitioners. The nine items comprise a generic model for successful Continuing Professional Engineering Education program development. They are:

1. *Relevance of Content to Corporate Needs*: Strategic and operational planning should yield detailed human-power specifications required to meet immediate and long-range business objectives. Comparing them with an assessment of current competencies defines competencies requiring new employees, professional development of current employees, or purchase of competency services. The importance of highly visible corporate commitment should be emphasized explicitly and implicitly at the highest operational level in a variety of ways including corporate organization, philosophy, policies and practices.
2. *Relevance of Content to Individual Needs and Desires*: Assessing individual employee strengths, limitations, competencies, interests, and potential for lateral or career moves relative to business needs should yield appropriate professional development plans and actions for each person. When the entire professional staff takes part in developing and maintaining program

content and delivery, this sense of ownership creates a collegial atmosphere that has a significant positive impact on program effectiveness.

3. *Attitude and Learning Skills of Individuals*: The manager should fully apprise the employee learner of the nature and purpose of specific educational activities. The employee should feel that the education would be helpful to him or her and to the business.
4. *Commitment and Expectations of One's Manager*: The manager's attitude toward educational activities influences how seriously the employee learner approaches them. The employee should understand the manager's expectations and the manager should serve as a role model by participating in educational activities.
5. *Climate for Professional Development*: Opportunities for education should be readily available to the employee. Approval routines should be minimal. In addition, employees should feel that participation is expected and not simply tolerated.
6. *Opportunity to Use New Learning on the Job*: Managers should encourage and expect employees to use what they have learned. A new work assignment requiring newly learned information accelerates professional development.
7. *Accessibility to Participants*: Programs must accommodate the convenience of time and place interaction based on the demands placed on employee learners.
8. *Application of Adult Education Theory - Andragogy not Pedagogy*: Programs and methods of instruction should reflect the art and science of helping adults to learn and not the art and science of teaching children. They should also take into account that the learner, in addition to devoting the

necessary time and intellectual effort for learning, must handle other work demands as well as family obligations.

9. *Learning Objectives: Every* aspect of the program, including course materials, teachers, participants, and mode of delivery should be carefully, continuously assessed to insure learning objectives are met. Programs should exhibit diversity in content and delivery method to accommodate multiple learning objectives and learner differences.

Continuing Professional Engineering Education, like the rest of education, needs to prepare for a changing world in which teaching existing knowledge has become less important than teaching effective information-gathering skills (Anders, 1944) and decision-making skills. Engineers must continually update their knowledge and skills throughout their careers and continuing professional engineering educators must understand the relationship between the engineer and the workplace, the professional process, and attitudes towards specific professions (Childers, 1993).

Practice-Oriented Continuing Professional Education for Engineers

> Continuing professional engineering education has not been heavily emphasized in the past because the technical environment was such that four or five years of formal education, on-the-job experience from appropriate assignments, and a modicum of self-directed study were sufficient for an engineer to remain professionally competent for life. But now, the entire world has become increasingly dependent on fast-growing complex technological systems.
>
> Robert Quinn, 1985

A professional can possess a wealth of knowledge and skills, but still be unable to solve problems encountered on the job. Further, a professional can possess a wealth of knowledge and skills, but still not perform in new and different jobs in the profession (Kaufman, 1978), implying a lack of competence on a higher level (Dubin, 1990).

Examples of technical obsolescence identified by engineering managers (Dubin, 1978) included:

1. Not being aware of the latest concepts and innovations in the field.
2. Not being familiar with the latest tools and equipment.
3. Not being able to comprehend the technical literature in the field.
4. Not being able to apply concepts to the area of specialization.
5. No longer being consulted by colleagues on technical matters.
6. No longer participating in decision making on the job.
7. Low tendency to be selected for key assignments.

Overcoming these problems has become one of the greatest challenges facing continuing professional educators. In order to ensure knowledge and skills have practical application, Continuing Professional Education must go beyond dispensing information and teaching technical procedures. It must develop lifelong learners who value the opportunity to improve their individual learning outcomes (Candy, 1991). By identifying learning needs based on performance deficiencies and developing programs that are directly related to practice, the learning experiences can lead to competency and enhanced performance (Queeney & Smutz, 1990). Continuing Professional Education must also help professionals build their collaborative, judgmental, reflective, and integrative capabilities (Queeney, 1998).

Engineers within manufacturing organizations operate in practical reality, where basic corporate missions often conflict with those of their profession. The vitality and competitiveness of a company manufacturing high-technology products depends on integrated productive engineering that conceives, designs, develops, and produces those products in a way that ensures competitiveness in a global market. Full-time corporate engineers, removed from the mainstream of engineering practice, must of necessity align themselves to the particular setting of their company. The National Society of Professional Engineers (NSPE) is slowly coming around to supporting a position that

engineers should update their knowledge on an annual basis to keep license or registration, and called on states to seek uniformity in their continuing professional competency requirements (Industrial Engineering, 1994). At the same time, it was decided that NSPE become a satellite television producer of preparatory classes to help engineers pass the Fundamentals of Engineering exam and the Principles and Practice exam required for engineering licensing. The courses will be broadcast through the satellite network of the National Technological University. But it must be remembered that industry-based engineers working within corporations are not generally required to obtain or retain regular licensing. Instead of acting as entrepreneurial engineers, they must act together with others to advance the company. Thus, the central educational task for them is to improve the quality of services or products the company provides to its customers.

Institutional managers must ask questions that address changes in knowledge, skills and attitudes, the application of newly learned information, and the impact of that application on profitability, or the application of knowledge and skills in the practice setting. Cervero listed four variables for a conceptual framework to answer such questions (Cervero, 1985): (1) the program itself, (2) the individual professional, (3) the nature of the change, and (4) the social system.

Programs responding to outcome questions abound, offered widely by universities, colleges, community colleges, other industrial entities, government, professional societies, commercial educational companies, and consultants. The programs differ widely in purpose, content, delivery, length, time and place offered, entrance and completion requirements and intended audience. As to why professional engineers undertake Continuous Professional Engineering Education, research by Wiesehugel (cited in Cole et al., 1984) indicated the motivational factors as:

1. Increased professional competence

2. Acknowledgement of a changing knowledge base and the subsequent need to remain abreast.
3. Absence of accepted certification in one's field.
4. Upward aspiration.

Regarding employee reasons for participating in both employer-originated and self-originated Continuing Professional Education by industry-based engineers, scientists, and technologists, five reasons were determined: (1) professional development, (2) professional service, (3) collegial learning, (4) personal benefits and job security, and (5) professional reflection (Tait, 1990).

Furthermore, the same general reasons were stated as reasons for Army engineers' participation in continuing education (Grzyb et al., 1997), but subsequent interviews provided evidence that their reasons for participation were influenced by the effects of organizational and professional culture and changing workplace dynamics (Figure 2).

Pre-professional education and competence evaluation neglect many "performance abilities" (Cervero & Wilson, 1994; Nowlen, 1988; Queeney, 1996). Even though the effectiveness of such programs has been documented, most high-technology manufacturing companies cannot and do not relate the effectiveness of their Continuing Professional Engineering Education programs to improved participant performance in fulfilling the company's mission.

IEEE Spectrum, in cooperation with the IEEE Educational Activities Board, polled more than one-thousand one-hundred electrical engineers to determine the role of lifelong education in their work. Their findings suggested that factors such as: engineer's age, attitude toward the employer, and company size all tend to influence participation and involvement in continuing education. Regarding the impact of behavioral variables on performance, a 1986 study based on Cervero's model linking Continuing Professional

Figure 2. Variables of Two Conceptual Frameworks

Education to behavioral change for engineers demonstrated that variables other than the training affected job performance, and accounted for up to 45% of the variance (Brue, 1986). Similarly, a 1985 study regarding the individual engineer's high perception of personal and internal locus of control is more likely to actively pursue learning that maintains technical competence. Chance or other external forces that dictate training programs, but do not give engineers control over their environment tend to be less predictable and more passive (Giles, 1985).

The degree to which engineers must stay technically current at work to remain secure appears to influence how much action they take to remain up-to-date. In addition, electrical engineers in small companies placed high emphasis on technical publications as a means of remaining current, while those in large companies rated job assignment slightly higher. In the IEEE Lifelong Education Survey (1984), most respondents rated work assignment as the strongest factor in maintaining engineering proficiency. Technical publications also rated highly, followed by continuing education courses, conferences, meetings, and self-study courses. There was no mention of a connection between continuing education and corporate goals. There was no bottom line of instructional soundness measured in performance appraisals for transferring newly learned information into the workplace.

It appears that employees and employers judge a course's effectiveness based on what each wants and their perceptions about how well that course relates to those wants. Regarding the process for selecting satellite distance learning systems within higher education, it was determined that group decision-making set the university's policy, regardless of the job, position, or department involved in the decision (Spears, H. K., 1991). Spears concluded that understanding the decision-making process helps

administrators of distance learning systems minimize concerns and facilitate policy development.

The IEEE study did not substantiate the notion that Continuing Professional Education remediates deficiencies, fosters growth, or facilitates change for professional practitioners (Scanlon, 1985). To advocate or mandate participation in Continuing Professional Education accomplishes little if the educational experience does not improve daily practice (Nowlen & Queeney, 1988) toward career and corporate goals.

One effective approach to improving daily practice through learning outcomes is the "Big Six Skills" approach developed in 1990 by Eisenberg and Berkowitz. This approach effectively supports Continuing Professional Education and problem-solving by teaching: task definition, information-seeking strategies, and how to use, synthesize and evaluate information (Eisenberg & Berkowitz, 1990).

Moving Toward Successful Strategies

If continuing professional educators can become reflective practitioners, they must engage in analyzing their own program development frameworks (Schon, 1983). Sork and Busky codified twenty years of systematic program planning processes to create a generic model or set of steps, tasks, or decisions which, when carried out, produce the design and outcome specifications for a systematic instructional activity (Sork & Busky, 1986) which are directly applicable to Continuous Professional Education. The similarity of such frameworks is noted by many adult and continuing professional educators (Apps, 1985; Brookfield, 1986; Sork & Busky, 1986; Pennington & Green, 1976).

Apps (1985) translated the process of constructing a program development framework into five tasks:

1. Identifying learners' needs.
2. Defining objectives.

3. Identifying learning experiences that meet these objectives.
4. Organizing learning experiences into an educational plan.
5. Comparing the outcome with the objectives.

In planning for training programs, four major considerations should be taken into account: content, external restraints, skills and preferences of the teacher, and learning styles of the participant (Dixon, 1982). Many experts have focused on experiential learning theory and the Learning Styles Inventory. The 1994 Learning Styles Inventory Bibliography of Research contains 375 documented publications.

Additionally, it has become more apparent that professionals can no longer rely on their own capabilities, but must function as part of a team in the workplace (Long and Vickers-Koch, 1995). The complex nature of interdisciplinary practice, highly specialized narrow fields, and the declining numbers of sole practitioners tend to require group or team approaches to on-the-job problem solving (Queeney, 1999). Continuing professional education must help professionals build their collaborative, judgmental, reflective, and integrative capabilities, and must consider the context of the application (Nowlen, 1988).

As a decision-making tool for continuing professional education providers, needs assessment must help identify gaps in practitioner performance and in the selection of delivery media. If continuing professional education can truly improve practice, then practice-oriented learning needs must feature into the earliest stages of program and system development. In other words, documentation of a performance gap must exist prior to intervention (Queeney, 1995).

In order for any Continuing Professional Educational intervention to improve professional practice, needs assessment must be accurate. Factors to consider include the nature of the needs being assessed, available resources and the population to be assessed.

Sound planning, careful execution, and proper analysis and interpretation are necessary (Queeney, 1999) just as they are necessary for effective program evaluation.

Models Meet the Challenge

In comparing and contrasting frameworks for developing programs, the most striking difference is in the "emphasis given…to the linkage between the educational program and the expected changes in the outcomes of professional practice" (Sork, 1983). This prompts an examination of the four frameworks designed for use in various professions.

1. *Pennington and Green's General Model*: This framework describes program development as a form of decision-making. The planning agent responds to a request or idea for a continuing education activity from inside or outside of the organization. If the request appears to be viable, the planner gathers resources and makes a number of decisions shaping the educational activity. These decisions involve a number of contextual factors, internal and external constraints, and resources (Pennington & Green, 1976; Cervero, 1988).
2. *Houle's Triple-Mode Model*: This prescriptive practice-oriented framework envisions the use of instruction, inquiry, and reinforcement to develop the program. It synthesizes several models and consists of ten distinct steps. The first six identify learners' needs, steps seven and eight set objectives and identify and organize the learning experiences, while steps nine and ten evaluate program outcomes.
3. *The Practice-Audit Model*: This prescriptive framework, similar to Houle's and also practice-oriented, involves a seven-phase process. Phase one organizes a profession team. Phase two develops practice descriptions. Phase three develops performance assessment materials. Phase four

conducts the practice audit session. Phase five compares performance to standards. Phase six designs the continuing education program and phase seven evaluates the outcome. Successfully used for systematic needs assessment and program development for professions like, nursing, architecture and medicine (Queeney & Smutz, 1990), this model shows potential to provide unique solutions to Continuing Professional Engineering Education by linking education and practice.

4. *Nowlen's Performance Model*: This practice-oriented prescriptive framework (Nowlen, 1988) is more expansive, integrating Houle's framework and Houle's eight decision points of adult education. Decision point one defines the educational activity. Decision point two begins action. Decision point three identifies objectives. Decision point four designs a suitable format. Decision point five fits the format. Decision point six implements the program. Decision point seven measures and appraises. Decision point eight examines new activity potential. Performance on the job brings more than job functions into the equation. Nowlen describes a triage (Nowlen, 1988) of other variable factors that have a strong influence on performance as:
    a. Baseline knowledge and skills
    b. Challenge of new roles
    c. Requisite skills in human relations
    d. Critical skills of mind
    e. Proficiency in self-managed learning
    f. Individual developmental progress
    g. Organizational developmental balance
    h. Fit of individual and organization to one another

i. Skills in coping with life's surprises and transitions
j. Understanding the influences of environments and cultures, and the skills to orchestrate them.

Program Value for Continuing Professional Education Update

Using models as strategic approaches to program design offers a glimpse into the complexities of real-world planning (Cervero, 1988). Continuing Professional Education has looked at three models to examine program value. The Update Model, the Competence Model and the Performance Model of Continuing Professional Education (Nowlen, 1988), equally important, each suggest a different motivator for professional development (Nowlen & Queeney, 1988). The Update Model is deficit-driven, tied to functionalism, and has its focus on filling in gaps or keeping up. The Competence Model has two ideas; the job function or context, and its requirements or standards of critical skills. The Performance Model, on the other hand, focuses on putting things in priority order, with balance between being an individual and being imbedded in the organization. Hence, it would seem that the Performance Model of Continuing Professional Engineering Education is more appropriate for the industry-based engineer.

These models also offer a different perspective on Cervero's functionalist, conflict, and critical theoretical viewpoints about the goals of the educational process (Cervero, 1988). Overlaying Nowlen and Queeney's models over Cervero's viewpoints also can help the Continuing Professional Educator determine their applicability.

Cervero's programs seek improved professional competence and performance resulting in individual, organizational and professional improvement and advancement. Along with Cervero, Schon believes that greater emphasis will be placed on expert decision-making on the job, and cause specific job assignments to drive continuing education (Schon, 1987). Cervero described the interrelationship of ethics and context by

stating that effective Continuing Professional Education comes from making the best judgment in a specific context for a specified outcome.

Practice-oriented Continuing Professional Education by definition is directly related to daily practice, and therefore the highest order of evaluation. Four levels of evaluation of training programs for effectiveness include: (1) reaction, (2) learning, (3) behavior, and (4) impact or results (Kirkpatrick, 1987).

Higher Order Strategic Linkages

The highest order or final measure of program effectiveness demonstrates the permanency of the residual change. One example is the three-month survey following a participant's return to job realities (Hersey, 1994). Participants must define linkages between what was taught and their own practice. By actively encouraging the development of these linkages, continuing professional educators increase the likelihood that what is taught will be learned and taken back to the work setting (Queeney, 1999).

Conditions of practice require a high degree of flexibility and adaptability on the part of the professional, who must work as a member of a team with increased specialization, and demonstrate strong problem-solving skills and technical strengths. Continuing professional educators must focus their offerings, learn the latest technologies, and help the professionals consider their roles within their own profession. Professionals must define problems, apply problem-solving skills to current issues, and respond when called upon as internal experts or consultants for others in their profession.

Leaders of Continuing Professional Education recognize that further development is vital to the success of the enterprise and of the individual engineer (Khan, 1996). Continuing Professional Engineering Education training objectives include improving group effectiveness, re-invigorating burned-out managers, and ensuring maximum use of technology (Chmura, Henton, & Melville, 1987). The approaches represented by

reflective practice and critical theory appeals to entrepreneurs and Continuing Professional Education practitioners (Novak, 1992; Edelson, 1992).

Peter Drucker, in the *Harvard Business Review* (1991, p. 78), discussed the importance of Continuing Professional Education to the institution and the individual. He called upon management to invoke changes by conceptualizing a particular type of intervention and then validate the intervention for better organizational communication and effective behaviors. Leadership in the decision-making situation proves key, because managers must manage a wide variety of people and their success depends on how well they recognize and adapt to changing needs and manage the people who work for them to do the same (Hersey, 1994).

The large number of training programs using the Hersey model demonstrates the vitality and acceptance of the situational approach. Lunsdane (1995) successfully used the technique of matching teachers' and learners' styles when teaching topics such as long-range creativity. Those paying for Continuing Professional Education want proof that it improves professional performance and that training dollars are well-spent (Queeney, 1996).

The many stakeholders of Continuing Professional Education recognize and criticize the goals and roles they and others play and endeavor to have a positive impact on professional performance. The existing range of performance support strategies suggests links such as motivation, performance capacity, expectations, environment and recognition among the practitioners themselves (Wedman & Graham, 1998). In the field of industrial engineering, as in others, the demand for continuing education was increased when work-place environments changed from product-based systems to knowledge-based systems (Ng & Gramoll, 1999). One response to the problem was developed at the

University of Oklahoma with the application of the educational technologies of the Internet.

The review system uses multiple forms of electronic media including graphics, animations, simulations, text and 3D visualizations, plus a randomly generated exam that is graded instantly and reported back to the user through the web (Potdar & Gramoll, 2000). These Fundamentals of Engineering, and Professional Engineering reviews prepare entry level and mid-career industrial engineers for licensing and registration. This one example of Internet-based learning adapts to the learning needs of the student and removes the geographical barriers between educator and learner without significantly changing the learning experience (McArthur & Lewis, 1998). As a result of responding to the needs of practicing engineers both in content and in delivery of the content, this engineering college produced an example of effective Continuing Professional Engineering Education (Matthews, D., 1998).

An interesting educational needs assessment was developed and distributed to engineers (Rutz, 2000) to help quantify practicing engineers' interest in continuing education offered through distance learning. In that study, 60% of the engineers responding to the assessment indicated high or moderate interest in participating in continuing education over the next three years. 47% had participated in continuing education or graduate study in the past three years. The responses indicated that 95% of this population has access to a "Pentium PC" or equivalent and 88% had Internet access. Newer delivery technologies are becoming increasingly available and preferred (Rutz, 2000).

Current research is acknowledging that Continuing Professional Education in the 21st century must include teamwork and collaboration, must encourage interdisciplinary

and interprofessional behavior, must be technology-based as appropriate, and must be available in multiple formats (Queeney, 1999).

Managerial Choice in Continuing Education

Technological improvements in telecommunications, particularly since the 1980s, have transformed distance education and captured our imagination. To develop a practical understanding of how technological innovation affects the learning process and to contemplate technology's implications for the future, we must consider the dynamics of corporate decision-making. Those dynamics strongly influence the learning equation, especially in corporate high-technology manufacturing organizations in the United States.

The Realities of Decision Theory

The formal study of decision theory is relatively recent and has a strong foundation in statistics and the behavioral sciences--which describe decision-making as a science, rather than an art. Seeking to define the elements that constitute decision theory, researchers have described the elements common to all decisions and have provided a framework for analyzing complex alternatives and consequences.

Specialists in the field have described several methods for classifying decisions. Herbert Simon categorized decisions as either routine and structured, or novel and unstructured (Simon, 1960). Routine decisions address frequent and repetitive problems, and incorporate a great deal of certainty about cause and effect relationships. In the business world, leaders establish policies, rules and procedures to deal with routine decisions. Known as programmed decisions, these allow managers to deal with common problems without expending unnecessary resources.

On the other hand, novel and unstructured decisions usually are complex and do not fit a particular pattern--making dealing with them extremely difficult and important. Business situations such as introducing new products, processes, and equipment or entering new markets rarely follow a set pattern; so dealing with them defies a routine procedure. These decisions have become known as nonprogrammed or unstructured because they are unique, cannot be handled in the same manner as previous decisions and deserve special treatment. The least is known about this type of process, (Simon, 1965; Soelberg, 1966; Agnew & Brown, 1985; Agor, 1986), and yet it is the process demanding the most of general problem solving, judgment, intuition and creativity (Brookfield, 1987).

In a management situation, first-level managers and middle managers concentrate primarily on programmed decisions, while the highest-level managers are more likely to deal with unstructured, nonprogrammed decisions. The nature, frequency and degree of certainty involved in decisions generally dictate the level of management required to make them (Kaplan, 1954; Gibson, Ivancevich, & Donnelly, 1988), even though formal and informal relationships between management levels often influence how ambiguous problems are solved (Stevenson & Gilly, 1991).

A review of the related empirical literature suggests that a basic format underlies unstructured processes. Although there is an abundance of normative literature on decision-making techniques, those techniques have little real impact on organizational decision behavior (Grinyet & Norburn, 1975; Hall, 1973; Whitehead, 1967). Little is known about how strategy decisions are made, as the commonly touted techniques have little relevance in such complex processes.

Research on individual decision-making has relied largely on analyzing thought processes while solving simplified problems. This research indicates that the decision-maker deals with unstructured situations by factoring them into familiar elements that can

be structured, and reducing a complex environment to a series of simplified conceptual models (Newell & Simon, 1972). This theory is unrealistic. Research into decision-making by groups has concerned itself with interactions among participants in an oversimplified laboratory situation and has not focused on the decision process, ignoring most crucial elements. The fallacy in this type of group research is that the very structure of the decision process is ignored (Mintzberg, Raisinghani, & Theoret, 1976).

Henry Mintzberg's "General Model of the Strategic Decision Process" or "Unstructured Decision Model" is a flow chart of seven steps with three identifiable phases--operating within an environment of three supporting routines, and having six sets of dynamic factors. All types of complex decisions fit within seven pathways through the model as identified and categorized by research.

Characteristics of unstructured decisions include novelty, complexity, open-endedness, little understanding of the problem or the route to its solution, and vague concepts of possible solutions and how the solution will be measured (Mintzberg, Raisinghani, & Theoret, 1976). A final choice results only from groping with many dynamic factors in a recursive, discontinuous process of many difficult steps over a considerable period of time.

The Realities of Studying Decision Theory

Research techniques for investigating the decision process include (Mintzberg, Raisinghani, & Theoret, 1976): (1) observation, (2) study of organizational records, and (3) interview or questionnaire. Observation, a powerful and reliable method, is extremely demanding of resources, since processes typically span years and the researcher often must study the process long after its completion. Investigation of records is often impossible because decision processes seldom leave reliable traces. With little direct opportunity to observe the essential operations of a decision, it is highly difficult to appraise decisions or the relative merits of the managers making them. It is a perplexing

fact that most high-level decisions produce no direct evidence of themselves and knowledge of them can be derived only from accumulated indirect evidence. Decisions are generally studied through inference from general results in which they are merely one factor (Barnard, 1966).

Interviews with those involved in the decision-making process reveal the most useful traces of the process. Naturally, there are disadvantages to relying on memories -- distortion and memory failure. One needs only a certain level of inherent honesty to agree that information may go unremembered or unreported. Although a single interview may distort findings, multiple interviews build a strong overall picture. Ways to evaluate decisions are by studying: (1) the stimuli that evoked them, (2) their solutions, and (3) the process used to arrive at them. Stimuli that evoke decisions can be thought of as occurring along a continuum. At one extreme are opportunity decisions, those initiated on a purely voluntary basis to improve an already secure situation, such as the introduction of a new product to enlarge secure market share. At the other extreme are crisis decisions, where a severe situation demands immediate action in response to intense pressures, for instance, seeking a merger to stave off bankruptcy. Opportunity and crisis decisions form the two ends of a continuum – with problem decisions falling between, evoked by somewhat milder pressures. Decisions may be considered as being given fully developed at the start of the process, revealed ready-made during the process, custom-made especially for the problem, or modified to fit the particular situation. Yet another method of evaluating decisions is through the process used to arrive at them.

This study will look at the process used for decision-making on all types of complex, problems, using the Mintzberg' General Model of the Strategic Decision Process. A simplified graphic of the process has been developed for discussion in this paper as it relates to the selection of delivery medium for Distance Education and Continuing Professional Education (Figure 3).

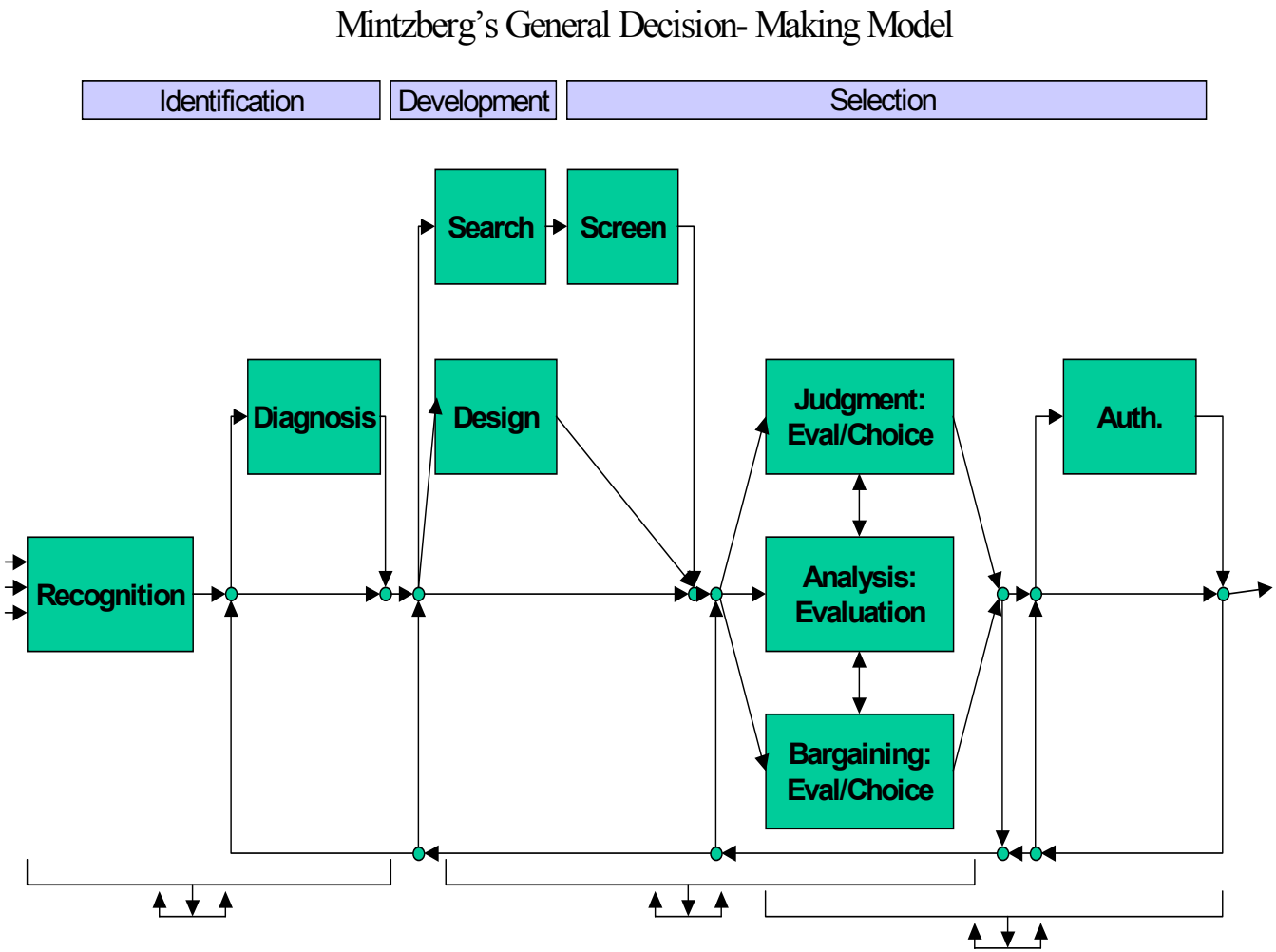

Figure 3. Mintzberg's General Decision-Making Model

The Decision-Making Process

> *Decision-making is a skill that is gained through experience of trial and error.*
>
> *Supervisory Management, 1995*

Organizations respond to problems with decisions. Without problems, decision-making would not be a necessary tool (Ackoff, 1987; Pounds, 1969; Watson, 1976). The means, rather than the ends, achieves a desired state. Gibson, Ivancevich and Donnelly (1988) presented a diagram of the decision-making process which looped the steps, but cautioned that decision-making should not be seen as a sequential process (Nutt, 1989), and that the diagram should serve only as mechanism for analyzing each element and not as a fixed procedure.

Sequential Responses to Problems

An oversimplification of the decision-making process describes the steps as: (1) establishing objectives, (2) measuring performance, (3) identifying the problem, (4) developing alternative solutions, (5) evaluating alternatives, (6) choosing an alternative, and (7) implementing the decision. The entire process suits problems that occur infrequently and with uncertainty. Problems that occur frequently do not require the entire process. In this case, established policies can deal with the problem without requiring a search for alternatives every time. The structured decision as described by Mintzberg can be addressed by policies and procedures.

In the business environment, the gap between goals and objectives and the level of performance required to achieve them usually constitutes the problem. This creates questions as to the goal's appropriateness or whether performance was adequate to achieve it. The decision-making process in this context must incorporate acceptance of

experimentation and failure (Augustine, 1994). An organization is doomed to mediocrity if it takes no risks.

Developing alternative solutions involves a search for internal or external information that translates into possible alternatives, usually a task for middle managers, who must handle the responsibility with creativity, intuition and tolerance for ambiguity. Several new techniques for developing alternatives exist, including scenario analysis to promote consideration of "what could be" rather than "what has been." (Mason, 1994) At the end of the process, the decision-maker either selects from the alternatives or creates additional alternatives (Solem, 1992). Resource constraints affect how much time and effort can be devoted to solving the problem (Shrivastava, 1985), but there also is a positive relationship between the number of alternatives and the speed of decision-making (Judge & Miller, 1991).

Once alternatives have been identified, they can be evaluated in terms of promise for the most favorable or least favorable outcomes. This involves contrasting and comparing anticipated outcomes with allocation of resources. Selection usually occurs under conditions of certainty or risk.

At this stage, statistics and operations research contributes strongly (Luthans & Koester, 1976). Some of the newest evaluation methods use advanced electronic technology and have proven useful in ranking and analyzing alternatives, especially in the area of game theory (Brandenburger & Nalebuff, 1995).

Selecting the proper alternative solves the problem. The decision-maker cannot possibly consider all possible alternatives, their consequences and their probability, so it is critical to recognize that decision-making is a dynamic process involving much more than simply choosing an alternative (Harrison, 1975). One alternative rarely achieves the given objective without affecting other objectives and such complex considerations complicate

the task for business decision-makers (Daft, 1978). This usually results in optimal decisions that meet an acceptable level of agreement and force the decision-maker to continually wonder--"What if?" (Kottemann, Davis, & Remus, 1994).

Decisions are little more than intellectual exercises if they aren't implemented, and good decisions suffer from poor or no implementation. Managerial skill and knowledge transform the solution into action and the effective manager solidly communicates the decision to those required to implement it (Schwenk, 1988). Ideally, expected outcomes are compared with results at the conclusion of the process. When a significant gap exists, the original objective or expected outcome should be reconsidered. If the objective or outcome is proven unrealistic or unattainable, the entire process should be repeated. Objectivity is key to the decision-maker's responsibilities.

The Process in Phases

From a theoretical viewpoint, the decision-making process appears to be a sequential process of phases, which can be described in five steps (McCall & Kaplan, 1990): (1) problem recognition, (2) problem interpretation, (3) attention to problems, (4) courses of action, and (5) aftermath. In reality, the complex and disorderly managerial environment requires a manager to shift continually between and among various phases (Warglien & Masuch, 1996).

When dealing with structured problems, the problem recognition phase is straightforward and usually follows defined procedures or guidelines. Unstructured problems, on the other hand, which occur in an atmosphere of uncertainty with inadequate information, are more difficult to recognize and may even be unconsciously denied (Kiechel, 1993). Conditions increasing the likelihood of incorrectly identifying the problem or solving the wrong problem include (Volkema, 1988):

1. Another person defined the problem.

2. The organization seeks a quick solution.
3. Low-quality solutions are acceptable.
4. The problem appears to be familiar.
5. Emotionally charged situations cause abbreviated searches.
6. The manager has no experience in handling challenging situations.
7. The problem is complex, hard to identify and measure.

Decision-makers' biases also affect problem recognition. Some biases include: risk propensity, problem framing, availability bias, confirmation bias, selective perception bias and small-number bias. In general, most people possess a low-risk propensity, prefer to choose a familiar course with a predictably satisfactory outcome as compared to risky courses--even though risky courses often present more satisfactory outcomes (Bernstein, 1997). Some people have a tendency to frame problems in either positive or negative terms, stressing the chance to lose or the chance to gain (Bernstein, 1997). Availability bias occurs when the decision-maker overestimates the frequency or consequences of a similar bad experience (Schwenk, 1995). Confirmation bias occurs when one seeks support for an initial view rather than looks for any evidence to the contrary (Larson, 1996). Similarly, some decision-makers search for information consistent with their own perspectives and undervalue contrary evidence (Starbuck & Mezias, 1996). This is known as selective perception bias. Small-numbers bias occurs when the decision-maker studies a small sample and accepts that sample as a proven rule for the larger population (Kahneman, 1991).

Once decision-makers recognize problems, they must deal with them, often without adequate time, resources or capabilities. When organizing priorities, managers usually select those with strong external pressure, those that can be handled with existing resources and those with some irresistible opportunity (Pablo, Sitkin, & Jemison, 1996).

Alternative solutions range from quick action to convoluted action. Quick action usually addresses structured problems but unstructured problems require a long period of time to implement, feature vested interests and power relationships, or engage many people in an extensive search for solutions (Bazerman, 1993).

In dealing with unstructured problems with complex solutions, evaluating results may require months or years before outcomes are known and consequences are determined. Often, if a negative aftermath appears possible, escalating commitment may result (Brockner, 1992).

Comparing the various phases of the McCall/Kaplan, and Carroll/Johnson and Xerox models with Mintzberg's highlights aspects of decision-making common to all models (Table 1).

In addition, Mintzberg's model permits feedback loops and paths for dealing with complex high-impact decisions and permits unending flow and crosscurrents. Because the Mintzberg model best accommodates the practical realities of corporate decision-making, this study will use that as a frame for organizing the review and creating the survey questionnaire. Nonetheless, the study will incorporate the model's detractors and their opinions. To begin, we will review the various frameworks.

Comparing How Experts Define Decision-Making Processes

Various frameworks describe the phases of decision-making. In 1910, John Dewey suggested five phases (Dewey, 1933), while others proposed from three to eight or more. Simon's Intelligence-Design-Choice trichotomy (Simon, 1965) is perhaps most well-known. Simplified, it describes the decision-making process in three phases: under-standing the problem, constructing solutions and selecting the appropriate alternative. Witte's work (1972) found that many decision processes consist of a number of different operations occurring at different points in time, but that Dewey's sequence of fiv

Table 1. Phases of Decision-Making.

Mintzberg		McCall & Kaplan	Carroll & Johnson	Xerox - Rational Model
Identification	Decision Recognition	Problem Recognition	Recognition	1. Identify & select problem
	Diagnosis	Problem Interpretation	Formulation	2. Analyze problem
Development	Search	Attention to Problem	Information Search	3. Generate potential solutions
	Design		Alternative Generation	
Selection	Screen			4. Select and plan solution
	Evaluation-Choice	Course of Action	Judgment or Choice	5. Implement the solution
	Authorization		Action	6. Evaluate the solution
Seven Paths through Model		Aftermath	Feedback	

phases cannot be supported. Instead, he uncovered evidence that decision processes consist of a plurality of sub-decisions.

Mintzberg's model is most enduring, delineating three distinct phases of the strategic decision process: identification, development, and selection. He described the phases in flow-chart form using seven central routines: (1) decision recognition, (2) diagnosis, (3) search, (4) design, (5), screen, (6) evaluation-choice, and (7) authorization. These routines are imbedded in an environment of three supporting routines and six sets of dynamic factors, primarily human factors, which act upon the total process.

In a high-technology company, continuing professional engineering education sustains the foundation, the substance and the lifeblood of the organization. A high-level directive to ensure the engineering workforce incorporates "the best and the brightest" is not taken lightly. How the Continuing Professional Engineering Educator chooses what programs to deliver and which technology to deliver them depends in great part on how that educator looks at the organization as a system. In this context, the interplay of human factors is highly significant but often denied or ignored.

Considering the Messages Behind Decision-Making Models.

As seen in Table 2, viewing three major decision-making constructs will highlight ways in which decision-making can be perceived and interpreted (Hellriegel, Slocum, & Woodman, 1998).

The rational model maximizes benefits to the organization by selecting from among thoroughly analyzed alternatives. All choices, individual and organizational, benefit the entire organization, and use evaluation criteria developed early in the process (Hogart & Reder, 1986). In addition, maximum emphasis is placed on logical thinking (Vos Savant, 1996). Assumptions explicit in the rational model include that complete information about alternatives is available; alternatives can be ranked according to

Table 2. Three Major Constructs of Decision-Making.

	Judicious / Scrupulous Rational*	**Rational Bounded Rationality***	**Pragmatic Political***
Emphasis	Maximize benefits to the organization	Recognize limitations of rationality	Individual personal interest
Perspective	Use logic for comprehensive problem definition	Review actual processes for reasonable goals	Preferences established early
Data Evaluation	Exhaustive consideration of alternatives. Early definition of evaluation criteria. Uses computer-aided techniques	Use reality to "satisfice," searching stops when something acceptable is found. Selects the less than best choice	Personal self interest dominates
Preference	Thorough data collection and analysis	Limited search for alternates	Early preferences seldom change
Explicit Assumption	Complete information is available Alternatives can be ranked Organization to get max benefit	Complete information may be impossible to attain. Inadequate control of forces or outcomes	Use distortion, deception
Implicit Assumption	Unbiased information exchange	Pyramid of approaches Ranked criteria	All is done to tilt bias
Ethics	No ethical dilemmas	Ethical dilemmas possible	Ethical dilemmas not allowed
Styles	Means and Ends Utilitarian	Avoids "Paralysis by Analysis" and "Extinction by Instinct"	Hedonistic, Conventionalist Might equals Right
** Reference:*	*Hogart & Reder, 1986; Garvin 1993; Vos Savant, 1996.*	*Gigerenzer & Goldstein, 1996; March, 1994; Schoemaker, & Russo, 1993.*	*Galbraith & Merrill, 1996.*

objective criteria and the alternative selected will provide maximum gain for the organization. Implicit assumptions include that ethical dilemmas don't exist and that the means-to-an-end and utilitarian principles dominate ethical considerations.

The well-defined steps of the rational model lend themselves to the use of computer-based technology. World leader Xerox takes advantage of this fact by providing hours of extensive training to decision-makers about how to use various computer-aided decision-making tools (Garvin, 1993).

The bounded rationality model tends to be less idealistic and tends to accommodate the limitations of day-to-day decision-making. It reflects individual tendencies to conduct limited searches for alternatives, make choices with inadequate information or control, and select the less-than-best solution, known as "satisficing" (March & Simon, 1993; Gigerenzer & Goldstein, 1996). Satisficing is the practice of selecting an acceptable goal, one easier to identify, less controversial and otherwise safer than the best-possible solution and very often reflecting the decision-maker's belief that it is reasonable to achieve (March, 1994; Simon, 1991).

Limited searches for possible goals occur when the search stops as soon as searchers find an adequate goal. If this one is good enough, why continue looking for more acceptable or ideal solutions? Inadequate information and inadequate control often result from calls for immediate action. Inadequate information about the consequences of the decision may result in unanticipated blunders or outrage. The decision-maker may follow a standard approach to ranking one criterion at a time even though a second or third criterion may have overriding importance (Schoemaker & Russo, 1993). Inadequate information and control also limit the ability to act between the extremes of "paralysis by analysis" or "extinction by instinct" (Pfeffer, 1994; Langley, 1995).

The political model occurs when the power hierarchy and self-serving interests dominate the process. Deception is a common result, with distorted figures often used to support predetermined preferences. These preferences seldom change even if analysis uncovers new information (Galbraith & Merrill, 1996). Definitions, searches and information exchange merely carry out the bias. This does not allow for ethical dilemmas, but draws upon the principles of hedonism, might-equals-right and conventionalism to maneuver legal practices, cultures or customs.

As noted, a further review of the McCall/Kaplan, Carroll/Johnson, and Mintzberg models shows a congruity of steps in each model. Making significant decisions is probably the most crucial managerial role within an organization. Decisions made within organizations range along a continuum from purely voluntary at one end, to involuntary and reactive at the other. Commonly faced problems fall within the middle of the continuum, and they lie between the entrepreneurial focus on voluntary action and the distribution handling efforts of the involuntary situation (Mintzberg, 1980).

Usually within the organization, the decision process is played out in actions, with each actor constituting a certain power over the whole process. In The Structuring of Organizations, (Mintzberg, 1979) describes power within the organization as control over actions, rather than control over decisions. And control over any step in the process constitutes a certain power over the whole process. Control over input information enables the selection of factors to be considered. The power to advise directs the decision down a certain path. Control over what happens after a choice has been made constitutes power, and of course, the right to authorize a choice is power to block or change it.

Any discussion of the maximized power and centralized control helps clarify and understand the decision process. When an individual controls all the steps, collects all the information, analyzes it, makes the choice, seeks no authorization, and executes the

job, the decision process is most highly centralized. In an organizational hierarchy, some of the power is lost to the information gatherers, the advisors, and the executors. With this in mind, and looking to the various forms of vertical and horizontal decentralization, power is transferred out, and a realm of informal power emerges. Most corporate decision-making is some form of selective and/or limited horizontal and vertical decentralization. Much of this is represented in terms or models and plans, with the model serving as an abstraction of reality, or as a set of causal relationships. A decision model then is a decision process that is reasonably well defined. Normative decision-making models have been designed to prescribe a desirable procedure but do not necessarily describe the decision process itself (Gordon, Miller, & Mintzberg, 1975). This research of business decision models in the normative literature and the real world defined nine separate decision types. One of the selected types of commonly encountered decisions is the Distribution Channels Decision where defining target markets is the logical first step. But the remainder of the process had very cursory description in the normative literature, because of the variability from one firm to another, and the need for generality detracted from describing meaningful detail. So at best, the Distribution Channels Decision model echoed a very simplistic approach. The need for more meaningful detail necessitates the application of Mintzberg general model as the framework for this study.

The Mintzberg Model

Henry Mintzberg's model consists of three phases: (1) identification, (2) development, and (3) selection. In addition, each phase also contains separate operating routines.

Identification. The first phase contains two separate and distinct routines: decision recognition and diagnosis .Decision recognition takes place as players recognize opportunities, problems and crises. Strategic decision-making exploits opportunities as well as reacts to problems and crises.

Selecting a delivery system for continuing professional education serves as an example. The process of choosing the system inextricably intertwines at least six of the seven central routines, with recognition most prevalent. What dictates the moment of action, if we consider how each element applies to Continuing Professional Engineering Educators, as they go about selecting technology for program delivery? The determining factor may be the relationship between the cumulative amplitude of stimuli and a predisposed action threshold. The amplitude of each stimulus depends on a number of factors, including the influence of its source, the interest of the decision-maker in it, the perceived payoff of taking action, the uncertainty associated with it, and the perceived probability of successful outcome.

The second routine, diagnosis, occurs as managers seek to comprehend the evoking stimuli and determine cause-and-effect relationships. Some evidence exists that formal diagnosis most commonly occurs when dealing with mild problems, but diagnosis need not be a formal, explicit routine. In many cases informal diagnosis is implicit and may not even be reported.

Development. The second phase, development, likewise contains two routines. The first is search; the second is design.

Search, which uses ready-made solutions, is a hierarchical, stepped process categorized into four types:

1. Memory search, scanning of existing human memory or documentation.
2. Passive search, waiting for unsolicited alternatives to appear.

3. Trap search, defining explicit terms for a solution.
4. Active search, directly seeking alternatives.

Initial failure in the search routine leads to use of more active search procedures and to searching in more remote, less familiar areas. Repeated failure in the search routine for acceptable ready-made solution results, if possible, in the design of a custom-made solution.

The second routine, design, develops custom-made solutions or modifies ready-made ones. Designing a custom-made solution is a complex, iterative procedure, beginning with a vague image of the ideal solution. A decision tree, with a sequence of cycles, may help by narrowing the focus until a solution crystallizes. Because design of custom-made solutions is usually expensive and time- consuming, organizations rarely spend resources on more than one alternative. In contrast, the cost of generating extra alternatives during the search routine is small. When relatively little design is involved, as in modifying existing solutions, organizations may develop a second candidate to compare with the first.

Selection. The final phase of the process is selection. Empirical literature suggests that selection is typically a multistage, iterative process, involving progressively deepening investigation of alternatives. Normative literature describes the phase in terms of three sequential routines: (1) determination of criteria for choice, (2) evaluation of the consequences of alternatives in terms of the criteria, and (3) making a choice. Mintzberg, however, described the selection phase in terms of: (1) screen, (2) evaluation-choice, and (3) authorization.

Screening reduces a large number of ready-made alternatives to a few feasible ones. A superficial routine, it eliminates what is infeasible rather than determines what is appropriate. Screening appears to challenge the appropriateness of new alternatives and

reduce all alternatives to those that can be stored and later used by time-constrained decision-makers.

The *Evaluation-Choice* routine enables investigation of feasible alternatives and selection of a course of action. Judgment, which appears to be a favored mode of selection because it is the fastest, most convenient and least stressful, allows one individual to make an arbitrary choice without explanation. In bargaining, a group of decision-makers with conflicting goal systems makes the selection, each *exercising* judgment. Bargaining routinely appears in the course of decision-making, typically when outside factors control the situation or when dealing with contentious participants and issues. In analysis, factual evaluation performed generally by technocrats is followed by managerial choice, then by judgment or bargaining. The normative literature emphasizes the analytic mode, clearly distinguishing fact and value in the selection phase. The normative literature postulates that alternatives are carefully evaluated, with factual consequences determined to meet certain goals or values, and then combined according to some choice to maximize utility. A more pragmatic view sees the analyst presenting factual analyses of the consequences of various alternatives to the manager, who subsequently determines tradeoffs and makes a choice.

By far, most literature has focused on the evaluation-choice routine, although Mintzberg's analysis indicates this routine appears to *be* less significant than diagnosis or design. Particularly in the case of the custom-made solution, evaluation-choice often occurs as a kind of process trimming by ratifying a solution already determined explicitly during design and, in part, implicitly during diagnosis. The raw data, presumably facts and values, are injected indistinguishably into a mind or a group meeting, and a choice emerges later. In this context, evaluation and choice are inextricably intertwined.

Authorization validates the decision-maker's choice at a higher level in the hierarchy. Decisions are authorized when the individual making the choice does not have the authority to commit the organization to a course of action. The decision must follow a tiered route of approval up the hierarchy and perhaps also out to other parties who have the power to block it. Typically, decision-makers seek authorization for a completed solution, after final evaluation and choice. Authorization appears to be a typically binary process, either accepting or rejecting the whole solution. Acceptance leads to presentation of the solution to the next highest level if necessary; rejection leads to its abandonment or redevelopment.

The authorization routine incorporates difficulties greater than those found in evaluation and choice, for various reasons. Human factors almost always create the problems. Time allotted is typically limited. The decision must accommodate other strategic decisions and *overall* resource constraints. Outside political forces may affect authorization and authorizers may lack the in-depth knowledge required to defend it. Often, the people who provide authorization do not fully comprehend the proposals presented. Thus, the relative ignorance of the manager combines with the inherent bias of the sponsor (Carter, 1971; Pettigrew, 1972). This explains why empirical studies of this kind of situation show it to be a somewhat distorted political process, far less analytical than the normative literature suggests it should be (Carter, 1971; Bower, 1970).

The foregoing describes human issues acting within the general model's flow. The process-supporting routines and dynamic factors, almost totally human elements, affect the overall scheme and strongly influence the environment in which decisions exist.

Decisions in an Environment of Human Factors

> Virtually every student of actual selection procedures agrees that the selection of strategic alternatives requires consideration of a great

> number of factors, most of them "soft," or nonquantitative; as a result they find that the evaluation-choice routine is in practice a crude one. A plethora of value and factual issues, few of them concrete, many involving emotions, politics, power, and personality must be considered. Dynamic factors and uncertainty further complicate this. Thus, the evaluation-choice routine gets distorted, both by cognitive limitations, that is, by information overload, and by unintended as well as intended biases. This has been found to apply to all the modes of selection, including analysis.
>
> (See Snyder & Paige, 1958; Ptifiner, 1960; Cyert & March, 1963; Feldman and Kanter, 1965; Soelberg, 1967; Whitehead, 1967; Stagher, 1969; Carter, 1971a & 1971b; Kakar, 1971-72; Newell & Simon, 1972.)
>
> Mintzberg, Administrative Science Quarterly, 1976

Decision support consists of three routines that support all phases of decision-making. They can be classed as: (1) control, (2) communications, and (3) politics. Control routines guide the decision process itself. Communication routines process necessary information. Political routines enable the decision-maker to achieve a solution in an environment of influencing or hostile forces. Metadecision-making controls the decision-making process itself, occurring when the decision-maker also plans the approach, allocates organizational resources and carries out the steps leading to the solution. Presumably, this happens when the decision-maker attempts to establish some preliminary boundaries, by determining a rough strategy and schedule for finding and developing a solution and an estimate of the resources required for developing the solution (Soelberg, 1967). Like so much else in strategic decision-making, these plans typically are informal and flexible, and are subsequently modified and clarified.

In Decision Communication Routines, Witte (1972) reveals that communication activities dominate every phase of unstructured decision-making. He delineates three communication categories or routines for general scanning of information used to: (1) identify decision situations, (2) built conceptual models, and (3) develop a general

database. Cyert, Simon and Trow (1956: 247) found that most communication time spent involved gathering information to investigate the consequences of alternatives.

Witte (1972) discovered that communication followed a U-shaped curve, most active toward the beginning and end of the process. In addition, the more people involved or interested in the outcome, the more time decision-makers spend disseminating information about its progress. This is notably true where authorization is a significant part of the selection phase rather than a formality.

Much normative literature about political routines confirms that political activities are key to strategic decision-making (Pettigrew, 1972; Carter, 1971; Bower, 1970). Business organizations emphasize internal political activities, while internal and external political pressures are found in public organizations (Gore, 1964). Political activities reflect the influence of individuals, inside or outside of the organization, seeking to satisfy personal and institutional needs. Their belief that they will be affected by the outcome ties them to the decision process. Their political activities serve to clarify power relationships in the organization, bring about consensus, and mobilize forces for implementing decisions.

Political activity generally manifests itself in bargaining among those with some control over choices. Efforts to reduce resistance later in the selection phase include disseminating information about the solution during the development and early selection phases. Resistance also decreases when potential dissidents participate in the development phase since it appears that if those with power are disregarded during development, they are likely to confront the process later. Gore (1964), Carter (1971), Bower (1970), and Pfifner (1960) called these approaches behavioral, persuasion and co-option routines. The more important and contentious the decision's outcome and the more the influence over

choice rests outside of the organization, the greater the emphasis on selection and communication in general, and bargaining and persuasion routines in particular.

A Prevalence of Dynamic Factors

> One gets the picture of everything chasing after everything else, trying to adjust to it...
>
> Delsing, 1967

Decisions do not follow a steady, undisturbed progression from one routine to another. Instead, the process is dynamic, operating in an open system that features interference, feedback, dead ends and other factors. Although dynamic human factors are the most characteristic and distinguishing features of decision process, they hardly receive mention in the literature (Mintzberg, Raisinghani, & Theoret, 1976).

Dynamic factors can delay the process, stop it and restart it. They can speed it up. They can create branches to new phases, cause cycling within one or between two phases, or recycling to an earlier point in the process. Mintzberg's view supports the conclusion that dynamic factors affect every decision element, not just individual elements, not even a combination or several combinations of several elements.

Dynamic factors have been classified into six groups largely inherent in the decision process itself (Mintzberg, Raisinghani, & Theoret, 1976): (1) Interruptions caused by environmental forces, (2) Scheduling delays and timing delays, (3) Speedups affected by the decision maker, (4) Feedback delays, (5) Comprehension cycles, and (6) Failure recycles.

Interruptions coincide with the discovery of unexpected new options and proposals that stimulate new development or selection activity. Some new options interrupt a process nearing termination, while others speed it up because the new option appears so preferable that participants terminate design and move immediately to final evaluation and

choice. Interruptions beget more interruptions. Interruptions of a political nature significantly delay strategic decision processes altogether.

Scheduling delays exist because of severe time constraints in the managerial environment. This often results in the breakdown of complex decisions into manageable steps that enable managers to schedule delays so they can attend to other tasks continually demanding their attention (Mintzberg, 1973). As a result, significant time delays often separate every step of the strategic decision process.

Experts have hardly studied timing, a major factor in strategic decision-making, probably because it appears to be largely a product of one manager's mind. Hardwick and Landuyt (1966) surveyed 183 books in the area of administration and found only ten that mentioned timing or surprise. Managers may purposely speed up or delay the process to take advantage of special circumstances, await support or improved conditions, synchronize action with another activity, effect surprise or gain time, but in general, they try to time steps for smooth execution. In competitive and hostile environments, with contentious issues, one can expect a greater incidence of timing speedups and delays. Examples include speeding up to beat a competitor to market and slowing down to wait for resistance to subside. In the study of crisis decision processes, Schwartzman (1971) found that managers sought delays by stalling, bluffing or finding temporary solutions to buy time.

During a feedback delay, the decision-maker waits for the results of the previous action. Many steps require reaction and each consumes time. In creative design processes, a period of incubation usually takes place before insight occurs (Lonergan, 1967). Thus, we would expect especially complex decisions involving insiders and outsiders to span longer time periods.

> Some have described decision-making as a groping, cyclical process, with factors causing recycling to earlier phases inherent to gaining comprehension.
>
> …the decision-making process is not linear but more circular; it resembles the process of fermentation in biochemistry rather than the industrial assembly line...
>
> Pfifiner, 1960

By cycling within one routine or between two routines, the decision-maker gradually comprehends complex issues. The decision-maker may cycle within the identification routine a number of times in order to recognize the issue or during the design routine may search through a maze of nested design and search activities to develop a solution. Decision-makers often cycle during the evaluation routine to understand the consequences of alternatives or between development and investigation routines to understand the problem (Delsing, 1967). They may cycle between selection and development routines to reconcile goals with alternatives or ends with means. The more complex and novel the strategic decision, the more likely it will involve the greatest incidence of comprehension cycles.

> Failure recycles are common. Decision processes sometimes stall for want of an acceptable solution. Solutions may be rejected as having insufficient payoff. They may encounter constraints they cannot satisfy. They may simply not appeal to those expected to authorize them. Faced with no acceptable solution, the decision-maker may simply delay until one appears, or modify criteria so that a solution previously rendered unacceptable becomes acceptable. Organizations faced with failure in finding or designing an acceptable solution may cycle back to the development phase. Given the failure of a solution, the decision-maker may first branch to remove a constraint and thereby make the solution acceptable. If this proves infeasible, the decision-maker may attempt to recycle to the development phase to modify the solution or create a new solution. In desperation, if resources will not permit a restart, the decision-maker may accept a previously unacceptable solution. (Mintzberg, Raisinghani, & Theoret, 1976)

Applying Mintzberg's Model

Mintzberg brought decision-making process elements into a common base, and developed them into his general model. The model delineates three distinct phases in the strategic decision process: identification, development, and selection, and describes the phases in a mainline of seven central routines: decision recognition, diagnosis, search, design, screen, evaluation-choice and authorization. Supporting routines and dynamic factors, critical to the model, are present in all unstructured decision-making.

The "main line" through the center of the model displays routines necessary for any decision. Recognizing need and evaluating and choosing a solution must happen or there is no problem and no need for a decision. Most decision processes involve development activity following recognition. Hence, there may be a branch from the main line into the search and screen routines to find a ready-made solution, or into the design routine to develop a custom-made solution.

A decision process may or may not involve formal diagnosis or authorization and many strategic decision processes involve interruptions of one kind or another. Mintzberg's model shows the three most common and also shows internal or political interruptions in the identification phase, where parties may disagree about the need for a strategic decision. Such interruptions come from within the organization and may lead either to cycling within the recognition routine to resolve disagreement or to political activity to remove resistance.

The model also shows external interruptions during the selection phase, where outside forces block the selection of a fully developed solution. These typically lead to design modification, complete redevelopment of a new solution or bargaining to confront the resistance directly. New option interruptions typically occur late in development or

during the evaluation-choice routine. These send the process back to design, to elaborate or modify the new option, or directly to evaluation-choice, to select or reject it immediately.

Finally, the model shows an inherent delay, in the form of a broken line, at the end of each routine. This reflects the fact that scheduling, feedback, and timing delays usually separate every step in the process. This model does not show the supporting routines, except for bargaining as a mode of selection, although decision control, communication and political routines can occur together with any or all of the routines it shows.

This general model, obviously complex, resulted from rigorous and intense analysis and study of the decision-making process. It has withstood scrutiny and review, and remains tested and proven. Decision-making has also been described as "strategic planning," with identified areas of concentration for further research (Mintzberg, 1994).

Behavioral Influences on Individual Decision-Making

Many behavioral influences have an impact on the decision-making process, but four in particular have a significant impact: values, personality, propensity for risk and potential for dissonance (disagreement).

Theoretical, economic, social, political and religious values, which are acquired early in life and intrinsic in an individual's thoughts, often guide choices and have a profound effect on all parts of the decision-making process (Harrison, 1975). Values dictate the individual's economic, legal and ethical responsibilities (Strong & Meyer, 1992) and decision alternatives very often primarily implement managerial values (Keeney, 1994).

Personality variables serve as one of the most important psychological forces influencing decision-making. Although Renwick and Tosi (1978) considered situation and interaction variables, they concluded that one person could not be equally proficient in all steps of the process, that intelligence was usually associated with certain steps in the

process, and that factors such as gender and social status profoundly influence the process. One study has indicated that the decision-maker's personality traits actually combine with situational and interaction variables to influence the decision-making process (Radford, Mann, Ohta, & Nakane, 1991).

A person with a high aversion to risk will tend to make choices only when certainty is high. Arbitrary decisions made by instinct denote a low aversion to risk, and over-reliance on numbers and analyses denote a high aversion to risk. (Langley, 1995). Individuals acting alone as compared to participating in a group will generally behave less boldly and with less innovation, and will take less risk.

More recent attention has focused on the decision itself and not on what happens afterwards (Gibson, Ivancevich & Donnelly, 1988). In 1957, Festinger referred to post-decision anxiety as cognitive dissonance, characterized by doubts and second thoughts about the choices made. Researchers currently refer to this as regret (Larrick & Boles, 1995). Doubts and second thoughts prevail when the decision was relatively important and with a number of alternative solutions, each of which possessed favorable features. Since these conditions occur commonly in most business decisions, we can expect a great deal of cognitive dissonance or regret.

Techniques for dealing with a "wrong" decision include looking for positive information or distorting negative information to support the decision, taking a less favorable attitude toward other alternatives and emphasizing the positive aspects of the selected alternative (McGuire, 1960; Adams, 1961; Mills, Aronsen & Robinson, 1959; Holmes & Houston, 1974). Behavioral factors strongly influence the potential for dissonance, particularly values, personality, propensity for risk and potential for dissonance (Gibson, Ivancevich & Donnelly, 1988).

Human Factors

Human factors affect every decision. Decision support routines, embedded with human factors, have a cumulative impact on the decision-making process. Following is a summary of the human elements in decision-making (Figure 4).

Decision Control Elements
Metadecision making, preliminary steps, planning approach, allocation of resources, decision planning, switching, project management

Decision Communication Elements
Exploration, investigation, dissemination

Political Routines
Internal, external, influence of individuals, power relationships, bargaining

Dynamic Factors
Interrupts, scheduling delays, feedback delays, timing delays and speedups, comprehension cycles, failure recycles

Behavioral Factors
Implicit weightings, confirmation, soft, non-quantitative, value issues, emotions, politics, power, personality, dynamic, uncertainty, cognitive limitations, information overload, intended bias, unintended bias

Mintzberg demonstrated with his general model that conceptual structuring accommodates immensely complex and dynamic strategic decision processes. He described critical elements and routines, notably diagnosis, design and bargaining; about which we know very little because research has focused on the selection routines--the trimmings in the overall process. Diagnosis is probably the single most important routine because it determines, in large part and however implicitly, the subsequent course of action.

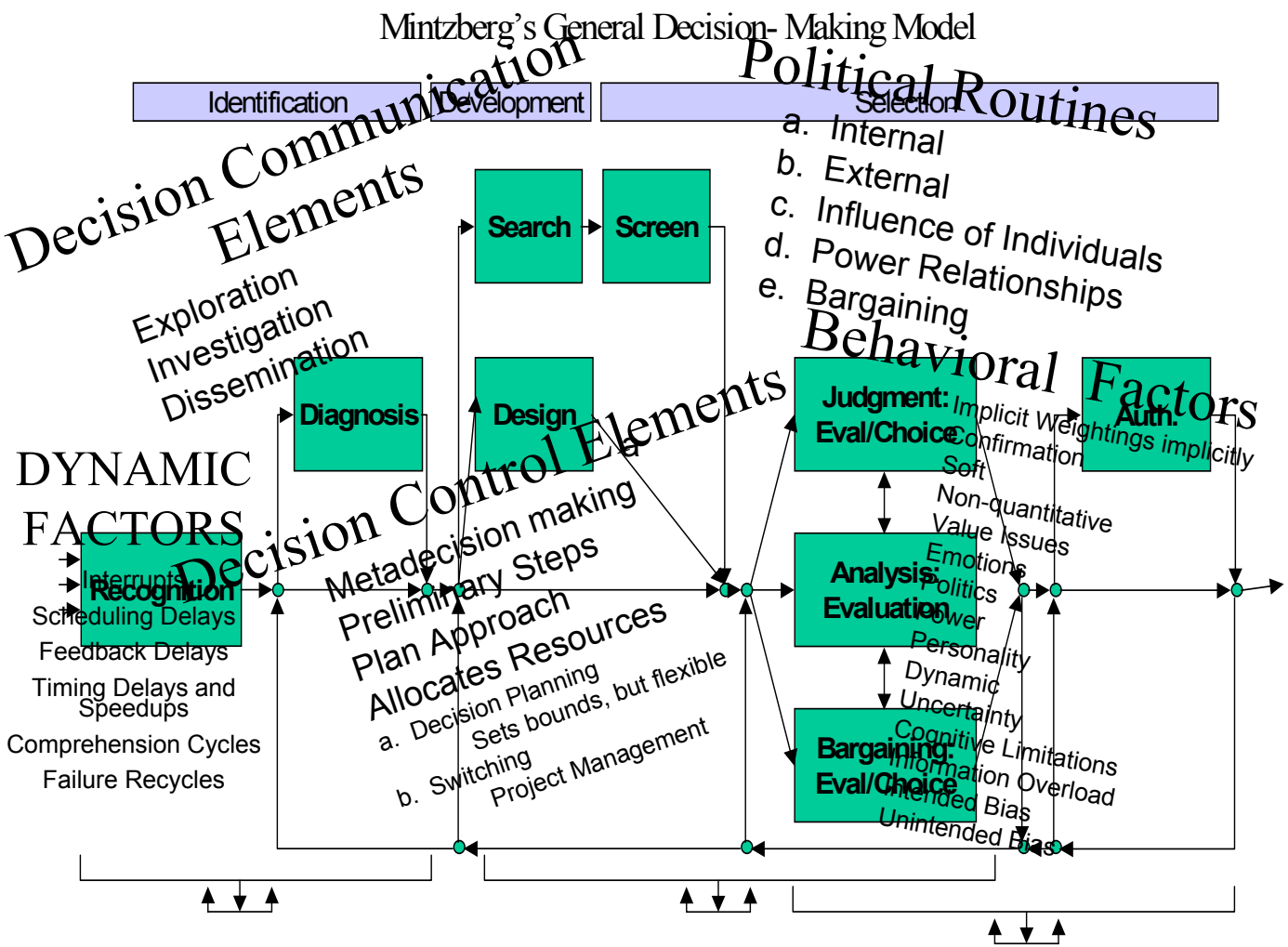

Figure 4. Human Elements in Decision-Making

Summary

The review of literature of this research project has been presented as a necessary foundation for understanding the data and experiences reported in the next chapter. Therein lies the intersection of vectors, with the Continuing Professional Engineering Educator interacting among multiple disciplines, yet immersed in the broader field of adult education. The responses reported here represent a unique study in a skills intensive learning environment that will add to the body of knowledge about technical education in the workplace and the engineering profession's quest for lifelong learning. When taken as a whole, the literature review leads to the following propositions.

1. Little is known about how Continuing Professional Engineering Educators make decisions with regard to teaching and learning.
2. Continuing Professional Engineering Educators view newer technological innovations as intrinsically better than the old.
3. Continuing Professional Engineering Educators do not focus on the process used to assess learning needs and provisions for continuing professional engineering education within their organizations.
4. Most high-level decisions produce no direct evidence of themselves, leaving corporate memories cloudy.
5. Meaningful differences of Continuing Professional Engineering Educator participation and involvement exist within the various company type models of decision-making.

Chapter 3

METHODS AND DESIGN

Introduction

This study identified the elements addressed by decision-makers and Continuing Professional Engineering Educators in high-technology businesses as they went about choosing delivery systems for employees' continuing professional engineering education (CPEE). Although decision-makers often equate "technology" with "goodness" and consider it an intrinsic improvement, little is known about how they make decisions with regard to teaching and learning. This study explored how Continuing Professional Engineering Educators view technological innovations and how they behave when selecting delivery media for their programs.

The study focused principally on the process used by these practitioners to identify human elements and soft issues, to analyze and assess learning needs, and to choose the delivery media. It addressed three specific research questions:

1. What are the key factors Continuing Professional Engineering Educators within the corporate training function consider when selecting, accepting, and implementing communication technologies for delivering CPEE?
2. Within the context of adult education, how do those decision makers within the corporate training function integrate educational, individual, and organizational goals and objectives into choosing the media relative to distance education theory and practice, and what is needed to support that technology?
3. What understanding do they have, or sense do they make, of these factors regarding the convergence of technologies, and the new learning approaches

(active, collaborative, inquiry-based, resource-centered learning) that have come to be associated with technology-based education?

The question of how continuing professional educators perform in such a complex environment connects with questions of meaning for participants. The research questions exploring these dynamics encompass specific inquiries including:

1. What are the key human elements?
2. What are the criteria for media selection?
3. How do salient elements change relative to rapidly emerging technologies?
4. How do elements change relative to varying company types?

Exploring the beliefs, actions, and reflections of decision makers provided insight into how they integrate the individual and the organization. The literature provides a context in which to examine these questions and the behavior of decision makers with regard to adult-learning and continuing-professional models. Mintzberg (1976) structured complex and dynamic decision processes within a common base. He described little known elements and routines and concluded that selection routines merely dress the overall decision process. Mintzberg identified decision-support routines with an impact on the process – routines occurring off the main line of the process and containing the soft issues that guide the process and its routines. Therefore, because those elements create the dynamics of the overall scheme, and strongly act upon and affect the entire process, Mintzberg's process is used as the framework for this study.

Strategy for the Research

Before describing the five-step research process, a brief discussion outlines the research method. Not everything of importance in this technological age can be reduced

to numbers, the grist of intelligence. Analysis by nature provides the meaning behind the numbers, the meaning that reveals new truths or validates previous insights.

Quantitative research has endured in the social sciences, accepted as objective, repeatable, generalizable, and driven by hypothesis. At the same time, the qualitative approach offers equally valid and valuable results. In qualitative research, names are used, observations are discussed, contrasts and similarities are uncovered, information is free-flowing; and very often it is only a tiny piece of the integrated whole.

For these reasons, this study used quantitative and qualitative approaches. Quantitatively, the tabulated responses provide discrete data that respondents can react to and reflect upon. In this way, they can inject meaning into their experiences. Deep truths often rest deeply imbedded, difficult to probe with a purely quantitative approach. Consequently, this study remained open, subjective, and personal by design – not to compare research approaches but to gather nominal data and seek for the meaning inexorably inherent there.

Qualitatively, the identified and manipulated variables produce reliable data. Consequently, reactions to this data in individual reflective interviews provide further insight into the whole phenomenon under study.

Researcher's Perspective

The researcher's personal goals and objectives influenced the decision to use quantitative and qualitative research methods. The researcher used both perspectives to observe the continuing education endeavors of NTU Advisory Board members, through their experiences and through their characteristics, to discover new and significant insights. The position of the represented organizations in the marketplace gave ample cause to collect measurable data and to conduct personal conversations. The researcher's experience as a registered professional engineer and certified manufacturing engineer with

more than 30 years of experience in high-technology manufacturing also contributed to the decision to use two research methods in combination.

In 1979, after two years of serving as manager of production and engineering for a medium-sized electronics manufacturer, the researcher made a career change into advanced manufacturing development. Recognizing that manufacturing systems development rested on the foundation of innovative professional development, he instituted continuing education courses to meet the needs of the working engineers. His affinity for continued professional development grew and the company's chief executive officer later validated this interest by transforming "corporate training" into an acclaimed learning organization, including a formal engineering education and development center.

The center directed an in-service learning program for more than 2,000 engineering professionals. The researcher served as course developer for 33 programs that constituted a three-part curriculum of core, specialized, and focused courses. The curriculum eventually grew to 130 course offerings each year. By 1991, the company had 4,000 scientists, engineers, and technicians in 165 sites in the U.S. and 27 other countries (Guisti, Baker and Graybash, 1991). Distance education techniques met the need to address mounting costs, provide courses in the broad range of engineering topics, and deliver high-impact information as quickly as possible to as many engineers as possible. As the company gained experience with this new approach, the use of satellite-based technology also grew and demonstrated the great potential of this technology.

It was then that the researcher learned about the work of Dr. Lionel V. Baldwin, professor and founder of the NTU, which focused on global sharing of educational resources. The NTU had received accreditation from the Commission on Institutions of Higher Education of the North Central Association of Colleges and Schools, and consequently each of 48 participating universities now offered engineering education

using the NTU satellite. The author's company was now able to receive graduate-level courses directly to its download sites for distribution via videotape to all engineering locations. Videotaped courses enabled students to learn at their convenience. The researcher's company joined the NTU's ranks.

The researcher's relationship with the NTU and visits to its home in Fort Collins, Colorado, provided the opportunity to meet Dr. Baldwin. This relationship fostered the researcher's interest in, and enhanced knowledge of, continuing professional engineering education. He soon became a member of the NTU's industrial Advisory Board. As the researcher began the process of designing a graduate research project in adult education, his strong connections to the field of continuing professional engineering education and the NTU Advisory Board converged to form the seed for this study.

While attending board meetings hosted by member corporations and discussing issues with board members in person, by e-mail, and telephone, the researcher developed an emerging research question – how did the other NTU Advisory Board members go about making the decision to choose the university's satellite-based programs. Further investigation revealed the validity of the question and determined a workable research process (taking into account travel demands, cost, and time). Visiting other corporations and touring their facilities heightened the researcher's enthusiasm for the prospective study and provided first-hand awareness of the challenges he faced.

Further based on this preliminary field information, the researcher undertook intensive research and reflection about continuing professional development. Reviews of research reports stimulated new perspectives on the research questions and the practice of adult education in general. This process further informed the appropriateness of combining quantitative and qualitative approaches.

Dr. Baldwin's support finalized the decision to continue. His letter of introduction about the project opened many doors. The researcher's association with Dr. Baldwin and other advisory board members validated the project. This strategy is consistent with the overall nature of qualitative research and with the idea that common ground, trust, and respect play an essential role in effective interview research. Interaction privately and in board sessions set the stage for open and flowing discussion of research issues.

The researcher followed university guidelines in seeking approval for research involving human subjects, including informed consent forms (Appendix A). The researcher also developed an interview guide detailing the inquiry's scope through schedules of questions. He recorded individual interviews on standard audio micro cassettes for transcription and analysis.

Research Approach

In this study, a survey collected fundamental data. The survey of key decision-makers in a purposive sample of 20 leading high-technology Fortune 500 companies occurred in five steps (Appendix B). Participation in this research included an interview with the president of the National Technological University (NTU), completion of a written survey of questions by appropriate members of the NTU advisory board, and individual reflective interviews addressing open-ended questions. Respondents were offered the opportunity for further in-depth discussion regarding their responses. Detail regarding the five steps follows:

Step 1. An interview of the president and founder of the National Technological University, using a guideline of interview questions with the objective of soliciting his perceptions and gathering information related to program delivery methods, techniques, and considerations.

Step 2. Pilot testing of the survey instrument using 10 CPEEs selected from industry and academia. The researcher contacted each of the pilot panel participants, explained the purpose of the pilot test, explained the purpose of the study and the questionnaire, and asked their assistance in completing and critiquing the questionnaire. Revisions made on the basis of the pilot test feedback were completed and coordinated according to university guidelines.

Step 3. A meeting with the advisory board to introduce the project and arrange subsequent personal, telephone, and e-mail contacts. Chapter 4 provides information about the difficulties encountered in locating past members of the board. In preparation for the study, NTU staff provided a current list of member names and addresses. Dr. Baldwin issued a letter of approval and introduction to the research project (Appendix C). The researcher issued a project opening announcement letter and e-mail to all known potential respondents. This first level evaluation offered participants interested in talking individually about their responses the opportunity to do by signing the request statement in the survey.

Step 4. Questionnaires (Appendix D) gathered by mail, telephone, fax, and e-mail. It was expected that the process would include the technique of using an initial letter of invitation to participate, and three follow-up reminders (Dillman, 1978). The follow up procedure began after a waiting period of two weeks.

Step 5. Open–ended questions derived from analysis of the questionnaires and comments to be addressed in individual reflective interviews. These questions sought to define and discuss technologies perceived to be the best match for delivering externally and/or internally provided competencies. They also asked participants to describe concerns, reservations, and perceived challenges of the past, the present, and the future. Further, they asked participants to reflect on the

human, economic, engineering, and environmental factors at play when selecting, accepting, and accommodating communication technologies for delivering continuing professional engineering education. Finally, they asked participants about their participation in the company's decision-making, and the decision-making environment within their corporations.

The Statistics Package for the Social Sciences provided aggregate numerical data concerning perceptions of CPEE issues, correlated factor value and frequency of use, established relative importance of factors affecting media selection, and gauged perceptions of emerging technologies. With regard to decision-making, the data defined CPEE involvement in the selection and development phases. Next, corporate characteristics described the decision-making settings in the various companies at the time the decision was made, and at the present. Finally, CPEE decision-making activities were compared within each company type.

Participants

Significant actors in the industry and in this study, identified by title, come from Fortune 500 companies with membership on the NTU Advisory Board. All take part in decision making with regard to the planning and programming of corporate engineering development programs.

1. Engineering Training Manager.
2. Distance Learning Manager.
3. Instructional Media Development Manager.
4. Director of Instructional Resources.
5. Graduate and Technical Degree Program Manager.
6. Human Resources Information Technology Coordinator.

These board members may have chosen to collaborate or confer with other appropriate persons in their organization who participated in the decision process, following the Dillman (1978) and Bradburn and Sudman (1983) techniques. Additionally, the study included an invitation to past member companies of the board to participate, because many had moved on in the years since the original decision was made. .

In 1998 and 1999, the NTU Advisory Committee included representatives from twenty-two major Fortune 500 corporations. All corporations are high-technology manufacturers, primarily engaged in producing electrical, electronic and telecommunications products. Most corporations represented have in excess of 10,000 employees, widely dispersed around the globe. All have been experiencing transitions brought about by the rapidly advancing growth and development of information technologies and telecommunications technologies and the waning economy.

The author followed university guidelines in seeking approval for research involving human subjects, including informed consent forms. In compliance with university guidelines, this study includes no company names or personally identifying information, and no identification of individual participant's comments appear in any communication outside the individual reflective interview group.

Data Collection Strategy

The study followed a five-step process. In the first step, the president and founder of the National Technological University responded to the following questions, as a starting point for discussion:

1. CPEEs are having difficulties attracting and training working engineers to practice in their locations. What are the barriers, and what can be done to correct this problem?
2. What kind of CPEE activity can overcome the apparent disadvantage that working engineers experience compared to full-time students with regard to their opportunities to keep abreast of innovations and upgrades?
3. Do CPEEs have any plans regarding the future of their practice of professional development and, if so, what are they?
4. How do CPEEs affect the selection of advanced educational programs and the media used to deliver them?
5. What are some of the concerns and plans NTU has for supporting the advanced educational needs of working graduate engineers?
6. What do you see as the major problems in CPEE today? Original decision time? Five years ago? Five years from now?
7. What kind of information is available that details the type of CPEE activities in which major corporations participate?
8. What are the major sources of educational programs available to working engineers?
9. What do CPEEs do to advance educational and telecommunications technologies to deliver instructional programs to working engineers at their work sites?
10. How do CPEEs go about integrating educational, individual, and organizational goals and objectives when making educational program delivery decisions?

After this interview, a pilot test of the five-page questionnaire (second step in the process) used ten CPEEs from industry and academia. Step three included meeting with the board, explaining the purpose of the study, and making arrangements for future contact and coordination.

Survey Instrument

Step four surveyed the 20 board members using a five-page, seven-part questionnaire (Appendix D). They had the option to return the questionnaire by mail, telephone, fax, or e-mail. Most chose e-mail, but the group used all four options. The questionnaire contained 45 questions in 7 parts and took about 25 minutes to complete.

Part I: Professional Information

Part II: Perceptions of Continuing Professional Engineering Education Issues (Select most important and least important issue, plus three program development questions, indicating agreement on a Likert scale)

Part IIIA: Comparing Factor Value and Frequency of Use (Rate importance of media match factors, then state how often each is used, nine questions on Likert scales, to be correlated)

Part IIIB: Relative Importance (Rate importance of media selection factor, nine questions on a Likert scale)

Part IV: Perception of Distance Education Emerging Technologies (State degree of agreement regarding telecom technology, six questions on a Likert scale)

Part V: CPEE Involvement in the Selection Phase of Decision Making (Rate agreement with participation, then rate level of involvement, four questions on Likert scales, to be correlated)

Part VI: CPEE Involvement in the Development Phase of Decision Making (Rate agreement with participation, then rate level of involvement, four questions on Likert scales, to be correlated)

Part VII: Establishing Some Defining Activities (Selecting descriptive characteristics of decision environment, seven questions, to identify company type)

Following the Total Design Method approach with a protocol of steps, events, and follow-up reminders, this instrument had a response rate of 82% (Dillman, 1978).

Individual Reflective Interviews

Prior to step five, analysis and summarization of the returned questionnaires resulted in open-ended questions as follows:

1. What was the basis for selecting the media? Defining learning needs? Instructional needs? Professional expertise? Technical expertise? Available budget?
2. How did costs affect your selection of the media? Because it cost more? Was more glamorous?
3. What were your selection criteria?
4. What other factors do you think CPEEs consider when selecting, accepting and accommodating communication technologies for delivering continuing professional engineering education?
5. In the last five years about how many advanced educational needs programs has your organization implemented? Developed?
6. Please describe your course delivery system(s).

7. How was/is data gathered to determine training requirements, or needs analysis? At original decision time? Five years ago? Today? (i.e., is it formal or informal? What are data sources?)
8. What factors were/are used to prioritize development needs? Five years ago? Today? (i.e., cost, corporate performance metric, increased productivity, etc.?)
9. Once a training need has been identified, how were/are training materials and courses developed? At original decision time? Five years ago? Today? (i.e., do you have internal resources? Who in your organization is responsible for the pedagogical theory that goes into your training materials? Is that person part of the decision-making process on technology based programs? What type of expertise would you have consulted in the process?)
10. How would the factors be different in making that selection decision today? (i.e., years, number of employees, number of programs, variety of technology used, etc.?)
11. If I were trying to initiate a telecom media delivered course, what advice would you give me? Five years ago? Today?
12. What is the factor that <u>most influences</u> the selection of a delivery medium?
13. What is the factor that <u>least influences</u> the selection of a delivery medium?

Interviewees were also given the opportunity to discuss, clarify, or add to the survey by mail, telephone, fax or e-mail.

<u>Interview Procedures</u>

All of those who participated in the individual reflective interviews were long-term associates who share similar characteristics, interests, and desires for their profession with the researcher. They proved highly eager to enter into discussion about their experiences.

Based on preliminary field information, original plans included a focus group session of five to six participants scheduled to coincide with an Advisory Board meeting. However, during the initial meeting with Dr. Baldwin, the researcher learned that waning economic conditions precluded future board meetings and that further business would take place via teleconference and e-mail.

Fortunately, the researcher did attend a final board meeting at a company site in Oklahoma to present and explain the research topic and its objectives, and to gain permission from the remaining current members to communicate through mail and electronic means. Since communication with board members would proceed through these means, the original focused-group-based protocol required alteration.

University guidelines again directed protocol changes. With participants located in Arizona, California, Minnesota, Pennsylvania, New Jersey, and Texas, it seemed fitting to engage in separate reflective interviews rather than gather everyone together in one location or to use a complex teleconference.

The researcher conducted and audio-taped face-to-face interviews separately at various locations, including professional offices, homes, or neutral locations such as a bookstore lounge. Audio-taped telephone interviews occurred with the permission of the interviewee using a telephone recording control.

Data analysis of the interviews consisted of three elements:

1. While transcribing the tapes, the researcher compared the research paper with the content of the interviews.

2. The researcher compared data to relevant literature and the flow and intent of the interview guide.

3. The researcher structured the data and coded it into categories or groupings, and then cross-referenced the information to the research questions.

Multi-level analysis of the data produced reliable findings directly related to the research question. The researcher's personal involvement and the CPEE professionals remains consistent with the intuitive and subjective nature of qualitative research (Merriam and Cunningham, 1989).

Data Analysis

Statistical Package for Social Sciences provided computation for aggregate, counts, crosstabs, descriptives, and factor analysis. Survey instrument calculations included:

Part I: Professional Information

Part II: Perceptions of Continuing Professional Engineering Education Issues Mode

Part IIIA: Comparing Factor Value and Frequency of Use
Mode and Kendall's Tau Correlation

Part IIIB: Relative Importance
Mode

Part IV: Perception of Distance Education Emerging Technologies
Mode

Part V: CPEE Involvement in the Selection Phase of Decision Making
Mode and Kendall's Tau Correlation

Part VI: CPEE Involvement in the Development Phase of Decision Making
Mode and Kendall's Tau Correlation

Part VII: Establishing Some Defining Activities
Descriptives and crosstabs

Summary

This chapter discusses the framework used in conducting the research project. It begins with an overview of the research design and describes each of the steps in detail. It discusses the aspects of applicable quantitative and qualitative research, the approaches, data collection strategy, instruments, and techniques used in this study.

The following chapters contain the data, analysis, and interpretation.

Chapter 4

REVIEW AND ANALYSIS OF DATA

Identifying and Locating Respondent Corporations

In 1998 and 1999 the National Technological University (NTU) advisory board consisted of 22 high-technology manufacturing members located throughout the U.S. Early investigation identified 33 entities having served as advisory board companies, but further work soon revealed that 11 did not fit the target study group. Five were eliminated as having been reorganized, restructured, downsized, shred-offs or start-ups. Three were educational, course content, or equipment suppliers, and three represented service and professional organizations. This decreasing number of candidate companies indicates how corporate acquisitions, restructures, and downsizing have had an impact on those chosen for study. As shown in Table 3, the remaining 22 companies fit the target as high-technology Fortune 500 manufacturers.

Intentions were to distribute surveys to 22 corporations (the total number of eligible qualified survey participants). Of these, two companies could not locate an appropriate continuing professional engineering education (CPEE) decision maker who participated in selecting the NTU satellite delivery method. The companies had undergone multiple significant organizational, structure, and personnel changes that no one was knowledgeable about the selection decision or the location of the appropriate person or persons. Furthermore, recently assigned education managers were unfamiliar

Table 3. NTU Advisory Board: Eligible High-Technology Fortune 500 Manufacturers..

Item		Number of Companies
Total number of past and present companies having served on the NTU Advisory Board		33
Number of companies not in high-technology manufacturing target study group		
Reorganized, restructured, downsized, start-up or shred-off companies	5	
Educational suppliers, course content suppliers and equipment suppliers	3	
Service and professional organizations	3	11
Eligible high-technology manufacturers target study group		22

with the subject decision topic, indicating a lack of corporate memory. For the foregoing reasons, only 20 decision-making CPEEs fit the pattern of eligibility to participate. These 20 would be asked to reflect on their decisions, and to relate their roles in the process. As shown in Table 4, the final study group represents only 20 decision-making CPEE respondents.

Worthy of note is that only eight of the 20 identified knowledgeable CPEEs remained in decision-making or in other continuing education jobs within the same company. Of the eight identified knowledgeable CPEEs, two had made significant site relocations throughout the corporation during subsequent years, causing considerable searching to find their location. Of the other 12, five had moved on, relocating to other

Table 4. NTU Advisory Board: Identified CPEE Decision-Makers.

Item	Number of Companies
Eligible high-technology manufacturers target study group	22
Company CPEEs unfamiliar with subject decision topic; company experienced multiple organizational structure and personnel changes	-2
Total study group of identified and knowledgeable CPEE decision-makers	20

industries, organizations, or private practice. Three CPEEs left industry through planned or early retirement; and two repositioned themselves to educational institutions. Two CPEEs elected not to participate in the study. They excused themselves from participating by indicating that too many changes in personnel, job descriptions, corporate structures, or life changes made it impossible for them to provide meaningful responses. All of the forgoing reasons indicate a high degree of mobility and a subsequent lessening of corporate memory. Eighteen of the 20 CPEE decision-makers completed the survey, a 90 percent response rate. Dr. Baldwin's introductory letter of support for this research project certainly contributed to the high response rate. Several respondents expressed great respect for Dr. Baldwin as a renowned educator "who changed the face of American education in profound ways." And others agreed they often think "well and warmly about the work we did with Lionel on the NTU advisory board."

As shown in Table 5 below, eighteen of the twenty identified CPEE decision-makers participated in this study by reflecting on their delivery method decision, and by openly discussing their involvement in the decision process with the author.

Table 5. NTU Advisory Board: Current Status of CPEE Decision-Makers.

Item	Number of Companies
CPEEs remaining in decision-making or similar roles within the same company	8
CPEEs relocated to other industry, organization, or private practice	5
CPEEs leaving industry through planned or early retirement	3
CPEEs repositioned to educational institutions	2
CPEEs electing not to participate in study	2
Total study group of identified CPEE decision-makers	20

Although this response rate appears excellent, the study group was quite small, and a single response could significantly affect results. Nonetheless, the study group does constitute 82 percent of the U.S. corporations represented on the NTU advisory board and a solid cross-section of companies on the forefront of their industries. Because of the small size of the group, the study cannot fully represent decision making by CPEEs. It does, however, indicate patterns in how corporations such as these have selected new learning technologies in the past, and can provide hypotheses for future research.

From this study also comes the possibility that the tenure of a CPEE in a large organization may be shorter than anticipated. More consideration may need to be given to CPEE personal development. Less than half remained with the same organization over the studied time.

Analysis and Review of Findings

Professional and Biographical Data

Part I of the survey requested professional information about the individual CPEE and the company. Table 6 shows responses by job title, indicating that eight responding CPEE professionals held the title of Manager of Education and Training, five held the title of Engineering Training Manager, and five held specialist designations including, information technology, distance learning, and instructional and media development. In not one instance did an Engineering Manager also function as a CPEE professional.

Table 6. Number of Respondents by Job Title.

Job Title	Number of Respondents
Manager of Education and Training	8
Engineering Training Manager	5
Distance Learning Manager	1
Instructional Media Development	1
Director of Instructional Resources	1
Graduate and Technical Degree Program Manager	1
Human Resources Information Technology Coordinator	1
Engineering Manager	0
	18

All of the companies represented were large manufacturers. As shown in Table 7, only one employed fewer than 10,000 people.

Table 7. Number of Employees.

Number of Employees	Number of Respondents
More than 10,000	17
1,001-10,000	1
1-1,000	0
	18

Fourteen of the 18 companies made the media selection more than eight years ago, two made the selections between six and eight years ago, and three between three and five years ago. All had made decisions more than two years ago and not at the same time. (See Table 8.) This highlights a previously suspected problem with technology implementation – communication technology has advanced dramatically since companies chose the communication media they still depend on for continuing professional education. Responses indicated that most of those selected were high-technology manufacturers or makers of communication hardware and electrical and electronic equipment. Table 9 shows that 13 of the 18 fall within these categories, with one each in continuous processing, information services, aerospace, materials, and refining.

Table 8. Number of Years of Participation in the NTU Educational Process.

Number of Years	Number of Respondents
More than 8	14
6-8	2
3-5	2
1-2	0
	18

Table 9. Primary Line of Manufacturing.

Product	Number of Respondents
Telecommunications	5
Hardware/Equipment	5
Electronics/Electrical	3
Continuous Processing	1
Information Services	1
Aerospace	1
Materials	1
Refining	1
	18

When asked which media best deliver content and facilitates interaction, 17 respondents noted Internet use for content delivery and 13 noted it for facilitating interaction. Satellite delivery had similar numbers: 15 for content delivery and 10 for facilitating interaction. Responses were evenly distributed for the various kinds of communication media, as shown in Table 10.

Table 10. Uses of Telecommunications Technology for Distance Education.

	Deliver Course Content	Facilitate Interaction
Internet	17	13
Satellite	15	10
Video	14	6
CD/DVD	12	3
Audio	10	11

In summary, professional biographical data indicate that CPEE professionals participating in the study generally were managers of education and training in large high-technology manufacturing companies who make use of multiple media technologies and who have, among them, selected satellite program delivery. Additionally, experienced CPEE professionals remain in their function regardless of corporate changes, and have remained in the continuing education field even after leaving manufacturing roles.

CPEE Perceptions of Adult Education Issues Affecting Technology Selection

Part II gained input about the perceptions that CPEE professionals have about the issues that affect technology selection in program development. Questions 1 and 2 focused on 10 factors relating to selection, including: Objectives of the organization, Initial cost, Trained personnel, Anticipated use, Level of interactivity desired, Technological infrastructure, Legal considerations, Equipment compatibility, Users, Cost of operation. Respondents selected the single most important and single least important factors from among these.

Most Important

Respondents selected organizational objectives as the factor of highest consideration, with 56 percent rating this factor as very important (see Table 11). As will be noted later under Relative Importance of Selection Factors, combining very important and somewhat important categories, organizational objectives had an 89 percent rating.

Table 11. Factors Considered Most Important by Respondents.

Factor	Frequency	Percent
Objectives of the organization	10	56
Anticipated use	4	22
Initial cost	2	11
Trained personnel	1	6
Technological infrastructure	1	6
	18	100

Respondents chose anticipated use as the second most important factor in choosing communication media, with 22 percent rating it so. However, when combining the very important and somewhat important categories, anticipated use rated the same as organizational objectives (89 percent). These findings mirror that of other research (Chute, Hancock and Balthazar, 1991; Naisbit, 1984; Coldeway, 1986; Souder, 1995; Ferguson, 1997).

Trained personnel and existing technological infrastructure ranked lower among the top five in importance.

Least Important

Table 12 shows that legal considerations were by far the least important issue to CPEE professionals choosing technologies for program delivery. Close to half (44 percent) listed this as least important and only one respondent rated legal considerations as very important.

Table 12. Factors Considered Least Important by Respondents.

Factor	Frequency	Percent
Legal considerations	8	44
Level of interactivity desired	6	33
Trained personnel	3	17
Equipment compatibility	1	6
	18	100

Respondents chose level of interactivity as the second least important factor in communication technology selection, highlighting one reason for the previously noted even distribution of communication technology.

Relative Importance of Selection Factors

Part IIIB listed the same 10 factors relating to communication technology selection. Respondents then indicated a level of importance for each factor on the following scale: Very important, Somewhat important, Neutral, Little importance, Not at all important.

In this case, organizational objectives and anticipated use also rated highest in their responses. Respondents chose initial cost as the third most important selection factor. The existing literature points overwhelmingly to the conclusion that distance education using interactive electronic telecommunications media is effective, and evaluation research (Coldeway, 1988; Stubbs & Burnham, 1990) supports this.

Table 13 shows the number of responses and percent of total response for each factor, listed by perceived relative importance. Based on these responses, we can conclude that CPEE professionals rely heavily on return-on-investment educational programs – with organizational objectives, cost of operation, anticipated use of the application, and initial cost at the forefront of considerations. Legal considerations, level of interactivity desired, equipment compatibility, and existing technological infrastructure mean less to them, as previously noted. CPEE professionals almost all agreed that all 10 factors matter when choosing communication media. Only one stated that existing technological infrastructure was of no importance.

Table 13. Relative Importance of Media Selection Factors

Rank	Very Important		Somewhat Important		Neutral		Little Importance		Not at All Important	
	n	%	n	%	n	%	n	%	n	%
1. Objectives of the organization	11	61	5	28	2	11	0	0	0	0
2. Cost of operation	7	39	11	61	0	0	0	0	0	0
3. Anticipated use of the application	9	50	7	39	2	11	0	0	0	0
4. Initial cost	7	39	10	55	1	6	0	0	0	0
5. Learners/participants	8	44	7	39	3	17	0	0	0	0
6. Qualified training personnel	7	39	8	44	2	11	1	6	0	0
7. Technological infrastructure already in place	4	22	10	56	2	11	0	0	1	6
8. Equipment compatibility	4	22	11	61	2	11	1	6	0	0
9. Level of interactivity desired	4	22	6	34	4	22	4	22	0	0
10. Legal considerations	1	6	6	33	5	28	5	28	0	0

Scale: 1=very important; 2=somewhat important; 3=neutral; 4=little importance; 5=not at all important

Overlaying Table 11 (Most Important Factors) with Table 12 (Least Important Factors) over Table 13 (Relative Importance of Factors) reveals two factors not selected as either most or least important (Table 14). Noting that all 18 (or 100 percent) of respondents listed cost of operation as either very important or somewhat important, curiously this table further shows that none had selected cost of operation as the highest consideration.

In like manner, 15 respondents (83 percent) listed learners/participants as either very important or somewhat important but none selected this issue as either most important or least important. It is surprising that cost of operation did not appear on the list of most important when the respondents were asked to choose a single most important factor. Asking the question in a different manner by ranking elicited the response that cost of operation is of second importance following the objectives of the organization.

Comparing Factor Value with Frequency of Use for Distance Education

Selection of telecommunication technology for delivering CPEE distance education requires that the chosen medium most matches and/or satisfies a range of factors. CPEE professionals in this study stated their perceptions of the value of various factors in the decision-making process. After doing so, they then indicated the frequency with which they used those factors. Each was asked how important a specific factor was and then how often he or she actually used that factor in decision-making.

In this way, Part IIIA of the survey compared theory with practice for each of nine media selection factors, in other words, the perception of each versus the reality of each.

Table 14. Relative Importance vs. Most and Least Important.

Factor	Rank Relative Importance	Rank Most Important	Rank Least Important
Objectives of the organization	1	1	-
Cost of operation	2	-	-
Anticipated use of the application	3	2	-
Initial cost	4	3	-
Learners/participants	5	-	-
Qualified training personnel	6	4	4
Technological infrastructure already in place	7	5	-
Equipment compatibility	8	-	3
Level of interactivity desired	9	-	2
Legal considerations	10	-	1

The factors included in the research resulted from a blending of items listed by the Institute of Electrical and Electronic Engineers (IEEE) Transactions on Education in 1983; Saline in 1983; and Quinn in 1987. They were:

- Relevance of content to corporate needs
- Relevance of content to learner needs and desires
- Accessibility of the program to participants
- Specific learning objectives
- Climate for professional development
- Opportunity to use new learning on the job
- Expectations of the learner's manager

- Learning skills of individuals
- Application of adult education theory

Although the survey focused on these nine factors, it also offered respondents the opportunity to indicate their willingness to participate in follow-up discussions about their responses.

Factor Value. CPEE professionals indicated the importance of each factor on a scale indicating very important, somewhat important, neutral, little importance, not at all important. Table 15 shows the ranking of importance for factor values. Respondents selected relevance of content to corporate needs as the most important factor for media selection, with 78 percent rating the factor as very important. Combining responses for very important with somewhat important raises relevance of content to corporate needs to 100 percent. Similarly high ratings resulted for relevance of content to learner needs and desires (72 percent rating as very important and 100 percent when combining very important and somewhat important).

Accessibility of the program to participants received a 95 percent rating as at least somewhat important, with only one respondent gauging that factor as a neutral issue. The remaining six factors had a wider range of perceived importance, with at least one participant noting each as of little importance.

Application of adult education theory ranked last, considerably lower than any other factor.

Frequency of Use. The second part of each question focused on the frequency with which respondents use each factor when selecting communication technology for

Table 15. Ranking of Importance for each Media Selection Factor

Rank	Very Important		Somewhat Important		Neutral		Little Importance		Not at All Important	
	n	%	n	%	n	%	n	%	n	%
1. Relevance of content to corporate needs	14	78	4	22	0	0	0	0	0	0
2. Relevance of content to learner needs/desires	13	72	5	28	0	0	0	0	0	0
3. Accessibility of the program to participants	10	56	7	39	1	6	0	0	0	0
4. Specific learning objectives	9	50	7	39	1	6	1	6	0	0
5. Climate for professional development	8	44	7	39	2	11	1	6	0	0
6. Opportunity to use new learning on the job	6	33	11	61	0	0	1	6	0	0
7. Expectations of the learners' manager	7	39	7	39	2	11	2	11	0	0
8. Learning skills of individuals	2	11	12	67	3	17	1	6	0	0
9. Application of adult education theory	3	17	10	56	3	17	2	11	0	0

Scale: 1=very important; 2=somewhat important; 3=neutral; 4=little importance; 5=not at all important

delivering distance education programs. The frequency ratings included always, regularly, often, occasionally, and not at all. Table 16 shows the ranking for frequency of use for each of the nine factors involved in the decision-making process. Results show that accessibility of the program to participants ranks highest in frequency of use, followed by relevance of content to corporate needs and relevance of content to learner needs and desires (tied for second place). These three also ranked in the top three in the preliminary part of this two-part question. Likewise, application of adult education theory ranked last and much lower than the other factors. Climate for professional development and application of adult education theory received "not at all" frequency rankings by one participant.

Together, the results suggest a few noteworthy facts. The items consistently and overwhelmingly ranked highest in importance were used "always" only 28 percent of the time, but were used "regularly" 50%, with 17 percent using them "very often," and 5 percent "occasionally." At the lower end of the importance scale, application of adult education theory was used "regularly" by only 22 percent of the respondents, "often" by 33 percent, and "occasionally" by 33 percent. In other words, they participated less on those activities that were perceived less important perception of use and actual use did not always correlate. The factors climate for professional development, and application of adult education theory were done "not at all" by one participant.

Table 17 lists the correlation between the importance of a factor and its frequency of use. The relationship between the top two items of importance and the frequency of their use was not significant. Respondents did not note any strong relationship between

Table 16. Ranking of Frequency of Use for each Media Selection Factor

Rank	Always		Regularly		Often		Occasionally		Not at All	
	n	%	n	%	n	%	n	%	n	%
1. Accessibility of the program to participants	4	22	11	61	2	11	1	6	0	0
2. Relevance of content to corporate needs	5	28	9	50	3	17	1	6	0	0
3. Relevance of content to learner needs/desires	5	28	9	50	3	17	1	6	0	0
4. Expectations of the learners' manager	1	6	10	56	4	22	3	17	0	0
5. Learning skills of individuals	0	0	9	50	4	22	5	28	0	0
6. Opportunity to use new learning on the job	2	11	6	33	7	39	3	17	0	0
7. Climate for professional development	1	6	8	44	5	28	3	17	1	6
8. Specific learning objectives	4	22	5	28	4	22	5	28	0	0
9. Application of adult education theory	0	0	4	22	6	33	6	33	1	6

Scale: 1=always; 2=regularly; 3=often; 4=occasionally; 5=not at all

Table 17. Correlation of Importance and Frequency of Use

	Importance		Frequency of Use		Correlation	
	Rank	Mean	Rank	Mean	K-Tau	Number
Relevance of content to corporate needs	1	1.22	2	0.84	0.419	-
Relevance of content to learner needs/desires	2	1.28	3	0.84	0.353	-
Accessibility of the program to participants	3	1.50	1	0.77	0.495*	6
Specific learning objectives	4	1.67	8	1.15	0.742**	2
Climate for professional development	5	1.78	7	1.05	0.792**	1
Opportunity to use new learning on the job	6	1.78	6	0.97	0.485*	7
Expectations of the learners' manager	7	1.94	4	0.86	0.529*	5
Learning skills of individuals	8	2.17	5	0.92	0.590**	3
Application of adult education theory	9	2.22	9	1.16	0.589**	4

[a] Scale: 1=Very important; 2=Somewhat important; 3=Neutral; 4=Little importance; 5=Not at all important
[b] Scale: 1=Always; 2 =Regularly; 3=Often; 4=Occasionally; 5=Not at all
* $p<.05$
** $p<.01$

the two even though on the average they "always" include those items considered "very important."

Surprisingly, respondents demonstrated the strongest relationship between frequency of use and perceived importance for climate for professional development, specific learning objectives, learning skills of individuals, and application of adult education theory. (Significance of Kendall's Tau for their correlation is <. 589, with p value >.01.)

The conclusion we reach from these results: CPEE professionals do what they say is important to do, but they also use educational theory even though they perceive it to be of less importance.

Convergence of Technologies and New Learning Approaches

Part IV of the questionnaire addressed practitioners' knowledge and experience, and the contextual influences on their performance. As shown in Table 18, 95 percent of respondents agreed that the effects of technology on human learning increase when educators attempt to transform distance learning to just-in-time performance support. These findings are consistent with similar research (Kirkpatrick, 1987; Nowlen, 1988; Queeney, 1996 and 1999; and Hersey, 1994). Similarly, 94 percent of respondents agreed that educational, individual, and organizational goals play a significant role in the success of distance learning (supported by Schramm, 1977; Moore and Thompson, 1997; Simpson, Pugh and Parchman, 1991; and Lehman and Kinney, 1991).

Table 18. Convergence of Technologies and New Learning Approaches

	Agree		Neutral		Disagree	
	n	%	n	%	n	%
The need to understand the effects of technology on human learning and motivation is greatly increased when the educator attempts to move distance learning to just-in-time performance support	17	94	1	6	0	0
Educational, individual and organizational goals must be integrated to achieve successful results in distance education	17	94	0	0	1	6
Typically the systematic approach to program design results in a mix of the media, even though it may not be the best educational mix	13	72	4	22	1	6
The student's advanced educational needs can be effectively met using any medium	4	22	2	11	12	67

Seventy-two percent of respondents agreed that the best use of old and new technologies to meet students' learning goals is to combine them – even though it may not be the best educational approach. Likewise, 67 percent felt that the students' advanced educational needs could not be met effectively using just any available medium. A likely reason for this attitude may relate to the previously noted even distribution of communication media types by all companies. This suggests a topic for future research.

The Internet and the World Wide Web

From the perspective of distance learning, the Internet and the World Wide Web offer the most basic and powerful options for delivering education and training quickly and for updating it regularly. Survey findings (Table 19) show that 100 percent of the respondents agreed that these features have revolutionized distance learning by providing a convenient time and place for the learner to interact.

Similar research supports these findings (Walter & Reddy, 1987;Bates, 1995; Wagner, 1998, 1999; Gantz, 1997; Klesius, Homan & Thompson, 1997; Baldwin, 1997).

Despite this view, only 50 percent agreed that the Internet would become the technology of choice among CPEE professionals. Use of the technology was not a negative issue for respondents, but they felt that student-learning goals, instructional needs, professional and technical expertise, and available budget play a greater role. The previously noted concern about media choice (i.e., not just any medium will do) supports this concern about adult educational theory.

Table 19. Internet and the World Wide Web.

	Agree		Neutral		Disagree	
	n	%	n	%	n	%
The World Wide Web and the Internet's ability to deliver training quickly and update it regularly will revolutionize distance education	18	100	0	0	0	0
Internet courses offer the learner the convenience of time and place of interaction	18	100	0	0	0	0
Internet courses are becoming the technology of choice among CPEEs	9	50	9	50	0	0
Five years ago, program delivery medium decisions were best left to the external educational provider	9	50	1	6	8	44
Today, program delivery medium decisions are still best left to the external educational provider	0	0	3	17	15	83

CPEE professionals have played an integral role in the corporate learning organization at a time when more advanced media have emerged. Strong in-house education and training capabilities strive to remain abreast, even though, as Table 19 shows, 50 percent of respondents agree that five years ago, program media decisions were best left to the external provider (such as NTU). One respondent remained neutral on this subject, but 45 percent of the others stood on the other side of the fence in this regard. One of those interviewed illustrated the conflict in perspective:

> Did you know that [company] was one of the strongest supporters of NTU's satellite delivery method, yet they were already producing more video programs than Hollywood or Los Angeles, and were very deep in their own computer-based training?

During the initial interview phase, Dr. Baldwin predicted we would experience a great deal of difficulty finding the original decision-making CPEE professionals. In reality, only 8 of the 18 respondents remain and provide the CPEE function within the same or new parent company. Locating the other 12 took an investigation of forensic proportions, and 2 were never found.

Even when their location remained the same, their views about media choice had changed. When asked if program media decisions are best left to external providers now, 83 percent disagreed and 17 percent remained neutral. Another interviewee reveals how companies have taken decisions into their own hands:

> At [company], the company is using its own Web, which is a satellite delivery-on-demand scheme for sales and product training. This is a very clever way to use television and broadband delivery by satellite for the firm. I am sure they are using DVDs and digital storage for their own people to get their stuff locally. I see that as a kind of jump over the frustrations of the Web and a look ahead.

Participation in the Decision Process: Involvement of CPEE Professionals in the Development Phase

Specialists in the field of decision making have described the elements common to all decisions and have provide a framework for analyzing complex alternatives and consequences. The Mintzberg model used for this research is a flow chart of steps through three identifiable phases in an environment of routines and dynamic factors. In the first phase of identification, the decisions involved the needs analysis which identified the problem – to find a way to effectively deliver continuing professional education to working engineers. This research project takes a more macro view of the second and third phases of Mintzberg's model: development and selection – how these companies went about choosing to use the NTU satellite-delivery system..

CPEE professionals responded by selecting to what degree they agree with the statement that they *do not* participate in the design and development phase for choosing communication delivery media. Following this they gauged their level of involvement in design and development. As shown in Table 20, respondents agreed to the initial statement on a scale indicating strongly agree, agree, neutral, disagree, and strongly disagree. Table 20 reveals that 17 percent of respondents strongly agreed that CPEE professionals do not participate in the search and design process and 44 percent agreed that they do not participate. By combining the "strongly agree" and "agree" responses, the results indicate that 61 percent of respondents do not participate in design work. Combining the "disagree" and "strongly disagree" views shows that 28 percent do participate in the design process.

Table 20. CPEE Agreement about Involvement in the Development Phase of the Decision-Making Process.

N = 17	Strongly Agree n	%	Agree n	%	Neutral n	%	Disagree n	%	Strongly Disagree n	%
Development of a communications technology delivery medium is complex, expensive and time consuming. CPEEs usually do not participate in the search and design portion	3	17	8	44	1	6	3	17	2	11
When the delivery medium is ready-made, the CPEE makes the selection	2	11	8	44	3	17	4	22	0	0
When the delivery system requires a modification to an off-the-shelf system or product, the CPEE makes the modification	1	6	4	22	5	28	6	33	1	6
When the delivery medium must be custom-made, the CPEE makes the design	4	22	2	11	5	28	6	33	0	0

Scale: 1=strongly agree, 2=agree, 3=disagree; 4=agree; 5=strongly agree

Continuing the survey, respondents reacted to the appeal of three varying design levels for the chosen communication medium: a ready made off-the-shelf system, a modified off-the-shelf system, and a custom system.

Eleven percent strongly agreed and 44 percent agreed that they would select a ready made off-the-shelf system, while 22 percent disagreed with making this selection. Six percent strongly agreed they would choose a modified off-the-shelf system and 22 percent agreed. Thirty-three percent disagreed with making this choice. Twenty-two percent strongly agreed with choosing a customized approach, followed by 11 percent who agreed. Thirty-three percent disagreed with choosing a custom approach.

Based on these responses, one must conclude that CPEE professionals rarely participate in design, but if they did, they would probably choose a ready-made design. With the trend toward increasing modification and customization in corporate communication environments, one suspects these professionals will be less and less likely to participate in the design portion of the development phase. (Note that Tables 20 and 21 do not incorporate responses from one CPEE professional, new to the position and unfamiliar with how past decisions were made. This professional did not respond to Parts V and VI of the questionnaire, therefore N = 17.)

Table 21 shows CPEE professionals' level of involvement in the development phase. As shown in Table 21, they rated their involvement in the design and development phase on a scale indicating: made the design, very involved, neutral, consulted, and not at all. Twelve percent either made the design or participated in its creation, while 50 percent stated they played a consulting role. Twenty-two percent remained neutral and 11 percent indicated they did not participate at any level.

Table 21. CPEE Actual Involvement in the Development Phase of the Decision-Making Process.

N = 17	Made the Design n	%	Very Involved n	%	Neutral n	%	Consulted n	%	Not at All n	%
Development of a communications technology delivery medium is complex, expensive and time consuming. CPEEs usually do not participate in the search and design portion	1	6	1	6	4	22	9	50	2	11
When the delivery medium is ready-made, the CPEE makes the selection	1	6	9	50	2	11	5	28	0	0
When the delivery system requires a modification to an off-the-shelf system or product, the CPEE makes the modification	2	11	8	44	2	11	4	22	1	6
When the delivery medium must be custom-made, the CPEE makes the design	3	17	5	28	3	17	5	28	1	6

Scale: 1=made the design, 2=very involved, 3=neutral; 4=consultant; 5=not at all

In the case of choosing a ready-made design, six percent stated they made the selection, 50 percent were very involved in selecting the design, and 28 percent played the role of consultant.

When a design required modification, 11 percent said they made the modification, 44 percent were very involved in the modification and 22 percent acted as consultants. Six percent were not at all involved.

With custom design, 17 percent made the design, 28 percent participated, and 28 percent acted as consultants in the process. Six percent were not at all involved.

Based on these responses, CPEE professionals participated minimally in the search and design process but often served as consultants. Regardless, more than half (55 percent) participated in selecting ready-made or modified designs, and 45 percent saw themselves as very involved in the process of creating a custom design. Thus, when considering the search and design process, CPEEs get highly involved beyond consulting.

Table 22 shows the linear relationship between the variables of agreement and involvement. The high correlation between these two variables indicates that the stronger the agreement, the greater the involvement.

With regard to the view that CPEE professionals do not participate in choosing the design of a complex, expensive, and time-consuming medium for delivery, one must conclude that stronger the agreement with the statement, the less involved a CPEE professional can be expected to be (as borne out by the negative correlation between the two values).

Table 22. Correlation of Agreement About Involvement and Actual Involvement in the Development Phase.

	Level of Agreement Mean	Level of Involvement Mean	Correlation K-tau
Development of a communications technology delivery medium is complex, expensive and time consuming. CPEEs usually do not participate in the search and design portion.	2.44	3.39	-0.079
When the delivery medium is ready-made, the CPEE makes the selection	2.39	2.50	0.571**
When the delivery medium requires a modification to an off-the-shelf system or product, the CPEE makes the modification	2.94	2.50	0.402*
When the delivery medium must be custom made, the CPEE makes the design	2.61	2.61	0.492*

*p<.05
**p<.0 1

Agreement Scale: 1=strongly agree, 2=agree, 3=neutral, 4=disagree, 5=strongly disagree
Involvement Scale: 1=made the design; 2=, 3=, 4=, 5=not at all

Regarding the statement that CPEE professionals select ready-made systems, one must also conclude that the stronger the agreement with that statement, the more likely the CPEE professional is to be involved (as seen with the K Tau value of .571 and $p < .01$).

Similarly, the statement that a CPEE professional engages in the choice to modify or custom-make a design leads to the conclusion that the stronger the agreement with that statement, the greater the CPEE professional's involvement.

Based on these responses, a high degree of involvement takes place in design decisions, even though respondents stated they do not participate in the design process. This contradiction offers great potential for future study.

Participation in the Decision Process: Involvement of CPEE Professionals in the Selection Phase

The research continued with questions about participation in the selection phase for choosing communication media. This section followed the same pattern as the previous section gauging design involvement.

Respondents rated their level of agreement of their participation in activities defined in the Mintzberg decision model as screening, evaluation and choice, and authorization. CPEEs also rated their agreement with ultimate selection being made by more than one individual and including multiple goal systems.

Table 23 shows that 17 percent of respondents strongly agreed with the statement that CPEE professionals help to identify and screen feasible alternatives. A further 61 percent agreed. Combining both views results in a total of 78 percent agreement with the statement that CPEE professionals help identify and screen alternatives. With regard to

Table 23. CPEE Agreement about Involvement in the Selection Phase of the Decision-Making Process.

N = 17	Strongly Agree n	%	Agree n	%	Neutral n	%	Disagree n	%	Strongly Disagree n	%
CPEEs usually function in the screening portion by helping identify the feasible alternatives	3	17	11	61	1	6	2	11	0	0
CPEEs usually function in the evaluation and choice portion by participating in the analysis	5	28	9	50	1	6	2	11	0	0
CPEEs usually function in the authorization portion by having or sharing approval authority	4	22	9	50	3	17	1	6	0	0
Ultimate selection was by more than one individual and considered multiple goal systems	6	33	10	56	0	0	1	6	0	0

Scale: 1=strongly agree, 2=agree, 3=disagree; 4=agree; 5=strongly agree

evaluation and choice of alternatives, 28 percent strongly agreed that CPEE professionals participate in this activity, with another 50 percent agreeing. Combining the two categories results in a 78 percent positive rating in support of this statement.

Twenty-two percent strongly agreed that CPEE professionals participate in authorizing the chosen alternative, while 50 percent agreed. By combining the two views, we can conclude that 72 percent noted that CPEE professionals participate in authorizing the choice.

In a follow-up interview, one respondent expressed this concern about the selection process:

> For me to suggest that I chose [approach] over some other organization, it would have had to be over some administrative standpoint. It was the engineering manager as our identified subject-matter expert who made the recommendation for course content, as we did the screening to choose an external provider. But to me, I was still being 'very involved.'

The final question in Table 23 about selection gauged the level of agreement with the view that the ultimate selection involved more than one individual and considered multiple goals. Thirty-three percent strongly agreed and 56 percent agreed with this statement, for a combined result of 89 percent. Five percent disagreed with this statement, while none strongly disagreed.

Table 24 shows the CPEE involvement in the Selection phase by helping identify feasible alternatives. Seventeen percent said they made the selection, and 50% were very involved. Combining the levels above consulting 67% were involved in identifying alternatives, while only 6% remained in a consulting role.

Table 24. CPEE Actual Involvement in the Selection Phase of the Decision-Making Process.

N = 17	Made the Selection n	%	Very Involved n	%	Neutral n	%	Consulted n	%	Not at All n	%
CPEEs usually function in the screening portion by helping identify the feasible alternatives	3	17	9	50	4	22	1	6	0	0
CPEEs usually function in the evaluation and choice portion by participating in the analysis	3	17	10	56	2	11	2	11	0	0
CPEEs usually function in the authorization portion by having or sharing approval authority	2	11	8	44	2	11	5	28	0	0
Ultimate selection was by more than one individual and considered multiple goal systems	4	22	10	56	1	6	2	11	0	0

Scale: 1=made the selection, 2=very involved, 3=neutral; 4=consulted; 5=not at all

In the function of Evaluation and Choice, 17% said they made the choice, 56% were very involved, and only 11% served as consultants.

Regarding the function of sharing approval authority, 11% had total approval authority, and 44% were very involved. Combining all views, 55% shared authority in approving the decision. 28% acted as consultants.

The final question in Table 24 gauged CPEE participation in the view that ultimate selection involved more than one individual and considered multiple goals. 78% had taken part in the group decision, and 11% offered advice as consultant. There we no instances in any of the selection queries where a CPEE was not involved.

Based on these responses, we must conclude that as noted previously, CPEEs state it is important to be involved in selection, and they actually do it, with their actual involvement in all three selection activities at a significantly high rate.

Respondents participate in the various selection steps well beyond consulting, with most either making the selection or participating at a high level. Table 25 delineates the highly significant correlation between agreement with the statement in support of participation and actual involvement (K Tau >.7 and p <.01).

In other words, CPEEs practice an extremely high level of involvement when the company is screening, evaluating, and approving delivery media for their continuing educational programs.

Table 25. Correlation of Agreement about Involvement and Actual Involvement in the Selection Phase.

	Level of Agreement Mean	Level of Involvement Mean	Correlation K-Tau
CPEEs usually function in the screening portion by helping identify the feasible alternatives	2.00	2.06	0.764**
CPEEs usually function in the evaluation and choice portion by participating in the analysis	1.89	1.89	0.882**
CPEEs usually function in the authorization portion by having or sharing approval authority	1.94	2.44	0.697*
Ultimate selection was by more than one individual and considered multiple goal systems	1.67	1.94	0.784**

*p<.05
**p<.0 1

Agreement Scale: 1=strongly agree, 2=agree, 3=neutral, 4=disagree, 5=strongly disagree
Involvement Scale: 1=made the design; 2=, 3=, 4=, 5=not at all

Matching Decision-Making Model Characteristics

Determining the Distribution: Judicious, Rational, or Pragmatic

Three major decision-making constructs demonstrate the way in which individuals perceive and interpret the process of making decisions. The literature identifies these constructs as decision-making models, each with discrete characteristics such as style, ethics, implicit and explicit assumptions, perspectives, emphasis preference, and evaluation techniques.

These constructs serve as basic models that define decision-making theory. The literature refers to them as rational, bounded rational, and political models (Hogart & Reder, 1986; Garvin, 1993; Vos Savant, 1996; Gigerenzer & Goldstein, 1996; March, 1994; Schoemaker & Russo, 1993; Galbraith & Merrill, 1996; Mintzberg, 1980). The rational model is more productive than the others, and maximizes benefits to the organization by selecting from thoroughly analyzed alternatives. The bounded rational model tends to be less idealistic, conducts limited searches for alternatives, and makes choices with less-than-best solutions. The political model is more Pragmatic and sagacious, and occurs when the power hierarchy dominates the process.

For this study, the constructs are described on a scale ranging from the more scrupulous Judicious, to the more flexible Rational, to the more sagacious Pragmatic. Characteristics of the Judicious model include: Scrupulous, conformable and sensible, looking to all options. Characteristics of the Rational model include: Flexible, reasonable alternatives are acceptable, good enough. Characteristics of the Pragmatic construct include: Ready and quick to decide or control, sagacious, instincts may be hidden.

Part VII of the survey gained input from CPEE professionals by asking them to select statements that match conditions present at the time the advisory board chose the NTU satellite delivery medium; and continued by asking them to gauge the conditions that exist today. (Respondents selected the characteristics in a blind-with-no-label-to-reference model.) See Table 26.

Trends within Decision-Making Models

Judicious Migration over Time

Figure 5 reveals decision-making environments of the past and present. Figure 5 portrays the environment, or company type within which CPEE professionals made decisions incorporating a scale from Judicious to Pragmatic. Part A shows conditions in the model at the time of the original decision to choose the NTU approach. At that time, five tended to be more Judicious, four more Pragmatic, and the remaining nine ranged between the two environments.

Part B reveals a similar view, but this is a reading of the environment if the CPEE professionals made such a decision today. Results indicate that the population has shifted considerably to become more Judicious, although one company remained unchanged and two became more Pragmatic.

Of course, consider the economic realities of today. At the outset of the investigation, the researcher was cautioned that CPEEs would be gone from the organizations, the economy is sour, policies follow the economy, and not much will be available for continuing professional development, except for a stronger reliance on self-directed learning. That's a far cry from the conditions of the heyday of the early 1990s, and the shifting distribution to the more Judicious approach is to be expected.

Table 26. Decision-Making Defining Activities by Company Type

	At Original Decision	At Present
a. Maximum benefit to the organization is paramount b. Limited benefit to the organization is recognized c. Individual personal interest guides selection	1.83	1.00
a. Logic is always used for comprehensive problem definition b. Reasonable goals are acceptable for good enough c. Preferences were established early in the process	2.11	1.75
a. Exhaustive consideration of alternatives is performed b. Searching stops when acceptable alternative is found c. Personal self-interests dominate the process	2.17	1.44
a. Thorough data collection and analysis of alternatives used b. Limited searches for acceptable alternatives used c. Early preferences prevailed throughout	1.89	1.33
a. Alternative choices can be ranked b. Some alternative choices cannot be measured c. Some alternative choices were dismissed or not considered	2.22	1.25
a. Open information exchange via open exchange of information b. Criteria were ranked prior to selection c. Internal/external efforts tended to drive selection	2.34	2.00
a. Selection style was utilitarian and went for many choices b. Selection style avoided 'paralysis by analysis' to keep it moving c. Selection style was dominated or dictated by others	1.83	1.87
Mean	2.09	1.57

a = Judicious, b = Bounded Rational, c = Pragmatic

B. If Decision were made at the present time

++ 'B' Average = **1.57**

				15	**11**														
				14	**10**														
	17			**13**	**9**		**7**	**5**											
18	**16**			**12**	**8**		**6**	**4**	**3**	**2**			**1**						

[----------Judicious----------][----(bounded) Rational -----][-----Pragmatic-----]

'B'++------Judicious Shift-------+'A'

A. Original Decision

+ 'A' Average = **2.09**

								13											
						17	**15**	**12**	**10**	**8**							**2**		
					18	**16**	**14**	**11**	**9**	**7**		**6**	**5**			**4**	**3**	**1**	

[----------Judicious----------][----(bounded) Rational-------][-----Pragmatic-----]

Figure 5. CPEE Decision-Making Models: Migration over Time.

CPEE Involvement in Decision-making within Corporate Classification

With membership at opposite ends of the scale determined, the study continued by looking at the participation of the individual respondent within the newly classified company environment. Questions became apparent. Were those in Judicious companies more or less involved in the design and selection of choosing a communication medium than those in other environments? Which parts of the design and selection phases experienced the greatest involvement of CPEE professionals?

As previously noted, in analyzing communication media selection, the research ranked factors in order of importance, then compared this with frequency of use to determine if the important factors actually played a part in implementation according to two phases: Development and Selection. This leads to further questioning about which construct or constructs enable more CPEE professional participation. For instance, If respondents rank the application of adult education theory as least important, but nonetheless actively apply adult education theory, for example, would they accomplish more in Judicious or Pragmatic surroundings?

Development Phase.

With regard to the statement that respondents do not generally participate in the design of the delivery system, but then conversely indicate a high level of involvement, which company type enables a higher level of involvement. The following tables indicate cross tabulation results of previously described composite data.

Table 27, in reference to the Development phase, shows 40 percent of respondents were involved in design in a Judicious setting, 44 percent in a Rational setting, and none in a Pragmatic setting. One respondent actually made the design in a Rational setting. One respondent in each of Judicious and Pragmatic was "not at all involved". Regarding consulting, Pragmatic ranked highest at 75 percent, with 45 percent in Rational, and 40 percent in Judicious. The only involvement in Pragmatic was in consulting.

Table 27. CPEE Involvement in the Development Phase of Decision-Making by Company Type: Non-participation in Design.

N = 17	Judicious n	Judicious %	Rational n	Rational %	Pragmatic n	Pragmatic %
Made the design	0	0	1	11	0	0
Very involved	1	20	0	0	0	0
Neutral	1	20	3	33	0	0
Consulted	2	40	4	45	3	75
Not at all involved	1	20	0	0	1	25
Total	5	100	8	89	4	100
Mean	3.60		2.89		4.25	

> "Design and development of a communications technology delivery medium is complex, expensive and time consuming. CPEEs usually do not participate in the design portion ."

These data show that CPEEs who desire to be involved in design would better serve in Judicious or Rational company types.

Table 28, in reference to the Development phase, shows 40 percent of respondents were involved in ready-made design selection in a Judicious setting, 78 percent in a Rational setting, and 75 percent in a Pragmatic setting. One respondent actually made the design selection in a Rational setting. No category reported, "not at all involved". Regarding consulting, Judicious ranked highest at 60 percent, with 25 percent in Pragmatic, and 11 percent in Rational.

Table 28. CPEE Involvement in the Development Phase of Decision-Making by Company Type: Ready-Made Delivery Medium.

N = 17	Judicious n	Judicious %	Rational n	Rational %	Pragmatic n	Pragmatic %
Made the design	0	0	1	11	0	0
Very involved	2	40	4	45	3	75
Neutral	0	0	2	22	0	0
Consulted	3	60	1	11	1	25
Not at all involved	0	0	0	0	0	0
Total	5	100	8	89	4	100
Mean	3.20		2.11		2.50	

> "When the delivery medium is ready-made, the CPEE makes the design selection."

These data show that CPEEs seem to be more involved and are higher achievers in Rational company types. All company types have CPEE involvement at some level.

Table 29, in reference to the Development phase, shows 60 percent of respondents were involved in design modification a Judicious setting, 78 percent in a Rational setting, and 50 percent in a Pragmatic setting. One respondent in each of Judicious and Rational actually made the design modification. One in Judicious reported, "not at all involved". Regarding consulting, Pragmatic ranked highest at 50 percent, with 20 percent in Judicious, and 11 percent in Rational.

Table 29. CPEE Involvement in the Development Phase of Decision-Making by Company Type: Modified Delivery Medium.

N = 17	Judicious n	Judicious %	Rational n	Rational %	Pragmatic n	Pragmatic %
Made the design	1	20	1	11	0	0
Very involved	2	40	4	45	2	50
Neutral	0	0	2	22	0	0
Consulted	1	20	1	11	2	50
Not at all involved	1	20	0	0	0	0
Total	5	100	8	89	4	100
Mean	2.80		2.11		3.00	

"When the delivery medium requires a modification to an off-the-shelf system or product, the CPEE makes the modification."

These data show that CPEEs are more involved in Rational company types when they are considering delivery media that require modification. Pragmatic company types prefer less CPEE involvement, and limit their decision activities to consulting roles.

Table 30, in reference to the Development phase, shows 40 percent of respondents were involved in custom-made design selection in a Judicious setting, 78 percent in a Rational setting, and 50 percent in a Pragmatic setting. Two respondents actually made the design selection in a Pragmatic setting; and one respondent actually made the design in a Rational setting. One respondent in a Judicious setting was "not at all involved". Regarding consulting, Pragmatic ranked highest at 50 percent, with 40 percent in Judicious, and 11in Rational.

Table 30. CPEE Involvement in the Development Phase of Decision-Making by Company Type: Custom-made Delivery Medium.

	Judicious		Rational		Pragmatic	
	n	%	n	%	n	%
Made the design	0	0	1	11	2	50
Very involved	1	20	4	45	0	0
Neutral	1	20	2	22	0	0
Consulted	2	40	1	11	2	50
Not at all involved	1	20	0	0	0	0
Total	5	100	8	89	4	100
Mean	3.60		2.11		2.50	

"When the delivery medium must be custom-made, the CPEE makes the design."

These data show that CPEEs' involvement remains high in a Rational setting. Although Pragmatic settings tend to limit CPEE activity in decision-making regarding custom-made delivery media, two CPEEs actually developed company-specific courses.

Based on these responses, CPEE professionals' involvement in development and design decision-making is not only higher than they perceive, but is highest in the Rational setting. Second highest involvement is the Judicious setting. And yet, one participant in the Judicious setting consistently rated involvement as "not at all".

Selection Phase.

Part V of the study addressed the CPEE professional's involvement in Selection, the final phase of the decision-making process. Empirical literature suggests that selection phase typically involves a multiplayer process of deepening investigation of alternatives. Normative literature describes the selection phase as a series of sequential routines. The shortcomings of both were remedied by Mintzberg in his General Model of the Strategic Decision Process, which was chosen for this study because of the need for more meaningful detail. In the Mintzberg mode, the selection phase is composed of three phases: screening, evaluation and choice, and authorization.

Earlier discussion focused on CPEE actual involvement in each of these three parts of selection which showing a very high level of involvement that significantly correlated with perspectives of their importance. Earlier discussion also described three specific company types of corporate environment, or company types, ranging from Judicious to Rational to Pragmatic.

This portion of the analysis distinguishes and indicates the differences within corporate environments in order to observe the effect of those differences on CPEE involvement.

Table 31, in reference to the Selection phase, shows 100 percent of respondents were involved in screening in a judicious setting, 89 percent in a Rational setting, and 75 percent in a Pragmatic setting. Two respondents actually made the selection in a Judicious setting; and one respondent actually made the selection in a Pragmatic setting. No category reported, "not at all involved". Regarding consulting, Pragmatic ranked highest at 25%, with 0 percent in Judicious, and 0% in Rational.

Table 31. CPEE Involvement in the Selection Phase of Decision-making by Company Type: Screening.

N = 17	Judicious n	Judicious %	Rational n	Rational %	Pragmatic n	Pragmatic %
Made the selection	2	40	0	0	1	25
Very involved	1	20	6	67	2	50
Neutral	2	40	2	22	0	0
Consulted	0	0	0	0	1	25
Not at all involved	0	0	0	0	0	0
Total	5	100	8	89	4	100
Mean	2.00		2.00		2.25	

> "CPEEs usually function in the screening portion by helping identify the feasible alternatives."

These data show that CPEEs have almost across-the-board maximum involvement in screening. Pragmatic company types limit some CPEEs to consulting roles in screening.

Table 32, in reference to the Selection phase, shows 100 percent of respondents were involved in the evaluation and choice in a Judicious setting, 89 percent in a Rational setting, and 50 percent in a Pragmatic setting. Two respondents actually made the selection in a Judicious setting; and one respondent actually made the selection in a Rational setting. No category reported, "not at all involved". Regarding consulting, Pragmatic ranked highest at 50 percent, with 0 percent in Judicious, and 0 percent in Rational.

Table 32. CPEE Involvement in the Selection Phase of Decision-making by Company Type: Evaluation and Choice.

N = 17	Judicious n	Judicious %	Rational n	Rational %	Pragmatic n	Pragmatic %
Made the selection	2	40	1	11	0	0
Very involved	3	60	6	67	1	25
Neutral	0	0	1	11	1	25
Consulted	0	0	0	0	2	50
Not at all involved	0	0	0	0	0	0
Total	5	100	8	89	4	100
Mean	1.60		1.78		2.50	

> "CPEEs usually function in the evaluation and choice portion by participating in the analysis."

These data show that CPEEs have maximum involvement in Judicious and Rational company types. Pragmatic settings limit more CPEEs to consulting roles.

Table 33, in reference to the Selection phase, shows 80 percent of respondents were involved in authorization in a Judicious setting, 78 percent in a Rational setting, and 25 percent in a Pragmatic setting. One respondent in each of Rational and Pragmatic actually made the approval. No category reported, "not at all involved". Regarding consulting, Pragmatic ranked highest at 75 percent, with 20 percent in Judicious, and 11 percent in Rational.

Table 33. CPEE Involvement in the Selection Phase of Decision-making by Company Type: Authorization.

N = 17	Judicious n	Judicious %	Rational n	Rational %	Pragmatic n	Pragmatic %
Made the selection	0	0	1	11	1	25
Very involved	4	80	4	45	0	0
Neutral	0	0	2	22	0	0
Consulted	1	20	1	11	3	75
Not at all involved	0	0	0	0	0	0
Total	5	100	8	89	4	100
Mean	2.40		2.11		3.25	

> "CPEEs usually function in the authorization portion by having or sharing approval authority."

These data show that CPEEs who aspire to be involved in authorization would do better in Judicious and Rational company types.

Table 34, in reference to the Selection phase, shows 100 percent of respondents were involved in the group or team decision in a Judicious setting, 89 percent in a Rational setting, and 25 percent in a Pragmatic setting. Two respondents actually made the CPEE recommendation on the team decision in a Judicious setting; and two respondents actually made the CPEE recommendation on the team decision in a Rational setting. No categories reported, "not at all involved". Regarding consulting, Pragmatic ranked highest at 50 percent, with 0 percent in Judicious, and 0 percent in Rational.

Table 34. CPEE Involvement in the Selection Phase of Decision-making by Company Type: Group or Team Decision-making.

N = 17	Judicious n	Judicious %	Rational n	Rational %	Pragmatic n	Pragmatic %
Made the selection	2	40	2	22	0	0
Very involved	3	60	6	67	1	25
Neutral	0	0	0	0	1	25
Consulted	0	0	0	0	2	50
Not at all involved	0	0	0	0	0	0
Total	5	100	8	89	4	100
Mean	1.60		1.56		3.25	

> "Ultimate selection was by more than one individual and considered multiple goal systems."

These data show that CPEEs appear to be most effective in the Judicious and Rational setting. In Pragmatic company types, power hierarchy tends to dominate the process.

Table 35 summarizes the aforementioned eight observations regarding CPEE involvement in decision-making within corporate classifications.

Regarding selection alone, CPEEs can expect to have most involvement in the Selection process of decision-making while functioning within the Judicious and Rational company types. They are more likely to be very involved in the details of the issue, and to have more influence over the decision outcome. Although involvement is markedly higher in the Judicious and Rational types than in the Pragmatic, there is yet more opportunity for involvement in the Judicious setting with its lower risk aversion and higher reliance on numbers. Pragmatic types prefer less CPEE involvement, and limits more to consulting.

Survey Summary

This chapter presented extensive description of survey data as rated and ranked among eighteen corporate Continuing Professional Engineering Educators. It is evident from the data that Continuing Professional Engineering Education professionals are in agreement on the important media selection factors regarding distance education as identified in the literature, and indeed actually practices the use of those factors at a high rate. And yet, they tend to emphasize implementation of educational theory even though it is perceived to be of relatively lesser importance.

Regarding participation in the decision-making process within the corporation, a high degree of involvement takes place in the development portion even though respondents stated they do not participate. More importantly, participation was expected

Table 35. Summary of Cross Tabulation Results for Activities by Company Type.

Reference	Activity	Observation
Development Phase		
Table 27	Non-participation in Design	CPEEs who desire to be involved in design would better serve in Judicious or Rational company types.
Table 28	Ready-Made Delivery Medium	CPEEs seem to be more involved and are higher achievers in Rational company types. All categories have involvement at some level.
Table 29	Modified Delivery Medium	CPEEs are more involved in Rational company types. Pragmatic types prefer less CPEE involvement, and limits more to consulting.
Table 30	Custom-made Delivery Medium	CPEEs' involvement remains high in a Rational setting. Unusually high activity in Pragmatic custom-made involvement indicates field leadership in company-specific course development.
Selection Phase		
Table 31	Screening: Helping to identify feasible alternatives.	CPEEs have almost across-the-board maximum involvement in screening in all company types. Pragmatic limits some to consulting.
Table 32	Evaluation and Choice: Participating in the analysis.	CPEEs have maximum involvement in Judicious and Rational company types. Pragmatic tends to limit more to consulting.
Table 33	Authorization: Having or sharing approval authority.	CPEEs who aspire to be involved in authorization would do better in Judicious and Rational company types.
Table 34	Group or Team Decision-Making	CPEEs appear to be most effective in the Judicious and Rational settings. Hierarchy tends to dominate the process in Pragmatic company type.

to be more than that in development, but in fact turned out to significantly exceed that higher expectation. Finally, it is evident from this quantitative data that meaningful differences of participation and involvement exist within the various company-type models of decision-making, where a greater range of performance and flexibility are offered in the Judicious and Rational company types.

Individual Reflective Interviews

After completing the questionnaire, a number of select advisory board members participated in in-depth individual reflective interviews. At this point, they were asked about their reaction to the survey responses, and about how they went through the selection process in choosing the system they are now using, identifying variables, and outlining common threads of thought about their respective corporate settings.

In this way, members who indicated willingness to discuss their responses on the questionnaire offered further clarification and detail. After comparing the content of the interviews with the research purpose, data were coded and compared to the relevant literature and the flow and intent of the interview guideline. Finally, data were structured and coded into categories or groupings that were cross-referenced to the three research questions. The interviewees were enthusiastic about the survey and reflect on the work they did on the advisory board. They looked with pride on the changing the face of American education that the opportunity presented to them. However, much of the discussion always came back to the present state of continuing education and the economy. One over-arching theme prevailed throughout, - it's both the economy and the technology. Like the Yin and Yang of opposite and complementary forces in Chinese

thought, there is an element of yang within yin and an element of yin within yang. Similarly, there is an element of the economy within the technology and an element of the technology within the economy. As stressed by Chinese philosophers, there is a posed juxtaposition today recognizing the importance of balance between the two to ensure harmony. Table 36 lists some of the balance within the economy and technology theme in this study. It does not go unnoticed that fourteen of the twenty-two members had moved on over the years, and that Sylvan Learning Systems had completed its acquisition of NTU on November 12, 2002. Multi-level analysis of the data resulted in reliable findings directly related to the research questions. The personal involvement of the researcher and the CPEE professionals was consistent with the intuitive and subjective nature of qualitative research.

Summary

This chapter has presented extensive description of the participants, their responses, and the researcher's observations during the study. The multi-level analysis process was reviewed, and the emergent theme was discussed to illustrate the overall picture. The implication of the study regarding adult education and decision-making is discussed in the following chapter.

Table 36. Summary List of Sub-components of the Economy and Technology Theme.

	Then	Now
1	NTU was the "old" revolution	Internet, WWW & CD are the new revolution
2	Value of CPEE was significant	Value of CPEE is less significant, but function still must be done
3	CPEE presence was prominent	CPEE persons are gone
4	Budget sign-off responsibility pushed down to first-level supervisor	Budget cut back, authority for approval back up at top level
5	CPEE tends to implement evolving satellite technology	CPEE tends to implement evolving Internet, WWW & CD technology
6	Engineering manager tends to use older, available technology	In-house program designs tend to combine both old and emerging technologies
7	Educators design a course then look for technology to deliver it	Educators look to available delivery technologies first, then design the course
8	Delivery medium decisions are best left to external providers	Delivery medium decision-making is retained internally
9	Satellite delivery brings learning to the workstation	Evolving technology enables company web sites and e-learning
10	Cost, cost, cost	Only when you can get past cost, can you champion education and learning theories
11	Cost-effective, Cost-effective, Cost-effective	Getting past cost is more challenging and critical
12	Advanced and graduate degrees get priority, are desirable	Advanced and graduate degrees get low priority
13	Multiple educational and learning opportunities are supported	Necessary company-specific and technical courses prevail
14	CPEE departments offer more development opportunities for working engineers	Working engineers will be on their own; with emphasis on self-directed learning
15	Internet and Web technology just being developed	Expanded Internet and Web technology enables in-house capabilities
16	Booming economy funds new NTU satellite technology	Waning economy retards educational development
17	Booming economy permits enlarged CPEE function and department	Waning economy significantly reduces staffing of CPEE function
18	Growing economy characterizes Rational decision-making approach	Slacking economy characterizes Judicious decision-making approach
19	Rational companies accept reasonable alternatives	Judicious companies critically evaluate conformable options
20	Company decision-making approach can be characterized as Judicious, Rational, and Pragmatic	Company decision-making approach changes with the economy and technology
	The following sub-components appear to be the same.	
1	Economy drives the company and its policies	Economy still drives the company and its policies
2	Technology enables company policy	Technology continues to enable company policy
3	CPEEs say they do not participate in major corporate decision-making; are actually very much involved in development and in selection decisions	CPEEs say they do not participate in major corporate decision-making; are actually very much involved in development and in selection decisions
4	CPEEs are most effective in Judicious and Rational company-types; are more likely to serve in consulting roles in Pragmatic settings	CPEEs are most effective in Judicious and Rational company-types; are more likely to serve in consulting roles in Pragmatic settings.
5	CPEE should recognize involvement in decision-making process; expect empowerment as economy thrives	CPEE should recognize involvement in decision-making process; expect empowerment as economy rebounds

Chapter 5

CONCLUSIONS AND IMPLICATIONS FOR RESEARCH AND PRACTICE

Review of the Study

This study focused on identifying issues addressed by high-technology businesses as they selected the telecommunications media for delivering distance education and training, particularly continuing professional engineering education.

The main issue of study related to those elements in decision-making that experts perceive to dictate or influence individual and organization choices, drive acceptance of those choices, and enable accommodation of communication technologies in the context of higher education and business. The participants in the study represent Fortune 500 companies and maintain membership on the National Technological University (NTU) Advisory Board. The study's phenomenological design targeted a description of themes that would provoke understanding of the elements and their link to improved decisions and decision-making. Additionally, this study investigated the involvement of Continuing Professional Engineering Education (CPEE) professionals in developing and selecting communication media and how their roles differ within the various corporate decision-making environments.

The results provide value to educators and working professionals involved in these processes by helping them better understand how decisions come about with regard to instructional design, learning environment, impact of the delivery medium, performance

improvement, learner attitude, just-in-time training, workforce development, and other factors.

Participants in this study served as Continuing Professional Engineering Education leaders during a time when the high-technology industry itself stood on the cusp of technological evolution and innovation. One of their major goals was to find the most effective way to deliver distance education to professional engineers. Their companies all chose emerging satellite-based programs provided by NTU, a technology pioneer in this field.

Since then, continued emergence of cutting-edge technologies and the waning economy have brought about organizational changes in the way these companies choose communication media for distance education. These include downsizing, restructuring, administrative philosophical shifts, financial constraints, and movement from traditional program topics. Thus, the study attempted to identify how participating in the process of choosing communication media has changed over time and through economic adjustments.

Eighteen individuals made up the target population: education and training managers, engineering training managers, a distance learning manager, an instructional media developer, a director of instructional resources, and other continuing education managers and coordinators. Although their job titles vary, participants' job responsibilities remain consistent in that they once held or hold primary responsibility for CPEE.

Personal interviews and data/reflection questionnaires provided detail-rich data based on individual perspectives and experiences. Broad-based correlations resulted from data analysis. Participants who volunteered for in-depth discussion received an analysis

of the data, from which they provided review and reflection. Final analysis includes results of these interviews. The NTU advisory board provided a good initial sample in an area where little work has been done, and may have proven to be a rich contextual in-depth study for modeling future studies.

Research Questions

Three research questions made up the study's framework. These questions explored CPEE decision-makers' perspectives and actions with regard to factors that affect communication technology selection in a complex corporate environment. The questions also investigated how decision makers integrate individual and organizational variables, how they rank such variables, and how that weight changes over time.

Question 1. What are the key factors Continuing Professional Engineering Educators within the corporate training function consider when selecting, accepting, and implementing communication technologies for delivering CPEE?

Survey results show that responding CPEE professionals rely most on organizational objectives as the factor of greatest importance. They chose cost of operation, and anticipated use respectively, as second and third. In contrast, respondents chose legal considerations least often, with level of interactivity chosen only slightly more often. The questionnaire then asked participants to rank all factors in order of importance. Not surprisingly, organizational objectives ranked first, with cost of operation second. These responses indicate that CPEE professionals rely heavily on organizational relevance to best integrate organizational objectives, cost of operation, anticipated use, and initial cost.

The questionnaire also sought information about respondents' perceptions of the value of nine factors involved in selecting communication technologies, and the frequency with which they used each factor. Respondents again selected relevance to corporate needs as the most important factor and relevance to learner needs as second. In performance-based programs, these factors tend to coincide.

Application of adult education theory ranked in the last position after all the other factors, as respondents relied heavily on organizationally-relevant cost-effective technology-delivered education.

The second part of the question focused on the frequency with which respondents use each factor when selecting communication technology. Results showed that accessibility of the program to participants, relevance of content to corporate needs, and relevance of content to learner needs came in first, second, and third. The corporation may be a learning organization, but it is focused learning with a specific purpose.

Application of adult education theory again came in last, with one respondent actually using this item "not at all."

Correlation between importance and frequency of use surprisingly showed the strongest relationship between climate for professional development, specific learning objectives, learning skills of individuals, and application of adult education theory. These responses demonstrate that CPEE professionals not only do what they consider to be most important, but that they also emphasize educational theory, even though they perceive this to be of least importance.

Question 2. What understanding do Continuing Professional Engineering Educators have or sense do they make of these selected factors regarding the convergence of technologies and the new learning approaches that are coming to be associated with technology-based education?

Responding CPEEs overwhelmingly agreed that the effect of new technology on human learning and motivation dramatically increases as the educator attempts to move distance learning to performance support, and that they must integrate educational, individual, and organizational goals to achieve successful results. CPEE professionals indicated that the Internet and the World Wide Web offer the most basic and powerful options for delivering education and training quickly and for updating it regularly. Yet, they do not feel that the Internet will become the overwhelming technology of choice. This result is somewhat surprising. In the individual reflective interviews, the researcher asked very specifically why CPEEs feel this way. Their response indicated that there is a continuum of technologies available, and that the use of technology depends more upon the educational needs of the program. CPEEs also indicated that the Internet and WWW are still emerging, and are not yet fully implemented. CPEE knowledge of instructional design and learning theory indicates that appropriate levels of interaction must match the learning need, and therefore recognize that the best program designs result from a mix of appropriate media. They will select the Internet and WWW for their strengths of convenience of time and place delivery, but not restrict all choices to that technology.

These educators have accepted that organizational needs and program design together determine the best choice and mode of interaction. Furthermore, CPEE professionals see their clients as employees first, and as students second.

Those responding CPEEs who acknowledged that program delivery media decisions were best left to external suppliers such as the NTU nearly unanimously expressed the belief that company specific course selections should remain in-house. Furthermore, under today's economic constraints and the breadth of available technology choices, almost none would choose an external supplier. They plan to develop their own sales and product training courses, and leave working engineers to their own devices in linking personal development with learning in a self-initiated imperative, especially for advanced degree work provided by universities.

Question 3. Within the context of adult education, how do those high-technology organizational CPEE decision-makers within the corporate training function integrate educational, individual, and organizational goals and objectives into choosing the media, relative to distance education theory and practice, and what is needed to support that technology?

Understanding the dynamics of corporate decision-making plays a significant role in understanding how technological innovation affects the learning process as well as in contemplating technological implications. Using Mintzberg's 1976 framework, the questionnaire sought descriptive information about CPEEs' decision-making activities, and their level of involvement in two phases: development and selection. CPEE respondents reported that they rarely participate in technological development, but if they do, it involves a ready-made design. CPEE professionals also reported that they expect a lower level of participation in the search and design portions of distance learning programs if the trend toward increasing modification and customization of

delivery media in the corporate environment continues. Thus, their actual involvement becomes minimal, even though they often serve as consultants and perceive themselves to be highly involved.

In addition, non-participation in decision-making by CPEEs who have a grasp and understanding of both the theory and practice of adult education suggests a return to the days of "product training" rather than performance development. Implications for further research in this area will be developed later in this chapter.

In contrast, the selection phase offers a different story. In this case, respondents frequently take part in all activities: screening, analysis, and authorization. Their responses indicate that they continue to champion the principles of adult education theory in this phase, even though they recognize that, in the grand corporate scheme of decisions, adult education theory does not enjoy high priority. Finally, large corporations usually involve more than one individual to represent the various stakeholders in complex decisions, with educators usually part of the group. In not one instance in any of the queries relating to selection did a respondent indicate no involvement.

Following Mintzberg and others, this study established decision-making process elements into three major constructs (Hellriegel, Slocum, & Woodman, 1998). The constructs highlight ways in which decision-making is perceived and interpreted. Within the context of this study, the three constructs range from the more scrupulous Judicious, to the more flexible and bounded Rational, to the more sagacious Pragmatic.

The first steps in this analysis involved categorizing organizations as one of three types: Judicious, Rational, or Pragmatic. In order to gain understanding of how CPEEs attempt to integrate educational, individual, and organizational goals in different company types, companies were first organized in one of the three categories. Then, the study looked at the participation of the individual respondent with the newly classified company type.

The categories used in this study are the three major constructs which highlight ways to perceive and interpret decision-making (Hogart & Reder, 1986; Vos Savant, 1996; Garvin, 1993; March & Simon, 1993; March, 1994; Simon, 1991; Gigerenzer & Goldstein, 1996; Shoenmaker & Russo, 1993; Pfeffer, 1994; Langley, 1996); and that preferences seldom change within these constructs, even if analysis uncovers new information (Galbraith & Merrill, 1996).

Respondents were first asked to describe the decision-making process characteristics that guided their technology selection at the time the decision to choose the communication media actually took place. Next, they were asked to describe the decision to choose the characteristics they would find to be important if they were making the decision at the present time. Data for the time of the original decision resulted in placement of the companies along the scale, with half of the companies falling in the Rational category. Data for the same decision being made today showed there would be a dramatic shift into the more Judicious decision-making category.

The reason for the dramatic shift in decision-making style is not clear from the survey results. However, in the individual reflective interviews, the researcher asked the respondents to speculate why their decision-making process would change so

dramatically. Answers ranged from changes in organizational structure, downsizing, and business realities to financial constraints and the availability of more technological options. Additional related implications will be developed later in this chapter.

Several conclusions emerged from the data.

- CPEE professionals seem more involved, and achieve more in Rational decision-making styles for all kinds of development activity.
- CPEE professionals are offered many opportunities to engage in search and design decisions in Judicious corporate settings.
- CPEE professionals take part to an even greater degree in the selection phase, and achieve maximum involvement in Judicious and Rational environments.
- CPEE professionals have high participation in the final approval and authorization of media selection in Judicious and Rational settings.
- CPEE professional's involvement in decision-making is largely limited to consulting in Pragmatic corporate environments.
- CPEE professionals are more likely to be left out of team and group decisions regarding telecommunications media selection in Pragmatic settings that are largely dominated by hierarchy.
- CPEE professionals have the greatest potential to affect telecommunications decisions in Judicious and Rational environments.

Data are silent with respect to whether CPEE involvement would be similar if the sane decisions were to be made at the present time. Directions and implications for future research will be developed later in this chapter.

Limitations

Chapter 1 outlined the practical and functional limitations of this study. Not all major corporations or Fortune 500 companies are studied or interviewed. The study analyzed information from twenty major high-technology companies whose select representatives serve on the NTU board. Although the study may not represent the larger population of high-technology manufacturers because of the small number of participants involved, the analysis provides valuable insights into the decision-making process, and the advisory board appears to be representative of the total. To counteract the fact that survey participants may not have had a true measure of the elements of decision-making and their link to better decisions, the author initially described the decision-making process and its stages before administering the survey questions. Now, with the data analyzed and findings presented, other limitations are acknowledged. The study did not include organizations other than high-technology manufacturing, other sizes or types of manufacturing, other professions, or other service organizations that may not value or strive to preserve the in-house continuing education function. Although this study did not focus on other organizations, their perspectives could add to the overall picture.

Second, some questions and relationships between the themes of the economy and emerging technology were observed but not investigated. Neither learning effectiveness or job performance improvements were critical to this investigation.

Third, testing for issues of gender differences both within the ranks of the working engineers and the professional CPEE were absent. Although female engineers and female CPEEs participated in the study, no distinction was asked or investigated regarding the women's perspective.

Fourth, the qualitative portion of this research has its own nature of limitations. Individual reflective interviews provide data rich in feelings and recollection, but rely heavily on participants' perceptions and memory.

Other possible limitations are the bias of the observer and the bias of participants. However, the author's corporate experience includes familiarity with the decision process in selecting satellite delivery of his company's distance learning courses, implementing that decision and participating in its operation. Furthermore, the author is a former member of the NTU advisory board that made up the targeted group of participants. Subjectivity is recognized as a possibility to be considered in the interest of impartial analysis, and studies of this type are always valuable in that they generate hypotheses for future study.

Implications for CPEE Practice

Data from the survey were used to construct a profile of CPEE professionals' involvement in the managerial decision-making process of selecting a telecommunication technology delivery medium for distance education. In general, these educators explained

how their practiced understanding contemplates technological implications affecting the learning process.

Key Factors

CPEEs rely heavily on organizational relevance and cost effectiveness to drive selection of telecommunications media for program delivery. They rarely allow education theory to interfere with relevance. Education must always align with organizational and learner goals. In addition, they strive to create a climate for professional development and for achieving specific learning objectives. CPEE professionals, as adult educators, tend to emphasize the instructional design and a supportive learning environment. The profile presented in this study and the data that support it conform with other information related to continuing education (Houle, 1980; Knowles, 1980; Merriam & Cunningham, 1989; Queeney, 1990; Ferguson, 1997). The profile and data also conform with material pointing to the value of learning as it relates to on-the-job performance (Grotelueschen, 1980; Queeney & Smutz, 1990; Smerndon, 1996; Childers, 1993). Finally, the study's conclusions also support information asserting that formal education activities serve as an integral component of productive engineering work (Saline, 1985; Quinn, 1985).

Review of the literature and consideration of the study's findings suggest several other implications for CPEEs, organizational managers and other adult education professionals. Taken as a whole, this suggests the following implications:

- Increase in the level of modified-design and custom-design selections will lead to a decrease in participation of CPEE involvement in decision-making.

- Decrease in the level of CPEE participation in delivery medium selection will lead to a reduction in achieved specific learning objectives and a reduced climate for professional development.

CPEEs also feel that adult education language and terminology must be targeted to the audience. For example, rather than discussing "adult education theory" principles with the working engineers and other staff managers, it would serve best to discuss "learning and motivation opportunities." CPEEs also feel that the program design should be tailored to demonstrate sufficient technical expertise of the educator, in order to enhance acceptance of the training by the student, who would prefer not being referred to as a student.

Increasingly, companies will be limiting training courses to job-related programs in order to concentrate on the company's portfolio of core competencies. Manufacturing companies will concentrate on productive manufacturing, rather than on becoming knowledge organizations. However, the high correlation between the CPEEs' perception of importance and degree of involvement concerning creating a climate for professional development is an indication of positive organizational support.

There is an inverse relationship between the expenditures for training and economic conditions. Continuing education is often viewed as an ancillary activity subject to constraints linked to economic conditions. But failure to provide theoretical underpinnings to programs will result in adoptions of a series of fragmented programs that advocate passing buzzwords or fads that are currently in vogue.

Converging Technologies And Learning Approaches

Enormous changes loom on the education horizon, encompassing all aspects of telecommunications technology and how technology relates to learning theory and continuing professional education. Discussion currently focuses on wireless technology, satellite technology, the Internet, and the World Wide Web. All of these approaches promise to deliver education and training quickly and to enable regular updating of related information. These approaches also offer a convenient time and place for educational interaction to the learner.

CPEE professionals possess a significant responsibility for delivering relevant and effective programs, knowledge bases, expert systems advisers, and learning experiences that help individuals enhance their job performance. In its embryonic stages, the NTU seemed to address many of these needs and CPEE professionals participated in the decision that brought satellite delivery into their companies. Since the advent of the Internet, many organizations have begun to experiment on their own by combining learning technologies with World Wide Web delivery. Today, most CPEE professionals prefer to choose that delivery media for company specific programming, and use institutions of higher learning to support the broader educational needs of working engineers.

Leaving the technology selection for delivery of graduate degree courses to the universities is contrary to the CPEEs' desire to retain control over the selection decision. Universities also have an equivalent of CPEEs who select delivery media for providing course delivery. As a provider of continuing professional engineering education, the university may look to a buy a generic technology that can fit a broad (and often unknown

beforehand) need and usage. Of course, a provider may just look to see which technology is available, and then design their courses using that technology - a process that has come to be known as the "technology-first" method of design.

The emphasis on in-house systems signals a new strategy for greater use of self-directed learning at the workstation. Thus, CPEE professionals are working themselves out of a job. At the time of the original decision, satellite-based program delivery offered great potential as an emerging technology. We now stand on the threshold of a new technological era, in which e-learning may revolutionize CPEE. This approach costs much less to administer, and has ushered in the paradigm of self-directed education via the Web. Current economic woes only exacerbate the situation. Despite this somewhat gloomy view for CPEE professionals, the situation offers some windows of opportunity as other new technologies emerge and as the valued expert may again become a necessity either internal to the organization, or as an external educational role of the CPEE. The current economic climate characterized the CPEEs, who remain in their jobs, as shifting their focus from running training programs with their own in-house staffs to that of a project manager who procures and manages training from external providers.

The CPEE is cycle-related, varying with the budget and the business cycle of profitability, and not simply the information revolution. To be fully effective in this role, the CPEE should have full understanding of the business organization.

Integrating Educational, Individual and Organizational Objectives

This inquiry provided insight into the role of educational context and professional experience in the decision-making process. The study's findings support educator participation and inclusive processes for planning and decision-making.

Discussion has focused on a model for instructional decision-making that accommodates the realities of corporate environments. In this study, CPEE professionals testified to dealing with a changing corporate environment. By cycling between routines, they managed to gradually comprehend all the associated and new complexities. As demonstrated by the data, many of the survey respondents are geographically dispersed, operate in separate organizational structures, and make decisions at different points in time. The technique in this study of viewing CPEE professionals' involvement in the development and selection phases of decision-making by differentiating their activity through the corporate environment offers great promise for an in-depth look at support routines. These routines of decision control, decision communication, and decision politics need further analysis to determine how they fare in Judicious, Rational, and Pragmatic settings. Similarly, the myriad dynamic factors of delay, feedback, speed-up, and interruption each have their own impact within the different corporate settings.

The job of the CPEE is changing from that of a trainer to that of a knowledge-broker so educational opportunities can be accessed through technology. The increasing use of external educational providers by industries, and the increasing trend of industries to concentrate on their core competencies will increasingly lead organizations to partner with a consortium of local schools and colleges (to include vocational technology schools,

community colleges and universities) for the purpose of providing a full range of training and educational services, and regional competencies.

When adults are seeking knowledge on their own initiative, the adult educator must always consider the learners' goals and the organization's goals. Methods, procedures, assumptions, and policies are devised for the purposes of furthering the goals of both. Working engineers impact the attitude of the CPEE, but organizational managers control the abilities of the CPEE; and the organizational manager may cause both the learner and the educator to leave if the experience is not positive and productive. Adult education can serve both best by facilitating discovery, providing information in a collegial way, and participating in professional development application strategies. The practice of CPEE is shaped by respect for the goals and objectives of the learner and the organization, but it is controlled by the goals and profitability of the organization. The second influence of this implication has to do with the nature and circumstance when goals of the individual and goals of the organization can coincide.

Implications for Business and Industry

It is perplexing that most high-level decisions produce no direct evidence of themselves and knowledge about them comes only from accumulated indirect evidence. Decisions generally undergo review only by reference from general results in which they act as one factor among many. Corporate memory with regard to CPEE decisions has grown cloudy. Persons holding CPEE responsibility are unfamiliar with the actions and motivations related to yesterday's technology choices. In the course of this study, few people (including managers and human resource personnel) even knew the location of the

decision makers, after as few as three to four years. Only eight of the 22 CPEE professionals on the NTU Advisory Board remain in decision-making positions or in other jobs in the same company. The other 14 have moved on, through career changes, business reorganizations, or life changes.

For example, one CPEE professional left her position in a high-technology manufacturing company and then obtained a similar position with a healthcare organization. At the time of her in-depth interview, she announced that she had just learned of her termination from the new position. What does such constant movement and inconsistency mean for the future of CPEE? How does a CPEE professional champion the cause of development if there is so little continuity?

Such experience stems from the changing nature of the corporate infrastructure. The educational paradigm within corporations also has begun to change. Where once a CPEE professional with expert knowledge and capabilities led the way by charting programs and choosing alternatives, no one takes the lead. Companies have removed equipment to enable distance learning. Centralized support has disappeared. Engineering managers now must manage education and training requirements, and the engineer must provide the linkage of the proposed education to job performance and results.

Corporate learning centers no longer offer support. (In one case, an education center's personnel list dropped from 220 people to eight.) Companies emphasize the use of new individually driven technologies such as the World Wide Web and CD-ROM. (One company uses DVDs and digital storage technology to enable employees to access information locally. Two others plan to follow suit.) Engineers have become more responsible for arranging and fulfilling their own continuing education requirements.

(One other company uses an intranet site to offer satellite delivery on demand for product and sales training.)

Where there is no CPEE function in the organization, selection of training programs tends to become a responsibility of first-line supervisors and engineering managers who do not have the training and expertise to make prudent selections, and who are frequently called upon to make the training decisions in an environment of budgetary restrictions. Similarly, the average working engineer is frequently called upon to find programs that make the most sense for personal and professional development without adequate information, awareness, or knowledge.

At a macro level, changes also have begun to affect former external suppliers such as NTU. In December 2002, Sylvan Learning Systems acquired the National Technological University. Although this could have a significant impact on the future of technology-based education, very little is known at this time about its long-range implications.

The survey data suggest serious implications for CPEE professionals who rely heavily on organizationally relevant educational programs, which must meet initial and operating cost requirements, to fulfill anticipated program usage. Both the companies and employees demand specific education with immediate application to the job. In an environment such as this, the working engineers become employees first, and students second. Educational theory often has no role in such considerations, either in the minds of the employees or in the minds of the organizational leaders. Consequently, CPEE professionals are obligated to emphasize performance support in their course offerings.

This study created a snapshot of a resting place in the rush to embrace emerging technologies, and how CPEE professionals fit in that landscape. Several respondents noted that they had experienced personal transformation as their organizations transformed. As organizations change, so do individuals, but in order for organizations to change, individuals must, initially at least, lead the way.

Many comments raised concern about the continuing education of the CPEE practitioner. They recommended that those aspiring to success in this field should achieve credentials in communication, interpersonal skills, and change management well beyond former requirements for adult and continuing education expertise. CPEE professionals also will need to develop capabilities for sensing shifts in the corporate environment, encouraging teamwork and inclusive decision making, and understanding the dynamics of change.

The corporate setting encourages team or group activities. Interpersonal skills will prove vital in this environment as CPEE professionals seek to champion the use of educational and learning theory to enhance program value. With overarching themes of organizational objectives and cost, it will prove difficult to raise adult education theory above the lowest priority. Interpersonal skills will help CPEE champions work behind the scenes regardless of their position in the corporate hierarchy. CPEEs have neither time nor opportunity to get upgraded, and may not recognize the trend toward their own obsolescence. Without increasing use of technology to pursue their own self-development, their opportunities for involvement in the decisions of the business will diminish, reducing their value to the entire process of continuing education. Non-

participation in decision-making by CPEEs who grasp and understand theory may mean a return to the days of "product training" rather than on-the-job performance improvement.

This study indicated that companies have shifted to a more Judicious decision-making style, which means that CPEEs might have a future of greater involvement in the development phase of decision-making if they choose to actively integrate themselves into the modified/customized selection process. Increasing attention on the part of CPEEs to developing sensitivity to the dynamics of change and the shifting corporate environment will lead to their increased participation in the development phase of selection decisions.

Current in-house adult educators now see themselves as project managers rather than deliverers of education. Increasingly serving as a project manager will improve the CPEE value to the corporation, and increasingly bring more involvement in business decisions, but will also increase the need for diligence in searching for external educational opportunities for the working engineers. Technology evolves, equipment becomes obsolete and modalities of delivery equipment are related to existing contracts.

Implications for Research

This study provided several paradoxes worth pondering. CPEEs face the serious possibility of creating their own occupational obsolescence. Companies frequently drop learning support as a cost-cutting move, leaving working engineers to fend for themselves. However, world-class companies are not cutting back on CPEEs, just transforming them. CPEE movement toward project management has a major implication for training and adult education professionals, and should become an inherent part of their career planning.

Ironically, as training design becomes increasingly complicated, in-house CPEEs may become unqualified to participate without upgrading their skills.

As educators, CPEE professionals have an obligation to find better and more effective ways to foster employee self-directed learning, and to enable more internal motivation toward learning on the job. Future research in this area could provide keys for CPEE professionals that will enable them to successfully link employee educational needs to educational resources. For example, most employees are technology savvy but don't have time for extensive research about educational alternatives. An e-learning expert could evaluate educational options and show employees where the best help is just a click away. More qualitative research into the use of electronic self-directed learning by working engineers would support such a career shift for CPEE professionals. Other topics for study could include individual learning strategies, knowledge databases, and enablers and barriers to participation.

One contradiction identified during this study regarded CPEE professionals' statements that they do not participate in the search and design stages of decision-making, while the survey indicates that they have a high degree of involvement. Further research and analysis can promise to uncover the meaning behind that contradiction. Understanding this phenomenon would enhance CPEE professionals' view of their current role, and their possibilities for the future.

An extension of this study could help to determine which learning approaches are most effective in each of the three corporate classifications. This would help decision makers better understand the unique variables presented by each corporate setting and improve the effectiveness of the decisions they make. The study's finding relating to one

kind of decision in different corporate settings may apply to a range of decisions, and to a range of industries. Research can help translate some of these finding to better understanding of other unstructured, complex decisions like market penetration or product launch.

Replication of this study with large organizations other than high-technology manufacturing, medium-sized manufacturing, and service organizations would offer significant insights into commonalities. Analysis would reveal similarities and dissimilarities among populations. The resulting information could indicate whether learning technology choices feature consistent characteristics throughout the broader population of decision makers.

Further qualitative and quantitative research in this area would help to determine the relative worth of the CPEE function to the organization, and study the characteristics of successful CPEE professionals to support profession value.

The change in emerging technologies tended to offer more telecommunications delivery options thereby causing corporations to shift from Rational decision-making to become more Judicious in their analysis. On the other hand, the waning economy may have reduced funding available, and the company may have been forced to be more Judicious. Data are silent with respect to whether the shift would be similar if the decisions were made at the present time.

As CPEEs become more aware organizational objectives are top priority to the corporation, they will increasingly be called upon to be change agents within the organization; and their advanced educational training will need more than a modest

amount of preparation as managers and entrepreneurs. Business training will be needed in their career preparation.

A Final Note

Participants in this study chose to promote continuing professional development, while operating within a unique corporate environment. Their educational goals were intertwined with organizational objectives and the learning goals of the individual working engineer.

The practice of their profession also meant risk and sacrifice, and many had experienced downsizing, restructuring, administrative philosophical shifts, financial constraints, and movement from traditional program topics. If there is dissatisfaction with the quality of their profession, this study may help identify some of the sources of dissatisfaction and point to inclusive areas for improvement.

Taken as a whole, the study of these CPEEs provides varied and rich possibilities for further research, and compels a thoughtful re-examination of the familiar assumptions about continuing professional engineering educators and the nature of their profession.

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Appendix A

INFORMED CONSENT FORM

INFORMED CONSENT FORM FOR BEHAVIORAL AND SOCIAL SCIENCE RESEARCH

The Pennsylvania State University

Title of Project: SELECTING TELECOMMUNICATIONS TECHNOLOGY FOR CONTINUING PROFESSIONAL ENGINEERING EDUCATION (CPEE) PROGRAM DELIVERY

Principal Investigator: Peter J. Graybash, Jr., 4 Cambridge Drive, Hershey, PA, 17033-2100
Phone: (717) 533-7923 Email: pjg2@psu.edu

1. Purpose of the Study: The purpose of this study is to identify human elements addressed by decision-makers and continuing professional engineering educators in high-tech industries as they decide on delivery systems for employee continuing education opportunities. Also of interest is how they become aware of innovations in communications technology and their behaviors regarding the selection of delivery medium for their continuing education programs.
2. Procedures to be followed: Participation in this research will include an interview with the President of the National Technological University, completion of a written survey of questions, and focus group discussion of open end questions. Respondents will be offered an opportunity for further discussion regarding their responses.
3. Discomforts and Risks: There are no risks in participating in this research beyond those experienced in everyday life.
4. Benefits: a. The benefits to participants include better insight into, and understanding of the practical and complex realities of decision-making in today's environment. This information could help continuing professional educators improve the quality of equipment selection decisions, enhance program delivery, and support adult educators as they define constituent profiles or develop marketing strategies. b. The benefits to society include helping distance education providers better understand the issues faced by corporate education professionals and therefore become more valuable as business partners. Its exploratory nature, posing questions and evaluating how responses indicate overall trends can offer insight into the challenges faced by business learning professionals, and could help corporate education professionals understand how learning is perceived throughout their organizations.
5. Duration/Time: It will take about one hour for the initial interview with the president of NTU, about 25 minutes to complete the survey form, and about one hour in focus group discussion. Discussion with participants who volunteer individual conversation will take about one hour.
6. Statement of Confidentiality: Only Peter J. Graybash, the principal investigator will know the identity of the respondents. If this research is published, no company names will be used. No personally identifying information will be disclosed. In communicating with others outside the focus group, no individual participant's comments will be identified.
7. Right to Ask Questions: Participants have the right to ask questions and have those questions answered. Contact Peter J. Graybash at 717-533-7923 with questions.
8. Compensation: None.
9. Voluntary Participation: Participation is voluntary. Respondents can decline to answer specific questions, withdraw from the study, or excuse themselves from any group discussions at any time by notifying Peter J. Graybash.
    - You must be 18 years of age or older to consent to participate in this research study.
    - Completing and returning the questionnaire, and/or completing the interview implies consent to participate in the study.
    - Volunteers sign off to indicate willingness to do follow-on phone interview.
    - Please sign two copies of this document, retain one for your records, and return the other.
    - Instructions on how to return the questionnaire: Mail, telephone, fax, or email to Peter J. Graybash.

Signature of Participant Date Signature of Investigator Date

Appendix B

RESEARCH DESIGN

RESEARCH DESIGN
Study Method

Five Steps

1. Interview the President and Founder of NTU to solicit perceptions and gather information related to educational program design and delivery considerations as witnessed by NTU.

2. Pilot the questionnaire. Revise it based on pilot study. Any revisions are to be filed with Office for Regulatory Compliance.

3. Meet with the Advisory Board. Introduce the project. The full NTU Advisory Board is the sounding group. Respondents are all members of the board.

4. Questionnaire is to be completed by the appropriate select members. Respondents are the study universe. Member may collaborate or confer with another appropriate person in the company to complete the survey. This is first level evaluation, but it offers participants who are interested in talking individually about their responses the opportunity to do so. They indicate willingness for further clarification by signing the request statement in the survey.

5. Collect the questionnaires, analyze and summarize the data. From this analysis, come the open-ended questions for Individual Reflective Interviews with five-to six select members. Explain the results and proceed with interview guideline. . Their input describes and identifies specific educational program delivery medium discussions. Variables are identified.

RESEARCH DESIGN

Study Method

Step One

Interview the President and Founder of the National Technological University

Interview the President and Founder of NTU to solicit perceptions and gather information related to educational program design and delivery considerations as witnessed by NTU. Questions about Continuing Professional Engineering Educators (CPEEs) include:

1. CPEEs are having difficulties attracting and training working engineers to practice in their locations. What are those barriers?

2. What kinds of CPEE activity can overcome the apparent disadvantage that working engineers experience compared to full time students in regard to their opportunities to keep abreast of innovations and upgrades?

3. Do CPEEs have any plans regarding the future of their practice of professional development, and if so, what are they?

4. How do CPEEs affect the selection of educational programs and the media used to deliver them?

5. What are some of the concerns and plans NTU has for supporting the advanced educational needs of working graduate engineers?

6. What do you see as the major problem(s) in CPEE today? Original decision time? Five years ago? Five years from now?

7. What kind of information is available that details the type of CPEE activities in which major corporations participate?

8. What are the major sources of educational programs available to working engineers?

9. What do CPEEs do to advance educational and telecommunications technologies to deliver instructional programs to working engineers at their work sites?

10. How do CPEEs go about integrating educational, individual, and organizational goals and objectives when making educational program delivery decisions?

RESEARCH DESIGN

Study Method

Step Two

Pilot the survey instrument

Pilot study the five-page questionnaire. Revise survey questionnaire based on pilot study. Any revisions are to be filed with Office for Regulatory Compliance.

Pilot group consists of ten Continuing Professional Engineering Educators from industry and academia.

Participants are asked to consider how appropriately the survey questionnaire addresses the many human, economic, and environmental elements in addition to engineering and professional considerations relative to distance education theory/practice.

Areas to cover include three research questions, as follows:

1. What are the key factors Continuing Professional Engineering Educators within the corporate training function consider when selecting, accepting and implementing communication technologies for delivering CPEE?

2. What understanding do Continuing Professional Engineering Educators have or sense do they make of these selected factors regarding the convergence of technologies, and the new learning approaches (active, collaborative, inquiry-based, resource-centered learning) that are coming to be associated with technology-based education?

3. Within the context of adult education, how do high-technology organizational CPEE decision-makers within the corporate training function integrate educational, individual and organizational goals and objectives into choosing the media relative to distance education theory and practice, and what is needed to support that technology?

RESEARCH DESIGN

Study Method

Step Three

Meet with the Advisory Board

Attend the advisory board meeting, and meet with the present members. Introduce the project. The full NTU Advisory Board is the sounding group. Respondents are both present and past members of the board representing high-tech manufacturers.

With current members, establish time and place to follow up with individual personal contact to deliver Letters of Invitation, Informed Consent Form, and Questionnaire.

With past members, conduct search of leads from companies, personnel, internet, and staff to locate the appropriate CPEE involved in the NTU selection decision.

Step Four

Administer and Analyze

Administer Questionnaires and analyze the results.

RESEARCH DESIGN

Study Method

Step Five

Individual Reflective Interviews

After questionnaires have been analyzed and summarized, open-ended questions will be posed during individual reflective interviews with five-to-six select members. Explain the results and proceed with the following guideline. Their input describes and identifies specific educational program delivery medium discussions. Variables are identified. Key questions are based on survey results. The questions:

a. Seek to define which technologies are perceived to be the best match for delivering externally provided competencies.

b. Ask participants to describe concerns, reservations, and perceived challenges of the past, the present, and the future.

c. Seek to find perspectives and consensus.

Open-ended questions concerning change brought about by the rapidly advancing growth and development in telecommunications technology include:

1. What was the basis for selecting the media? Defined learning needs? Instructional needs? Professional expertise? Technical expertise? Budget?

2. How did costs affect your selection of the media? What were your criteria?

3. What factors were/are used to prioritize development needs? At original decision time? Five years ago? Today? (i.e., cost, corporate performance metric, increased productivity, etc.)

4. Who in your organization is responsible for the learning theory that goes into training materials? Is that person part of the decision-making process on technology based programs? What type of expertise would you have consulted in the process?

5. How would the factors be different in making that selection decision today? (i.e., years, number of employees, number of programs, variety of technology used, etc)?

6. If I were trying to initiate a telecom media delivered course, what advice would you give me? At original decision time? Five years ago? Today?

Other issues requiring further discussion or clarification of the survey will be addressed as requested.

Appendix C

CORRESPONDENCE

Research Project Introduction Letter from Dr. Lionel V. Baldwin

Dear (NTU Advisory Board Member):

I am pleased to support the graduate research of Peter J. Graybash, a doctoral candidate in Adult Education at the Pennsylvania State University. Peter's research is entitled "Selecting Telecommunications Technology for Continuing Professional Engineering Education: Decision-Making within High-Technology Manufacturing Companies."

During a trip to Fort Collins, Peter visited with me and Gerry Johnson to describe his research project. He will be collecting data using a questionnaire to select NTU advisory board members and conducting personal interviews with volunteers willing to individually discuss their responses to the questionnaire, which is in relation to their decision-making process for selecting NTU's satellite-delivered programs. He has also agreed to report the results to NTU and its advisory board members.

Peter will be contacting you directly either by mail, e-mail, or telephone. Should you require additional information, please do not hesitate to contact me at Baldwin@ntu.edu or 970-482-4189.

Lionel V. Baldwin
President Emeritus, NTU

Research Project Initial Letter from Researcher

Dear (NTU Advisory Board Member)

How do you make decisions? Do you plan and calculate, use intuition, or just react? Educators in industry need a better understanding of how people make decisions such as picking the right technology for their programs.

The National Technological University has always focused on what actually happens at the firm level with the use of satellite-based engineering training. As a doctoral candidate at Penn State studying continuing professional development for engineers and scientists, I invite the Advisory Board members of NTU to help by participating in a study of how decisions are made as you seek to satisfy continuing education needs.

Here are some good reasons why you should participate:

1. You are providing effective Continuing Professional Education to your company.
2. You can contribute to the study of decision-making.
3. Your opinions will be heard, and will have an impact on future program development.
4. You have made and are making these selection decisions.
5. You need only to reflect; I will do the work.
6. Whatever you tell is kept confidential.

I welcome your interest in this research whatever your level or role of involvement in the decision-making selection process, and I will contact you to explain the rest of the study.

Thank you for your cooperation.

Sincerely,

Research Project Initial E-mail from Researcher

Hello (NTU Advisory Board Member),

By now, I hope that you received Dr. Baldwin's email regarding my decision-making research project. The project looks at how NTU advisory board members went about making their decisions to select NTU's satellite-delivered programs.

As the field of Continuing Professional Engineering Education progresses, it is always useful to reflect on what has been done,……..and how it can be better done in the future.

Please take a few minutes to reflect on that decision by completing the survey. You can do it conveniently on-line, and also send it back to me on-line at pjg2@psu.edu, or pjgraybash@earthlink.net.

Your help is greatly appreciated.

Appendix D

SURVEY INSTRUMENT

Telecommunications Technology Selection Survey

PART I: PROFESSIONAL INFORMATION
PI 1 - 5

PART II: PERCEPTIONS OF CONTINUING PROFESSIONAL ENGINEERING EDUCATION (CPEE) ISSUES
Mode
Q 1 - 5

PART III A: COMPARING FACTOR VALUE AND FREQUENCY OF USE
Selection of communications technology for delivery of distance education programs requires that the media must match and/or satisfy many different factors.
Correlate
Q 6ab – 14ab

PART III B: RELATIVE IMPORTANCE
Continuing Professional Engineering Educators often agree that many different factors affect media selection
Mode
Q 15 – 24

PART IV: PERCEPTION OF DISTANCE EDUCATION EMERGING TECHNOLOGIES
Please indicate your agreement with each of the following statements relating to the use of telecommunications technology.
Mode
Q 25 – 30

PART V: CPEE INVOLVEMENT IN THE SELECTION PHASE OF THE DECISION-MAKING PROCESS
This survey does not consider the Identification phase of decision-making. Selection includes (Screening, Evaluation and Choice, and Authorization). Reflect on your role. State your level of agreement with the following statements.
Correlate
Q 31ab – 34ab

PART VI: CPEE INVOLVEMENT IN THE DEVELOPMENT PHASE OF THE DECISION-MAKING PROCESS
Development includes (Diagnosis and Design). Regarding the development phase of decision-making for choosing a telecommunications medium, reflect on your role. State your level of agreement and involvement in the following statements.
Correlate
35ab – 38ab

PART VII: ESTABLISHING SOME DEFINING ACTIVITIES
Please indicate which statement (a, b, or c) best describes aspects of your decision-making process for delivery medium selection?
Mode
39 abc – 45 abc

Telecommunications Technology Selection Survey

PART I: PROFESSIONAL INFORMATION

PI 1 – 5 Part I lists the respondent's professional information
The questionnaire is in seven parts, each using a 5-variable Likert scale.

PART II: PERCEPTIONS OF CONTINUING PROFESSIONAL ENGINEERING EDUCATION (CPEE) ISSUES Q 1 - 5

Mode Part II and IIIB look at the CPEE issues identified in the literature by Noreberg and Lundblad (1987) as related to emerging telecommunications technology and their perception of the importance of each issue.

PART III A: COMPARING FACTOR VALUE AND FREQUENCY OF USE

Selection of communications technology for delivery of distance education programs requires that the media must match and/or satisfy many different factors. Q 6ab – 14 ab

Correlate Part IIIA is a comparison of theory to practice for each of the media selection factors relating to distance education. The issues are a blend of items listed by the IEEE, Saline, and those used Drexel University's Dr. Quinn, who was our educational consultant. Each question asks, "Just how important do you think a specific factor is?" and then, "How often do you really do it?" Perception versus reality.

PART III B: RELATIVE IMPORTANCE

Continuing Professional Engineering Educators often agree that many different factors affect media selection Q 15 – 24

Mode Part II and IIIB look at the CPEE issues identified in the literature by Noreberg and Lundblad (1987) as related to emerging telecommunications technology and their perception of the importance of each issue.

PART IV: PERCEPTION OF DISTANCE EDUCATION EMERGING TECHNOLOGIES

Please indicate your agreement with each of the following statements relating to the use of telecommunications technology. Q 25 – 30

Mode Part IV asks their agreement with statements about various emerging telecommunications technologies.

PART V: CPEE INVOLVEMENT IN THE SELECTION PHASE OF THE DECISION-MAKING PROCESS

This survey does not consider the Identification phase of decision-making. Selection includes (Screening, Evaluation and Choice, and Authorization). Reflect on your role. State your level of agreement with the following statements. Q 31ab – 34ab

Correlate Parts V and VI address the decision-making process and involvement in it, based on the Mintzberg Model of Decision Making. Each question in Part V focuses on a discrete specifically identified portion of the Selection phase.

PART VI: CPEE INVOLVEMENT IN THE DEVELOPMENT PHASE OF THE DECISION-MAKING PROCESS

Development includes (Diagnosis and Design). Regarding the development phase of decision-making for choosing a telecommunications medium, reflect on your role. State your level of agreement and involvement in the following statements. 35ab – 38ab

Correlate Parts V and VI address the decision-making process and involvement in it, based on the Mintzberg Model of Decision Making. Each question in Part VI focuses on a discrete specifically identified portion of the Development phase.

PART VII: ESTABLISHING SOME DEFINING ACTIVITIES

Please indicate which statement (a, b, or c) best describes aspects of your decision-making process for delivery medium selection? 39 abc – 45 abc

Descriptive In Part VII, seven questions are be used to categorize the individual company according to three major decision-making constructs (Judicious, Rational, Pragmatic).

Cross Reference of Survey Questions to Research Questions

The framework of the study was based on three research questions exploring soft issues and elements addressed in adult education by decision-makers and continuing professional engineering educators in high-tech industries as they decide on delivery systems for employee continuing education opportunities. Of interest is how they become aware of innovations in communications technology and their behaviors regarding the convergence of technologies for distance education and the new learning approaches regarding the selection of delivery medium for their continuing education programs

Question 1

What are the key factors Continuing Professional Engineering Educators within the corporate training function consider when selecting, accepting and implementing communication technologies for delivering CPEE?

Part II	Q 1, Q2
Part III b	Q 15 - 24

Question 2

What understanding do Continuing Professional Engineering Educators have or sense do they make of these selected factors regarding the convergence of technologies, and the new learning approaches that are coming to be associated with technology based education?

Part III a	Q 6 – 14
Part V	Q 31 – 34
Part VI	Q 35 – 38
Part VII	Q 39 – 45
Decision Control Elements	
Decision Communication Elements	
Behavioral and Political Factors	

Question 3

Within the context of adult education, how do high-technology organizational CPEE decision-makers within the corporate training function integrate educational, individual and organizational goals and objectives into choosing the media relative to distance education theory and practice, and what is needed to support that technology?

Part II	Q 3
Part IV	Q 25 – 30

TELECOMMUNICATIONS TECHNOLOGY SELECTION SURVEY

The purpose of this survey is to assess the perceptions of Continuing Professional Engineering Educators (CPEEs) regarding the issues that affect the selection of telecommunications technology used in program development.

PART I: PROFESSIONAL INFORMATION
Please complete the information below by selecting the appropriate response.

1. What position best describes your CPEE role in your company (select one)?
   - A. ☐ Engineering Training Manager
   - B. ☐ Engineering Manager
   - C. ☐ Manager of Professional Development
   - D. ☐ Personnel Manager
   - E. ☐ Manager of Education and Training
   - F. ☐ Director of Instructional Resources
   - G. ☐ Instructional/Media Development
   - H. ☐ Other: _____

2. Your company's primary line of high tech manufacturing?
   - A. ☐ Electronics/Electrical
   - B. ☐ Telecommunications
   - C. ☐ Continuous processing
   - D. ☐ Hardware/Equipment
   - E. ☐ Information Services
   - F. ☐ Manufacturing Processes
   - G. ☐ Aerospace
   - H. ☐ Other: _____

3. Forms of distance education used in your company:

		To Deliver content	To facilitate interaction
A.	Print	☐	☐
B.	Audio	☐	☐
C.	Video	☐	☐
D.	CD/DVD	☐	☐
E.	Satellite	☐	☐
F.	Internet	☐	☐
G.	Other	☐	☐

4. Number of company employees:
   - A. ☐ 1-100
   - B. ☐ 101-1000
   - C. ☐ 1001-10,000
   - D. ☐ More than 10,000

5. Number of years of participation in National Technological University educational process?
   - A. ☐ 1-2
   - B. ☐ 3-5
   - C. ☐ 6-8
   - D. ☐ More than 8

PART II: PERCEPTIONS OF CONTINUING PROFESSIONAL ENGINEERING EDUCATION (CPEE) ISSUES
Please indicate your choice of which factor listed below is (1) the most important, and (2) the least important in relating to telecommunications selection.

	1. Most Important (Select one)	2. Least Important (Select one)
☐	Objectives of the organization	☐
☐	Initial Cost	☐
☐	Trained Personnel	☐
☐	Anticipated Use	☐
☐	Level of interactivity desired	☐
☐	Technological infrastructure	☐
☐	Legal considerations	☐
☐	Equipment compatibility	☐
☐	Users	☐
☐	Cost of operation	☐

Please indicate your agreement with each of the following statements relating to telecommunications selection. Please select the appropriate number.

3. The student's advanced educational needs can be effectively met using any medium.

1	2	3	4	5
☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

4. Five years ago, program delivery medium decisions were best left to the external educational provider.

1	2	3	4	5
☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

5. Today, program delivery medium decisions are still best left to the external educational provider.

1	2	3	4	5
☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

TELECOMMUNICATIONS TECHNOLOGY SELECTION SURVEY

PART III A: <u>COMPARING</u> FACTOR VALUE TO FREQUENCY OF USE

Selection of telecommunications technology for delivery of CPEE distance education programs requires that the media must match and/or satisfy many different factors. Some are listed below.

For the factors listed below, please indicate your perception of its value in the decision-making process by selecting the appropriate number. Also, please indicate the frequency with which that factor is used.

6. Relevance of Content to Corporate Needs

Importance

1	2	3	4	5
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

Frequency of Use

1	2	3	4	5
Always	Regularly	Often	Occasionally	Not at all

7. Relevance of Content to Learner Needs and Desires

Importance

1	2	3	4	5
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

Frequency of Use

1	2	3	4	5
Always	Regularly	Often	Occasionally	Not at all

8. Learning Skills of Individuals

Importance

1	2	3	4	5
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

Frequency of Use

1	2	3	4	5
Always	Regularly	Often	Occasionally	Not at all

9. Expectations of the Learners' Manager

Importance

1	2	3	4	5
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

Frequency of Use

1	2	3	4	5
Always	Regularly	Often	Occasionally	Not at all

10. Climate for Professional Development

Importance

1	2	3	4	5
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

Frequency of Use

1	2	3	4	5
Always	Regularly	Often	Occasionally	Not at all

11. Opportunity to Use New Learning on the Job

Importance

1	2	3	4	5
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

Frequency of Use

1	2	3	4	5
Always	Regularly	Often	Occasionally	Not at all

12. Accessibility of the program to participants

Importance

1	2	3	4	5
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

Frequency of Use

1	2	3	4	5
Always	Regularly	Often	Occasionally	Not at all

13. Application of Adult Education Theory

Importance

1	2	3	4	5
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

Frequency of Use

1	2	3	4	5
Always	Regularly	Often	Occasionally	Not at all

14. Specific Learning objectives

Importance

1	2	3	4	5
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

Frequency of Use

1	2	3	4	5
Always	Regularly	Often	Occasionally	Not at all

TELECOMMUNICATIONS TECHNOLOGY SELECTION SURVEY

PART III B: RELATIVE IMPORTANCE Please indicate the importance of these factors in media selection. Please select the appropriate number.

15. Objectives of the organization

1	2	3	4	5
☐	☐	☐	☐	☐
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

16. Initial cost

1	2	3	4	5
☐	☐	☐	☐	☐
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

17. Qualified training personnel

1	2	3	4	5
☐	☐	☐	☐	☐
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

18. Anticipated use of the application

1	2	3	4	5
☐	☐	☐	☐	☐
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

19. Level of interactivity desired

1	2	3	4	5
☐	☐	☐	☐	☐
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

20. Technological infrastructure already in place

1	2	3	4	5
☐	☐	☐	☐	☐
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

21. Legal considerations

1	2	3	4	5
☐	☐	☐	☐	☐
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

22. Equipment compatibility

1	2	3	4	5
☐	☐	☐	☐	☐
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

23. Learners/Participants

1	2	3	4	5
☐	☐	☐	☐	☐
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

24. Cost of operation

1	2	3	4	5
☐	☐	☐	☐	☐
Very Important	Somewhat Important	Neutral	Little Important	Not at all Important

PART IV: PERCEPTION OF DISTANCE EDUCATION EMERGING TECHNOLOGIES Please indicate your agreement with each of the following statements relating to the use of telecommunications technology. Please select the appropriate number.

25. The need to understand the effects of technology on human learning and motivation is greatly increased when the educator attempts to move distance learning to Just-In-Time performance support.

1	2	3	4	5
☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

26. Educational, individual, and organizational goals must be integrated to achieve successful results in distance education.

1	2	3	4	5
☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

27. Internet courses offer the learner the convenience of time and place of interaction.

1	2	3	4	5
☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

28. Internet courses are becoming the technology of choice among CPEEs.

1	2	3	4	5
☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

29. Typically the systematic approach to program design results in a mix of the media, even though it may not be the best educational mix.

1	2	3	4	5
☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

30. The World Wide Web and the Internet's ability to deliver training quickly and update it regularly will revolutionize distance education.

1	2	3	4	5
☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

TELECOMMUNICATIONS TECHNOLOGY SELECTION SURVEY

PART V: CPEE's INVOLVEMENT IN THE SELECTION PHASE OF THE DECISION-MAKING PROCESS This survey does not consider the Identification phase of decision-making. Selection includes (Screening, Evaluation and Choice, and Authorization). Reflect on your role. *State your level of agreement and involvement with the following statements. Please select the appropriate number.*

31. CPEEs usually function in the Screening portion by helping identify the feasible alternatives.

Agreement

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Involvement

1	2	3	4	5
Made the selection	Very Involved	Neutral	Consulted	Not at all

32. CPEEs usually function in the Evaluation and Choice portion by participating in the analysis.

Agreement

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Involvement

1	2	3	4	5
Made the selection	Very Involved	Neutral	Consulted	Not at all

33. Ultimate selection was by more than one individual and considered multiple goal systems.

Agreement

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Involvement

1	2	3	4	5
Made the selection	Very Involved	Neutral	Consulted	Not at all

34. CPEEs usually function in the Authorization portion by having or sharing approval authority.

Agreement

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Involvement

1	2	3	4	5
Made the selection	Very Involved	Neutral	Consulted	Not at all

PART VI: CPEE's INVOLVEMENT IN THE DEVELOPMENT PHASE OF THE DECISION-MAKING PROCESS

Development includes (Diagnosis and Design). Regarding the development phase of decision-making for choosing a telecommunications medium, reflect on your role. ***State your level of agreement and involvement in the following statements by marking the number.***

35. Design and development of a communications technology delivery medium is complex, expensive and time consuming. CPEEs usually do not participate in the Design portion.

Agreement

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Involvement

1	2	3	4	5
Made the Design	Very Involved	Neutral	Consulted	Not at all

36. When the delivery medium is ready-made, the CPEE makes the selection.

Agreement

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Involvement

1	2	3	4	5
Made the selection	Very Involved	Neutral	Consulted	Not at all

37. When the delivery medium requires a modification to an off-the-shelf system or product, the CPEE makes the modification.

Agreement

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Involvement

1	2	3	4	5
Made the Design	Very Involved	Neutral	Consulted	Not at all

38. When the delivery medium must be custom-made, the CPEE makes the design.

Agreement

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Involvement

1	2	3	4	5
Made the Design	Very Involved	Neutral	Consulted	Not at all

PART VII: ESTABLISHING SOME DEFINING ACTIVITIES

Please indicate which statement (a, b, or c) best describes aspects of your decision-making process for delivery medium selection, as it was five years ago, and as it is today.

Example: Five Years Ago a Today b

	Item	At Original Decision	Today
39	a. Maximum benefit to the organization is paramount b. Limited benefit to the organization is recognized c. Individual personal interest guides selection		
40	a. Logic is always used for comprehensive problem definition b. Reasonable goals are acceptable or good enough c. Preferences were established early in the process		
41	a. Exhaustive consideration of alternatives is performed b. Searching stops when acceptable alternative is found c. Personal self-interests dominate the process		
42	a. Thorough data collection and analysis of alternatives used b. Limited searches for acceptable alternatives used c. Early preferences prevailed throughout		
43	a. Alternative choices can be ranked b. Some alternative choices cannot be measured c. Some alternative choices were dismissed or not considered		
44	a. Open information exchange via open exchange of information b. Criteria were ranked prior to selection c. Internal/external efforts tended to drive selection		
45	a. Selection style was utilitarian and went for many choices b. Selection style avoided "paralysis by analysis" to keep it moving c. Selection style was dominated or dictated by others		

RESPONDENTS COMMENTARY:

Thank you for taking the time to participate in this survey. Your response will remain confidential and will be viewed only by myself.

If you are interested in talking to me individually about your responses, please indicate your willingness by signing below.

_____
Print Name

_____ _____
Signature Date

VITA

Peter J. Graybash, Jr.

Birthplace: Mount Carmel, PA Date: June 4, 1931

Education

High School Diploma, May 1948, Middletown, Pennsylvania
Bachelor of Science, BSIE, May 1957, The Pennsylvania State University
Master of Business Administration, MBA, August 1973, Auburn University
Doctor of Education, Adult Education, May 2003, The Pennsylvania State University

Employment

AMP Incorporated, January 1979 - 1998
- Global Human Resource Development, Engineering Programs, 1993 - 1998
- Corporate Training, Engineering Education Manager, 1989 - 1993
- Manufacturing Systems, Engineering Manager, 1982 - 1989
- Advanced Manufacturing Development, Project Engineer, 1979 - 1982

Syracuse Electronics, 1977 - 1979
- Production & Engineering Manager

Schick Electric, 1973 - 1977
- Plant Engineering Manager

Armstrong World Industries, 1958 - 1973
- Plant Industrial Engineer

Other experience includes thirty-five years total in multiple military assignments, both active and reserve within the Air Force, retiring at the rank of Colonel in 1986. Military Professional Development included Squadron Officer School, Air Command and Staff College, and Air War College.

Professional Affiliations

American Society for Engineering Education, Continuing Professional Development
Society of Manufacturing Engineers, Certified Manufacturing Engineer
Pennsylvania Association of Adult and Continuing Education
U.S. Air Force Academy, Admissions Liaison Officer
Registered Professional Engineer, Commonwealth of Pennsylvania